ALCOHOL AND PROBLEM DRINKING AS RISK FACTORS FOR TUBERCULOSIS

By

Tiwonge Jaranthowa Mkandawire

MKNTIW001

SUBMITTED TO THE UNIVERSITY OF CAPE TOWN

In partial fulfillment of the requirements for the Master of Public Health in the Department of Public Health and Family Medicine

Faculty of Health Sciences

University of Cape Town

November 2009

Supervisor: Professor Rodney Ehrlich

Course Convener (Master of Public Health)

ABSTRACT

Background

Tuberculosis is a major public health concern for South Africa which has one of the highest recorded incidence rates in the world. Previous research [1998 South African Demographic and Health Survey (SADHS)] reported a crude association between alcohol use and tuberculosis. This study aimed to examine evidence for a relationship, and the size thereof, between alcohol consumption and previous tuberculosis in the 2003 SADHS as a means of informing tuberculosis prevention.

Methods

This study was a secondary analysis of cross sectional data collected as part of the 2003 SADHS. Tuberculosis lifetime risk was derived from respondent reports of past tuberculosis episodes based on being informed by a healthcare worker. Alcohol consumption, problem drinking as well as selected explanatory variables were generated from similar questions from the adult questionnaire of the SADHS. The CAGE questionnaire was used to measure symptoms of alcohol problems. Logistic regression was used to model the relationship between past tuberculosis and both alcohol consumption and CAGE.

Results

Current and previous alcohol consumption were found to be associated with an increase in odds of tuberculosis in both men and women, with odds ratios ranging

from 1.1 (95% CI 0.9 – 2.5) to 2.8 (95% CI 1.4 – 5.7) after adjusting for potential confounding effects of socioeconomic factors, smoking, nutritional status and age. Having a CAGE score of either 1 to 2 or 3 to 4 was associated with a doubling [OR 2.2 (95% CI 1.0 – 4.8) and quadrupling [OR 4.4 (95% CI 1.4 – 13.4)] in the odds of tuberculosis respectively.

Discussion and conclusion

Behavioural and biological mechanisms of effect of alcohol on tuberculosis may explain the findings. Impairment of the immune system, both acute and long term, has been suggested as the mechanism of increased susceptibility to tuberculosis. On the other hand, high risk living conditions and behaviour associated with problem drinking provide potential for increased exposure and susceptibility to tuberculosis infection. The study was able to control for several potentially confounding socioeconomic predictor variables although not HIV infection.

The results complement a body of research that has documented the adverse effects of alcohol consumption on health in general and tuberculosis specifically. The findings thus provide more evidence for public health practitioners to tackle the problem of tuberculosis via specific efforts to control alcohol use and abuse, in addition to other methods of tuberculosis control.

DECLARATION

I, Tiwonge Jaranthowa Mkandawire, hereby declare that the work on this dissertation is based on my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university.

Signature……

Date……..

ACKNOWLEDGEMENTS

Naming the people who have supported me through the process of writing this thesis would be easy but I will probably not be able to thank them enough. My heartfelt gratitude goes to the Cannon Collins Trust for the financial support toward my studies. I am also grateful for the access to the data for the analysis from the Department of Health's Medical Research Council. My thanks also go to my supervisor, Professor Rodney Ehrlich for all the guidance and wisdom towards structuring this thesis.

A special thank you goes to my mother and father for the "Mount Everest" of love, support and encouragement without which I might not have started this degree, let alone finish it. My gratitude also goes to Munyaradzi and my friends and family for the constant interest and encouragement to finish this thesis. Above all else I would like to thank God for his never failing love, protection and guidance through all the days of my life.

Table of Contents

List of Tables

List of Figures

Appendices

Appendix 1: Unadjusted logistic regression between recurrent tuberculosis (vs. one episode) and exposure variables stratified by gender (N=191)

Appendix 2: SADHS adult questionnaire

Appendix 3: UCT ethics approval letter

1. Introduction

Tuberculosis (TB) is a curable disease that has been and still remains one of the leading causes of death in middle and low-income countries. An estimated 1.79 million deaths occur worldwide annually, with the bulk of them being registered in Africa where the disease is epidemic (Maartens 2007). There has been a marked increase in the incident cases of tuberculosis in the past two decades as a result of the HIV epidemic.

In 2006, South Africa had the fourth highest recorded tuberculosis incidence rate in the world with 382 sputum smear positive cases per 100 000 per year (WHO 2006). Accounting for 5.0% of total years of life lost (YLL), tuberculosis is the third most common cause of death in South Africa (Bradshaw D. et al. 2000). Tuberculosis remains a major public health concern in the country. The rate of notification has continued to rise with a considerable proportion (20%) of cases being relapse or re-treatment cases (WHO 2006). The country is reported as having achieved "100% Directly Observed Treatment, Short course (DOTS) coverage" in 2006 which has contributed to the control of the epidemic. "DOTS coverage" is defined here as the population living in administrative areas where DOTS services are available. However, despite the implementation of several preventative and treatment strategies, tuberculosis remains a leading cause of death in the country.

The aetiology of tuberculosis is complex. Mycobacterium tuberculosis is a necessary causal agent but is not sufficient to cause tuberculosis. The alveoli in the human lungs are usually the initial site of infection. Macrophages and lymphocytes ingest the

invading organism as the body's first line of defense. In most instances, the immune system is able to control the initial infection, leading to tubercle organisms lying dormant within the lung tissues and other parts of the body. This dormant phase is referred to as latent tuberculosis. Approximately 90% of individuals are not likely to develop the disease after the initial infection. Reactivation of these organisms, which leads to active tuberculosis, is more likely to occur when the immune system is compromised in some way.

Previous studies have identified several risk factors for the initial infection as well as reactivation of disease at the individual as well as community levels (Harling G. et al. 2007, Lienhardt C. et al. 2005, Borgdorf M. et al. 2000). These factors include age, gender, race, immunosuppression, smoking, socioeconomic factors and alcohol consumption. This last factor is the focus of this thesis.

A previous study based on the South African Demographic and Health Survey (SADHS) found a significant association between alcohol consumption and "any lifetime" as well as "a recent" tuberculosis disease episode (Harling G. et al. 2007). Crude associations have been found between alcohol consumption and risk of both tuberculosis infection and disease (Harling G. et al. 2007, Lienhardt C. et al. 2005). Alcoholism and the lifestyle and behaviour related to it are considered to be the factors most closely associated with increased risk of disease as well as disease relapse (Thomas A. et al. 2005). People who habitually drank were classified as alcoholics in this study.

Despite the reporting of these associations between alcohol and tuberculosis, there has been little epidemiological research carried out on this topic although this is growing. Most studies report crude associations preparatory to controlling for alcohol in exploring the relationship of tuberculosis with other risk factors. The aim of this study was to explore the relationship between risk of tuberculosis disease and both alcohol consumption and problem drinking in South Africa. “Prevalence” of reported past tuberculosis disease was used as a proxy for lifetime risk of disease.

2. Literature review

2.1. Tuberculosis

Although there are other mycobacteria that cause disease, *M. tuberculosis* is the most common cause of infection globally. The infection is acquired via the inhalation of infected droplet nuclei, with the alveoli in the lungs being the first site of infection. Symptoms of tuberculosis include cough, night sweats, fatigue, reduced appetite and weight loss.

When human beings are infected with M. tuberculosis they have an approximately 10% lifetime likelihood of developing symptomatic illness provided they are reasonably healthy. There have been several studies carried out to determine risk factors for the re-activation of disease as well as the increased risk of infection (Jacobson J. 1992). Journal articles were initially searched for in the Pubmed database using “alcohol” and “tuberculosis” as keywords. Further readings were included from citations in these publications. Articles were included in the literature review if they involved a measure of the association between alcohol consumption and problem drinking with tuberculosis and followed sound research methodology. Literature exploring the relationship between tuberculosis and other risk factors was included where relevant as a means of identifying potential confounders of the associations being investigated.

The following section provides a brief summary of tuberculosis risk factors that have been cited in literature.

2.2. Risk factors for tuberculosis infection, disease and reactivation of disease

2.2.1. Age

Increasing age has been associated with an increase in risk of disease. The South African Demographic and Health Survey (SADHS) 1998 shows patterns of tuberculosis incidence in men with a peak observed in the age group 35 - 44 years (SADHS 1998). This pattern is thought to be partly a result of increasing exposure to infection with adulthood. The pattern of disease incidence in women is different from that in men with peaks observed earlier at age 25 to 34 years and again in women 65 years and older. Several hypotheses have been put forward (Borgdorff M. et al. 2000, Holmes C. et al. 1998) and are discussed in the section that follows.

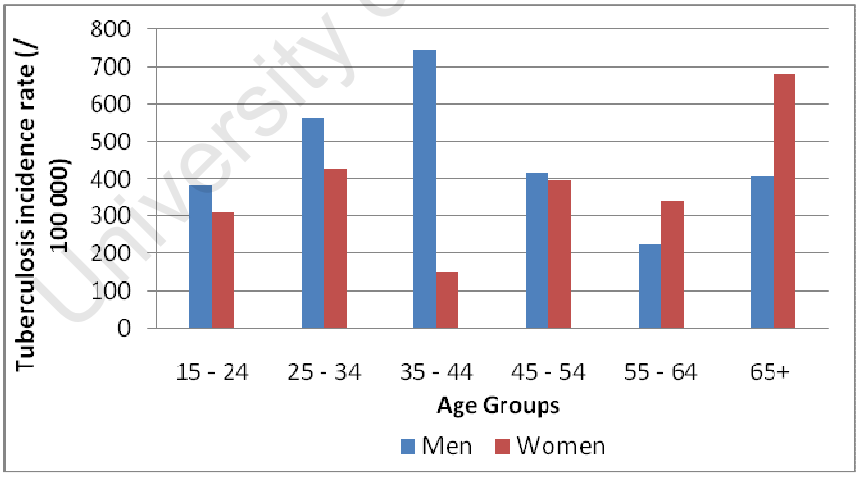


Figure 1: South Africa tuberculosis incidence in men and women 1998

2.2.2. Sex

Sex refers to the biological differences between men and women whereas gender takes into account socioeconomic, cultural and other societal factors that are different

for the two groups. Reports from country surveillance systems have shown differences in the prevalence and notification rates between men and women (Borgdorff M. et al. 2000, Holmes C. et al. 1998). In most cases, prevalences of tuberculosis are higher in men than they are in women. This male excess has generally been reported for age groups above adolescence. However, several studies have reported that women generally have higher notification rates and progression to disease in the young to middle age groups (9 to 40 years on average) than their male counterparts. In a similar fashion, tuberculosis mortality rates are higher in women in the age group from adolescence to middle age. In contrast, men over the age of 40 years tend to have higher rates of mortality than women (Holmes C. et al. 1998).

Several hypotheses have been put forward to explain the differences in prevalence, notification rates and mortality between men and women. One proposition is that there is differential access to health care services between the two groups (Borgdorff M. et al. 2000). Studies have generally shown that passive case finding (which is normally used for country disease surveillance) tends to yield lower notification rates in women than in males than active case finding (Cassels A. 1982). On the other hand, women in their reproductive ages tend to have higher notification rates than older men and women. It is thought that these women seek health services more frequently during the child bearing ages and hence have a higher likelihood of being diagnosed with tuberculosis (Holmes C. et al. 1998). Since women consume less alcohol than men (SADHS 1998), sex is a significant risk factor that needs to be taken into consideration as a potential confounder of the relationship between alcohol and tuberculosis.

2.2.3. Immunosupression

The progression of disease after infection depends on the level of immunity of the individual. The fact that the majority of infected individuals do not develop the disease after infection implies that any factors that compromise immunity are likely to promote disease progression. In support of this general hypothesis, a higher risk of tuberculosis is strongly associated with Human Immunodeficiency Virus (HIV) co-infection. HIV increases the risk of reactivating latent tuberculosis as well as increasing the risk of rapid disease progression after new infection (Corbett E. et al. 2003).

2.2.4. Malnutrition

Malnutrition and weight loss have been linked with tuberculosis for a long time in literature (Macallan. D 1993) dating back to a time in history when the disease was referred to as the "wasting" disease. On the other hand tuberculosis has been reported to affect nutritional status via a possible number of mechanisms such as increased energy expenditure, reduced energy intake as well as impairment of amino acid utilization substrates. Severe micronutrient deficiencies have also been reported in patients with tuberculosis. Vitamin A, D and E have been among some of the most reduced micronutrients in tuberculosis patients (Lettow. M 2003).

Malnutrition, on the other hand, has also been reported as a possible risk factor of tuberculosis resulting in increased susceptibility to the disease, due to impaired immune function, as well as increased morbidity (Macallan. D 1993).

2.2.5. Smoking

Smoking is known to be associated with increased susceptibility to chest infection. In keeping with this trend, it has been hypothesized that smoking could also be a risk factor for tuberculosis. Davies P. et al. (2006) sought to summarize findings of studies on the subject carried out in the United Kingdom (UK), China and India to test this hypothesis. An increased risk of tuberculosis disease in smokers was found in five of the studies included in the report. “Where an association has been found there seems to be an increase in tuberculosis case rates of between two- and four-fold for those smoking in excess of 20 cigarettes a day.” (Davies P. et al. 2006). It has been suggested that smoking could lead to a reactivation of latent tuberculosis as a result of nicotine decreasing the levels of tumor necrosis factor alpha (TNF-α) in the lung. TNF-α is a cytokine whose primary function is the regulation of immune cells (Davies P et al. 2006).

