

# **A multilevel analysis of the influence of neighborhood- and individual-level socioeconomic factors on smoking among South African adults**

---

**Submitted as Partial fulfilment for the award of the degree of  
Master of Public Health (MPH)  
University of Pretoria  
Pretoria.**

**Chigozie Eberechukwu EZEH**

**Student Number: 28511507**

**Supervisor: Prof. OA AYO-YUSUF**

**12 February 2015**



**UNIVERSITEIT VAN PRETORIA  
UNIVERSITY OF PRETORIA  
YUNIBESITHI YA PRETORIA**  
Faculty of Health Sciences

## PART A: PREAMBLE

### DECLARATION

I hereby declare that every aspect of this dissertation, entitled: “A multilevel analysis of the influence of neighbourhood- and individual-level socioeconomic factors on smoking among South African adults”, was undertaken by me. It has not been submitted for any degree or examination at any other university, and all the resource materials used have been duly acknowledged.

---

Chigozie Eberechukwu Ezeh

06 February 2015

Date

---

SUPERVISOR

06 February 2015

Date

Prof O.A. Ayo-Yusuf

School of Health Systems & Public Health

## DEDICATION

I dedicate this piece of work to my beautiful children, **Adanna, Nonso and Kamdi**.

To my husband **Dr. Emeka Onyemaobi**, you were a pillar of support and encouragement to me especially in times when I thought that I could not pull through. Thank you dear.

I love you all.

## ACKNOWLEDGEMENTS

My earnest gratitude goes to the following individuals for their unwavering support through the entire duration of this program.

**Prof. Olalekan Ayo-Yusuf**, my supervisor and mentor, thank you for the unwavering guidance, positive insights and for your dedication towards excellence.

**Dr. Flavia Senkubuge**, I acknowledge the fact that you allowed yourself to be used by God on my behalf. I thank you for all your advice, support and help.

**Dr. Bukola Olotola** you are a true friend. You often told me that I could do this even when I didn't believe in myself. Thank you Bukky. I also acknowledge your contribution in the analysis and interpretation of the data.

To my colleagues **Neo Dikgale, Brian Maphosa, Paul Ebusu, Emma Wanyonyi**; It was wonderful walking this path with you all. Many thanks.

I also want to acknowledge my family friends who were always willing to pick up my children no matter how late they called to do so. **Aunty Nneka, Aunty Bola and Aunty Amanda**. May God bless you all richly.

Above all, my utmost appreciation goes to the **Almighty God** for the divine intervention and strength in this academic pursuit and endeavour. I could never have done it on my own.

## ABSTRACT

**Background:** In addition to the influence of an individual's socioeconomic status, the neighbourhoods in which people live may influence health-related behaviours including smoking. This study therefore sought to determine the influence of the socioeconomic context in which South African adults lived on their smoking behaviour, and explore the potential gender differences of contextual influences.

**Method:** This study involved a representative sample of South African adults ( $\geq 16$  years) who participated in the 2010 ( $n=3,112$ ) and 2011 ( $3,003$ ) South African Social Attitude Survey (SASAS). The 2009 General Household Survey ( $n=25,548$  households) was used to obtain the socioeconomic characteristics of the neighbourhoods where SASAS participants lived, including proportion of households with access to tap water, access to flush toilets and the level of employment in the area (3-item deprivation index;  $\alpha=0.84$ ). Information obtained from SASAS included participants' tobacco use status and socio-demographic characteristics, including participants' self-rated socioeconomic position within the society. Data analysis included a multi-level Poisson regression analysis.

**Results:** Of the respondents who participated in the 2010/2011 survey, 19.4% ( $n=1302$ ) were current smokers (30% men and 9.8% women). Smoking was more prevalent among those living in areas in the upper-third socioeconomic status (SES) than in areas in the lower-third SES (22.9% vs. 13.5%;  $p=0.01$ ). The neighbourhood socioeconomic context had a greater influence on the prevalence of smoking among women than among men. In particular, the gender gap in smoking prevalence was higher among those living in areas in the lowest-third SES (24.6% men vs. 4.6% women) than among those in areas of highest-third SEP (31.5% men vs. 15% women). Overall, smoking was less likely among those with greater than high school education than among those with less than high school education (OR=0.68; 95%CI=0.56-0.82).

**Conclusion:** The findings suggest a greater neighbourhood socioeconomic contextual influence on women than men and highlight the need for community-level interventions targeting the least educated living in areas of highest socioeconomic position in South Africa. Interventions and public health policies to decrease tobacco smoking should be

A multilevel analysis of the influence of neighbourhood- and individual-level socioeconomic factors on smoking among South African adults:

**EZEH CE 28511507**

developed with some neighbourhood-specific modifications and should also be actively implemented.

**Keywords:** Smoking; Policy; Socioeconomic status; South African adults; neighbourhood; gender.

## TABLE OF CONTENTS

PART A: PREAMBLE .....	i
DECLARATION .....	i
DEDICATION .....	ii
ACKNOWLEDGEMENTS .....	iii
ABSTRACT .....	iv
LIST OF TABLES .....	vi
PART B: RESEARCH PROTOCOL .....	1
Executive Summary .....	1
Introduction .....	2
Marketing/ Promotion .....	5
Norms and Culture .....	5
AIM AND OBJECTIVES .....	7
Aim of the study .....	7
Specific objectives .....	7
Null hypotheses .....	7
METHODS AND STUDY DESIGN .....	8
Study design .....	8
Study setting .....	8
Study population and sampling .....	9
Study population .....	9
The SASAS sampling method .....	9
The GHS sampling method .....	9
Sample size .....	10
Measurement .....	10
Individual-level socio-economic measures obtained from the SASAS .....	10
Main outcome variable .....	11
Neighbourhood-level socio-economic measures obtained from the 2009 GHS .....	11
Data Management and Analysis .....	12
Ethical considerations .....	12

Logistics and time schedule .....	13
Budget/ Resource .....	13
Reporting of results.....	13
References .....	14
<b>PART C: JOURNAL MANUSCRIPT .....</b>	<b>18</b>
Cover Letter .....	18
ABSTRACT.....	19
Background .....	21
Methods.....	23
Survey design/sample .....	23
Measures.....	24
Statistical Analyses.....	26
Results.....	26
Discussion.....	28
Conclusion.....	31
List of abbreviations.....	31
Competing interests.....	32
Authors' contributions.....	32
Authors' information .....	32
Acknowledgements.....	32
<b>PART D: POLICY IMPLICATIONS.....</b>	<b>43</b>
<b>PART E: APPENDICES.....</b>	<b>44</b>
Appendix A: Study's Gantt Chart .....	44
Appendix B: Action Plan.....	45
Appendix C: Budget.....	46
Appendix D: South African Social Attitudes Survey 2010 Questionnaire .....	47
Appendix E: General Household Survey 2009 Questionnaire .....	51
Appendix F: Letter Of Approval From Ethics Committee.....	53

Appendix G: Authors Instruction ..... 54

## LIST OF TABLES

Table 1: Characteristics of the study population .....	38
Table 2: Individual-level and Area-level Characteristics of current smokers .....	38
Table 3: Multilevel Poisson regression model of the association of individual and community-level characteristics with current smoking .....	40
Table 4: Multilevel model of the determinants of current smoking among Males and Females. ....	41

**PART B: RESEARCH PROTOCOL**

**University of Pretoria  
Faculty of Health Sciences  
School of Health Systems & Public Health**

**Analysis of neighbourhood-level socioeconomic status on  
smoking among South African adults**

**A Research Protocol submitted In partial fulfilment of the requirements of the Degree of  
Master of Public Health (MPH)  
University of Pretoria.**

**Chigozie Eberechukwu EZEH  
Student Number: 28511507**

**Supervisor: Prof. O.A. AYO-YUSUF  
lekanay@gmail.com**

**February 28<sup>th</sup>, 2014.**

## Executive Summary

It still remains poorly understood the degree to which certain health behaviours build up given the neighbourhood-level characteristics. Some studies have found associations between smoking and neighbourhood disadvantages even after considering individual characteristics, showing that picking up habits like smoking is not just due to individual characteristics. Diez Roux et al in their study of the incidence of coronary heart disease and neighbourhood of residence indicated that individuals who lived in socioeconomically advantaged neighbourhoods are less likely than the individuals living in disadvantaged neighbourhoods to develop coronary heart disease.

It is thus reasonable to enquire whether neighbourhood conditions influences smoking once individual characteristics are taken into account. For example: Are people who live in poor neighbourhoods more likely to smoke only because they themselves are poor as individuals, or do characteristics of the neighbourhood they live in have an additional influence? This study, using multilevel analysis of nationally representative samples of South African adults, therefore seeks to explore the extent to which neighbourhood-level and individual-level socioeconomic characteristics influence smoking among South African adults during 2010 and 2011.

## Introduction

Poor health outcomes related to smoking is on the increase and this remains a significant public health problem. According to the figures released by the World Health Organization (WHO), about 70% of the 4 million deaths attributable to tobacco use each year occur in the developing countries and these figures are projected to increase by 2020 to about 8.4million.<sup>1</sup> Smoking has been found to contribute about 8.5% of all the deaths in South Africa in 2000,<sup>2</sup> thus in evaluating risk factors of mortality, smoking ranked third (after sexually transmitted diseases and high blood pressure).

The effect of environmental factors (stressors) that modifies an individual vulnerability and resistance to risk factors relating to poor health outcomes is also marked. The rise in inequality or social disparities among different neighbourhoods is still very evident and is believed to influence an individual's choice and behaviour in taking up smoking. The probabilities of smoking between two otherwise identical individuals living in two different neighbourhoods can be said to be influenced by neighbourhood-level characteristics. This neighbourhood-level influence has been demonstrated in a study conducted in the 23 cities and counties of Taiwan which assessed the impact of smoking disparities on health disparities and showed varied differences in smoking behaviours across the different cities and counties in Taiwan.<sup>3,4</sup> Other authors<sup>5-7</sup> have also demonstrated that even after controlling for the individual-level socioeconomic status (SES), the neighbourhood-level characteristics remained an independent predictor of individual-level smoking behaviour. It has been theorized that where an individual lives affects one's health behaviours via a range of mechanisms among which are psychological stress related with residing in an underprivileged neighbourhood, community values and norms, availability of social amenities (such as goods and services ).<sup>3,8-9</sup>

Risky health behaviours and choices, chronic conditions, injuries, violence and crime etc. have been associated to some of the economic and social features of neighbourhood in which one resides.<sup>10,11</sup> The socioeconomic characteristics of a neighbourhood can have effect on the choices that its residents make for themselves, whether they smoke<sup>9,10</sup> practice safe sex and family planning<sup>12</sup> and also eat healthy meals.<sup>13</sup> Neighbourhoods with

activities such as playgrounds for sports will engage the youths and thus decrease the prevalence of smoking among such neighbourhoods. This is because the time spent in gang involvement, lurking at the corners of the street and committing crimes will then be spent on the sports field developing their personal skills. Scarce healthy role models, concentrated tobacco sale outlets and advertisement, are some of the constraint of living in deprived or low- SES neighbourhoods, which then encourages the habit of smoking.<sup>3</sup> It is therefore essential that the socioeconomic status of our neighbourhoods be significantly improved by efficient policies and intervention strategies to encourage easier adoption and maintenance of healthy lifestyles and behaviours.<sup>14</sup>

Delva et al.<sup>15</sup> showed in their community-based work how the neighbourhood-level characteristics influences smoking. These could be protective (social support) or risk factors. In their study of the low-income African American women living in the poorest area of Detroit, Michigan, they showed that the perception of unfair treatment and discrimination,<sup>16,17</sup> and feeling of anger regarding their poverty status<sup>18</sup> among other factors contributed to their picking up of this health risk behaviour (smoking).<sup>19</sup> Smoking has become their own way of coping in this under-served population. Others have suggested that beyond the individual characteristics, living in a deprived neighbourhood has an independent influence on smoking,<sup>20,21</sup> Ahern et al.<sup>22</sup> found no association between neighbourhood socioeconomic characteristics and smoking. Stead et al.<sup>23</sup> believes that picking up the risky health behaviour (smoking) is mostly influenced by individual factors than contextual factors.

Certain theories have been postulated which tries to explain the relationships and effects between neighbourhood-level characteristics and individual-level SES. The “double jeopardy” hypothesis suggests that individuals residing in poor neighbourhoods are greatly affected by the harmful effects posed by their low-socioeconomic/poverty states.<sup>24</sup> Other studies have suggested that individuals of low socioeconomic status living in high socioeconomic neighbourhoods may actually fare worse than their counterparts living in low-socioeconomic neighbourhoods because they feel inferior to their more affluent

neighbour as a result of negative psychological effects.<sup>25,27</sup> This hypothesis is called the “relative deprivation” hypothesis.