2.2.6. Socioeconomic factors

The impact of socioeconomic factors on the risk of infection and severity of disease is one of the most researched relationships in tuberculosis. Several measures have been used as proxies for socioeconomic status. Level of education, levels of income and size of households are three of the most commonly utilized proxies. Low socioeconomic status is generally found to be associated with increased risk of disease. Lack of a fixed income was found to be associated with greatly increased odds of having tuberculosis [odds ratio 12.3 95% CI 3.12 – 47.35) in an evaluation of potential risk factors in a case control study in Estonia (Tekkel M. et al. 2002). A case control study in West Africa found that household crowding was a significant risk

factor for tuberculosis [OR 2.31 95% CI 1.05 - 5.12]. The analysis of the 1998 SADHS reported an association between increased tuberculosis risk and lower levels of education, unemployment and lower household wealth (Harling G. et al. 2007). Controlling for socioeconomic status in the exploration of the relationship between alcohol and tuberculosis is thus essential.

2.3. Alcohol as a risk factor for tuberculosis

Alcohol has been linked with an increase in the risk for tuberculosis infection in several studies in literature. Figure 2 provides a summary of possible sites of alcohol effects on tuberculosis as suggested in the literature.

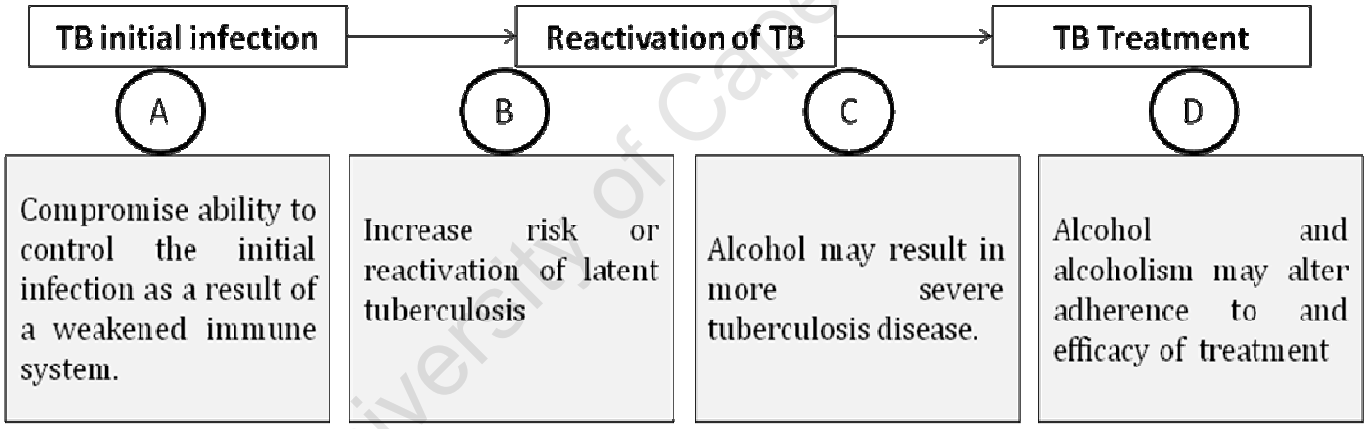


Figure 2: Possible sites of alcohol effects on tuberculosis

In animal studies, chronic and acute alcohol consumption has been showed to influence the rates of tuberculosis infection. A study conducted to determine the effect of alcohol consumption on murine pulmonary tuberculosis found that alcohol led to an increase in lung organism burden after inoculation with tuberculosis. Additionally, alcohol-fed rats showed a weakened ability to control tuberculosis infection owing to a

compromised immune system (Mason C. et al. 2004). Although these results cannot be directly translated to human biology, the mechanisms involved are similar enough to the mammalian systems that it is worth exploring the hypothesis.

Alcohol use has been found to be positively associated with tuberculosis in several epidemiological studies (Tekkel M. et al. 2002, Crampin A. et al 2004). Lienhardt C. et al. (2005) found that alcohol resulted in a significantly increased odds of disease of 1.84 [95% CI 1.28 - 2.66] in univariate analysis of risk factors. The odds ratio, however, dropped to 1.06 [95% CI 0.58 – 2.08] in multivariate analysis after controlling for socioeconomic factors, gender and smoking. Another study reported a two fold increase in tuberculosis disease with current alcohol consumption [Odds ratio 2.13 (95% CI 1.02 – 4.44)] (Shetty N. et al. 2006).

Alcoholism and heavy drinking have also been associated with strongly increased odds of tuberculosis disease in several instances in literature (Coker R. et al. 2006 , Kim S. et al. 2005). Heavy drinkers were found to have triple [Odds ratio 3.33 (95% CI 1.99-5.59)] the odds of tuberculosis as compared to non drinkers in a study on occupational risk factors for tuberculosis (Rosenham K. et al. 1995). Alcoholism has also been linked with tuberculosis relapse in patients on a DOTS program. Alcoholics (defined in this study as patients who habitually drank alcohol) were found to have twice the odds of relapse (Odds ratio 2.13 95% CI 1.3 – 4.1) compared to non drinkers (Thomas A. et al. 2005).

A systematic review published during the course of this analysis reported a pooled relative risk of 3.50 (95% CI: 2.01 – 5.93) associated with drinking more than 40g of

alcohol per day or having an alcohol disorder. The most conservative relative risk was 2.94 (95% CI: 1.89–4.59) derived from a subset of the studies which met the inclusion criteria (Lönnroth K. et al. 2008).

South Africa has the fourth highest burden of tuberculosis as well as one of the highest alcohol consumption per capita rates in the world, estimated at 20 litres per adult per year (Parry C. 2005). The 1998 SADHS reported population alcohol consumption prevalence of 28% which translated to 8.3 million South African adults who were using alcohol at that time. Men had higher consumption prevalence than women.

In order to determine the change in alcohol consumption prevalence over a 5 year period, these results are compared with the SADHS 2003 findings. The SADHS 2003 found that there had been a sharp and unexplained decline in the alcohol consumption (reported ever having consumed alcohol) and problem drinking (defined as having a CAGE greater than 1) in both men and women since the previous survey. Despite this decrease, there are still some provinces such as Gauteng, Western Cape, North West, Northern Cape and Eastern Cape, which have consumption prevalence higher than 37% (SADHS 2003).

Differences in consumption prevalence were reported across the four race categories measured. Whites were reported as the population with the highest prevalence of alcohol consumption (i.e. any consumption), followed by Coloureds, Indians and Africans. In each of these race categories, men consistently had higher alcohol consumption prevalences than women.

An analysis of the 1998 SADHS found a relationship between having a CAGE score greater than 1 and odds of recent tuberculosis [OR 1.97, 95% CI 1.21 – 3.22], and odds of having had tuberculosis in one's lifetime [2.52, 95% CI 1.86 – 3.4] (Harling G. et al. 2007). These results were reported in multivariate analysis including several socioeconomic factors.

The same study reported a crude association between ever having drunk alcohol and an increased odds of recent tuberculosis [OR 1.72, 95% CI 0.99 – 2.97] and lifetime tuberculosis [OR 2.44 95% CI 1.88 – 3.17]. Alcohol consumption was however not included in multivariate analysis for this study due to co-linearity with the CAGE variable.

The high burden of tuberculosis disease in the country requires relevant and effective preventive actions as a means of reducing incidence and prevalence. A positive association between alcohol and tuberculosis would be important for public health in the South African setting owing to the high reported rates of alcohol use and abuse particularly if a causal relationship was demonstrated.

There is, however, very little literature exploring the effects of alcohol on tuberculosis in South Africa. In 2008, 25 international experts from different countries met to examine evidence with regards to the role alcohol and problem drinking play in infectious disease pathways. It was concluded that there is a link between them which warrants further research in order to inform prevention (Parry C. et al 2009). The hypothesis was that alcohol not only contributes to the incidence of tuberculosis but may also increase the progression of the disease.

The purpose of this study was thus to explore the relationship between alcohol consumption and tuberculosis using a nationally representative sample of the South Africa population, and to compare the results between 1998 and 2003 SADHSs.

2.4. Goal

To examine evidence for a relationship, and the size thereof, between alcohol consumption and tuberculosis in South Africa as a means of informing tuberculosis prevention.

2.5. Research question

Is alcohol consumption associated with a higher risk of tuberculosis disease?

Specific Hypothesis: Alcohol consumption is likely to be associated with a 2 fold increase in risk of tuberculosis disease (Odds ratio ~ 2) and problem drinking with a three fold increase in risk of tuberculosis (Odds ratio ~ 3) based on previous studies (Harling G. et al. 2007).

2.6. Objectives

2.6.1. Analytic

- To test the hypothesis that alcohol consumption is associated with an increased history of tuberculosis disease, with prevalence of tuberculosis history as a proxy for lifetime tuberculosis risk.

2.6.2. Descriptive

- To describe the lifetime frequency of previous tuberculosis in South Africa.
- To describe the pattern of alcohol consumption in South Africa.
- To compare and describe changes in tuberculosis prevalence and patterns of alcohol consumption between 1998 and 2003 in South Africa.

3. Methods

This study is a secondary analysis of cross sectional data collected as part of the 2003 South African Demographic and Health Survey (SADHS). The SADHS is based on an international methodology with the aim of providing data on population, health and nutrition in developing countries. The 2003 SADHS is the second of its kind in South Africa, following the 1998 survey. It was carried out by the African Strategic Research Corporation (ASRC) under contract to the Department of Health.

3.1. Study population and sampling

The SADHS survey utilized a nationally representative sample of 7,756 households (Department of Health 2003). An important objective of the study was to provide information for each of the nine provinces as well as for the four "race groups", as defined in South Africa[1]. Areas with predominantly Asian/Indian populations were oversampled due to the small proportion of this population group.

The study utilized a two stage design. The country was stratified into the nine provinces and each province was further stratified into urban and non-urban. The first stage consisted of selecting census enumeration areas (EAs) as primary sampling units, with probability proportional to size based on the number of households in the EA. A total of 630 EAs was selected (360 urban and 262 non urban) from the 86,000 EAs that served as a sampling frame. Fieldwork was completed in nine sample units.

[1] Apartheid sought to categorize all South Africans into one of four racial groups: Asian (or Indian), African (or Black), Coloured and White. The social stratification by racial group reflects large and enduring historical disparities in SES, quality of housing and services and access to medical care, and consequently in disease risk. Racial group stratification has been retained in national health surveillance in South Africa to reflect a social complexity not fully captured by conventional measures of socioeconomic position (education, income, etc.) and to monitor progress toward reduction of health disparities.

The second stage of selection involved the systematic sampling of households/stands from the selected EAs (Department of Health 2003). Using aerial photos, Africa Strategic Research Corporation (ASRC) identified the global positioning system (GPS) coordinates of all the plots located within the boundaries of the selected EAs and selected 16 in each EA, for a total of 10 080 selected. The GPS coordinates provided a means of uniquely identifying the selected plot.

All women aged 15-49 years resident in the households in the sample or visitors present in the household on the night of the survey were eligible to be interviewed in the survey. In every second household selected for the survey, all men aged 15-59 years were also eligible to be interviewed. The sampling rate was higher for women than men in order to fulfill on other requirements of the survey.

In the households not selected for the men's survey, all adults aged 15 years and over were eligible to be interviewed with the adult questionnaire. The SADHS 2003 survey had 9164 eligible participants which gave the current analysis 100% power to detect an odds ratio of 2 at the 95% confidence interval assuming an alcohol use prevalence of 30% and a tuberculosis prevalence of 20%.

Measurements

Five questionnaires were utilized in the 2003 SADHS: a household questionnaire, a women's questionnaire, a men's questionnaire, an adult questionnaire, and an additional child's questionnaire. For the purpose of this analysis selected responses from the adult questionnaire were used as variables in the analysis.

3.2. Variable selection

3.2.1. Tuberculosis episodes and frequency

The dependent variables in this analysis were (a) having had an episode of tuberculosis and (b) frequency of these episodes. The variables were derived from the following questions:

- Has a doctor or nurse or health worker at a clinic or hospital told you that you have or have had TB?

- How many episodes of tuberculosis have you ever been treated for?

Response options were “yes”, “no” and “don’t know” for the first question. A binary variable was created from the “yes” and “no” responses. Among those answering yes, the tuberculosis frequency variable was created with three levels, having had the disease once, twice and more than twice.

3.2.2. Alcohol consumption

A categorical variable for alcohol consumption status was created from two questions:

- Have you ever consumed a drink that contains alcohol such as beer, wine, spirits or sorghum beer?

- Was this within the past 12 months?

A no response to the first question was categorised as “never drank alcohol” whereas a positive response to both questions was labeled “current alcohol consumption”. A positive response to the first question coupled with a negative response to the second question was categorized as “previous (ex) alcohol consumption”.

3.2.3. CAGE

The CAGE questionnaire is an internationally validated tool (Castells M. et al 2005, Dervaux A. et al 2005) for assessing alcohol dependency in adults. The questionnaire comprises of four questions:

- Have you ever felt that you should **c**ut down on your drinking? (C)
- Have people **a**nnoyed you by criticizing your drinking habits? (A)
- Have you ever felt bad or **g**uilty about your drinking? (G)
- Do you need to have a drink as an **e**ye-opener in the morning to steady your nerves or get rid of a hangover? (E)

An affirmative answer to more than one of these questions is considered an indicator of symptoms of problem drinking which was used as a proxy for alcoholism. Each affirmative answer scores one point and the points are summed to yield the CAGE score to a maximum of 4. The final variables had five levels including the zero score. This was further aggregated as 0, 1-2, 3-4 for analysis purposes.

3.2.4. Education

Respondents were asked to indicate the number of years of schooling they had attained. These were categorized into primary (0 to 7 years), secondary (8 to 12 years) and tertiary (>12 years) levels of education.

3.2.5. Wealth index

The wealth index was calculated by the South African Medical Research Council (MRC) using questions from the SADHS household questionnaire. Responses to questions regarding household assets were analyzed using principal component analysis to create a multinomial variable with five quintiles with higher ranking representing higher wealth categories.

3.2.6. *Body mass index (BMI)*

BMI was used as a measure of nutritional status in this study. BMI was calculated from direct measurement of weight and height in respondents of the SADHS. The resulting values were categorized to indicate respondents who were underweight (< 18 kg/m^2), normal weight (18 – 25.0 kg/m^2), and overweight (25.1 – 30 kg /m^2) and very overweight (> 30 kg/m^2). The normal weight category was used as the base / reference category in regression analysis.

3.2.7. *Heating and cooking fuels*

Respondents were asked to select the type of fuel used for cooking out of a possible seven options. For the purpose of this analysis, these were grouped into smoky and

non smoky fuels. Electricity, gas and paraffin were categorized as non smoky fuels whilst coal, candles, firewood and animal dung were classified as smoky fuels.

3.2.8. Occupational exposure

A binary variable was created to represent occupational exposures from the following survey question:

- Have you ever worked in a job where you were regularly exposed to smoke, dust, fumes or strong smells?

The remaining variables were created as binary explanatory variables from yes or no answers to survey questions or as observed by the interviewer. Age was created from responses whilst race and area of residence (rural *vs.* urban) were assigned by the interviewer.

3.3. Analytic methodology

3.3.1. Data entry and weighting

The SADHS data were captured by the Human Sciences Research Council using CSPro software. All data were entered twice. The MRC developed sample weightings at the individual and household levels for the SADHS to account for the sampling strategy used in the survey. For the current analysis, the data were obtained from the MRC in STATA format. STATA version 10.0 (StataCorp; College Station, TX) was used for statistical analysis.

3.3.2. Summary statistics

All variables used in the analysis were either true categorical or continuous variables grouped into categories. All variables were summarized using proportions and corresponding 95% confidence intervals (CI). Correlation coefficients could not be used to explore the possibility of co-linearity as some categorical variables were nominal. Logistic regression, which yields odds ratios, was used to explore the relationship between tuberculosis and alcohol use, CAGE and the other explanatory variables. Survey estimation, using the weights provided by the MRC, was used to determine adjusted proportions and other summary statistics in order to account for the sampling strategy employed.

3.3.3. Unadjusted logistic regression

Logistic regression was used to analyse the relationships between tuberculosis history and recurrent tuberculosis and all the explanatory variables. The unadjusted logistic regression models were fitted separately for the two outcomes “ever having had tuberculosis” and “recurrent tuberculosis”. Dummy variables were created for variables such as alcohol consumption which were multinomial. Odds ratios and their corresponding 95% confidence intervals were reported.

3.3.4. Adjusted logistic regression

This was carried out with the aim of determining the presence and extent of any association between tuberculosis and the dependent variables alcohol consumption and CAGE after controlling for all measured confounding variables. Multivariate

analysis was carried out only for the “ever having had tuberculosis” owing to insufficient observations for calculating valid associations between tuberculosis frequency and the exposure variables.

Multivariate logistic models were fitted initially for known confounders age and smoking and were stratified by gender as these have been cited in literature as being strong risk factors for disease and associated with alcohol consumption. Using this as a base model, separate models were fitted for each of the other exposure variables separately as a way of avoiding over adjusting since most of them could be regarded as proxies for socioeconomic status. The observed odds ratios were reported with their corresponding 95% confidence interval to provide an indication of the extent of the association between alcohol and tuberculosis episodes. A similar approach was used for assessing the relationship between CAGE and tuberculosis.

3.3.5. Model checking

Each of the models was subjected to a Pearson’s goodness of fit test statistic to determine whether they were a significant improvement on a null model. Outlying and potentially influential observations were explored by plotting changes in Pearson’s statistics if covariate pattern *i* was omitted as well as plots of Pearson’s and Deviance residuals.

3.4. Ethical and legal considerations

The SADHS was a cross sectional survey and did not involve any form of intervention among the participants. Participants in the study were interviewed with only non-

invasive anthropometric investigations such as weight, height, waist and hip circumference as well as resting blood pressure and pulmonary flow measurements taken. Consequently, the key ethical considerations were informed consent, confidentiality and dissemination of information.

3.4.1. Informed consent and confidentiality

Consent was obtained from each of the respondents included in this survey. The information in the dataset is not traceable to any of the participants. Questionnaire responses were number coded to ensure the confidentiality of the participants.

3.4.2. Ethical approval

The SADHS is part of an international programme of representative national surveys that is conducted in over 70 countries worldwide. The SADHS 2003 protocol received approval from the South African Medical Research Council ethics committee. Approval to analyse the data was obtained from the Department of Health (DOH). The Faculty of Health Sciences Research Ethics Committee of the University of Cape Town provided approval for the analysis of the dataset for this thesis.

3.4.3. Dissemination of information

Findings from this analysis will be provided in full to the MRC and the DOH as detailed in the request for access to the dataset. In addition, the final thesis will be kept by the UCT Libraries in accordance with requirements for post-graduate students

at that institution. Findings will also be made available to the public via peer reviewed journals if possible.

4. Results

4.1. Summary statistics

The SADHS yielded 8 115 adult interviews out of 9 164 eligible men and women accounting for an 84 percent response rate. Tables 1 and 2 provide crude and survey adjusted prevalence of tuberculosis and predictor variables.

4.1.1. Tuberculosis

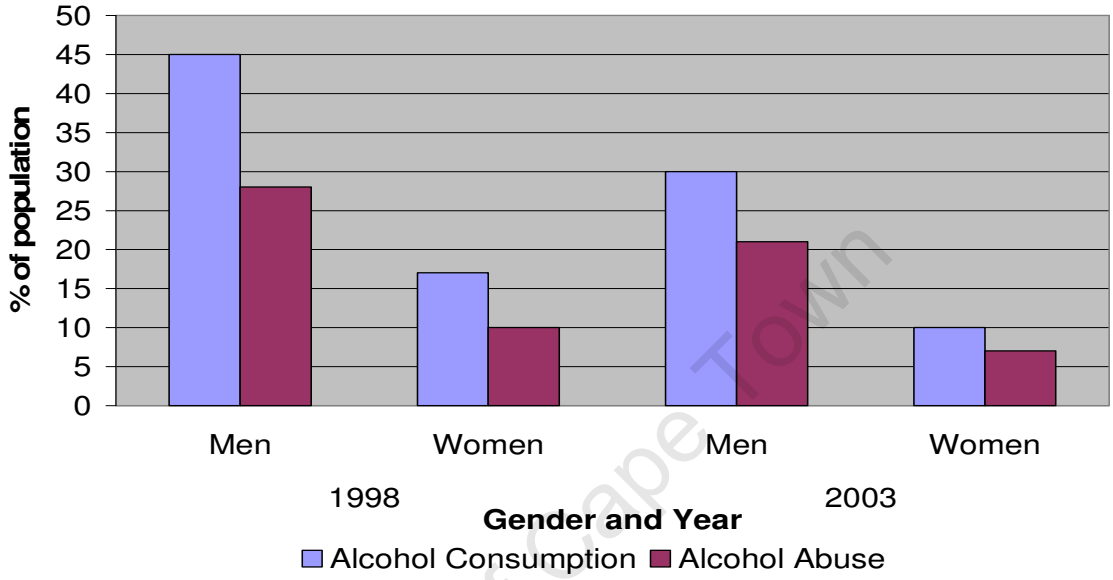
A total number of 205 individuals with past tuberculosis were recorded resulting in a self reported lifetime risk of 2.7% [95% CI 2.3 – 3.2] after adjusting for survey design effect. Men were more likely to report a past episode of tuberculosis than women, with prevalences of 3.4% [95% CI 2.7 – 4.3] and 2.2% [95% CI 1.8 – 2.8] respectively (Table 1). In the 1998 SADHS survey (SADHS 1998) three percent of men and two percent women reported having had an episode of tuberculosis. As these each fall within the confidence intervals of the current survey estimates, it is not possible to infer any change between the two surveys.

4.1.2. Alcohol consumption

The overall level of current reported alcohol consumption fell from 28% (No confidence interval available in the original report) in 1998 to 25.4% [95% CI 24.2 – 26.5] in the 2003 survey. The reduction in reported consumption was observed in both men and women. Alcohol consumption in men fell from 45% to 38.8% [95% CI 36.7 – 40.9] whilst in women it fell from 17% to 15.5% [95% CI 14.2 – 16.9] as shown

in figure 3. A total of 624 (8%) adults reported being previous alcohol consumers out of a total 8 089 who responded to the alcohol question.

Figure 3: Alcohol consumption and problem drinking (CAGE)



4.1.3. CAGE score

A total of 2 517 adults responded to the CAGE questions with 902 of them [39.1%], providing a negative response to all four questions. The non-zero CAGE score with the highest number of responses (21%) was 2 for both men and women, whilst score 4 had the lowest number of responses (9%).

4.1.4. Other exposure characteristics

Women, with 4 787 responses, accounted for the larger proportion of the sample whilst men represented 41.1%. The median age of adults in the survey was 36 years in women and 32 years in men with an overall median age of 35 years (IQR 23 – 50). Blacks represented the majority of the sample at 82.6 % followed by Coloureds

who represented close to 12%. The population of whites was under-sampled in the survey; however, after adjusting for the survey design, whites represented the third largest proportion, 6.4%, followed by Asians at 2.2%.

Although an overall 27% of respondents [95% CI 25.3 – 27.8] reported ever having smoked, there was a marked difference in the prevalence of smoking amongst men and women. Men were more likely to smoke with 43.0% [95% CI 41.1 – 54.4] ever having smoked compared to 14.2% [95% CI 13.0 - 15.5] of women who reported the same. Women reported higher rates of using smokeless tobacco than men. Occupational exposure to smoke and dust was also higher in men that women with 27% of the former responding positively to the question *versus* 12% in the latter.

Approximately 15% of the population reported having never attended any school whilst the majority (54%) reached the secondary school level as defined in this thesis. The quintiles in the wealth index ranged from 19.3% to 20.7% of the sample and were thus considered to have been equally sampled. A total of 4% of the sample were classified as being underweight whilst nearly half (46.6%) were either overweight or very overweight. .

Table 1: Crude and survey adjusted prevalence of tuberculosis episodes and predictor variables for all adults (N=8 115)

	N	Crude %	Adjusted for survey design %	95% CI	
TB Episode					
No	7848	97.0	96.7	96.2	97.2
Yes	205	2.5	2.7	2.3	3.2
Don't Know	40	0.5	0.6	0.4	0.8
TB Frequency					
Never	7922	97.7	97.5	97.1	97.9
Once	105	1.3	1.4	1.1	1.7
Twice	44	0.5	0.5	0.4	0.8
More than twice	42	0.5	0.6	0.4	0.8
Alcohol consumption					
Never	5294	65.5	67.3	66.0	68.5
Current	2171	26.8	25.4	24.2	26.6
Ex	624	7.7	7.4	6.7	8.1
CAGE Score					
0	902	35.8	39.1	36.6	41.6
1	430	17.1	17.4	15.5	19.4
2	521	20.7	19.3	17.5	21.4
3	439	17.4	14.7	13.1	16.5
4	225	8.9	9.5	8.1	11.0
Age (Years)					
< 30	3252	40.1[2]			
30 to 45	2209	27.2			
45 plus	2654	32.7			
Race					
White	307	3.8			
Black/African	6040	75.2			
Coloured	961	12.0			
Asian/Indian	720	9.0			
Smoking Status					
Never Smoked	5202	64.1	67.1	65.8	68.3
Ever Smoked	2306	28.5	26.5	25.3	27.8
Smokeless	596	7.4	6.4	5.8	7.1
Occupational Exposure					
No	6626	82.1	84.3	83.3	85.3
Yes	1449	17.9	15.7	14.7	16.7
Residence					
Urban	4,641	57.2	68.2	67.3	69.1
Rural	3474	42.8	31.8	30.9	32.7
Education					
No school	1,017	17.3	14.9	13.9	16.1
Primary	1234	21.0	19.2	18.1	20.5
Secondary	3165	54.0	57.6	56.0	59.2
Tertiary	449	7.7	8.2	7.3	9.2
Wealth Index					
Poorest	1,706	21.1	20.1	19.1	21.1
2	1716	21.2	19.4	18.4	20.4
3	1672	20.7	20.7	19.6	21.8
4	1473	18.2	20.5	19.4	21.7
Richest	1527	18.9	19.3	18.2	20.5
Cooking Fuel					
Non-Smoky	6575	81.7	85.4	84.7	86.0
Smoky	1475	18.3	14.6	14.0	15.3
Heating Fuel					
Non-Smoky	4242	65.7	73.4	72.3	74.5
Smoky	2515	34.4	26.6	25.5	27.7
BMI					
Underweight	311	4.0	3.1	2.7	3.6
Normal	3676	47.0	45.8	44.4	47.2
Overweight	2372	30.4	31.4	30.1	32.8
Very Overweight	1454	16.6	19.7	18.6	20.9