Effects of neighbourhood characteristics on lifestyle behaviour and choices can be viewed from two different perspectives; structural and contagion.<sup>28</sup> From the structural viewpoint, there could either be opportunities or limitations to residents living within a certain neighbourhood. Disadvantaged neighbourhoods will have limited resources and opportunities available to them such as social amenities to actively engage them thus making them more vulnerable to smoking.<sup>8,26-28</sup> Accessibility to municipal services, quality of schools, employment prospects and even the availability of good transport systems are highly associated with where an individual resides. Health can be directly influenced by health care, while indirectly by employment opportunities, education and other services which provide the means (incomes) to realize an adequate standard of living at the present and in the future. Smoking has been associated with a perceived way of temporarily relieving stress and depression associated with living in the under-served and disadvantaged areas.<sup>15</sup> Social disadvantages that leads to smoking (risky) behaviours can be reinforced by limited employment opportunities and education differences seen across neighbourhoods.<sup>29</sup> Structural effect on smoking has been demonstrated in previous studies that showed that limiting smoking in work places can reduce cigarette consumption and encourage cessation of smoking among workers.<sup>8,30</sup>

Contagion is another viewpoint where people imitate the behaviour of others around them.<sup>28</sup> This is to say that the norms and culture of a neighbourhood can influence the choices that an individual makes. For example, communities where the elders offer cigarette as gifts to visitors<sup>31</sup> demonstrates how acceptable cigarette smoking is within such neighbourhood and thus encourages early initiation of smoking among the youths. Healthy role models influences others by discouraging risky behaviours like gang involvement, smoking, alcohol abuse and the use of illicit drugs, thereby making the neighbourhood a safer place to live and develop.<sup>32,33</sup>

### **Marketing/ Promotion**

Easy accessibility and availability of cigarettes has been found to be associated to continue smoking behaviour. Some studies have shown that reductions in the tobacco products availability and exposure to tobacco advertisements on television, billboards and posters within a given neighbourhood will also reduce the uptake of smoking among its residents.<sup>3,7,9</sup> Although, the tobacco companies have continued to claim that cigarette advertisement is only targeted at adults to enhance branding (loyalty and switching) but studies have shown that these adverts also targets the vulnerable youths and children who are easy swayed by the adverts.<sup>39</sup> Lack of strict enforcement of tobacco control regulations<sup>30</sup> particularly in poor neighbourhoods<sup>30</sup> may increase an individual's vulnerability to smoking. Studies have shown that the disadvantaged poor and minority neighbourhoods are the most targeted in tobacco advertisement given the number of billboards within the neighbourhood when compared to the more affluent neighbourhoods.<sup>9,40</sup>

### **Norms and Culture**

Neighbourhood norms and culture can either enhance or serve as a deterrent to smoking. For example living in or moving into a neighbourhood where smoking is a norm can reinforce an individual's belief that smoking is acceptable.<sup>41</sup> The communication of some observed social norms towards smoking can be influenced by social interaction which may also be influenced by the ethnic composition of a neighbourhood. Although irrespective of the SES of a neighbourhood, high social cohesiveness characterised by high collective efficacy among people can exercise an informal social control,<sup>32</sup> example scolding a child seen exhibiting unruly or risky behaviours like smoking because it is believed that a child belongs to the community and thus the responsibility of the community to mould an individual's character. Community-level cohesiveness or social support can acts as a protective mechanisms against stress and depression, both of which affects behaviours such as smoking.<sup>15,42,43</sup> Stress has also been associated to neighbourhood-level SES which in turn may be associated to health care accessibility, available means to quit smoking and health information.<sup>44-46</sup>

Studies have shown that neighbourhood-level and individual-level characteristics are associated with smoking. In South Africa, there are limited studies focusing on the effects of

neighbourhood-level characteristics on smoking, yet evidence is needed to support any policy that might inform a public health intervention at neighbourhood-level. Therefore, using the multilevel analysis, this study seeks to examine the independent effects of neighbourhood socioeconomic status (SES) on smoking. Conducting this study we will attempt to answer the following two questions: (1) Does neighbourhood-level SES characteristics affect smoking; (2) Does the neighbourhood-level SES characteristics moderate the individual-level factors (i.e. are the individual factors going to show effect depending on where you are living). The research objectives will be: (1) to determine the factors associated with smoking among adult South Africans; and (2) to explore the community-level or neighbourhood-level factors associated with adult smoking.

## **AIM AND OBJECTIVES**

### **Aim of the study**

The aim of this study was to examine the effect of the social and economic context in which people live on their smoking behaviour. Hopefully in the long term, the findings of this study will also inform the design of suitable community-level interventions for the enhancement and the reduction of social inequalities among South African neighbourhoods.

### **Specific objectives**

- to determine the factors associated with smoking among South African adults
- to explore the independent effect of neighbourhood-level socio-economic status on smoking among South African adults.

### **Null hypotheses**

The following null hypotheses will be tested:

- Ho 1: Socio-economic factors do not affect smoking.
- Ho 2: No substantial variations in smoking can be attributed to neighbourhood-level socio-economic characteristics.

## **METHODS AND STUDY DESIGN**

### **Study design**

The study will be a population-based, cross-sectional analytical study using the multilevel model. It will involve the secondary analysis of surveys conducted in South Africa - the 2010 and 2011 South African Social Attitudes Survey (SASAS) and the 2009 General Household Survey (GHS).

### **Study setting**

Adult South African residents, who participated in both the SASAS (2010 and 2011) and GHS (2009) surveys, and whose households and enumeration areas (EAs) could be identified in the surveys. While the individual-level characteristics will be obtained from the 2010 and 2011 South African Social Attitudes Survey (SASAS), the neighbourhood-level characteristics will be from the 2009 General Household Survey (GHS).

### **Data for the study**

The master samples of both the SASAS and GHS datasets include the enumeration areas. Enumeration Areas (EAs) as contained in the Statistics SA Census 2001 geographical framework are primary structural units well delineated geographically in a given area. For the purpose of this study, a new dataset will be derived from merging the SASAS and the GHS datasets. The various datasets will be merged at the magisterial district level through related codes that are exclusively given to each district in the datasets. Magisterial districts are government's primary level of administration and service delivery. The first three digits of the EAs will be used to generate the magisterial districts in the datasets. SASAS 2010 and 2011 will be appended to generate one dataset which will then be merged with the GHS 2009. To link these two datasets, the area level variables from the GHS will be incorporated into the appended SASAS data by cross-tabulating these variables with the magisterial districts in the GHS, province by province. The values from this cross-tabulation will then be entered into the appended SASAS for each respondent interviewed in the same magisterial district for which the aggregate characteristics of the people or households in a particular magisterial district will be computed.

## **Study population and sampling**

### **Study population**

The study population will include all adults 16 years and above who participated in the 2010 and 2011 SASAS survey and whose EA and thus magisterial district could be identified in the 2009 GHS.

**Exclusion criteria:** Youths younger than 16 years. Special institutions such as hospitals, military camps, old people homes, schools and university hostels, recreational areas, industrial areas and vacant EAs were also excluded from the survey.

### **The SASAS sampling method**

This secondary data analysis will use data obtained from two nationally representative samples of South African adults (aged  $\geq 16$  years) who participated in the 2010 ( $n = 3112$ , response rate-88.9%) and 2011 ( $n = 3003$ , response rate-85.8%) South African Social Attitude Surveys (SASAS). The SASAS is a household survey which uses a multistage probability sampling strategy with census enumeration areas as the primary sampling unit. For each of the two years, a sample of 3 500 households was drawn from the master sample of the Human Sciences Research Council (HSRC) which consisted of 1000 EAs based on the 2001 population census.

The SASAS sample was stratified by socio-demographic domain of the provinces, geographical sub-types, gender, age groups and the four ethnic/race groups. This stratification is designed to ensure sufficient geographical distribution across all nine provinces, and adequate distribution between South Africa's four race groups, namely: Black African; Coloured; Indian or Asian; and White. From each of the households, one eligible person ( $\geq 16$  years old) was randomly selected for participation in the survey.

### **The GHS sampling method**

The GHS, an annual nationally representative sample survey data which including access to public services, used the used a two-stage, stratified design. Enumeration areas (EAs) as contained in the 2001 Population Census also served as the primary sampling units (PSUs). The detailed methods used in ensuring that standard protocol was followed during the

process for the survey is available.<sup>48</sup> The GHS 2009 was used to determine neighbourhood-level variables as that year preceded the two individual survey dates of 2010 and 2011.

### **Sample size**

The sample size for this study, will be limited to the number of respondents in the SASAS survey for which their neighbourhood-level data are available (could be linked) in the GHS dataset. The response rate for the SASAS was 88.9% (n=3112) in 2010 and 85.8% (n=3003) in 2011. For the 2009 GHS, the response rate was 93% of the targeted 25,303 households (n = 94,263 individuals).

### **Measurement**

The SASAS used an interviewer-administered questionnaire to collect among others, data on the demographic characteristics of the population, including information on age, gender, race and socio-economic status.

### **Individual-level socio-economic measures obtained from the SASAS**

#### *Socio-economic status*

- *Education*: Respondents were asked: 'What is the highest level of education that you have ever completed?' The options will be grouped into three categories, namely (1) Less than grade 12 (<Grade 12), (2) Grade 12, (3) Higher than Grade 12.
- *Employment*: Respondents were also asked in the survey about their current employment status from several options. The options will be grouped into three categories, namely (1) Employed, (2) Unemployed, and (3) Permanently sick/Student/Pensioner/Housewife not looking for a job.
- *Subjective social status*: Respondents were asked about their social positioning in this question: 'In our society there are groups which tend to be towards the top and groups which tend to be towards the bottom. Where would you put yourself on a scale of 1 to 10, where 10 is the top and 1 the bottom?' This will be assessed on a continuous scale to estimate the respondents' reported social positioning.

### *Tobacco use status*

SASAS participants were asked: ‘Do you use or have you used any of the following tobacco products?’ The tobacco products listed were manufactured cigarettes, roll-your-own cigarettes (Zols) and other tobacco products. For each of these products, the options ‘Every day’, ‘Some days’, ‘Stopped less than 6 months ago’, ‘Stopped more than 6 months ago’ and ‘Never before’ were given. Current smokers will be those who responded ‘Every day’ and ‘Some days’ to the above question.

### **Main outcome variable**

The main outcome variable for this study will be “current smoker”. This will be those who responded ‘Every day’ or ‘Some days’ to the question: ‘Do you use or have you used any of the following tobacco products?’ The option includes manufactured cigarettes, roll-your-own cigarettes (Zols), pipes or cigars, nasal snuff and oral snuff. The “current smokers” will be the individuals, whose responses to manufactured cigarettes and/or roll-your-own cigarettes (Zols) were ‘Every day’ or ‘Some days’.

### **Neighbourhood-level socio-economic measures obtained from the 2009 GHS**

#### Physical infrastructure

- *Household’s source of water supply:* Household’s main source of water will be calculated from 2009 GHS participants answer to the question: ‘What is the household’s main source of water?’ Their responses will be categorized into piped and non-piped water sources. Proportion of households with piped water in each neighbourhood will be estimated.
- *Sanitation:* Household’s type of toilet facility will also be assessed using this question: ‘what type of toilet facility is used by this household?’ Their responses will be categorized into flush and non-flush toilet facility. Proportion of households with flush toilet in each neighbourhood will be estimated.
- *Energy Source:* Household’s energy source will be assessed from the 2009 GHS. The responses which will be dichotomized into groups (1) Residents whose main energy source was electricity, and (2) Residents whose main energy source was not

electricity. Proportion of households whose source of energy is electricity will be estimated in each neighbourhood.

#### Economic resources

- *Employment:* Household's economic activities will be assessed using the following "Yes or No" question; "During the last calendar week (Sunday to Saturday) did you work for a wage, salary, commission or any payment in kind (including paid domestic work), even if it was for one hour?"

#### Measure of social capital per household

- *Household's cell phone availability:* As a measure of social capital per household, the study will assess the household's cell phone availability in the 2009 GHS using the following: 'Is there a functional/working cellular telephone available to this household for regular use?' The response will either be 'Yes' or 'No'. Proportion of households with available cell phones for use will be estimated in each neighbourhood.

#### Data Management and Analysis

The data will be analysed using STATA Version 12. Both a univariate and multivariate multilevel binomial logit link model will be used to assess the effect of neighbourhood-level socio-economic status on smoking after the individual-level socio-economic status has been controlled for.

#### Ethical considerations

For the purpose of this study, permission was obtained from the Human Sciences Resource Council (HSRC) to access the SASAS datasets. The GHS data is publicly available and, as such, does not require permission before the data can be used.

The data so obtained will solely be for research purposes and since the datasets are without personal identifiers, confidentiality of the participants' details is guaranteed. Additionally, the magisterial districts are not identified by name, thus data collected cannot be traced back to any individual who participated in the survey. Only the researchers directly involved in this study will have access to the data and only for the purpose of this study.

The study protocol will be subjected to approval by the University of Pretoria's Faculty of Health Sciences' Research Ethics Committee.

### **Logistics and time schedule**

Project management timetable (Action Plan and or Gantt chart) are available in the Appendices A and B.

### **Budget/ Resource**

A table has been provided showing an estimated cost of R7,325 for the study. The study will be funded by the researcher.