[2] Age and race were not adjusted for survey design because they were the focal variables for oversampling and were thus used to calculated sampling weights

Table 2: Crude survey adjusted prevalence of tuberculosis episodes and predictor variables stratified by gender (8 115)

	Women					Men				
			Adjusted for survey design					Adjusted for survey design		
	n	%	%	95% CI		n	%	%	95% CI	
TB Episode										
No	4651	97.5	97.3	96.7	97.8	3197	96.3	95.9	94.9	96.6
Yes	102	2.1	2.2	1.8	2.8	103	3.1	3.4	2.7	4.3
Don't Know	19	0.4	0.5	0.3	0.8	21	0.6	0.7	0.4	1.1
TB Frequency										
Never	4693	98.0	98.1	97.5	98.5	3229	97.1	96.8	95.9	97.4
Once	41	0.9	0.9	0.6	1.2	64	1.9	2.1	1.6	2.8
Twice	28	0.6	0.6	0.4	0.9	16	0.5	0.5	0.2	0.9
More than twice	25	0.5	0.5	0.3	0.8	17	0.5	0.7	0.4	1.1
Alcohol consumption										
Never	3655	76.6	78.5	77.0	80.0	1639	51.9	51.9	49.8	54.1
Current	795	16.7	15.5	14.2	16.9	1376	41.5	38.8	36.7	40.9
Ex	321	6.7	6.0	5.2	6.9	303	9.1	9.2	8.1	10.6
CAGE Score										
0	410	42.8	47.6	43.5	51.8	492	31.6	34.3	31.2	37.4
1	156	16.3	15.4	12.6	18.7	274	17.6	18.5	16.1	21.2
2	189	19.7	18.5	15.5	,21.88	332	21.3	19.8	17.5	22.4
3	154	16.1	13.5	11.0	16.3	285	18.3	15.5	13.4	17.8
4	50	19.7	5.1	3.6	7.0	175	11.2	11.9	10.0	14.2
Age (Years)										
< 30	1781	37.2				1471	44.2			
30 to 45	1332	27.8				877	26.4			
45 plus	1674	35.0				980	29.5			
Race										
White	185	3.9				122	3.7			
Black/African	3509	74.2				2531	76.7			
Coloured	618	13.1				343	10.4			
Asian/Indian	418	8.8				302	9.2			
Smoking Status										
Never Smoked	3473	72.7	75.6	74.1	77.1	1729	52.1	55.4	53.3	57.6
Ever Smoked	757	15.8	14.2	13.0	15.5	1549	46.6	43.3	41.1	54.4
Smokeless	550	11.5	10.2	9.2	11.3	46	1.38	1.3	0.9	1.9
Occupational Exposure										
No	4207	88.3	90.3	89.3	91.3	2419	73.1	76.1	74.2	77.9
Yes	557	11.7	9.7	8.7	10.7	892	26.9	23.9	22.1	26.8
Residence										
Urban	2694	56.3	66.9	65.6	68.3	1947	58.5	70.0	68.4	71.5
Rural	2093	43.7	33.1	31.8	34.4	1381	41.5	30.0	28.5	31.6
Education										
No school	677	19.4	16.8	15.4	18.4	340	14.4	12.3	10.8	13.9
Primary	722	20.6	18.6	17.1	20.2	512	21.6	20.1	18.2	22.2
Secondary	1842	52.6	57.1	55.0	59.1	1323	55.9	58.4	55.9	60.9
Tertiary	258	7.4	7.5	6.4	8.7	191	8.1	9.2	7.7	11.0
Wealth Index										
Poorest	987	20.7	19.9	18.6	21.2	719	21.7	20.4	18.8	22.0
2	1009	21.1	19.8	18.5	21.1	707	21.3	18.9	17.4	20.5
3	986	20.6	20.2	18.8	21.7	686	20.7	21.4	19.6	23.3
4	892	18.7	21.0	19.5	22.6	581	17.5	19.9	18.1	21.8
Richest	904	18.9	19.2	17.7	20.8	623	18.8	19.5	17.7	21.4
Cooking Fuel										
Non-Smoky	3,883	81.6	85.0	84.0	85.9	2,692	81.7	85.9	84.7	87.0
Smoky	873	18.4	15.1	14.1	16.0	602	18.3	14.1	13.0	15.3
Heating Fuel										
Non-Smoky	2485	65.3	72.9	71.3	74.4	1,757	66.3	74.2	72.3	76.0
Smoky	1320	34.7	27.1	25.7	28.7	895	33.8	25.8	24.0	27.7
BMI										
Underweight	125	2.7	2.1	1.7	2.7	186	5.8	4.4	3.6	5.3
Normal	1760	38.3	36.5	34.7	38.3	1916	59.6	58.4	56.1	60.5
Overweight	1514	32.9	33.7	31.9	35.5	858	26.7	28.4	26.4	30.4
Very Overweight	1199	26.1	27.7	26.1	29.5	255	7.93	8.9	7.7	10.3

4.1.5. Potential confounders

Tables 3 and 4 provide measures of association between alcohol and CAGE and their respective potential confounding variables. The relationship between tuberculosis and either alcohol consumption or problem drinking could potentially be confounded by several factors.

Adults in the age group 30 to 45 years were the most likely to be current alcohol consumers, [OR 1.4 (95%CI 1.2 – 1.5)] and were less likely than those 45 years or more to be previous consumers of alcohol (Table 3). Adults in the age group 30 to 45 years were also most likely to have a high CAGE score than all the other groups. Men were more likely to be current and previous consumers of alcohol than women. They were also more likely to have a CAGE score greater than zero than women [OR 4.2 (95% CI 3.6 – 5.0)].

Whites and Asians had the highest odds of being current and previous consumers of alcohol followed by Coloureds. The inverse was true with respect to odds of having a high CAGE score. Whites and Asians were least likely to have a score greater than zero. Coloureds were more likely than Blacks to have a non zero score OR 1.9 [95% CI 1.6 – 2.3]. There was a strong association between ever having smoked and currently consuming alcohol, OR 7.6 [95% CI 6.8 – 8.5], as well as with being a previous consumer of alcohol. Smoking was also strongly associated with having a non zero CAGE score. Similarly, occupational exposure was strongly associated with both current and previous alcohol consumption as well as having a high CAGE score.

Underweight respondents were more likely to be current alcohol consumers as well as have a high CAGE score than those with normal weight. Inversely, overweight respondent were less likely to be in either of the two problem drinking categories than normal weight individuals.

Using residence and choice of cooking and heating fuels as a proxy suggests adults with lower socioeconomic status are less likely to be current or previous alcohol consumers. On the other hand, lower socioeconomic status participants who do consume alcohol had a higher likelihood of being classified as problem drinkers with non zero CAGE scores. This trend is supported by the wealth index which shows adults in lower quintiles having a lower likelihood of consuming alcohol but greater odds of being problem drinkers if they do. The trend is not as clear if the education variable is considered.

Education, wealth index, residence, and fuel types could all be used as proxies for socioeconomic status in modeling the relationship between alcohol and tuberculosis. Logistic regression relationships between tuberculosis history as well as recurrent tuberculosis and each of these exposure characteristics were calculated and are presented in the following section.

Table 3: Associations between alcohol consumption and potential confounders (N=8 089)

	Current Alcohol Consumption					Ex Alcohol Consumption			
	N	%	OR[3]	95% CI		%	OR	95% CI	
Age (Years)									
Age < 30	3246	25.9	1.0	-	-	5.3	1.0	-	-
30 to 45	2197	20.1	1.4	1.2	1.5	5.7	1.8	1.4	2.2
45 plus	2646	24.6	1.0	0.9	1.1	10.2	2.0	1.7	2.5
Gender									
Females	4771	16.7	1.0	-	-	*1.0*		-	-
Males	3318	41.5	3.9	3.5	4.3	41.5	2.1	1.8	2.5
Race									
Black/African	6023	23.3	1.0	-	-	6.2	1.0	-	-
Coloured	960	37.8	2.3	1.9	2.6	11.1	2.5	2.0	3.2
White/Asian	1026	38.5	2.5	2.1	2.8	13.6	3.3	2.6	4.0
Smoking Status									
Never Smoked	5195	14.1	1.0	-	-	4.9	1.0	-	-
Ever Smoked	2296	56.9	11.	*9.8*	12.5	13.4	7.6	*6.3*	9.1
Smokeless	595	22.2	1.9	*1.5*	2.3	9.6	2.3	*1.7*	3.1
Occupational Exposure									
No	6613	22.6	1.0	-	-	6.0	1.0	-	-
Yes	1448	46.1	3.8	3.4	4.3	15.7	4.9	4.1	5.9
Residence									
Urban	4629	31.8	1.0	-	-	9.4	1.0	-	-
Rural	3460	20.2	0.5	0.5	0.6	5.4	0.5	0.4	0.5
Education									
No school	1014	26.0	1.0	-	-	7.5			
Primary	1227	25.3	0.9	0.8	1.0	8.5	1.1	0.8	1.4
Secondary	3156	25.8	0.9	0.8	1.0	7.2	0.9	0.7	1.1
Tertiary	448	33.7	1.4	1.1	1.7	9.8	1.5	1.0	2.1
Wealth Index									
Poorest	1700	22.8	1.0	-	-	5.5	1.0	-	-
2	1708	24.9	1.1	1.0	1.3	6.2	1.1	0.9	1.5
3	1668	26.5	1.3	1.1	1.5	7.0	1.3	1.0	1.8
4	1469	26.6	1.3	1.1	1.5	9.3	1.8	1.4	2.4
Richest	1523	34.2	2.0	1.7	2.3	11.0	2.6	2.0	3.3
Cooking Fuel									
Non-Smoky	6558	28.3	1.0	-	-	8.3	1.0	-	-
Smoky	1467	20.0	0.6	0.5	0.7	5.0	0.5	0.4	0.7
Heating Fuel									
Non-Smoky	4233	28.6	1.0	-	-	9.4	1.0	-	-
Smoky	2207	23.7	0.7	0.7	0.8	6.3	0.6	0.5	0.7
BMI									
Underweight	310	38.1	1.3	1.0	1.7	5.8	0.9	0.5	1.1
Normal	3665	32.4	1.0	-	-	7.4	1.0	-	-
Overweight	2363	22.9	0.6	0.6	0.7	8.8	1.1	0.9	1.3
Very Overweight	1452	17.6	0.5	0.4	0.5	7.2	0.8	0.6	1.0

[3] OR: Odds ratio

Table 4: Associations between CAGE scores [4] and potential confounders (N=2 517)

		Cage Score 1-2 vs. 0				Cage Score 3-4 vs. 0			
Variable	**N**	**%**	**OR**	**95% CI**		**%**	**OR**	**95% CI**	
Age (Years)									
Age < 30	930	11.3	1.0	-	-	7.1	1.0	-	-
30 to 45	779	8.9	0.9	0.8	1.2	6.9	1.5	0.9	1.5
45 plus	808	11.2	0.9	0.7	1.1	8.0	1.0	0.8	1.3
Gender									
Females	959	7.2	1.0	-	-	4.3	1.0	-	-
Males	1558	18.2	1.5	1.2	1.8	13.8	1.9	1.5	2.3
Race									
Black/African	1649	11.4	1.0	-	-	8.3	1.0	-	-
Coloured	428	18.1	0.9	0.7	1.2	13.1	0.9	0.7	1.2
White/Asian	430	8.1	0.2	0.1	0.2	3.6	0.1	0.1	0.2
Smoking Status									
Never Smoked	853	5.7	1.0	-	-	3.3	1.0	-	-
Ever Smoked	1491	25.5	1.7	1.4	2.0	19.3	2.2	1.8	2.8
Smokeless	173	1.2	1.7	1.1	2.5	8.1	2.0	1.3	3.1
Occupational Exposure									
No	1725	9.9	1.0	-	-	6.5	1.0	-	-
Yes	845	20.2	1.1	0.9	1.3	15.9	1.3	1.1	1.6
Rural / Urban									
Urban	1672	12.7	1.0	-	-	9.1	1.0	-	-
Rural	845	10.4	1.7	1.4	2.1	7.0	1.6	1.3	2.0
Education									
No school	320	13.9	1.0	-	-	8.2	1.0	-	-
Primary	370	12.7	1.9	1.4	2.6	10.4	2.5	1.8	3.5
Secondary	932	11.1	1.2	0.9	1.1	8.3	1.4	1.1	1.8
Tertiary	178	11.8	0.6	0.4	0.8	6.9	0.6	0.4	0.9
Wealth Index									
Poorest	455	11.8	1.0	-	-	7.6	1.0	-	-
2	498	11.8	1.0	0.7	1.3	9.7	1.2	0.9	1.7
3	523	13.1	1.0	0.8	1.4	10.5	1.3	0.9	1.8
4	458	12.6	0.8	0.6	1.1	8.5	0.8	0.6	1.1
Richest	578	9.2	0.2	0.2	0.3	4.3	0.2	0.1	0.2
Cooking Fuel									
Non-Smoky	2145	11.7	1.0	-	-	8.2	1.0	-	-
Smoky	348	10.2	1.7	1.3	2.2	7.3	1.7	1.3	2.3
Heating Fuel									
Non-Smoky	1392	11.1	1.0	-	-	7.6	1.0	-	-
Smoky	628	12.7	2.3	1.8	2.9	8.7	2.3	1.8	2.9
BMI									
Underweight	311	17.4	1.3	0.9	1.8	13.2	1.4	1.0	1.9
Normal	3676	14.8	1.0	-	-	10.9	1.0	-	-
Overweight	2372	9.2	0.6	0.5	0.7	6.1	0.5	0.4	0.6
Very Overweight	1454	6.9	0.4	0.3	0.5	4.3	0.4	0.3	0.5

[4] Among current alcohol consumers

4.2. Unadjusted logistic regression

4.2.1. Tuberculosis episodes

Table 5 shows the relationships between tuberculosis and selected exposure variables. Men who preciously drank alcohol were the most likely to have had an episode of tuberculosis OR 3.6 [95% CI 2.0 – 6.5]. Overall, adults who drank alcohol previously were more likely to have had tuberculosis than current and non drinkers. An increasing CAGE score was associated with an increasing odds of having had tuberculosis, with odds of ratios ranging from 2.7 [95% 1.6 – 5.0] in those with CAGE score 1 - 2, to 4.6 [95% CI 2.5 – 8.4] in the higher score category. A similar trend was observed for both men and women.

Predictably, older people were more likely to have had an episode of tuberculosis than those in lower age categories. Adults aged 45 years or more were approximately twice more likely to have a history of tuberculosis than those 30 years and younger. Overall, Coloured people were most likely to have tuberculosis. This finding however, was not statistically significant. Whites and Asians had 70% lower odds of having had tuberculosis than blacks. Owing to the fact that there were so few cases among White/Asian women, the relevant measure of association could not be computed.

Smoking as well as occupational exposure was strongly associated with having had tuberculosis. The relationship between tuberculosis and occupation exposure was, however, different by gender. Men exposed at work were more likely to have had tuberculosis, OR 2.7 [95% CI 1.8 – 4.0] whilst such females had a 10% reduced

likelihood of having had tuberculosis. Women using smokeless tobacco had a higher likelihood of tuberculosis disease than those not using such tobacco.

The effect of smoky heating and cooking fuels was inconclusive as the confidence interval included one. The general direction of effects reported showed people living in rural areas as well as those who used smoky fuels for cooking were less likely to have had an episode of tuberculosis than their reference comparison groups, whilst those who used smoky fuels for heating had a small increase in odds of disease.

Those with primary education had the highest odds of past tuberculosis regardless of gender. Secondary and tertiary level education was associated with 20% and 60% reduction respectively in tuberculosis history compared to those who had never attended school.

A similar trend was observed with the wealth index where those in higher quartiles had a lower probability of having had a tuberculosis episode than those in the lower quartiles.

Underweight adults were twice as likely as normal weight people to have had tuberculosis disease. Being overweight was associated with a 40% reduction in odds of past tuberculosis disease.

Table 5: Unadjusted logistic regression associations between tuberculosis and exposure variables stratified by gender (N=8 053)

			Total				Women				Men		
			OR	95% CI		%	OR	95% CI		%	OR	95% CI	
Alcohol consumption													
Never	*5254*	*1.8*	1	-	-	1.9	1	-	-	1.7	1	-	-
Current	*2157*	*3.7*	2.1	1.5	2.8	3.3	1.8	1.1	2.9	4.0	2.2	1.4	3.5
Ex	*618*	*4.5*	2.5	1.7	3.9	2.8	1.6	0.8	3.1	6.3	3.6	2.0	6.5
CAGE Score													
0	*893*	*1.9*	1	-	-	1.8	1	-	-	2.0	1	-	-
1 – 2	*946*	*4.1*	2.7	1.6	5.0	4.4	3.7	1.3	10.2	4.0	2.2	1.0	4.8
3 – 4	*662*	*6.8*	4.6	2.5	8.4	5.4	4.6	1.6	13.4	7.4	4.2	2.0	8.9
Age (Years)													
Age < 30	3225	1.7	*1*			1.8	*1.0*	-	-	1.7	1	-	-
30 to 45	2192	2.5	*1.5*	1.0	2.1	2.2	*1.3*	0.8	2.1	3	1.8	1	3.1
45 plus	2636	3.6	*2.1*	1.5	2.9	2.5	*1.5*	0.9	2.3	5.3	3.2	2	5.2
Race													
Black/African	*5992*	*2.8*	1	-	-	2.3	1	-	-	3.5	1	-	-
Coloured	*957*	*3.5*	*1.2*	0.9	1.8	3.6	*1.6*	1.0	2.6	3.2	*0.9*	0.5	1.7
Whites/Asians	*1019*	*0.3*	*0.1*	0.0	0.3	0.0				0.7	*0.2*	0.1	0.6
Smoking Status													
Never Smoked	5159	1.4	1	-	-	1.4	1	-	-	1.6	1	-	-
Ever Smoked	*2297*	*4.8*	*3.4*	2.6	4.6	4.8	*3.6*	2.3	5.6	4.9	*3.1*	2.0	4.8
Smokeless	*588*	*3.2*	*2.7*	1.4	3.8	3.5	*2.6*	1.5	4.5	0	-	-	-
Occupational Exposure													
No	*6574*	*2.2*	1.0	-	-	2.2	1.0	-	-	2.2	1.0	-	-
Yes	*1441*	*4.2*	*2.0*	1.5	2.7	2.0	*0.9*	0.5	1.7	5.6	*2.7*	1.8	4.0
Residence													
Urban	*4613*	*2.8*	1.0	-	-	2.2	1.0	-	-	3.6	1.0	-	-
Rural	*3440*	*2.2*	0.8	0.6	1.1	2.1	0.9	0.6	1.4	2.5	0.7	0.5	1.1
Education													
No school	*1009*	*4.4*	1.0	-	-	3.6	1.0	-	-	5.9	1.0	-	-
Primary	*1221*	*4.5*	1.9	1.3	2.6	3.8	1.8	1.1	3.0	5.6	1.9	1.2	3.1
Secondary	*3140*	*2.1*	0.8	0.6	1.2	1.7	0.8	0.5	1.3	2.6	0.9	0.5	1.4
Tertiary	*447*	*1.1*	0.4	0.2	1.1	1.2	0.6	0.2	1.8		0.3	0.1	1.4
Wealth Index													
Poorest	*1680*	*3*	1.0	-	-	2.2	1.0	-	-	4.1	1.0	-	-
2	*1709*	*3*	1.0	0.7	1.5	2.8	1.3	0.7	2.3	3.3	0.8	0.5	1.4
3	*1661*	*3.3*	1.1	0.8	1.7	3.1	1.5	0.8	2.6	3.7	0.9	0.5	1.6
4	*1465*	*2.3*	0.8	0.5	1.2	1.9	0.9	0.5	1.7	2.8	0.7	0.4	1.2
Richest	*1517*	*1.1*	0.4	0.2	0.6	0.7	0.3	0.1	0.8	1.6	0.4	0.2	0.8
Cooking Fuel													
Non-Smoky	*6553*	*2.7*	1.0	-	-	2.2	1.0	-	-	3.5	1.0	-	-
Smoky	*1458*	*1.9*	0.7	0.4	1.0	2.0	0.9	0.5	1.5	1.7	0.5	0.2	0.9
Heating Fuel													
Non-Smoky	*4208*	*2.4*	1.0	-	-	3.0	1.0	-	-	3.0	1.0	-	-
Smoky	*2196*	*2.6*	1.1	0.8	1.5	2.8	1.2	0.8	2.0	2.8	0.9	0.6	1.5
BMI													
Underweight	*286*	*7.7*	2.6	1.7	4.1	7.2	2.9	1.4	6.0	8.1	2.4	1.3	4.2
Normal	*3653*	*3.0*	1.0	-	-	2.5	1.0	-	-	3.4	1.0	-	-
Overweight	*2308*	*1.8*	0.6	0.4	0.8	1.9	0.7	0.4	1.1	1.7	0.5	0.3	0.8
Very Overweight	*1428*	*1.1*	0.3	0.2	0.6	1.2	0.4	0.4	0.8	0.8	0.2	0.1	0.9

4.2.2. Recurrent tuberculosis

In order to assess the relationship between exposure variables and recurring tuberculosis, logistic regression models compared having had two or more than two episodes of tuberculosis *versus* having had only one episode of the disease as the reference stratum (Please refer to appendix 1 for detailed information). The results show a reduction in risk of multiple episodes of disease in those who consumed alcohol and had alcoholic potential (CAGE > 0). These results were unexpected in light of the positive association between these exposure variables and having any episode of tuberculosis.

However, the sample sizes used in modeling the recurrent tuberculosis relationship were considerably smaller than those used for modeling “any” tuberculosis. As a consequence, the 95% confidence intervals were wide for all of the exposure characteristics. Owing to this finding, multivariate analyses were carried out only for the relationships between having ever had tuberculosis (relative to never having had an episode) and the exposure variables.

4.3. Adjusted logistic regression

4.3.1. Alcohol and tuberculosis

With the main aim of discerning the associations between tuberculosis and alcohol consumption as well as CAGE score, multivariate logistic regression models were constructed with each of these and potential confounders. Age, gender and smoking are likely to be confounders of the relationship between alcohol and tuberculosis and were thus included in all the models.

Race, education, residence as well as wealth index could all be used as proxies of socioeconomic status. Types of fuels and occupational exposure could also fall into this category whilst also having a direct effect on tuberculosis risk. In order to control for the effect of socioeconomic status without over controlling for it, separate models were constructed for each of these, in addition to age, gender and smoking as explanatory variables. A similar approach was followed for the alcohol consumption and CAGE models.

The adjusted relationships are shown in tables 6 to 9. Overall, adults who drank previously were more likely to have had tuberculosis than those who were current and non-drinkers, with most of the odds ratios in the range of 1.6 to 2.3 in the various models. The effect was stronger in previous male drinkers who were approximately three times more likely to have had an episode of tuberculosis than those males who never consumed alcohol. On the other hand, women who currently consumed alcohol were more likely to have had the disease than both those who previously drank and those who never consumed alcohol (Tables 6 & 7).

Smoking and age emerged as confounding variables in this analysis and were suitably controlled for. Socioeconomic status and BMI did not alter the effect of the association under investigation. Consequently, any of the models from four to ten could have been used as a basis for interpreting the findings.

According to these models alcohol consumption resulted in an increased odds of disease in both men and women. The findings for alcohol consumption in women had confidence intervals which included one however and are considered not significant.

In general, alcohol consumption resulted in a higher likelihood of disease in men than in women. Women had odds ratios that were only marginally different from the null. Adjusting for the effect of potential confounding variables did not alter these trends significantly. Tables 6 & 7 provide detailed information for the alcohol consumption associations.

4.3.2. CAGE and tuberculosis

The effect of CAGE score on tuberculosis was determined only among those who had ever consumed alcohol (N= 2 501). These associations are shown in tables 8 and 9.

Adults who had a CAGE score between one to two as well as three to four were more likely to have had tuberculosis than those who had a zero CAGE score. CAGE scores one and two had odds ratios ranging from 1.1 to 1.5 after controlling for age, smoking and each of the other exposure variables.

The higher CAGE score category (3 – 4) yielded similar results with an increased odds of disease as compared to those with a zero CAGE score. Models 1 to 10 in Tables 8 and 9 all show a similar trend with odds ratios ranging from 1.8 [95% CI 0.6 – 5.4] in model number 9 to 4.4 [95% 1.4 – 13.4] in women after controlling for the effect of potential confounders. Similar models yielded 3.4 (95% CI 1.6 – 7.3) and 5.8 (95% CI 2.3 – 14.2) respectively in men.

In the model controlling for education (model 4), CAGE was associated with nearly a three fold increase in lifetime risk of tuberculosis in women and a four fold increase in men. The findings for the two non-zero categories, however, have overlapping confidence intervals. Hence a difference in effect between them could not be inferred.

Although women consistently reported slightly lower odds of disease than men in each of these models, a positive association between a high CAGE score and increased risk of tuberculosis was uniform in all the groups.

The findings presented in this chapter are discussed in detail in the following chapter.