See Appendix C.

### **Reporting of results**

The findings of this study will be presented as a research report in partial fulfilment of the requirements for the award of the degree of Master of Public Health (MPH) of the University of Pretoria.

The results of the study will also be published to possibly inform policy making and the public in general. Papers and abstracts from the study will be submitted to reputable peer-reviewed journal for publication. Dr. Chigozie Ezeh will be the first author and Prof. O.A. Ayo-Yusuf will be the co-author.

## References

1. World Health Organization: Combing the tobacco epidemic: The World health report 1999. Geneva;1999.
2. Groenewald P, Vos T, Normann R, Laubscher R, van Walbeek C, Saloojee Y, et al. Estimating the burden of disease attributable to smoking in South Africa in 2000. *S Afr Med J*. 2007;97:674–681.
3. Chuang Y, Li Y, Yi-Hua W, Chao HJ. A multilevel analysis of neighbourhood and individual effects on individual smoking and drinking in Taiwan. *BMC Public Health*. 2007; 7:151 doi:10.1186/1471-2458-7-151. Accessed 5-9-2013
4. Cheng TY, Wen CP, Tsai SP, Chung WS, Hsu CC. Reducing health disparity in Taiwan: quantifying the role of smoking. *Tob Control*. 2005;14:23-27.
5. Cubbin C, Hadden WC, Winkleby MA. Neighbourhood context and cardiovascular disease risk factors: the contribution of material deprivation. *Ethn Dis*. 2001;11:687–700.
6. Macintyre S, Ellaway A, Cummins S. Place effects on health: how can we conceptualise, operationalise and measure? *Soc Sci Med*. 2002;55:125–139.
7. Hyland A, Travers MJ, Cummings M. Tobacco outlet density and demographics in Erie County, New York. *Am J Public Health*. 2003;93:1075–1076.
8. Datta GD, Subramanian SV, Colditz GA, Kawachi I, Palmer JR, Rosenberg L. Individual, neighbourhood, and state-level predictors of smoking among US Black women: a multilevel analysis. *Soc Sci Med*. 2006;63:1034-1044.
9. Chuang YC, Cubbin C, Ahn D, Winkleby MA. Effects of neighbourhood socioeconomic status and convenience store concentration on individual level smoking. *J Epidemiol Community Health*. 2005;59:568-573.
10. Pickett KE, Pearl M. Multilevel analyses of neighbourhood socioeconomic context and health outcomes: a critical review. *J Epidemiol Community Health*. 2001;55:111-122.
11. Robert SA. Socioeconomic position and health: The independent contribution of community socioeconomic context. *Annu Rev Sociol*. 1999;25:489-516.
12. Averett SL, Rees DI, Argys LM. The Impact of Government Policies and Neighbourhood Characteristics on Teenage Sexual Activity and Contraceptive Use. *Am J Public Health*. 2002;92: 1773-8.

13. Diez-Roux AV, Nieto FJ, Caulfield L. Neighbourhood Differences in Diet: The Atherosclerosis Risk in Communities (Aric) Study. *J Epidemiol Community Health*. 1999;53:55-63.
14. Cubbin C, Pedregon V, Egerter S, Braveman P. Where We Live Matters for Our Health: Neighbourhoods and Health. Issue brief 3. Sept 2008. [www.commissionhealth.com](http://www.commissionhealth.com). (Accessed 5-9-2013)
15. Delva J, Tellez M, Finlayson TL. Correlates of cigarette smoking among low-income African American women. *Ethn Dis*. 2006;16:527–533.
16. Landrine H, Klonoff EA. Racial discrimination and cigarette smoking among Blacks: findings from two studies. *Ethn Dis*. 2000;10:195–202.
17. Guthrie BJ, Young AM, Williams DR, Boyd CJ, Kintner EK. African American girls' smoking experiences and day-to-day experiences with racial discrimination. *Nurs Res*. 2002;51:183–190.
18. Whiteman MC, Fowkes FGR, Deary IJ, Lee AF. Hostility, cigarette smoking, and alcohol consumption in the general population. *Soc Sci Med*. 1997;44:1089–1096.
19. Wallace JM Jr, Brown TN, Bachman JG, LaVeist TA. The influence of race and religion on abstinence from alcohol, cigarettes, and marijuana among adolescents. *J Stud Alcohol*. 2003;64:843–848.
20. Kleinschmidt I, Hills M, Elliott P. Smoking behavior can be predicted by neighbourhood deprivation measures. *J Epidemiol Community Health*. 1995;49:72–77.
21. Duncan C, Jones K, Moon G. Smoking and deprivation: are there neighbourhood effects? *Soc Sci Med*. 1999;48:497–505.
22. Ahern J, Pickett KE, Selvin S, Abrams B. Preterm birth among African American and White women: a multilevel analysis of socioeconomic characteristics and cigarette smoking. *J Epidemiol Community Health*. 2003;57:606-611.
23. Stead M, MacAskill S, MacKintosh A-M, Reece J, Eadie D. "It's as if you're locked in": qualitative explanations for area effects on smoking in disadvantaged communities. *Health Place*. 2001;7:333-343.

24. Wen M, Christakis NA. Neighbourhood effects on posthospitalization mortality: a population-based cohort study of the elderly in Chicago. *Health Serv Res.* 2005;40:1108-1127.
25. Winkleby M, Cubbin C, Ahn D. Effect of cross-level interaction between individual and neighbourhood socioeconomic status on adult mortality rates. *Am J Public Health.* 2006;96:2145-2153.
26. Browning CR, Cagney KA. Neighbourhood structural disadvantage, collective efficacy and self-rated physical health in an urban setting. *J Health Soc Behav.* 2002;43:383-399. (Accessed 10-09-2013).
27. Stafford M, Marmot M. Neighbourhood deprivation and health: does it affect us all equally? *Int J Epidemiol.* 2003;32:357-366.
28. Ross CE. Neighbourhood disadvantage and adult depression. *J Health Soc Behav.* 2000;41:177-187.
29. Williams DR, Collins C. Racial residential segregation: a fundamental cause of racial disparities in health. *Public Health Rep.* 2001;116:404–416.
30. Fichtenberg C, Glantz S. Effect of smoke-free workplaces on smoking behavior: Systematic review. *British Medical Journal.* 2002;325:188–194.
31. Ng N, Weinehall L, Othman O. 'If I don't smoke, I'm not a real man'—Indonesian teenage boys' views about smoking. *Health Education Research.* 2007;22:794-804.
32. Sampson RJ, Raudenbush SW, Earls F. Neighbourhoods and violent crime: A multilevel study of collective efficacy. *Science.* 1997;277:918-924.
33. Morenoff JD, Sampson RJ, Raudenbush SW. Neighbourhood inequality, collective efficacy, and the spatial dynamics of urban violence. *Criminology.* 2001;39:517-558.
34. Christie D, Viner R. Adolescent development. *Br Med J.* 2005; 330: 301–304.
35. Burns DM, Lora L, Vaughn JW, Chiu YK, Shopland D. Rates of smoking initiation among adolescents and young adults. *Tob Control.* 1995;4:2–8.
36. Biener L, Albers AB. Young adults: vulnerable new targets of tobacco marketing. *Am J Public Health.* 2004;94:326–330.

37. Wakefield M, Flay B, Nichter M. Role of the media in influencing trajectories of youth smoking. *Addiction* 2003;98:79–103.
38. Zhang L, Wang W, Zhao Q. Psychosocial predictors of smoking among secondary school students in Henan, China. *Health Educ Res.* 2000;15:415–422.
39. Farkas A, Gilpin EA. Influence of tobacco marketing and exposure to smokers on adolescent susceptibility to smoking. *J Natl Cancer Inst.* 1995;87:1538–1545.
40. Luke D, Esmundo E, Bloom Y. Smoke signs: patterns of tobacco billboard advertising in a metropolitan region. *Tob Control.* 2000;9:16-23 doi:10.1136/tc.9.1.16. (Accessed 15-09-2013).
41. Beard JR, Tomaska N, Earnest A, Summerhayes R, Morgan G. Influence of socioeconomic and cultural factors on rural health. *Aust. J. Rural Health.* 2009;17:10–15
42. Tsoh JY, Lam JN, Delucchi KL, Hall SM. Smoking and depression in Chinese Americans. *Am J Med Sci.* 2003;326:187–191.
43. Kim SS, Son H, Nam KA. The sociocultural context of Korean American men's smoking behavior. *West J Nurs Res.* 2005;27:604–623.
44. Virtanen M, Kivimaki M, Kouvonen A. Average household income, crime, and smoking behaviour in a local area: the Finnish 10-Town study. *Soc Sci Med.* 2007;64:1904–1913.
45. Tseng M, Yeatts K, Millikan R, Newman B. Area-level characteristics and smoking in women. *Am J Public Health.* 2001;91:1847–1850.
46. Kandula NR, Wen M, Jacobs EA, Lauderdale DS. Association between neighbourhood context and smoking prevalence among Asian Americans. *Am J Public.* 2009;99:885-892.
47. South African Social Attitude Survey (SASAS) 2010 study information – DataFirst [www.datafirst.uct.ac.za/dataportal/index.php/catalog/490/.../6505](http://www.datafirst.uct.ac.za/dataportal/index.php/catalog/490/.../6505) (accessed 27-08-2013)
48. Statistics South Africa, General Household Survey, June 2009. <http://www.statssa.gov.za/publications/P0318/P0318June2009.pdf> (accessed 27-08-2013).

## **PART C: JOURNAL MANUSCRIPT**

### **Cover Letter**

School of Health Systems and Public Health.

University of Pretoria.

November 10<sup>th</sup>, 2014.

The Editor in Chief,

BMC Public Health

### **SUBMISSION OF ORIGINAL ARTICLE**

We hereby forward for publication in your journal, an original article titled: "A multilevel analysis of the influence of neighbourhood- and individual-level socioeconomic factors on smoking among South African adults"

This final manuscript has been seen and approved by all authors and is not under consideration for publication in any other journal.

Thank you.

Yours faithfully,

Chigozie Ezeh

## A multilevel analysis of the influence of neighbourhood- and individual-level socioeconomic factors on smoking among South African adults

Chigozie Ezeh<sup>1</sup> and Olalekan A Ayo-Yusuf<sup>1,2</sup>

<sup>1</sup>School of Health Systems and Public Health, University of Pretoria, Pretoria, South Africa

<sup>2</sup> Office of the Director, School of Oral Health Sciences, Sefako Makgatho Health Sciences University, Pretoria, South Africa

Corresponding author: Olalekan A Ayo-Yusuf: [Lekan.Ayo-Yusuf@smu.ac.za](mailto:Lekan.Ayo-Yusuf@smu.ac.za)

### ABSTRACT

**Background:** In addition to the influence of an individual's socioeconomic status, the neighbourhoods in which people live may influence health-related behaviours including smoking. This study therefore sought to determine the influence of the socioeconomic context in which South African adults lived on their smoking behaviour, and explore the potential gender differences of contextual influences.

**Method:** This study involved a representative sample of South African adults ( $\geq 16$  years) who participated in the 2010 ( $n=3,112$ ) and 2011 (3,003) South African Social Attitude Survey (SASAS). The 2009 General Household Survey ( $n = 25,548$  households) was used to obtain the socioeconomic characteristics of the neighbourhoods where SASAS participants lived, including proportion of households with access to tap water, access to flush toilets and the level of employment in the area (3-item deprivation index;  $\alpha=0.84$ ). Information obtained from SASAS included participants' tobacco use status and socio-demographic

characteristics, including participants' self-rated socioeconomic position within the society.

Data analysis included a multi-level Poisson regression analysis.

**Results:** Of the respondents who participated in the 2010/2011 survey, 19.4% (n=1302) were current smokers (30% men and 9.8% women). Smoking was more prevalent among those living in areas in the upper-third socioeconomic status (SES) than in areas in the lower-third SES (22.9% vs. 13.5%;  $p=0.01$ ). The neighbourhood socioeconomic context had a greater influence on the prevalence of smoking among women than among men. In particular, the gender gap in smoking prevalence was higher among those living in areas in the lowest-third SES (24.6% men vs. 4.6% women) than among those in areas of highest-third SEP (31.5% men vs. 15% women). Overall, smoking was less likely among those with greater than high school education than among those with less than high school education (OR=0.68; 95%CI=0.56-0.82).

**Conclusion:** The findings suggest a greater neighbourhood socioeconomic contextual influence on women than men and highlight the need for community-level interventions targeting the least educated living in areas of highest socioeconomic position in South Africa. Interventions and public health policies to decrease tobacco smoking should be developed with some neighbourhood-specific modifications and should also be actively implemented.