Table 6: Adjusted association between tuberculosis (ever) and alcohol consumption in women (N= 4 203)

			Model 1			Model 2			Model 3			Model 4			Model 5			Model 6			Model 7			Model 8			Model 9			Model 10		
	N	%	OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI	
Alcohol consumption																															
Never	3628	*1.8*	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-
Current	792	*3.3*	1.8	1.2	2.9	1.1	0.7	1.9	1.3	0.8	2.1	1.2	0.7	1.9	1.1	0.7	1.9	1.2	0.7	2.2	1.1	0.7	1.9	1.1	0.7	1.9	1.2	0.7	2.1	1.0	0.6	1.7
Ex	318	*2.8*	1.5	0.7	3.0	1.0	0.5	2.1	1.2	0.6	2.5	1.1	0.5	2.2	1.0	0.5	2.1	1.2	0.6	2.7	1.1	0.5	2.3	1.0	0.5	2.1	1.1	0.5	2.4	1.1	0.5	2.1
Age (Years)																															
Age < 30	1768	*1.8*	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-
30 to 45	1323	*2.2*	1.2	0.7	2.0	1.0	0.6	1.7	1.1	0.6	1.8	0.9	0.5	1.6	1.0	0.6	1.7	1.0	0.6	1.8	1.0	0.6	1.7	1.0	0.6	1.7	1.0	0.6	1.8	1.2	0.7	2.1
45 plus	1662	*2.5*	1.5	0.9	2.3	1.1	0.7	1.8	1.1	0.7	1.9	0.9	0.5	1.5	1.1	0.7	1.8	0.9	0.5	1.6	1.1	0.7	1.8	1.1	0.7	1.8	1.1	0.7	1.8	1.3	0.8	2.2
Smoking Status																															
Never Smoked	3446	*1.4*				1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-
Ever Smoked	757	*4.8*				3.4	2.1	5.6	3.7	2.1	6.5	3.3	2.0	5.4	3.4	2.1	5.6	3.4	1.9	6.0	3.5	2.2	5.8	3.4	2.1	5.7	3.6	2.1	5.9	3.1	1.4	4.4
Smokeless Tobacco	44	*43.2*				2.5	1.4	4.4	2.1	1.2	3.7	2.4	1.3	4.2	2.5	1.4	4.4	2.7	1.4	5.3	2.5	1.4	4.4	2.5	1.4	4.4	2.1	1.2	3.7	2.5	1.2	5.3
Race																															
Black/African	3485	*2.3*							1.0	-	-																				
Coloured	616	*3.6*							0.9	0.5	1.5																				
White/Asian	596	*0*																													
Education																															
No school	672	*3.6*										1.0	-	-																	
Primary	719	*3.8*										1.7	1.0	2.8																	
Secondary	1825	*1.7*										0.8	0.5	1.4																	
Tertiary	256	*1.2*										0.6	0.2	2.0																	
Cooking Fuel																															
Non-Smoky	3856	*2.2*													1.0	-	-														
Smoky	867	*2*													1.0	0.6	1.7														
Heating Fuel																															
Non-Smoky	2464	*1.9*																1.0	-	-											
Smoky	1311	*2.4*																1.2	0.8	2.0											
Occupational Exposure																															
No	4178	*2.2*																			1.0	-	-								
Yes	553	*2*																			0.7	0.3	1.3								
Residence																															
Urban	2673	*2.2*																						1.0	-	-					
Rural	2080	*2.1*																						1.1	0.7	1.6					
Wealth Index																															
Poorest	978	*2.1*																									1.0	-	-			
2	1005	*2.8*																									1.4	0.8	2.4			
3	979	*3.1*																									1.4	0.8	2.5			
4	886	*1.9*																									0.8	0.4	1.6			
Richest	896	*0.7*																									0.3	0.1	0.7			
BMI																															
Underweight	125	*7.2*																												2.5	1.2	5.3
Normal	1,753	*2.51*																												1.0	-	-
Overweight	1,499	*1.87*																												0.7	0.4	1.1
Very Overweight	1,190	1.18																												0.4	0.2	0.8

Table 7: Adjusted association between tuberculosis (ever) and alcohol consumption in men (N=3 300)

	N	%	Model 1			Model 2			Model 3			Model 4			Model 5			Model 6			Model 7			Model 8			Model 9			Model 10		
			OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI	
Alcohol consumption																															
Never	1626	1.7	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1.0	-	-
Current	1365	4	2.08	1.3	3.3	1.5	0.9	2.5	1.6	0.9	2.6	1.5	0.9	2.5	1.5	0.9	2.4	1.7	0.9	3.1	1.3	0.8	2.2	1.5	0.9	2.4	1.5	0.9	2.5	1.4	0.8	2.3
Ex	300	6.3	3	1.7	5.5	2.2	1.2	4.1	2.4	1.3	4.6	2.2	1.2	4.2	2.1	1.1	4	2.8	1.4	5.7	1.9	1	3.6	2.1	1.1	4	2.3	1.2	4.4	2.3	1.2	4.4
Age (Years)																															
Age < 30	1457	1.7	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1.0	-	-
30 to 45	869	3	1.6	0.9	2.7	1.4	0.8	2.4	1.5	0.8	2.6	1.4	0.8	2.4	1.3	0.8	2.4	1.3	0.7	2.6	1.2	0.7	2.1	1.4	0.8	2.4	1.4	0.8	2.5	1.8	1.0	3.2
45 plus	974	5.3	2.9	1.8	4.7	2.5	1.5	4.1	2.7	1.6	4.4	2.3	1.4	3.8	2.5	1.5	4.1	2.5	1.4	4.5	2.3	1.4	3.7	2.5	1.5	4.1	2.6	1.6	4.3	3.3	2.0	5.5
Smoking Status																															
Never Smoked	1713	1.6				1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1.0	-	-
Ever Smoked	1540	4.9				2.1	1.3	3.5	2.2	1.3	3.7	2	1.2	3.4	2.1	1.3	3.4	2.1	1.2	3.8	2	1.2	3.3	2.1	1.3	3.4	2.1	1.2	3.4	1.9	1.3	4.4
Race																															
Black/African	2507	3.5							1	-	-																				
Coloured	341	3.2							0.7	0.4	1.3																				
White/Asian	423	0.7							0.1	0	0.4																				
Education																															
No school	337	5.9										1	-	-																	
Primary	502	5.6										1.6	1	2.6																	
Secondary	1315	2.6										1	0.6	1.5																	
Tertiary	191	1										0.4	0.1	1.6																	
Cooking Fuel																															
Non-Smoky	2677	3.5													1	-	-														
Smoky	591	1.7													0.5	0.3	1.1														
Heating Fuel																															
Non-Smoky	1744	3																1	-	-											
Smoky	885	2.8																1	0.6	1.6											
Occupational Exposure																															
No	2396	2.2																			1	-	-								
Yes	888	5.6																			1.8	1.2	2.7								
Residence																															
Urban	1940	3.6																						1	-	-					
Rural	1360	2.5																						0.8	0.5	1.2					
Wealth Index																															
Poorest	702	4.1																									1	-	-		
2	704	3.3																									0.8	0.5	1.5		
3	682	3.7																									0.9	0.5	1.5		
4	579	2.8																									0.6	0.3	1.2		
Richest	621	1.6																									0.3	0.2	0.7		
BMI																															
Underweight	185	8.11																												2.4	1.3	4.4
Normal	1,900	3.37																												1	-	-
Overweight	851	1.65																												0.3	0.2	0.6
Very Overweight	254	0.79																												0.2	0.0	0.7

Table 8: Adjusted association between tuberculosis (ever) and CAGE score in women (N=956)

	N	%	Model 1			Model 2			Model 3			Model 4			Model 5			Model 6			Model 7			Model 8			Model 9			Model 10		
			OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI	
CAGE																															
0	408	*1.2*	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-
1 to 2	344	4.4	3.6	1.3	10	3.2	1.1	9	2.1	0.8	6	2.9	1	8.3	3.2	1.1	9.1	2.2	0.7	6.7	3.2	1.1	8.9	3.1	1.1	8.7	1.8	0.6	5.1	3.1	1.1	8.7
3 to 4	204	5.4	4.5	1.5	13	3.9	1.3	11.4	2.4	0.8	7	3.4	1.1	10.1	3.8	1.3	11.4	4.4	1.4	13.4	3.8	1.3	11.3	3.6	1.2	10.7	1.8	0.6	5.4	3.6	1.2	10.8
Age (Years)																															
Age < 30	331	2.1	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1.0	-	-
30 to 45	301	4	1.8	0.7	4.7	1.6	0.6	4.2	1.7	0.6	4.5	1.5	0.5	4	1.6	0.6	4.3	1.7	0.6	4.7	1.7	0.6	4.3	1.6	0.6	4.3	1.5	0.6	4.1	1.8	0.7	4.7
45 plus	324	3.7	1.7	0.7	4.3	1.4	0.5	3.7	1.4	0.5	3.9	1.4	0.4	3.3	1.4	0.5	3.8	1.3	0.4	3.9	1.4	0.5	3.9	1.3	0.5	3.5	1.2	0.4	3.3	1.5	0.6	4.1
Smoking Status																															
Never Smoked	412	1.7				1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1.0	-	-
Ever Smoked	393	4.3				1.9	0.8	4.9	1.9	0.8	5.1	1.8	0.7	4.5	1.9	0.8	4.8	2	0.7	5.3	2	0.8	5	2	0.8	5	1.9	0.7	5.1	1.7	0.7	4.4
Smokeless Tobacco	151	4.6				2	0.7	6.1	1.7	0.6	5.3	1.7	0.6	5.3	2	0.6	6.1	1.8	0.5	6.4	2	0.6	6	1.8	0.6	5.6	1.3	0.4	4.1	2.0	0.7	6.3
Race																															
Black/African	539	3.9							1	-	-																				
Coloured	219	4.6							1	0.4	2.5																				
White/Asian	195	0																													
Education																															
No school	143	4.2										1	-	-																	
Primary	123	8.1										2.6	1	6.6																	
Secondary	352	2.8										1.2	0.5	3																	
Tertiary	84	1.2										0.8	0.1	6.4																	
Cooking Fuel																															
Non-Smoky	829	3.1													1	-	-														
Smoky	119	4.2													1	0.4	2.8														
Heating Fuel																															
Non-Smoky	546	2.8																1	-	-											
Smoky	241	4.6																1.1	0.5	2.6											
Occupational Exposure																															
None	754	3.5																			1	-	-								
Some	200	2.5																			0.7	0.3	1.8								
Residence																															
Urban	672	2.5																						1	-	-					
Rural	284	4.9																						1.7	0.8	3.7					
Wealth Index																															
Poorest	157	5.1																									1	-	-		
2	167	6.6																									1.4	0.5	3.6		
3	192	5.2																									1.1	0.4	2.8		
4	177	1.1																									0.3	0.1	1.3		
Richest	260	0.0																													
BMI																															
Underweight	46	7.14																												1.6	0.4	5.9
Normal	406	3.69																												1	-	-
Overweight	277	3.25																												0.9	0.4	2.2
Very Overweight	191	1.05																												0.3	0.1	1.2

Table 9: Adjusted association between tuberculosis (ever) and CAGE score in men (N=1 545)

	N	%	Model 1			Model 2			Model 3			Model 4			Model 5			Model 6			Model 7			Model 8			Model 9			Model 10		
			OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI	
CAGE																														
0	485	1.9	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-
1 to 2	602	4.0	2.4	1.1	5.2	2.3	1.1	5.0	1.8	0.8	3.9	2.2	1.0	4.8	2.3	1.1	5.1	2.8	2.8	1.1	2.2	1.0	4.8	2.3	1.1	5.1	1.8	0.8	3.9	2.0	0.9	4.3
3 to 4	458	7.4	4.5	2.1	9.6	4.4	2.1	9.3	3.4	1.6	7.3	4.2	2.0	9.0	4.4	2.1	9.4	5.8	2.3	14.2	4.0	1.9	4.7	4.4	2.1	9.3	3.4	1.6	7.3	3.7	1.7	7.9
Age (Years)																																
Age < 30	591	2.2	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-
30 to 45	474	3.2	1.4	0.7	3.0	1.3	0.6	2.8	1.4	0.7	3.0	1.3	0.6	2.8	1.3	0.6	2.8	1.2	0.5	2.9	1.2	0.6	2.5	1.3	0.6	2.8	1.3	0.6	2.8	1.6	0.7	3.4
45 plus	480	8.1	4.1	2.1	7.7	3.8	2.0	7.3	4.0	2.1	7.8	3.4	1.7	6.6	3.8	2.0	7.4	3.5	1.7	7.3	3.3	1.7	6.5							4.4	2.3	8.6
Smoking Status																																
Never Smoked	433	2.5				1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-	1.0	-	-
Ever Smoked	1093	5.1				1.5	0.8	3.0	1.6	0.8	3.1	1.5	0.8	2.9	1.6	0.8	3.0	1.3	0.6	2.6	1.4	0.7	2.8	1.5	0.8	3.0	1.5	0.7	2.9	1.4	0.7	2.8
Race																																
Black/African	1099	5.2							1.0	-	-																					
Coloured	206	4.4							0.9	0.4	1.8																					
White/Asian	233	0.4							0.1	0.1	0.7																					
Education																																
No school	176	9.1										1.0	-	-																		
Primary	242	7.9										1.3	0.7	2.5																		
Secondary	575	3.3										0.8	0.4	1.4																		
Tertiary	94	0																														
Cooking Fuel																																
Non-Smoky	1305	4.7													1.0	-	-															
Smoky	226	2.7													0.5	0.2	1.1															
Heating Fuel																																
Non-Smoky	834	4.3																1.0	-	-												
Smoky	386	4.2																0.8	0.4	1.5												
Occupational Exposure																																
None	960	2.8																			1.0	-	-									
Some	579	6.9																			2.1	1.2	3.4									
Residence																																
Urban	991	4.2																						1.0	-	-						
Rural	554	4.5																						0.9	0.6	1.6						
Wealth Index																																
Poorest	294	6.1																									1.0	-	-			
2	329	5.2																									0.9	0.5	1.8			
3	328	6.1																									1.0	0.5	2.0			
4	277	3.3																									0.6	0.2	1.3			
Richest	315	1																									0.2	0.1	0.7			
BMI																																
Underweight	82	10.98																												1.9	0.9	4.1
Normal	939	4.79																												1.0	-	-
Overweight	365	2.47																												0.4	0.2	0.9
Very Overweight	115	0.87																												0.1	0.0	1.1

5. Discussion

The findings presented in this thesis support the hypothesis that alcohol consumption as well as problem drinking is associated with increased odds of tuberculosis disease.

5.1. Key findings

The most conservative finding regarding the association between alcohol consumption and ever having had tuberculosis is that women who currently or previously consumed alcohol had a 20% increase in tuberculosis odds. Men who were current alcohol consumers had a 50% increase in disease odds whilst previous alcohol consumers had a two fold increase in disease odds.