**Keywords:** Smoking; Policy; Socioeconomic status; South African adults; neighbourhood; gender.

## Background

Poor health outcomes related to smoking is on the increase and this remains a significant public health problem [1, 2] yet, this burden can be greatly reduced or prevented by decreasing tobacco use. According to the figures released by the World Health Organization (WHO), about 70% of the 4 million deaths attributable to tobacco use each year occurs in developing countries and these figures are projected to increase by 2020 to about 8.4million [3]. Over the past years, significant reduction in the prevalence of cigarette smoking recorded in countries like the USA [4] and South Africa [5], have been attributed to stringent anti-tobacco policies and campaigns by the government and anti-tobacco groups [6]. Notwithstanding the substantial decline recorded in the cigarette smoking prevalence in South Africa from 30.2% to 24.1% in 1995 and 2004 [7], about 20.9% of the adult population still smoke in 2007, this includes 33% males and 9.5% females [8]. Smoking has be found to contribute about 8.5% of all the deaths in South Africa in 2000 [9], and in a study evaluating risk factors of mortality, smoking ranked third (after sexually transmitted diseases and high blood pressure). Smoking still remains widespread among certain ethnic groups and neighbourhoods [6, 7].

Van Walbeek in his study found that smoking rate did not decrease among females and households with high income, rather the differences were more evident among the ethnic groups [7]. In the past, the society, cultural norms and beliefs were not so tolerant at the images of female smokers [10, 11]. However, considerable variations in the magnitude of differences in smoking rates among men and women have been observed recently. Different hypothesis have been postulated to help describe the relationship between

smoking and the decreasing gap found in gender differences. Some of them are the increasing women self-sufficiency, and the increasing social acceptance [11, 12].

In addition to the influence of an individual's socioeconomic status, the neighbourhoods in which people live may influence health-related behaviours including smoking. Easy accessibility and availability of cigarettes has been found to be associated with continued smoking behaviour [13]. Some studies have shown that reductions in the tobacco products availability and exposure to tobacco advertisements on television, billboards and posters within a given neighbourhood will also reduce the uptake of smoking among its residents [14-15].

Delva et al. [16] in their community-based work among the low-income African American women living in the deprived neighbourhood of Detroit, Michigan, showed how neighbourhood characteristics influence smoking. While some others have also suggested that beyond the individual characteristics, living in a deprived neighbourhood has an independent influence on smoking [17,18]. Ahern et al. [19] found no association between neighbourhood socioeconomic characteristics and smoking while Stead et al. [20] believes that picking up the risky health behaviours is mostly influenced by individual factors than contextual factors.

In South Africa, there are limited studies focusing on the effects of neighbourhood characteristics on smoking, yet evidence is needed to support any policy that might inform a public health intervention at neighbourhood-level. Therefore, using the multilevel analysis, the objectives of this study were therefore to determine the influence of the socioeconomic

context in which South African adults lived on their smoking behaviour, and explore the potential gender differences of contextual influences.

## **Methods**

### **Survey design/sample**

Data employed for this analysis is a nationally representative sample of adult South Africans aged 16 years and above. The socio-demographic characteristics of participants in this study were obtained from the 2010 and 2011 South African Social Attitudes Survey (SASAS), while the neighbourhood-level characteristics, were obtained from the General Household Survey (GHS) conducted in 2009. The 2009 General Household Survey (n =25,548 households) was used to obtain the socioeconomic characteristics of the neighbourhoods where SASAS participants lived, including proportion of households with access to tap water, access to flush toilets and the level of employment in the area (3-item deprivation index;  $\alpha=0.84$ ).

Participants from the SASAS were selected following a multi-stage probability sampling strategy. The SASAS sample was drawn from the master sample of the South African Human Sciences Research Council (HSRC), comprising of enumeration areas drawn from the 2001 population census. The enumeration areas which formed the primary sampling units, were stratified to be representative of South African socio-demographics, geographical sub-types and the majority population groups—black, white, coloured (of mixed race) and Indian/Asian [21].

The GHS sample survey data used a two-stage, stratified design. Enumeration areas (EAs) as contained in the 2001 Population Census served as the primary sampling units (PSUs). The in depth methods in ensuring that standard protocol was followed during the process for the survey is available [22].

The master samples of both the SASAS and GHS datasets includes the enumeration areas that make up magisterial districts. For the purpose of this study, a new dataset emerged which comprised of the two datasets which have been merged at the magisterial district level through related codes that were exclusively given to each district in the datasets. The response rate for the SASAS was 88.9% (n=3112) in 2010 and 85.8% (n=3003) in 2011. For the 2009 GHS, the response rate was 93% of the targeted 25,303 households (n = 94,263 individuals).

### **Measures**

An interviewer-administered questionnaire was used to assess the respondent's information.

### ***Socio-demographic characteristics***

The socio-demographic characteristics measured included age in years (16–24, 25–34, 35–44, 45–54, 55–64 and  $\geq 65$ ); gender (male or female); educational status (Less than Gr 12, Gr 12, or Higher than Gr 12); marital status (never married, separated/widowed/divorced, or married); employment status and ethnicity (self-reported as Black, Coloured (mixed descent), Indian/Asian, or White).

### ***Current smoker***

The main outcome variable for this study is “current smoker”. Current smokers are the respondents whose response to smoking manufactured cigarettes and/or roll-your-own cigarettes (Zols) were ‘Every day’ or ‘Some days’ to the question: ‘Do you use or have you used any of the following tobacco products in the past? The tobacco products listed were manufactured cigarettes, roll-your-own cigarettes (Zols) and other tobacco products. For each of these products, the response options ‘Every day’, ‘Some days’, ‘Stopped less than 6 months ago’, ‘Stopped more than 6 months ago’ and ‘Never before’ were provided. Non-

smokers are respondents whose responses are either 'Stopped less than 6 months ago', 'Stopped more than 6 months ago' or 'Never before' The responses were dichotomized into current and non-current smokers.

### ***Subjective socioeconomic position***

Self-rated socioeconomic status or social position was assessed using the question "In our society there are groups which tend to be towards the top and groups which tend to be towards the bottom. Where would you put yourself on a scale of 1 to 10, where 10 is the top and 1 the bottom?" The responses were assessed both on a continuous scale and, also divided into ranks each accounting for a third of the sample namely, lower third rank (below the 33.3th percentile), middle third rank (the 33.3th to 66.7th percentiles), and the higher third rank (above the 66.7th percentile).

### ***Area wealth index***

Using the 2009 GHS data, the area wealth index (public service availability) was assessed using questions about the household's main source of water (piped or non-piped water), access to flush toilet and the employment status of the household. For the purpose of this study, the percentage of households with access to pipe water, percentage with access to flush toilets and percentage employed were first standardized using z-scores as the variances were different, and then combined into a single variable called the area-level wealth index following factor analysis. This area-level wealth index was then divided into ranks each accounting for a third of the sample namely, lower third rank (below the 33.3th percentile), middle third rank (the 33.3th to 66.7th percentiles), and the higher third rank (above the 66.7th percentile).

### Statistical Analyses

All data were analyzed using STATA version 12 (STATA Corp Inc., College Station, TX, USA).

To obtain nationally representative estimates and to account for the response pattern, all data were weighted. All analysis also took account of the complex sample design used in SASAS. A chi-squared test was used to assess the group differences. To evaluate the effect of neighbourhood-level characteristics on current smoking status after controlling for the individual-level factors, a multilevel Poisson regression analysis was used. The use of Poisson regression in assessing the prevalence ratio of smoking in this cross-sectional data ensures that our measure of association “prevalence rate ratio” is not unduly overestimated given that current smoking is a common outcome [23]. Furthermore, the Interpretation and communication of prevalence ratio is also much easier using Poisson regression instead of the logistic regression [23]. All statistical tests at a significance level of  $p < 0.05$  were two-tailed. Three models were successively generated, starting with model 1 to model 3. Model 1 contained only the outcome variable (current smokers), and then the neighbourhood-level factor was added in model 2. Furthermore, the individual-level characteristics were also added to model 2 to develop the model 3.

Consistent with previous research which found the modifying effect of gender between wealth index and smoking [24], the interactions between gender and area-level wealth index ranking as a measure of socioeconomic status was further assessed. Any significant interaction effect was then be followed by stratified analysis present in the predictive models for both the female and male respondents separately.

### Results

Of all the respondents who participated in the 2010/2011 survey, the prevalence of current smoking was 19.4% (n=1303) (30% men and 9.8% women). The mean age of the study

respondents is 40.6 (SD = 20.5) years. Most were blacks 76.7% (n=3664), 52.4% (n= 3607) of the respondents were female, 35.3% indicated that they were unemployed, only 13.1% had educational status higher than grade 12.

Bivariate analysis showed that the proportion of cigarette smokers, is significantly higher among those living in the neighbourhoods of upper-third socioeconomic position (SEP) than in the neighbourhoods of lower-third SEP (22.9% vs. 13.5%  $p < 0.001$ ). Across the age groups, higher percentage of smokers was observed among the 35-44 (22.8%) and 45-54 (23.0%) age groups (Table 2). However, an individual's subjective socioeconomic position was not significantly associated with current smoking. Other socio-demographic factors associated with current smoking are shown in Table 2.

In the overall multi-variable Poisson regression model, smoking was more likely among those with less than high school education than among those with greater than high school education (PR=0.68; 95%CI=0.56-0.82). Compared to respondents in the age group 16-24 years, respondents in the age group 25-34 years were more likely to be current smokers (PR=1.23; 95%CI: 1.02-1.49). In contrast, the respondents in the age group  $\geq 65$  years were less likely to be current smokers compared to the age group 16–24 years (PR = 0.75; 95% CI: 0.57-0.99)(Table 3).

There was a significant interaction between gender and the neighbourhood wealth index ( $p < 0.01$ ); therefore the analyses were stratified by gender (Tables 4). The population group that identified themselves as Coloured and White women, were more likely to be smokers (Coloured: PR = 6.57; 95%CI: 5.04-8.56; White: PR = 5.81; 95% CI: 4.17-8.10) compared to those who identified themselves to be black African women. There was a greater significant difference in smoking by ethnicity and area-level socio-economic position among women

than among men. In particular, the gender gap in smoking prevalence was higher among those living in neighbourhoods of the lowest-third SEP (24.6% men vs. 4.6% women) than among those in neighbourhoods of the highest-third SEP (31.5% men vs. 15% women).

### **Discussion**

Despite the decline in the smoking prevalence among South African adults, the results of our study indicated that about 30% of men and 9.8% of women were still smokers during 2010/2011. This shows that as compared to a similar survey carried out in 2003, smoking prevalence among women appears to be on the increase while that of their male counterparts is decreasing (35.8% of men and 8.1% of women) [7,8]. This increase observed among South African women is consistent with that observed among women in other low- and middle- income countries [11]. The reduction observed in gender gap in smoking prevalence, may not solely be attributed to social factors (social acceptability of women smoking) and women economic empowerment (available financial means), but could also be related to the strategic targeting of young women by the tobacco industries as a symbol of emancipation [11,24,25-27].

Our study also showed that smoking prevalence varied across different age groups as observed in previous studies [28,29]. The fact that compared to the 16-24 year-olds, smoking prevalence was higher in the 25-44 year age group is of particular concern considering that this is not only the economically productive age, but it also represent the prime reproductive age for women. This therefore poses a future public health problem given that studies have found that not only is smoking associated with adverse reproductive outcomes [30], children born to smoking mothers are also more likely to be addicted to nicotine [31] and to be smokers themselves in the future [32]. These potential public health challenges

underscore the need for antismoking campaigns being directed towards women of this age group.

Consistent with previous studies [29,33-34], our study also found smoking to be more likely among those with less than high school education than among those with greater than high school education. Largely, an individual's life status can be related to the level of education attained [35]. The association between lower educational status with higher likelihood of smoking observed in our study can be explained. It is conceivable that those with greater education may be more likely to positively respond to the well published adverse health consequences of smoking than those with lower education. A greater exposure to knowledge of health consequences of smoking is believed to inform attitude and compliance to educational health messages which emphasises the benefits of living a healthy lifestyle [29, 33]. On the other hand, individuals with lower education are more likely to experience some amount of stress than those with higher education [29], thus, smoking may be perceived as a form of coping mechanism for stress among the less educated individuals [16, 32].

The neighbourhood socioeconomic context was significantly associated with prevalence of current smoking. The prevalence of smoking among those living in the upper-third socioeconomic position (SEP) neighbourhoods was more than that observed in the lower-third SEP (22.9% vs. 13.5%) neighbourhood. Contrary to what is popularly known about the association of smoking with less-advantaged or deprived neighbourhoods, [15] we found smoking, to be more prevalent in the more "advantaged neighbourhoods" in South Africa. It is conceivable that poor neighbourhoods in South Africa might be much poorer than the poor areas in the more developed countries where these other studies have documented a

seemingly contradictory observation. It is possible that in the presence of extreme poverty as in South Africa's poor neighbourhoods, there would be high level of unemployment and thus cigarettes would be unaffordable.

The neighbourhood socioeconomic context had a slightly stronger influence on the prevalence of smoking among women than among men with women living in areas in the upper-third of socio-economic position being significantly more likely to smoke than those living in the lowest third. This may not be very surprising, given that, with the increasing female participation in the labour force, women may have more disposal income to spend on luxury goods such as cigarettes [11, 24]. Furthermore, the norm in the wealthier neighbourhoods might be supportive of women smoking than the prevailing norm in the poorer neighbourhoods.

This study also suggests greater ethnic differences in smoking prevalence among women than among men. Although men generally smoked more than women, our study showed that women of other ethnic groups smoked more than black South African women who constitute the majority in terms of women population (80.2%) [36]. Specifically, as compared to black African women, women from other population groups were several folds more likely to be a smoker, unlike that observed among men. This observation might be related to a greater social taboo associated with women smoking among black African population [37]. It is therefore important that efforts are directed to continually keep smoking prevalence low among the large majority black African population, particularly among those living in wealthier neighbourhoods.

This study has some limitations. Firstly, the current smoking status of the survey respondents was self-reported and this may have been misreported in some instances and

thus result in reporting bias. However, self-report of smoking status have been previously shown to be valid measure of smoking [38]. Secondly, the cross sectional design of the study calls for caution when making inferences since causality cannot be established in this study. Despite the above limitations, this study which has used a large nationally representative sample has demonstrated the relative importance of the context in which people live when planning for a targeted intervention to reduce smoking prevalence in South Africa. It also emphasizes the urgent need for relevant community-based anti-smoking interventions especially among young South African girls.

### **Conclusion**

The findings of this study suggest that neighbourhood socioeconomic status significantly influence smoking with a greater influence on women than men. The study findings therefore highlight the need for community-level tobacco control policy interventions targeting women living in areas of highest socioeconomic position in South Africa. The authors of this study recommend that further research will be worthwhile given the findings observed in the study.

### **List of abbreviations**

EAs	Enumeration Areas
GHS	General Household Surveys
HSRC	Human Sciences Research Council
PSU	Primary Sampling Units
SASAS	South African Social Attitudes Survey
SEP	Socioeconomic Position
SES	Socioeconomic Status
WHO	World Health Organization

### **Competing interests**

The authors declare that they have no competing interests.

### **Authors' contributions**

CE contributed in conceiving the study design, searched relevant literature, data analysis, discussion of the core ideas, outlined the paper, and drafted the final manuscript. OA-AY was involved in acquisition of the data used for the study, conceiving the study design, statistical analysis, and made substantial contributions to the drafting of the manuscript. All authors read and approved the final manuscript.

### **Authors' information**

CE is an MPH student at the School of Health Systems and Public Health, at the University of Pretoria. OAA is a public health practitioner and holds the position of Professor and Director, at the School of Oral Health Sciences at the University of Limpopo Medunsa Campus. OAA is also an Extraordinary Professor in the School of Health Systems and Public Health at the University of Pretoria.

### **Acknowledgements**

The authors are grateful to the staff of the South African Human Sciences Research Council for logistic support in data collection. The authors are also grateful to Dr. Bukola Olutola of the University of Pretoria for her assistance with the data analysis and the editing of the final manuscript.

## References

1. U.S. Department of Health and Human Services. **The Health Consequences of Smoking—50 Years of Progress: A Report of the Surgeon General**. Atlanta: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, 2014.  
<http://www.surgeongeneral.gov/library/reports/50-years-of-progress>
2. Centers for Disease Control and Prevention. **Health Effects of Cigarette Smoking**.  
[http://www.cdc.gov/tobacco/data\\_statistics/fact\\_sheet](http://www.cdc.gov/tobacco/data_statistics/fact_sheet).
3. World Health Organization. **Combing the tobacco epidemic: In world health report**. Geneva: World Health Organization; 1999.  
[[www.who.int/tobacco/.../en\\_tfi\\_gender\\_women\\_summary\\_overview.pdf](http://www.who.int/tobacco/.../en_tfi_gender_women_summary_overview.pdf)]
4. Marlow SP, Stoller JK: **Smoking cessation**. *Respir Care* 2003,**48**:1238–1254.
5. Steyn K, Bradshaw D, Norman R, Laubscher R, Saloojee Y: **Tobacco use in South Africa during 1998: the first demographic and health survey**. *J Cardiovasc Risk* 2002, **9**: 1-10.
6. Peer N, Bradshaw D, Laubscher R, Steyn K: **Trends in adult tobacco use from two South African demographic and health surveys conducted in 1998 and 2003**. *S Afr Med J* 2009,**99**:744-749.
7. Van Walbeek C: **Recent trends in smoking prevalence in South Africa-some evidence from AMPS Data**. *S Afr Med J* 2002, **92**:468-472.

8. Ayo-Yusuf OA, Agaku IT: **Intention to Switch to Smokeless Tobacco Use among South African Smokers: Results from the 2007 South African Social Attitudes Survey.** *PLoS One* 9(4): e95553. doi:10.1371/journal.pone.0095553.
9. Groenewald P, Vos T, Normann R, Laubscher R, van Walbeek C, Saloojee U, Sitas F, Bradshaw D: **Estimating the burden of disease attributable to smoking in South Africa in 2000.** *S Afr Med J* 2007, **97**: 674–681.
10. Saloojee Y. Tobacco control in South Africa. [[www.mrc.ac.za/chronic/cdlchapter5.pdf](http://www.mrc.ac.za/chronic/cdlchapter5.pdf)]
11. Amos A, Haglund M: **From social taboo to “torch of freedom”: the marketing of cigarettes to women.** *Tobacco Control* 2000, **9**: 3-8 doi: 10.1136/tc.9.1.3 pmid: 10691743.
12. Mackay J, Amos A: **Women and tobacco.** *Respirology* 2003, **8**: 123-130.
13. Chuang YC, Cubbin C, Ahn D, Winkleby MA: **Effects of neighbourhood socioeconomic status and convenience store concentration on individual level smoking.** *J Epidemiol Community Health* 2005,**59**:568-573.
14. Chuang Y, Li Y, Yi-Hua W, Chao HJ: **A multilevel analysis of neighbourhood and individual effects on individual smoking and drinking in Taiwan.** *BMC Public Health* 2007,**7**: 151 doi:10.1186/1471-2458-7-151. Accessed 5-9-2013
15. Hyland A, Travers MJ, Cummings M: **Tobacco outlet density and demographics in Erie County, New York.** *Am J Public Health* 2003,**93**:1075–1076.
16. Delva J, Tellez M, Finlayson TL: **Correlates of cigarette smoking among low-income African American women.** *Ethn Dis* 2006,**16**:527-533.

17. Kleinschmidt I, Hills M, Elliott P: **Smoking behavior can be predicted by neighbourhood deprivation measures.** *J Epidemiol Community Health* 1995,**49**:72–77.
18. Duncan C, Jones K, Moon G: **Smoking and deprivation: are there neighbourhood effects?** *Soc Sci Med* 1999,**48**:497–505.
19. Ahern J, Pickett KE, Selvin S, Abrams B: **Preterm birth among African American and White women: a multilevel analysis of socioeconomic characteristics and cigarette smoking.** *J Epidemiol Community Health* 2003,**57**:606-611.
20. Stead M, MacAskill S, MacKintosh A-M, Reece J, Eadie D: **“It’s as if you’re locked in”:** **qualitative explanations for area effects on smoking in disadvantaged communities.** *Health Place* 2001,**7**:333-343.
21. Human Sciences Research Council: **South African Social Attitudes Survey (SASAS).** [<http://www.hsrc.ac.za/en/departments/sasas>].
22. Statistics South Africa. **General Household Survey 2009.** [<http://microdata.worldbank.org/index.php/catalog/926/download/23066>]
23. Barros AJD, Hirakata VN: **Alternatives for logistic regression in cross-sectional studies: an empirical comparison of models that directly estimate the prevalence ratio.** *BMC Med Res Methodol* 2003,**3**:21.
24. Hitchman SC, Fong GT: **Gender empowerment and female-to-male smoking prevalence ratios.** *Bulletin of the World Health Organization* 2011,**89**:195-202. doi: 10.2471/BLT.10.079905.

25. World Health Organization: **WHO report on the global tobacco epidemic, 2009: implementing smoke-free environments.** [[www.who.int/tobacco/mpower/2009/en/](http://www.who.int/tobacco/mpower/2009/en/)]
26. Schaap MM, Kunst AE, Leinsalu M, Regidor E, Espelt A, Ekholm O, Helmert U, Klumbiene J, Mackenbach JP: **Female ever-smoking, education, emancipation and economic development in 19 European countries.** *Soc Sci Med* 2009,**68**:1271-1278. doi: 10.1016/j.socscimed.2009.01.007.
27. Kaleta D, Usidame B, Polańska K: **Tobacco advertisements to women: creating an awareness among women.** *Cent Eur J Public Health* 2011,**19**:73–8.
28. Ali M, Chaix B, Merlo J, Rosvall M, Wamala S, Lindström M: **Gender differences in daily smoking prevalence in different age strata: A population-based study in southern Sweden.** *Scand J Public Health* 2009,**37**(2):146–52.
29. Kaleta D, Makowiec-Dąbrowska T, Dzionkowska-Zaborszczyk E, Fronczak A: **Prevalence and socio-demographic correlates of daily cigarette smoking in Poland: Results from the Global Adult Tobacco Survey (2009–2010).** *Int J Occup Med Environ Health*. 2012,**25**(2):126-36. doi: 10.2478/S13382-012-0016-8.
30. Ernster V: **Impact of tobacco use on women's health.** In: SametJM, YoonS-Y (eds). **Women and the Tobacco Epidemic. Challenges for the 21st Century.** World Health Organization, Geneva, 2001; 1–16.
31. Obel C, Linnet KM, Hanriksen TB, Rodriguez A, Jarvelin MR, Kotimaa A, Moilanen I, Ebeling H, Bilenberg N, Taanila A, Ye G, Olsen J: **Smoking during pregnancy and hyperactivity-inattention in the offspring: comparing results from three Nordic cohort.** *Int J Epidemiol* 2009,**38**:1-8.

32. O'Callaghan FV, O'Callaghan M, Najman JM, Williams GM, Bor W, Alati R: **Prediction of adolescent smoking from family and social risk factors at 5 years, and maternal smoking in pregnancy and at 5 and 14 years.** *Addiction* 2006,**101**:282-290.
33. Gilman SE, Martin LT, Abrams DB, Kawachi I, Kubzansky L, Loucks EB, Rende R, Rudd R, Buka SL: **Educational attainment and cigarette smoking: a causal association?** *Int J Epidemiol* 2008,**37**: 615–24.
34. Schaap MM, Van Agt HM, Kunst AE: **Identification of socioeconomic groups at increased risk for smoking in European countries: Looking beyond educational level.** *Nicotine Tob Res* 2008,**10**:359-369. DOI: 10.1080/14622200701825
35. Laaksonen M, Rahkonen O, Karvonen S, Lahelma E: **Socioeconomic status and smoking: analyzing inequalities with multiple indicators.** *Eur J Public Health* 2005,**15**:262–269.
36. Statistics South Africa: **Mid-year population estimates 2014.** [beta2.statssa.gov.za/publications/P0302/P03022014.pdf](http://beta2.statssa.gov.za/publications/P0302/P03022014.pdf).
37. Marks S A, Steryn K, Ratheb E: **Tobacco use by black women in Cape Town. MRC policy briefs to government 2001.** <http://www.mrc.co.za/policybriefs/polbrief1.htm>.
38. Bremberg S, Galanti MR, Gilljam H, Meurling L, Post A, Rosendahl I: **Validity of self reports in a cohort of Swedish adolescent smokers and smokeless tobacco (snus) users.** *Tobacco Control* 2005;**14**:114-117.