On the other hand, both men and women exhibited at least a two fold increase in tuberculosis odds if they had a CAGE score of either one or two. The higher CAGE category (three to four) exhibited the highest increase in disease odds reaching four times higher than those with a zero score in certain instances.

5.2. Study strengths and limitations

The sample size utilized for the study was adequate to generate statistically significant results for the association between past episodes of tuberculosis and the explanatory variables explored. The analysis, however, failed to determine the extent of the relationship between these variables and recurrent tuberculosis.

The use of reported tuberculosis rather than an objective measurement of the disease is a limitation. Reported tuberculosis is subject to a level of recall bias depending on the respondent's perception of the disease and understanding of the question. Objective measurement of past tuberculosis would have yielded a more valid estimate of disease lifetime risk. The same applies to the measurement of predictor variables such as smoking and occupational exposure.

The SADHS adult questionnaire (Appendix 2) posed questions related to wealth, education, occupation and several other factors. Responses to these questions were used to generate predictor variables were unlikely to have been influenced by respondent's tuberculosis status. This reduces the potential for differential misclassification of the predictor variables utilized in this analysis.

Adjusting for the effect of several potential confounding variables of the relationship between tuberculosis and alcohol consumption as well as CAGE, strengthens confidence in the validity of the findings. This included the use of variables such as education and wealth indices as proxies for socioeconomic status, an important potential confounder.

The association between alcohol consumption and tuberculosis could in part be explained, however, as the result of confounding of other factors that were not measured in this study, particularly HIV and malnutrition. HIV increases the risk of reactivation of latent tuberculosis as well as increasing the risk of rapid disease

progression after new infection with tuberculosis (Corbett E. et al. 2003). Alcohol consumption and alcoholism or problem drinking are associated with risky sexual behaviour and thus increased risk of HIV infection (Adefuye A. et al 2009).

Malnutrition is associated with tuberculosis (Lettow. M 2003, Macallan. D 1993) and alcohol consumption. Alcohol has been reported to affect the absorption of essential nutrients and consequently contributes to malnutrition (Watzl B 1992). A BMI score of less than 18 kg/m^2, which is categorized as being underweight, was used a proxy for malnutrition in this study and provided a partial means for controlling for the potential confounding effect. Interestingly, there was a consistently strong and graded association between low BMI and the tuberculosis odds.

5.3. Possible mechanisms of effect

The findings of this study are plausible in that alcohol consumption and problem drinking have been reported to influence the rates of tuberculosis infection and disease via a number of pathways. These pathways include biological and behavioural effects of alcohol consumption and problem drinking on tuberculosis.

5.3.1. Biological effects of alcohol.

The human body has a two phase response to invading organisms. The first is an inflammatory response which involves the use of phagocytes which help eliminate the

pathogen. The second phase is the development of a T-cell mediated immunity to that particular pathogen.

It has been suggested that alcohol consumption might increase the likelihood of tuberculosis infection progressing to disease owing to a compromised immune system (Mason C. et al 2004). Both chronic and acute alcohol consumption have been found to reduce the ability of phagocytes to ingest and break down pathogenic bacteria which is an important defense in the control of tuberculosis infection in humans (Szabo G. 1997, Happel K. et al. 2005).

The specific mechanism via which alcohol influences the inflammatory reaction remains unclear. It has been suggested that alcohol reduces levels of TNF-α in the human body and thus renders it difficult to induce the inflammatory response to invading *Mycobacteria* (Nelson S, et al 1995). Acute, moderate and chronic alcohol use all reduce the levels of TNF- α in the human body. Consequently, people who consume alcohol are generally less able to fight off the initial tuberculosis infection.

Alcohol has also been reported to significantly reduce the body's cell mediated immunity which increases an individual's susceptibility to active tuberculosis as well as the re-activation of latent tuberculosis (Szabo G. 1997). The main hypothesis is that alcohol use alters the balance between the levels of T-helper-2 (Th2) cells which are associated with humoral immunity in such a way that they dominate over T-helper-1 cells which perform a similar function in cell mediated immunity.

Disruption of this balance disturbs the mechanism via which the body generates cell mediated immunity which occurs several weeks after the body is challenged with an invading pathogen (Szabo G. 1997).

In summary, alcohol might impair the ability of the human body to develop sufficient immunity to tuberculosis thus facilitating active tuberculosis or reactivation of latent disease.

5.4. Behavioural effects of alcohol consumption and problem drinking

Apart from the biological changes influenced by alcohol consumption, alcohol consumption and problem drinking are associated with several behavioural and socioeconomic factors that could contribute to an increased likelihood of infection or disease reactivation. Behavioural factors in most instances are believed to be associated with increased exposure to infection owing to poor living conditions. Problem drinking could also be linked to poor eating habits, compromised immunity and consequently increased susceptibility to tuberculosis disease.

5.4.1. High risk living conditions

Tuberculosis tends to be highly prevalent in densely populated communities such as prisons, homeless shelters and squatter camps. In many cases, severe alcoholics tend to live in crowded and impoverished conditions such as these. Prolonged exposure to other individuals in the vicinity greatly increases the potential for infection with tuberculosis (Kline S, 1995).

Using education as well as wealth index as proxies for this measure, this study also supports the genera view that low socioeconomic status is associated with increased risk of tuberculosis. The confounding effect of socioeconomic status was adjusted for and cannot explain away the relationship between tuberculosis disease and alcohol as well as problem drinking.

5.4.2. Nutrition

Alcohol and problem drinking both play a role in the development of malnutrition. Alcohol inhibits the absorption and utilization of several essential micronutrients such as thiamine (vitamin B1), vitamin B12 , folic acid, and zinc which are involved in human metabolism amongst other processes. On the other hand, many alcoholics tend not to consume a balanced diet and are thus prone to nutritional deficiencies. The most severe forms of deficiencies are found in heavy drinkers and alcoholics who have medical conditions such as liver disease which may arise as a consequence of alcohol consumption. Regardless of the mechanism via which alcohol results in malnutrition, the resulting effect is a reduction in the body's immune response which increases susceptibility to disease (Lieber C. 2003).

In summary, it is plausible that alcohol consumption results in an increase risk of tuberculosis as a result of compromised immunity, whilst the behaviour characteristic of alcoholics renders drinkers more exposed and susceptible to tuberculosis infection as well as active disease.

6. Conclusion

This study has found that both alcohol consumption and problem drinking (CAGE) are associated with an increased risk of tuberculosis disease. The study design was such that direct causality could not be inferred.

However, evidence in the literature supports the hypothesis and provides plausible mechanisms for the suggested effect. Increased levels of tuberculosis in people who consume alcohol could be attributed to a weakened immune system or behavioural factors characteristic f problem drinkers. The latter is linked with an increased risk of exposure and thus infection with the Mycobacterium that cause the disease. The association between recurrent tuberculosis and alcohol is a question which could not be answered.

South Africa has one of the highest levels of tuberculosis incidence and prevalence globally. Consequently, the findings of this study have implications for efforts aimed at the reduction of alcohol consumption and abuse as a means of controlling the burden of tuberculosis in the country.

7. References

Adefuye A, Abiona T, Balogum J 2009. HIV sexual risk behaviours and perception of risk among college students: implications for planning interventions. *BioMed Central Public Health* (9) 281 http://www.biomedcentral.com/1471-2458/9/281/abstract (date accessed 20 August 2009)

Bradshaw D, Groenewald P, Laubscher R 2003. Initial burden of disease estimates for South Africa. *South African Medical Research Council*.

Cassels A, Heinemann E, LeClerq S 1982. Tuberculosis case finding in Eastern Nepal. *Tubercle,* September 63 (3), *175-85*

Coker R, McKee M, Atun R 2006. Risk factors for pulmonary tuberculosis in Russia: case-control study. *British Medical Journal, (332), 85 – 87*

Comstock G, Cauthen G 1993. In tuberculosis: a comprehensive international approach. *Marcel Dekker Inc (*66), *23-48.*

Corbett E, Watt C, Walker N 2003. The growing burden of tuberculosis: global trends and interactions with the HIV epidemic. *Archives Of Internal Medicine, (163), 1009 – 1029*

Crampin A, Glynn J, Floyd S 2004. Tuberculosis and gender: exploring the patterns in a case control study in Malawi. *International Journal Of Tuberculosis And Lung Disease*, 8 (2), *194 – 203*

Davies P, Yew W, Ganguly D 2002. Smoking and tuberculosis: the epidemiological association and immunopathogenesis. *Royal Society Of Tropical Medicine And Hygiene, (100), 291 – 298*

Department of Health South Africa 2004. South African demographic and health survey 2003 *Pretoria, South Africa*

Happel K, Nelson S 2005. Alcohol, Immunosuppression, and the Lung. *American Thoracic Society, 2, 428-432*

Harling G, Ehrlich R, Myer L 2007. The social epidemiology of tuberculosis: a multilevel analysis. *Social Science And Medicine* (66), *492-505*

Jacobson J, 1992. Alcoholism and tuberculosis. *Alcohol Health & Research World* 16(1), *39-45*

Kim S, Crittenden K 2005. Risk factors for tuberculosis among inmates: a retrospective analysis. *Public Health Nursing* 2, (22), *108 – 118*

Kline S, Hedemar L, Davies F 1995. Outbreak of tuberculosis among regular patrons of a neighborhood bar. *The New England Journal Of Medicine,* (333), 222 – 227

Lettow M, Fawzi W, Semba R 2003. Triple trouble: The role of Malnutrition in tuberculosis and human immunodeficiency virus co-infection. *Nutrition Reviews*, 3 (61), *81 - 90*

Lieber C 2003. Relationships between nutrition, alcohol use, and liver disease. *Alcohol Research & Health,* (27), *220 – 231*

Lienhardt C, Fielding K, Sillah J 2005. Investigation of the risk factors for tuberculosis: a case-control study in three countries in West Africa. *International Journal Of Epidemiology, (*34), *914 – 923*

Lönnroth K, Williams B, Stadlin S 2008. Alcohol use as a risk factor for tuberculosis – a systematic review. *Biomed Central Public Heath,* (8), *289* http://www.biomedcentral.com/1471-2458/8/289 (date accessed 7 November 2008)

Maartens G, Wilkinson R 2007. Tuberculosis *Lancet,* (370) *2030 – 43*

Mason C, Doubard E, Zhang P 2004. Alcohol exacerbates murine pulmonary tuberculosis. *Infection and Immunity, (May), 2556 – 2563*

Mbulaiteye S, Ruberantwari A, Nakiyingi J 2000. Alcohol and HIV: A study among sexually active adults in rural south west Uganda. *International Journal Of Epidemiology, (29), 911 – 915*

Nelson S, Mason C, Bagbay G 1995. Alcohol, tumor necrosis factor, and tuberculosis *Alcoholism: Clinical And Experimental Research, 19 (1), 17 - 24*

Parry C 2005. South Africa: Alcohol today. *Addiction 100 (4), 426 – 429*

Parry C, Rehm J, Poznyak V Room R 2009. Alcohol and infectious diseases: an overlooked causal linkage? *Addiction,* (104), 331 – 332

Rosenham K, Hall N 1996. Occupational risk factors for developing tuberculosis. *American Journal Of Industrial Medicine,* (30), *148-154*

Shetty N, Shemko M, Vaz M 2006. An epidemiological evaluation of risk factors in south India: a matched case-control study. *International Journal Of Tuberculosis And Lung Disease,* 10(1), *80-86*

Szabo G 1997. Alcohol's contribution to compromised immunity. *Alcohol Health & Research World, 21 (1)*

Tekkel M, Rahu M, Loit H 2002. Risk factors for pulmonary tuberculosis in Estonia. *International Journal Of Tuberculosis And Lung Disease,* 6(10), *887 -894*

Thomas A, Gopi P, Santha T 2006. Predictors of relapse among pulmonary tuberculosis patients in a DOTS program in South India. *International Journal Of Tuberculosis And Lung Disease,* 9(5), *556 – 561*

Watzl B, Watson R 1992. Role of alcohol abuse in nutritional immunosuppression. *The Journal Of Nutrition,* (122), 733-737

World Health Organisation 2008. South Africa country profile *WHO TB Report*, 145-*148*

Appendix 1: Unadjusted logistic regression between recurrent tuberculosis (vs. one episode) and exposure variables stratified by gender (N=191)