**Table 1: Characteristics of the study population**

Characteristics		% (n)
<b>Gender</b>	Men	47.6 (2508)
	Women	52.4 (3607)
<b>Age</b>	16-24	27.2 (1184)
	25-34	25.6 (1406)
	35-44	18.2 (1224)
	45-54	12.6 (956)
	55-64	9.3 (742)
	+65	7.1 (598)
<b>Ethnicity</b>	Black	76.7 (3664)
	coloured	9.4 (1037)
	Indian/Asia	2.9 (624)
	White	11.0 (788)
<b>Marital status</b>	Never married	57.3 (2797)
	Separated/Divorced/Widowed	10.2 (903)
	Married	32.5 (2294)
<b>Employment status</b>	Employed	35.3 (2268)
	Housewives /students/pensioners	28.1 (1763)
	Unemployed	36.6 (1784)
<b>Educational level</b>	<Grade 12	55.5 (3381)
	Grade 12	31.5 (1751)
	>Grade 12	13.1 (892)

**Table 2: Individual-level and Area-level Characteristics of current smokers**

Characteristics		Current smoker %(n)	p-value
<b>Socio-demographics</b>			
<b>Gender</b>			<0.001
	Men	30.0 (799)	
	Women	9.8 (503)	

<b>Age</b>			0.0002
	16-24	16.1(316)	
	25-34	20.2(316)	
	35-44	22.8(287)	
	45-54	23.0(230)	
	55-64	21.1(180)	
	+65	12.2(81)	
<b>Ethnicity</b>			<0.001
	Black	13.9(247)	
	Coloured	36.1(198)	
	Indian and Asian	21.9(73)	
	White	30.8(115)	
<b>Marital status</b>			0.2052
	Never married	18.3(562)	
	Separated/Divorced/ Widowed	19.6(187)	
	Married	20.8(519)	
<b>Employment status</b>			<0.001
	Employed	25.3(607)	
	Housewives /students/pensioners	13.7(267)	
	Unemployed	18.0(358)	
<b>Educational level</b>			0.2283
	<Grade 12	19.7(740)	
	Grade 12	17.6(352)	
	>Grade 12	21.3 (186)	
<b>Subjective socioeconomic position</b>			0.4658
	Lower third	18.4 (534)	

	Middle third	19.6 (470)	
	Upper third	20.7 (275)	
<b>Neighbourhood SES</b>			
<b>Area wealth index</b>			<0.001
	Lowest third	13.5(293)	
	Middle third	22.7(442)	
	Highest third	23.0(538)	

**Table 3: Multilevel Poisson regression model of the association of individual and community-level characteristics with current smoking**

Characteristics		PR (95% confidence interval)	P Value
<b>Gender</b>			
	Male	1.0(reference)	
	Female	0.42(0.37-0.47)	0.00
<b>Age</b>			
	16-24	1.0 (reference)	
	25-34	1.23(1.02-1.49)	0.03
	35-44	1.14(0.94-1.39)	0.19
	45-54	1.12(0.91-1.37)	0.27
	55-64	1.11(0.89-1.38)	0.40
	+65	0.75(0.57-0.99)	0.05
<b>Subjective SEP</b>			
		0.93(0.90-0.97)	0.00
<b>Employment</b>			
	Unemployed	1.0(reference)	
	Housewives/students /pensioners	0.77(0.64-0.92)	0.01
	Employed	1.07(0.92-1.23)	0.39

<b>Education</b>			
	<Grade 12	1.0(referent)	
	Grade 12	0.78(0.67-0.90)	0.01
	>Grade 12	0.68(0.56-0.82)	0.01
<b>Area wealth index</b>			
	Lowest third	1.0 (reference)	
	Middle third	1.28(1.08-1.50)	0.00
	Highest third	1.19(1.01-1.41)	0.07

**Table 4: Multilevel model of the determinants of current smoking among Males and Females.**

<b>Characteristics</b>		<b>Female</b>		<b>Male</b>	
		<b>PR (95% confidence interval)</b>	<b>p value</b>	<b>PR (95% confidence interval)</b>	<b>p value</b>
<b>Educational status</b>					
	<Gr 12	1 (referent)		1 (referent)	
	Gr 12	0.81(0.64-1.03)	0.088	0.76(0.63-0.90)	0.002
	>Gr 12	0.68(0.49-0.95)	0.025	0.71(0.56-0.89)	0.004
<b>Ethnicity</b>					
	Black	1 (referent)		1 (referent)	
	Coloured	6.57(5.04-8.56)	0.000	1.38(1.10-1.73)	0.004
	Indian and Asian	2.09(1.34-3.24)	0.001	1.35(1.05-1.73)	0.019
	White	5.81(4.17-8.10)	0.000	1.64(1.28-2.11)	0.000
<b>Subjective SEP</b>					
		0.92(0.87-0.97)	0.003	0.93(0.89-0.98)	0.002
<b>Employment status</b>					
	Employed	1 (referent)		1 (referent)	
	Housewives /students/pe	0.77(0.59-0.99)	0.046	0.71(0.55-0.91)	0.008

A multilevel analysis of the influence of neighbourhood- and individual-level socioeconomic factors on smoking among South African adults:

EZEH CE 28511507

	nsioners				
	Unemployed	0.95(0.75-1.20)	0.655	1.12(0.93-1.34)	0.243
<b>Neighbourhood SES</b>					
<b>Area wealth index</b>					
	Lower third	1 (referent)		1 (referent)	
	Middle third	1.41(1.05-1.90)	0.022	1.22(1.01-1.49)	0.044
	Higher third	1.40(1.05-1.87)	0.022	1.11(0.90.1.36)	0.331

## **PART D: POLICY IMPLICATIONS**

In summary, our study has observed an association between neighbourhood-level SES measures and current smoking status among South African adults. These findings we believe can be useful in developing effective strategies and policies that will improve smoking prevention programmes targeted to both the individuals and neighbourhoods alike.

Therefore, neighbourhood characteristics which increases an individuals' susceptibility to smoking like availability and accessibility of tobacco, poverty, lack of social amenities, unemployment, unsafe environment etc should all be targeted to reduce the prevalence of smoking among South African adults especially the younger girls.

**PART E: APPENDICES**
**Appendix A: Study's Gantt chart**

Activity	2014									
	Jan	Feb	Mar	April	May	Jun	Jul	Aug	Sept	Oct
First draft of research protocol										
Final draft of research protocol										
Presentation to UP Research Ethics Committee										
Data collection										
Data analysis										
First draft study report										
Final study report										
Submission										

**Appendix B: Action Plan**

<b>Actions</b>	<b>Responsible</b>	<b>Time</b>	<b>Budget</b>	<b>Action Specification</b>
First draft of research protocol	Student	September 2013	R200	Draft protocol
Final draft of research protocol	Student	January 2014	R200	Finalize protocol
Presentation to UP Research Ethics Committee	Student/Supervisor	March 2014	R400	Submit finalized protocol to UP REC
Data analysis	Statistician/Student	April-August 2014	R5,000	Hire statistician
First draft study report	Statistician/Student/Supervisor	September 2014	R500	Draft report
Final study report	Student/Supervisor	October 2014	R1,000	Finalize report

**Appendix C: Budget**

Budget Item	Quantity	Units	Unit Cost (ZAR)
<b>Photocopying and Printing</b>			
Research protocol (20 copies)	20	Copies	20
Research report	10	Copies	150
Paper	5	Boxes	400
Questionnaire	10	Copies	5
Toner	3	Containers	450
Stata	1	Package	1000
<b>Sub-Total</b>			<b>2025</b>
<b>Miscellaneous</b>			
Internet and communication	5	Months	300
Hire statistician	10	Days	5000
<b>Sub-Total</b>			<b>5300</b>
<b>GRAND TOTAL</b>			<b>7325</b>

## DATA COLLECTION TOOLS

### Appendix D: SOUTH AFRICAN SOCIAL ATTITUDES SURVEY 2010 QUESTIONNAIRE SMOKING & TOBACCO BEHAVIOUR

Do you use or have you used any of the following tobacco products in the past?

	Every day	Some days	Stopped less than 6 months ago	Stopped more than 6 months ago	Never before
162. Manufactured Cigarettes	1	2	3	4	5
163. Roll-your-own cigarettes (Zol)	1	2	3	4	5

### RESPONDENT CHARACTERISTICS

225. Sex of respondent [copy from contact sheet]

Male	1
Female	2

226. Race of respondent [copy from contact sheet]

Black African	1
Coloured	2
Indian/Asian	3
White	4
Other	5

226. Age of respondent in completed years [copy from contact sheet]

--	--	--

 Years  
 (Don't know) = 998

**227. Do you have a spouse/partner and if yes, do you share the same household?**

Yes, I have a spouse/partner and we live in the same household	1
Yes, I have a spouse/partner but we don't live in the same household	2
No spouse/partner	3
(Refused)	9

**228. What is your current marital status?**

Married (customary only)	1
Married (civil only)	2
Married (both customary and civil)	3
Separated from spouse/civil partner	4
Divorced from spouse/civil partner	5
Widowed/civil partner died	6
Never married/never in civil partnership	7
(Refused to answer)	8
(Don't know)	9

**229. What is the highest level of education that you have ever completed?**

No schooling	00
Grade 0/Grade R	01
Sub A/Grade 1	02
Sub B/Grade 2	03
Grade 3/Standard 1	04
Grade 4/Standard 2	05
Grade 5/Standard 3	06
Grade 6/Standard 4	07

Grade 7/Standard 5	08
Grade 8/Standard 6/Form 1	09
Grade 9/Standard 7/Form 2	10
Grade 10/Standard 8/Form 3	11
Grade 11/Standard 9/Form 4	12
Grade 12/Standard 10/Form 5/Matric	13
NTC I	14
NTC II	15
NTC III	16
Diploma/certificate with less than Grade 12/Std 10	17
Diploma/certificate with Grade 12/Std 10	18
Degree	19
Postgraduate degree or diploma	20
Other, specify	21
(Do not know)	98

245.

**What is your current employment status? (Which of the following best describes your present work situation?)**

Employed full time	01
Employed part time	02
Employed less than part time (casual work/piecework)	03
Temporarily sick	04
Unemployed, not looking for work	05
Unemployed, looking for work	06
Pensioner (aged/retired)	07
Permanently sick or disabled	08
Housewife, not working at all, not looking for work	09
Housewife, looking for work	10
Student/learner	11
Other (specify) .....	12

**263.**

**In our society, there are groups which tend to be towards the top and groups which tend to be towards the bottom. Below is a scale that runs from the top to the bottom. Where would you put yourself on this scale?**

TOP .....	10
	9
	8
	7
	6
	5
	4
	3
	2
BOTTOM....	1

## Appendix E: GENERAL HOUSEHOLD SURVEY 2009 QUESTIONNAIRE

### 3.13 WATER

What is the household's main source of water? <i>Mark one code only</i>	Drinking	Other
01 = Piped (tap) water in dwelling/house	1	1
02 = Piped (tap) water on site or in yard	2	2
03 = Borehole on yard	3	3
04 = Rain-water tank on yard	4	4
05 = Neighbour's tap	5	5
06 = Public/communal tap	6	6
07 = Water-carrier/ tanker	7	7
08 = Borehole outside yard	8	8
09 = Flowing water/stream/river	9	9
10 = Stagnant water/ Dam/pool	10	10
11 = Well	11	11
12 = Spring	12	12
13 = Other, ( <i>specify</i> )	13	13

### 3.24: SANITATION

What type of toilet facility is used by this household?	
1= Flush toilet connected to a public sewerage system	
2= Flush toilet connected to a septic tank	
3= Chemical toilet	
4= Pit latrine/toilet with ventilation pipe	
5= Pit latrine/toilet without ventilation pipe	
6= Bucket toilet	
7= None	
8 = Other ( <i>specify</i> )	

### 3.34 ELECTRICITY

<b>What is the main source of energy/fuel for this household?</b>	<b>Lighting</b>
01 = Electricity from mains	01
02 = Electricity from generator	02
03 = Gas	03
04 = Paraffin	04
05 = Wood	05
06 = Coal	06
07 = Candles	07
08 = Animal dung	08
09 = Solar energy	09
10 = Other, <i>specify</i>	10
11 = None	11

### 3.44 COMMUNICATION

<b>Is there a functional/working cellular telephone available within this household?</b>	
1 = YES	1
2 = NO	2

## Appendix F: Letter of approval from Ethics committee

The Research Ethics Committee, Faculty Health Sciences, University of Pretoria complies with ICH-GCP guidelines and has US Federal wide Assurance.

- FWA 00002567, Approved dd 22 May 2002 and Expires 20 Oct 2016.
- IRB 0000 2235 IORG0001762 Approved dd 13/04/2011 and Expires 13/04/2014.



UNIVERSITEIT VAN PRETORIA  
UNIVERSITY OF PRETORIA  
YUNIBESITHI YA PRETORIA

Faculty of Health Sciences Research Ethics Committee

27/03/2014

### Approval Certificate New Application

Ethics Reference No 91/2014

**Title** A multilevel analysis of the influence of neighbourhood- and individual-level socioeconomic factors on smoking among South African adults

Dear Dr. EZEH CHIGOZIE EBERECHUKWU

The **New Application** as supported by documents specified in your cover letter for your research received on the 28/02/2014, was approved by the Faculty of Health Sciences Research Ethics Committee on the 26/03/2014.

Please note the following about your ethics approval:

- Ethics Approval is valid for 2 years
- Please remember to use your protocol number (**91/2014**) on any documents or correspondence with the Research Ethics Committee regarding your research.
- Please note that the Research Ethics Committee may ask further questions, seek additional information, require further modification, or monitor the conduct of your research.

**Ethics approval is subject to the following:**

- The ethics approval is conditional on the receipt of 6 monthly written Progress Reports, and
- The ethics approval is conditional on the research being conducted as stipulated by the details of all documents submitted to the Committee. In the event that a further need arises to change who the investigators are, the methods or any other aspect, such changes must be submitted as an Amendment for approval by the Committee.

We wish you the best with your research.

Yours sincerely



Dr R Sommers; MBChB; MMed (Int); MPharMed.

Deputy Chairperson of the Faculty of Health Sciences Research Ethics Committee, University of Pretoria

*The Faculty of Health Sciences Research Ethics Committee complies with the SA National Act 61 of 2003 as it pertains to health research and the United States Code of Federal Regulations Title 45 and 46. This committee abides by the ethical norms and principles for research, established by the Declaration of Helsinki, the South African Medical Research Council Guidelines as well as the Guidelines for Ethical Research: Principles Structures and Processes 2004 (Department of Health).*

♦ Tel:012-3541330

♦ Fax:012-3541367 Fax2Email: 0866515924

♦ E-Mail: [fhsethics@up.ac.za](mailto:fhsethics@up.ac.za)

♦ Web: [//www.healthethics-up.co.za](http://www.healthethics-up.co.za)

♦ H W Snyman Bld (South) Level 2-34

♦ Private Bag x 323, Arcadia, Pta, S.A., 0007

## Appendix G: Authors Instruction

[www.comp.nus.edu.sg/~giw2013/gif/InstructionsForAuthors-BMC.pdf](http://www.comp.nus.edu.sg/~giw2013/gif/InstructionsForAuthors-BMC.pdf)

### Instructions for authors

#### Research articles

[Criteria](#) | [Submission process](#) | [Preparing main manuscript text](#) | [Preparing illustrations and figures](#) | [Preparing tables](#) | [Preparing additional files](#) | [Style and language](#)

Assistance with the process of manuscript preparation and submission is available from [BioMed Central customer support team](#). See '[About this journal](#)' for information about policies and the refereeing process. We also provide a collection of links to [useful tools](#) and resources for scientific authors on our page.

#### Criteria

Research articles should report on original primary research, but may report on systematic reviews of published research provided they adhere to the appropriate reporting guidelines which are detailed in our [Editorial Policies](#). Please note that non-commissioned pooled analyses of selected published research will not be considered.

#### Submission process

Manuscripts must be submitted by one of the authors of the manuscript, and should not be submitted by anyone on their behalf. The submitting author takes responsibility for the article during submission and peer review.

Please note that *BMC Public Health* levies an article-processing charge on all accepted Research articles; if the submitting author's institution is a [BioMed Central member](#) the cost of the article-processing charge may be covered by the membership (see [About](#) page for detail). Please note that the membership is only automatically recognised on submission if the submitting author is based at the member institution.

To facilitate rapid publication and to minimize administrative costs, *BMC Public Health* prefers [online submission](#).

Files can be submitted as a batch, or one by one. The submission process can be interrupted at any time; when users return to the site, they can carry on where they left off.

See below for examples of [word processor](#) and [graphics file formats](#) that can be accepted for the main manuscript document by the online submission system. Additional files of any type, such as [movies](#), animations, or [original data files](#), can also be submitted as part of the manuscript.

During submission you will be asked to provide a cover letter. Use this to explain why your manuscript should be published in the journal, to elaborate on any issues relating to our editorial policies in the ['About BMC Public Health'](#) page, and to declare any potential competing interests. You will be also asked to provide the contact details (including email addresses) of potential peer reviewers for your manuscript. These should be experts in their field, who will be able to provide an objective assessment of the manuscript. Any suggested peer reviewers should not have published with any of the authors of the manuscript within the past five years, should not be current collaborators, and should not be members of the same research institution. Suggested reviewers will be considered alongside potential reviewers recommended by the Editorial team, Editorial Advisors, Section Editors and Associate Editors.

Assistance with the process of manuscript preparation and submission is available from [BioMed Central customer support team](#).

We also provide a collection of links to useful tools and resources for scientific authors on our [Useful Tools](#) page.

### File formats

The following word processor file formats are acceptable for the main manuscript document:

- Microsoft word (DOC, DOCX)
- Rich text format (RTF)
- Portable document format (PDF)
- TeX/LaTeX (use [BioMed Central's TeX template](#))
- DeVice Independent format (DVI)

TeX/LaTeX users: Please use [BioMed Central's TeX template](#) and BibTeX stylefile if you use TeX format. During the TeX submission process, please submit your TeX file as the main manuscript file and your bib/bbl file as a dependent file. Please also convert your TeX file into a PDF and submit this PDF as an additional file with the name 'Reference PDF'. This PDF will be used by internal staff as a reference point to check the layout of the article as the author intended. Please also note that all figures must be coded at the end of the TeX file and not inline.

If you have used another template for your manuscript, or if you do not wish to use BibTeX, then please submit your manuscript as a DVI file. We do not recommend converting to RTF.

For all TeX submissions, all relevant editable source must be submitted during the submission process. Failing to submit these source files will cause unnecessary delays in the publication procedures.

### Publishing Datasets

Through a special arrangement with [LabArchives](#), LLC, authors submitting manuscripts to BMC Public Health can obtain a [complimentary subscription to LabArchives](#) with an allotment of 100MB of

storage. LabArchives is an Electronic Laboratory Notebook which will enable scientists to share and publish data files in situ; you can then link your paper to these data. Data files linked to published articles are assigned digital object identifiers (DOIs) and will remain available in perpetuity. Use of LabArchives or similar data publishing services does not replace preexisting data deposition requirements, such as for nucleic acid sequences, protein sequences and atomic coordinates.

Instructions on assigning DOIs to datasets, so they can be permanently linked to publications, can be found on the LabArchives website. Use of LabArchives' software has no influence on the editorial decision to accept or reject a manuscript.

Authors linking datasets to their publications should include an [Availability of supporting data](#) section in their manuscript and cite the dataset in their reference list.

### Preparing main manuscript text

General guidelines of the journal's style and language are given [below](#).

### Overview of manuscript sections for Research articles

Manuscripts for Research articles submitted to *BMC Public Health* should be divided into the following sections (in this order):

- [Title page](#)
- [Abstract](#)
- [Keywords](#)
- [Background](#)
- [Methods](#)
- [Results and discussion](#)
- [Conclusions](#)
- [List of abbreviations used](#) (if any)
- [Competing interests](#)
- [Authors' contributions](#)
- [Authors' information](#)
- [Acknowledgements](#)
- [Endnotes](#)
- [References](#)
- [Illustrations and figures](#) (if any)

- [Tables and captions](#)
- [Preparing additional files](#)

The **Accession Numbers** of any nucleic acid sequences, protein sequences or atomic coordinates cited in the manuscript should be provided, in square brackets and include the corresponding database name; for example, [EMBL:AB026295, EMBL:AC137000, DDBJ:AE000812, GenBank:U49845, PDB:1BFM, Swiss-Prot:Q96KQ7, PIR:S66116].

The databases for which we can provide direct links are: EMBL Nucleotide Sequence Database ([EMBL](#)), DNA Data Bank of Japan ([DDBJ](#)), GenBank at the NCBI ([GenBank](#)), Protein Data Bank ([PDB](#)), Protein Information Resource ([PIR](#)) and the Swiss-Prot Protein Database ([Swiss-Prot](#)).

You can [download a template](#) (Mac and Windows compatible; Microsoft Word 98/2000) for your article.

For reporting standards please see the information in the [About](#) section.

### Title page

The title page should:

- provide the title of the article
- list the full names, institutional addresses and email addresses for all authors
- indicate the corresponding author

Please note:

- the title should include the study design, for example "A versus B in the treatment of C: a randomized controlled trial X is a risk factor for Y: a case control study"
- abbreviations within the title should be avoided

### Abstract

The Abstract of the manuscript should not exceed 350 words and must be structured into separate sections: **Background**, the context and purpose of the study; **Methods**, how the study was performed and statistical tests used; **Results**, the main findings; **Conclusions**, brief summary and potential implications. Please minimize the use of abbreviations and do not cite references in the abstract. **Trial registration**, if your research article reports the results of a controlled health care intervention, please list your trial registry, along with the unique identifying number (e.g. **Trial registration**: Current Controlled Trials ISRCTN73824458). Please note that there should be no space between the letters and numbers of your trial registration number. We recommend manuscripts that report randomized controlled trials follow the [CONSORT extension for abstracts](#).

### Keywords

Three to ten keywords representing the main content of the article.

## Background

The Background section should be written in a way that is accessible to researchers without specialist knowledge in that area and must clearly state - and, if helpful, illustrate - the background to the research and its aims. Reports of clinical research should, where appropriate, include a summary of a search of the literature to indicate why this study was necessary and what it aimed to contribute to the field. The section should end with a brief statement of what is being reported in the article.

## Methods

The methods section should include the design of the study, the setting, the type of participants or materials involved, a clear description of all interventions and comparisons, and the type of analysis used, including a power calculation if appropriate. Generic drug names should generally be used. When proprietary brands are used in research, include the brand names in parentheses in the Methods section.

For studies involving human participants a statement detailing ethical approval and consent should be included in the methods section. For further details of the journal's editorial policies and ethical guidelines see ['About this journal'](#).

For further details of the journal's data-release policy, see the policy section in ['About this journal'](#).

## Results and discussion

The Results and discussion may be combined into a single section or presented separately. Results of statistical analysis should include, where appropriate, relative and absolute risks or risk reductions, and confidence intervals. The Results and discussion sections may also be broken into subsections with short, informative headings.

## Conclusions

This should state clearly the main conclusions of the research and give a clear explanation of their importance and relevance. Summary illustrations may be included.

## List of abbreviations

If abbreviations are used in the text they should be defined in the text at first use, and a list of abbreviations can be provided, which should precede the competing interests and authors' contributions.

## Competing interests

A competing interest exists when your interpretation of data or presentation of information may be influenced by your personal or financial relationship with other people or organizations. Authors must disclose any financial competing interests; they should also reveal any non-financial competing interests that may cause them embarrassment were they to become public after the publication of the manuscript.

Authors are required to complete a declaration of competing interests. All competing interests that are declared will be listed at the end of published articles. Where an author gives no competing interests, the listing will read 'The author(s) declare that they have no competing interests'.

When completing your declaration, please consider the following questions:

#### *Financial competing interests*

- In the past five years have you received reimbursements, fees, funding, or salary from an organization that may in any way gain or lose financially from the publication of this manuscript, either now or in the future? Is such an organization financing this manuscript (including the article-processing charge)? If so, please specify.
- Do you hold any stocks or shares in an organization that may in any way gain or lose financially from the publication of this manuscript, either now or in the future? If so, please specify.
- Do you hold or are you currently applying for any patents relating to the content of the manuscript? Have you received reimbursements, fees, funding, or salary from an organization that holds or has applied for patents relating to the content of the manuscript? If so, please specify.
- Do you have any other financial competing interests? If so, please specify.

#### *Non-financial competing interests*

Are there any non-financial competing interests (political, personal, religious, ideological, academic, intellectual, commercial or any other) to declare in relation to this manuscript? If so, please specify.

If you are unsure as to whether you, or one your co-authors, has a competing interest please discuss it with the editorial office.

#### **Authors' contributions**

In order to give appropriate credit to each author of a paper, the individual contributions of authors to the manuscript should be specified in this section.

According to [ICMJE guidelines](#), An 'author' is generally considered to be someone who has made substantive intellectual contributions to a published study. To qualify as an author one should 1) have made substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data; 2) have been involved in drafting the manuscript or revising it critically for important intellectual content; 3) have given final approval of the version to be published; and 4) agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. Each author should have participated sufficiently in the work to take public responsibility for appropriate portions of the content. Acquisition of funding, collection of data, or general supervision of the research group, alone, does not justify authorship.

We suggest the following kind of format (please use initials to refer to each author's contribution): AB carried out the molecular genetic studies, participated in the sequence alignment and drafted the manuscript. JY carried out the immunoassays. MT participated in the sequence alignment. ES participated in the design of the study and performed the statistical analysis. FG conceived of the study, and participated in its design and coordination and helped to draft the manuscript. All authors read and approved the final manuscript.

All contributors who do not meet the criteria for authorship should be listed in an acknowledgements section. Examples of those who might be acknowledged include a person who provided purely technical help, writing assistance, or a department chair who provided only general support.

### **Authors' information**

You may choose to use this section to include any relevant information about the author(s) that may aid the reader's interpretation of the article, and understand the standpoint of the author(s). This may include details about the authors' qualifications, current positions they hold at institutions or societies, or any other relevant background information. Please refer to authors using their initials. Note this section should not be used to describe any competing interests.

### **Acknowledgements**

Please acknowledge anyone who contributed towards the article by making substantial contributions to conception, design, acquisition of data, or analysis and interpretation of data, or who was involved in drafting the manuscript or revising it critically for important intellectual content, but who does not meet the criteria for authorship. Please also include the source(s) of funding for each author, and for the manuscript preparation. Authors must describe the role of the funding body, if any, in design, in the collection, analysis, and interpretation of data; in the writing of the manuscript; and in the decision to submit the manuscript for publication. Please also acknowledge anyone who contributed materials essential for the study. If a language editor has made significant revision of the manuscript, we recommend that you acknowledge the editor by name, where possible.

The role of a scientific (medical) writer must be included in the acknowledgements section, including their source(s) of funding. We suggest wording such as 'We thank Jane Doe who provided medical writing services on behalf of XYZ Pharmaceuticals Ltd.'

Authors should obtain permission to acknowledge from all those mentioned in the Acknowledgements section.

### **Endnotes**

Endnotes should be designated within the text using a superscript lowercase letter and all notes (along with their corresponding letter) should be included in the Endnotes section. Please format this section in a paragraph rather than a list.

### **References**

All references, including URLs, must be numbered consecutively, in square brackets, in the order in which they are cited in the text, followed by any in tables or legends. Each reference must have an individual reference number. Please avoid excessive referencing. If automatic numbering systems are used, the reference numbers must be finalized and the bibliography must be fully formatted before submission.

Only articles, datasets, clinical trial registration records and abstracts that have been published or are in press, or are available through public e-print/preprint servers, may be cited; unpublished abstracts, unpublished data and personal communications should not be included in the reference list, but may be included in the text and referred to as "unpublished observations" or "personal communications" giving the names of the involved researchers. Obtaining permission to quote personal communications and unpublished data from the cited colleagues is the responsibility of the author. Footnotes are not allowed, but endnotes are permitted. Journal abbreviations follow Index Medicus/MEDLINE. Citations in the reference list should include all named authors, up to the first 30 before adding '*et al.*'..

Any *in press* articles cited within the references and necessary for the reviewers' assessment of the manuscript should be made available if requested by the editorial office.

Style files are available for use with popular bibliographic management software:

- [BibTeX](#)
- [EndNote style file](#)
- [Reference Manager](#)
- [Zotero](#)

Examples of the *BMC Public Health* reference style are shown [below](#). Please ensure that the reference style is followed precisely; if the references are not in the correct style they may have to be retyped and carefully proofread.

All web links and URLs, including links to the authors' own websites, should be given a reference number and included in the reference list rather than within the text of the manuscript. They should be provided in full, including both the title of the site and the URL, in the following format: **The Mouse Tumor Biology Database** [http://tumor.informatics.jax.org/mtbwi/index.do]. If an author or group of authors can clearly be associated with a web link, such as for weblogs, then they should be included in the reference.

#### Examples of the *BMC Public Health* reference style

##### *Article within a journal*

Koonin EV, Altschul SF, Bork P: **BRCA1 protein products: functional motifs**. *Nat Genet* 1996,**13**:266-267.

##### *Article within a journal supplement*

Orengo CA, Bray JE, Hubbard T, LoConte L, Sillitoe I: **Analysis and assessment of ab initio three-**

**dimensional prediction, secondary structure, and contacts prediction.** *Proteins* 1999, **43**(Suppl 3):149-170.

*In press article*

Kharitonov SA, Barnes PJ: **Clinical aspects of exhaled nitric oxide.** *Eur Respir J*, in press.

*Published abstract*

Zvaifler NJ, Burger JA, Marinova-Mutafchieva L, Taylor P, Maini RN: **Mesenchymal cells, stromal derived factor-1 and rheumatoid arthritis [abstract].** *Arthritis Rheum* 1999, **42**:s250.

*Article within conference proceedings*

Jones X: **Zeolites and synthetic mechanisms.** In *Proceedings of the First National Conference on Porous Sieves: 27-30 June 1996; Baltimore*. Edited by Smith Y. Stoneham: Butterworth-Heinemann; 1996:16-27.

*Book chapter, or article within a book*

Schnepf E: **From prey via endosymbiont to plastids: comparative studies in dinoflagellates.** In *Origins of Plastids. Volume 2*. 2nd edition. Edited by Lewin RA. New York: Chapman and Hall; 1993:53-76.

*Whole issue of journal*

Ponder B, Johnston S, Chodosh L (Eds): **Innovative oncology.** In *Breast Cancer Res* 1998, **10**:1-72.

*Whole conference proceedings*

Smith Y (Ed): *Proceedings of the First National Conference on Porous Sieves: 27-30 June 1996; Baltimore*. Stoneham: Butterworth-Heinemann; 1996.

*Complete book*

Margulis L: *Origin of Eukaryotic Cells*. New Haven: Yale University Press; 1970.

*Monograph or book in a series*

Hunninghake GW, Gadek JE: **The alveolar macrophage.** In *Cultured Human Cells and Tissues*. Edited by Harris TJR. New York: Academic Press; 1995:54-56. [Stoner G (Series Editor): *Methods and Perspectives in Cell Biology*, vol 1.]

*Book with institutional author*

Advisory Committee on Genetic Modification: *Annual Report*. London; 1999.

*PhD thesis*

Kohavi R: **Wrappers for performance enhancement and oblivious decision graphs.** *PhD thesis*. Stanford University, Computer Science Department; 1995.

*Link / URL*

**The Mouse Tumor Biology Database** [<http://tumor.informatics.jax.org/mtbwi/index.do>]

*Link / URL with author(s)*

Corpas M: **The Crowdfunding Genome Project: a personal genomics community with open source**

**values** [<http://blogs.biomedcentral.com/bmcblog/2012/07/16/the-crowdfunding-genome-project-a-personal-genomics-community-with-open-source-values/>]

*Dataset with persistent identifier*

Zheng, L-Y; Guo, X-S; He, B; Sun, L-J; Peng, Y; Dong, S-S; Liu, T-F; Jiang, S; Ramachandran, S; Liu, C-M; Jing, H-C (2011): **Genome data from sweet and grain sorghum (*Sorghum bicolor*)**. *GigaScience Database*. <http://dx.doi.org/10.5524/100012>.

*Clinical trial registration record with persistent identifier*

Mendelow, AD (2006): **Surgical Trial in Lobar Intracerebral Haemorrhage**. *Current Controlled Trials*. <http://dx.doi.org/10.1186/ISRCTN22153967>

## Preparing illustrations and figures

Illustrations should be provided as separate files, not embedded in the text file. Each figure should include a single illustration and should fit on a single page in portrait format. If a figure consists of separate parts, it is important that a single composite illustration file be submitted which contains all parts of the figure. There is no charge for the use of color figures.

Please read our [figure preparation guidelines](#) for detailed instructions on maximising the quality of your [figures](#).

## Formats

The following file formats can be accepted:

- PDF (preferred format for diagrams)
- DOCX/DOC (single page only)
- PPTX/PPT (single slide only)
- EPS
- PNG (preferred format for photos or images)
- TIFF
- JPEG
- BMP

## Figure legends

The legends should be included in the main manuscript text file at the end of the document, rather than being a part of the figure file. For each figure, the following information should be provided: Figure number (in sequence, using Arabic numerals - i.e. Figure 1, 2, 3 etc); short title of figure (maximum 15 words); detailed legend, up to 300 words.

**Please note that it is the responsibility of the author(s) to obtain permission from the copyright holder to reproduce figures or tables that have previously been published elsewhere.**

### Preparing tables

Each table should be numbered and cited in sequence using Arabic numerals (i.e. Table 1, 2, 3 etc.). Tables should also have a title (above the table) that summarizes the whole table; it should be no longer than 15 words. Detailed legends may then follow, but they should be concise. Tables should always be cited in text in consecutive numerical order.

Smaller tables considered to be integral to the manuscript can be pasted into the end of the document text file, in A4 portrait or landscape format. These will be typeset and displayed in the final published form of the article. Such tables should be formatted using the 'Table object' in a word processing program to ensure that columns of data are kept aligned when the file is sent electronically for review; this will not always be the case if columns are generated by simply using tabs to separate text. Columns and rows of data should be made visibly distinct by ensuring that the borders of each cell display as black lines. Commas should not be used to indicate numerical values. Color and shading may not be used; parts of the table can be highlighted using symbols or bold text, the meaning of which should be explained in a table legend. Tables should not be embedded as figures or spreadsheet files.

Larger datasets or tables too wide for a portrait page can be uploaded separately as additional files. Additional files will not be displayed in the final, laid-out PDF of the article, but a link will be provided to the files as supplied by the author.

Tabular data provided as additional files can be uploaded as an Excel spreadsheet (.xls) or comma separated values (.csv). As with all files, please use the standard file extensions.

### Preparing additional files

Although *BMC Public Health* does not restrict the length and quantity of data included in an article, we encourage authors to provide datasets, tables, movies, or other information as additional files.

Please note: All Additional files **will be published** along with the article. Do not include files such as patient consent forms, certificates of language editing, or revised versions of the main manuscript document with tracked changes. Such files should be sent by email to [editorial@biomedcentral.com](mailto:editorial@biomedcentral.com), quoting the Manuscript ID number.

Results that would otherwise be indicated as "data not shown" can and should be included as additional files. Since many weblinks and URLs rapidly become broken, *BMC Public Health* requires that supporting data are included as additional files, or deposited in a recognized repository. Please do not link to data on a personal/departmental website. The maximum file size for additional files is 20 MB each, and files will be virus-scanned on submission.

Additional files can be in any format, and will be downloadable from the final published article as supplied by the author. We recommend CSV rather than PDF for tabular data.

Certain supported files formats are recognized and can be displayed to the user in the browser. These include most movie formats (for users with the Quicktime plugin), mini-websites prepared according to our guidelines, chemical structure files (MOL, PDB), geographic data files (KML).

If additional material is provided, please list the following information in a separate section of the manuscript text:

- File name (e.g. Additional file 1)
- File format including the correct file extension for example .pdf, .xls, .txt, .pptx (including name and a URL of an appropriate viewer if format is unusual)
- Title of data
- Description of data

Additional files should be named "Additional file 1" and so on and should be referenced explicitly by file name within the body of the article, e.g. 'An additional movie file shows this in more detail [see Additional file 1]'

#### **Additional file formats**

Ideally, file formats for additional files should not be platform-specific, and should be viewable using free or widely available tools. The following are examples of suitable formats.

- Additional documentation
  - PDF (Adode Acrobat)
- Animations
  - SWF (Shockwave Flash)
- Movies
  - MP4 (MPEG 4)
  - MOV (Quicktime)
- Tabular data
  - XLS, XLSX (Excel Spreadsheet)
  - CSV (Comma separated values)

As with figure files, files should be given the standard file extensions.

#### **Mini-websites**

Small self-contained websites can be submitted as additional files, in such a way that they will be browsable from within the full text HTML version of the article. In order to do this, please follow these instructions:

1. Create a folder containing a starting file called index.html (or index.htm) in the root.
2. Put all files necessary for viewing the mini-website within the folder, or sub-folders.
3. Ensure that all links are relative (ie "images/picture.jpg" rather than "/images/picture.jpg" or "http://yourdomain.net/images/picture.jpg" or "C:\Documents and Settings\username\My Documents\mini-website\images\picture.jpg") and no link is longer than 255 characters.
4. Access the index.html file and browse around the mini-website, to ensure that the most commonly used browsers (Internet Explorer and Firefox) are able to view all parts of the mini-website without problems, it is ideal to check this on a different machine.
5. Compress the folder into a ZIP, check the file size is under 20 MB, ensure that index.html is in the root of the ZIP, and that the file has .zip extension, then submit as an additional file with your article.

## Style and language

### General

Currently, *BMC Public Health* can only accept manuscripts written in English. Spelling should be US English or British English, but not a mixture.

There is no explicit limit on the length of articles submitted, but authors are encouraged to be concise.

*BMC Public Health* will not edit submitted manuscripts for style or language; reviewers may advise rejection of a manuscript if it is compromised by grammatical errors. Authors are advised to write clearly and simply, and to have their article checked by colleagues before submission. In-house copyediting will be minimal. Non-native speakers of English may choose to make use of a copyediting service.

### Language editing

For authors who wish to have the language in their manuscript edited by a native-English speaker with scientific expertise, BioMed Central recommends [Edanz](#). BioMed Central has arranged a 10% discount to the fee charged to BioMed Central authors by Edanz. Use of an editing service is neither a requirement nor a guarantee of acceptance for publication. Please contact [Edanz](#) directly to make arrangements for editing, and for pricing and payment details.

### Help and advice on scientific writing

The abstract is one of the most important parts of a manuscript. For guidance, please visit our page on [Writing titles and abstracts for scientific articles](#).

Tim Albert has produced for BioMed Central a [list of tips](#) for writing a scientific manuscript. [American Scientist](#) also provides a list of resources for science writing. For more detailed guidance on preparing a manuscript and writing in English, please visit the [BioMed Central author academy](#).

## Abbreviations

Abbreviations should be used as sparingly as possible. They should be defined when first used and a list of abbreviations can be provided following the main manuscript text.

## Typography

- Please use double line spacing.
- Type the text unjustified, without hyphenating words at line breaks.
- Use hard returns only to end headings and paragraphs, not to rearrange lines.
- Capitalize only the first word, and proper nouns, in the title.
- All lines and pages should be numbered. Authors are asked to ensure that line numbering is included in the main text file of their manuscript at the time of submission to facilitate peer-review. Once a manuscript has been accepted, line numbering should be removed from the manuscript before publication. For authors submitting their manuscript in Microsoft Word please do not insert page breaks in your manuscript to ensure page numbering is consistent between your text file and the PDF generated from your submission and used in the review process.
- Use the *BMC Public Health* [reference format](#).
- Footnotes are not allowed, but endnotes are permitted.
- Please do not format the text in multiple columns.
- Greek and other special characters may be included. If you are unable to reproduce a particular special character, please type out the name of the symbol in full. **Please ensure that all special characters used are embedded in the text, otherwise they will be lost during conversion to PDF.**

## Units

SI units should be used throughout (liter and molar are permitted, however).