	Women									Men								
		TB Twice *vs.* Once				TB Three & more *vs.* Once					TB Twice *vs.* Once				TB Three & more *vs.* Once			
Variable	**N**	**%**	**OR**	**95% CI**		**%**	**OR**	**95% CI**		**N**	**%**	**OR**	**95% CI**		**%**	**OR**	**95% CI**	
Alcohol consumption																		
Never	59	32.2	1.0	-	-	27.1	1.0	-	-	26	15.4	1.0	-	-	23.1	1.0	-	-
Current	26	19.2	0.5	0.1	1.5	26.9	0.8	0.2	2.3	51	19.6	1.5	0.4	5.3	19.6	1.0	0.3	3.1
Ex	9	44.4	1.7	0.3	8.5	22.2	1.0	0.1	6.7	18	11.1	0.6	0.1	3.7	5.6	0.2	0.0	1.9
CAGE Score																		
0	68	32.4	1.0	-	-	27.9	1.0	-	-	43	14.0	1.0	-	-	18.6	1.0	-	-
1 to 2	15	26.7				13.3	0.1	0.0	1.2	23	21.7	2.1	0.2	22.5	17.4	0.9	0.1	6.0
3 to 4	11	18.2				36.4	0.5	0.1	4.9	31	16.1	1.4	0.1	14.7	16.1	0.7	0.1	4.7
Age																		
Age < 30	28	35.7	1.0	-	-	10.7	1.0	-	-	22	13.6	1.0	-	-	9.1	1.0	-	-
30 to 45	28	32.1	1.2	0.4	4.0	28.6	3.6	0.8	16.9	24	20.8				16.7			
45 plus	38	23.7	0.9	0.3	2.8	36.8	4.7	1.1	19.7	51	15.7				21.6			
Race																		
Black/African	73	28.8	1.0	-	-	27.4	1.0	-	-	84	17.9	1.0	-	-	19.0	1.0	-	-
Coloured	21	33.3	1.2	0.4	3.7	23.8	0.9	0.3	3.0	9	11.1	0.5	0.1	4.5	11.1	0.5	0.1	4.2
Whites/Asians	0									3	0.0	0.0	0.0	.	0.0	0.0	0.0	
Smoke Status																		
Never Smoked	42	38.1	1.0	-	-	31.0	1.0	-	-	25	20.0	1.0	-	-	24.0	1.0	-	-
Ever Smoked	35	28.6	0.5	0.2	1.4	22.9	0.5	0.2	1.5	71	15.5	0.7	0.2	2.2	15.5	0.6	0.2	1.8
Smokeless	17	11.8	0.1	0.0	0.8	23.5	0.4	0.1	1.4			-	-	-		-	-	-
Occupational Exposure																		
No	83	27.7	1.0	-	-	28.9	1.0	-	-	49	18.4	1.0	-	-	20.4	1.0	-	-
Yes	11	45.5	1.6	0.4	6.0	9.1	0.3	0.0	2.7	47	14.9	0.7	0.2	2.1	14.9	0.6	0.2	1.9
Residence																		
Urban	54	25.9	1.0	-	-	22.2	1.0	-	-	64	12.5	1.0	-	-	15.6	1.0	-	-
Rural	40	35.0	2.2	0.8	5.8	32.5	2.3	0.8	6.5	33	24.2	2.6	0.8	7.8	21.2	1.8	0.6	5.4
Education																		
No school	22	22.7	1.0	-	-	45.5	1.0	-	-	19	15.8	1.0	-	-	15.8	1.0	-	-
Primary	26	23.1	0.6	0.2	2.0	26.9	0.6	0.2	1.9	26	11.5	0.4	0.1	1.9	19.2	1.0	0.3	3.7
Secondary	27	37.0	1.1	0.3	3.4	18.5	0.4	0.1	1.6	34	11.8	0.4	0.1	1.7	17.6	0.9	0.2	3.1
Tertiary	3	33.3	0.6	0.1	8.0	0.0	0.0	0.0	.	2	50.0	2.6	0.1	47.2	0.0	0.0	0.0	.
Wealth Index																		
Poorest	19	26.3	1.0	-	-	42.1	1.0	-	-	26	19.2	1.0	-	-	19.2	1.0	-	-
2	26	38.5	1.0	0.2	4.3	15.4	0.3	0.1	1.2	23	17.4	0.8	0.2	3.5	13.0	0.6	0.1	2.9
3	27	18.5	0.4	0.1	2.1	29.6	0.4	0.1	1.7	23	13.0	0.6	0.1	2.9	17.4	0.8	0.2	3.5
4	17	41.2	1.1	0.2	5.0	11.8	0.2	0.0	1.2	15	13.3	0.6	0.1	4.0	20.0	1.0	0.2	4.9
Richest	5	20.0	1.2	0.1	24.5	60.0	2.3	0.2	27.4	10	20.0	1.1	0.2	7.1	20.0	1.1	0.2	7.1
Cooking Fuel																		
Non-Smoky	79	30.4	1.0	-	-	24.1	1.0	-	-	89	16.9	1.0	-	-	18.0	1.0	-	-
Smoky	15	26.7	1.2	0.3	4.9	40.0	2.3	0.6	8.4	8	12.5	0.6	0.1	5.8	12.5	0.6	0.1	5.4
Heating Fuel																		
Non-Smoky	42	28.6	1.0	-	-	31.0	1.0	-	-	51	21.6	1.0	-	-	19.6	1.0	-	-
Smoky	29	17.2	0.5	0.1	1.8	34.5	0.9	0.3	2.8	21	9.5	0.3	0.1	1.6	9.5	0.4	0.1	1.8
BMI																		
Normal	40	27.5	1.0	-	-	32.5	1.0	-	-	60	15.0	1.0	-	-	21.7	1.0	-	-
Underweight	9	66.7	4.2	0.7	24.0	11.1	0.6	0.0	7.3	13	23.1	1.9	0.4	8.5	15.4	0.8	0.2	4.2
Overweight	26	23.1	0.6	0.2	2.0	23.1	0.5	0.2	1.7	14	14.3	0.9	1.7	4.8	7.1	0.3	0.0	2.5
Very Overweight	13	23.1	0.6	0.1	2.7	23.1	0.5	0.1	2.3	2	100	-	-	-	0.0	0.9	-	-

UNIVERSITY OF CAPE TOWN

Health Sciences Faculty
Research Ethics Committee
Room E52-24 Groote Schuur Hospital Old Main Building
Observatory 7925
Telephone [021] 406 6338 • **Facsimile** [021] 406 6411
e-mail: lamees.emjedi@uct.ac.za

3 November 2008

REC REF: 448/2008

Ms T Mkandawire
Health Economics Unit
Public Health & Family Medicine

Dear Ms Mkandawire

PROJECT TITLE: THE ASSOCIATION BETWEEN ALCOHOL AND TUBERCULOSIS.

Thank you for submitting your study to the Research Ethics Committee for review.

It is a pleasure to inform you that the Ethics Committee has **formally approved** the above-mentioned study.

Approval is granted for one year till the 15th November 2009.

Please submit an annual progress report if the research continues beyond the expiry date. Please submit a brief summary of findings if you complete the study within the approval period so that we can close our file.

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Please quote the REC. REF in all your correspondence.

Yours sincerely

PROFESSOR M BLOCKMAN
CHAIRPERSON, HSF HUMAN ETHICS

Federal Wide Assurance Number: FWA00001637.
Institutional Review Board (IRB) number: IRB00001938

lemjedi

This serves to confirm that the University of Cape Town Research Ethics Committee complies to the Ethics Standards for Clinical Research with a new drug in patients, based on the Medical Research Council (MRC-SA), Food and Drug Administration (FDA-USA), International Convention on Harmonisation Good Clinical Practice (ICH GCP) and Declaration of Helsinki guidelines.

The Research Ethics Committee granting this approval is in compliance with the ICH Harmonised Tripartite Guidelines E6: Note for Guidance on Good Clinical Practice (CPMP/ICH/135/95) and FDA Code Federal Regulation Part 50, 56 and 312.

kmjedi

SOUTH AFRICA DEMOGRAPHIC AND HEALTH SURVEY 2003
ADULT HEALTH QUESTIONNAIRE

IDENTIFICATION

PROVINCE* _____ ☐

DISTRICT _____ ☐☐☐

EA NUMBER..... ☐☐☐☐

EA TYPE (URBAN FORMAL=1; URBAN INFORMAL=2; RURAL FORMAL=3; TRIBAL AREA=4)..... ☐

SADHS CLUSTER NUMBER ..... ☐☐☐

STAND NUMBER ..... ☐☐

HOUSEHOLD NUMBER..... ☐☐

NAME OF HOUSEHOLD HEAD _____

NAME AND LINE NUMBER OF ADULT _____ ☐☐

INTERVIEWER VISITS

	1	2	3	FINAL VISIT
DATE				DAY ☐☐
				MONTH ☐☐
				YEAR 2 0 0 ☐
INTERVIEWER'S NAME				INT.CODE ☐☐☐
RESULT**				RESULT ☐
NEXT VISIT: DATE				TOTAL NO. OF VISITS ☐
TIME				

** RESULT CODES:

1	COMPLETED	4	REFUSED	7	OTHER _____ (SPECIFY)
2	NOT AT HOME	5	PARTLY COMPLETED		
3	POSTPONED	6	INCAPACITATED		

LANGUAGE

LANGUAGE OF QUESTIONNAIRE: **ENGLISH** 0 1

LANGUAGE OF INTERVIEW *** _____

HOME LANGUAGE OF RESPONDENT*** _____

WAS A TRANSLATOR USED? (YES=1, NO=2) .....

*** LANGUAGE CODES:

01 ENGLISH	04 isiZULU	07 SePEDI	10 XITSONGA
02 AFRIKAANS	05 SeSOTHO	08 SiSWATI	11 isiNDEBELA
03 isiXHOSA	06 SeTSWANA	09 TshiVENDA	12 OTHER_____ (SPECIFY)

SUPERVISOR	FIELD EDITOR	OFFICE EDITOR	KEYED BY
NAME _____ ☐☐	NAME _____ ☐☐	☐☐	☐☐
DATE _____	DATE _____		

*PROVINCE: WESTERN CAPE=1; EASTERN CAPE=2; NORTHERN CAPE=3; FREE STATE=4; KWAZULU-NATAL=5; NORTHWEST=6; GAUTENG=7; MPUMALANGA=8; LIMPOPO=9

SECTION 1: HEALTH SERVICE UTILIZATION

NO.	QUESTIONS AND FILTERS			CODING CATEGORIES
101	RECORD THE TIME.			HOUR..... ☐☐ MINUTES ..... ☐☐
1	During the **last month** have you been to any of the following health services for medical care for yourself : PROBE.		2. Were you satisfied with the care you received at (PLACE)?	3. Why were you not satisfied with the care you received at (PLACE)? DO NOT READ ANSWERS TO RESPONDENT.
1A	Community Health Centre?	YES 1 / NO 2 →	YES 1 → / NO 2	LONG WAIT ..... 01 SHORT CONSULTATION..... 02 STAFF RUDE/UNKIND ..... 03 DIDN'T SEE DOCTOR..... 04 NO PRESCRIBED DRUGS AVAILABLE ..... 05 OTHER_____ 96 (SPECIFY)
1B	Government Hospital/Government Clinic?	YES 1 / NO 2 →	YES 1 → / NO 2	LONG WAIT ..... 01 SHORT CONSULTATION..... 02 STAFF RUDE/UNKIND ..... 03 DIDN'T SEE DOCTOR..... 04 NO PRESCRIBED DRUGS AVAILABLE..... 05 OTHER_____ 96 (SPECIFY)
1C	Private Hospital/Private Clinic?	YES 1 / NO 2 →	YES 1 → / NO 2	LONG WAIT ..... 01 SHORT CONSULTATION..... 02 STAFF RUDE/UNKIND ..... 03 DIDN'T SEE DOCTOR..... 04 TOO EXPENSIVE ..... 05 OTHER_____ 96 (SPECIFY)
1D	Private Doctor?	YES 1 / NO 2 →	YES 1 → / NO 2	LONG WAIT ..... 01 SHORT CONSULTATION..... 02 STAFF RUDE/UNKIND ..... 03 TOO EXPENSIVE ..... 04 OTHER_____ 96 (SPECIFY)
1E	Chemist/Pharmacist?	YES 1 / NO 2 →	YES 1 → / NO 2	LONG WAIT ..... 01 SHORT CONSULTATION..... 02 STAFF RUDE/UNKIND ..... 03 DIDN'T SEE PHARMACIST..... 04 DRUGS TOO EXPENSIVE ..... 05 OTHER_____ 96 (SPECIFY)
1F	Faith Healer?	YES 1 / NO 2 →	YES 1 → / NO 2	LONG WAIT ..... 01 SHORT CONSULTATION..... 02 STAFF RUDE/UNKIND ..... 03 OTHER_____ 96 (SPECIFY)
1G	Traditional Healer or Herbalist?	YES 1 / NO 2 →	YES 1 → / NO 2	LONG WAIT ..... 01 SHORT CONSULTATION..... 02 STAFF RUDE/UNKIND ..... 03 TOO EXPENSIVE ..... 04 OTHER_____ 96 (SPECIFY)
1H	Health Services at the Workplace?	YES 1 / NO 2 →	YES 1 → / NO 2	LONG WAIT ..... 01 SHORT CONSULTATION..... 02 STAFF RUDE/UNKIND ..... 03 DIDN'T SEE DOCTOR..... 04 OTHER_____ 96 (SPECIFY)

NO.	QUESTIONS AND FILTERS			CODING CATEGORIES
1I	Have you had visits by Home-Based Care Services/House visits/Community-Based Care?	YES 1 / NO 2 →	YES 1 → / NO 2	LONG WAIT ..... 01 SHORT CONSULTATION..... 02 STAFF RUDE/UNKIND ..... 03 OTHER_____ 96 (SPECIFY)
1J	Dentist/Oral Hygienist/Oral Therapist?	YES 1 / NO 2 →	YES 1 → / NO 2	LONG WAIT ..... 01 SHORT CONSULTATION..... 02 STAFF RUDE/UNKIND ..... 03 TOO EXPENSIVE ..... 04 OTHER _____ 96 (SPECIFY)
1K	Rehabilitation Therapists? (e.g. physiotherapists; occupational therapists; speech, hearing and language therapists; orthotists/prosthetists; or optometrist).	YES 1 / NO 2 →	YES 1 → / NO 2	LONG WAIT ..... 01 SHORT CONSULTATION..... 02 STAFF RUDE/UNKIND ..... 03 TOO EXPENSIVE ..... 04 OTHER _____96 (SPECIFY)
1L	Other? _____ (SPECIFY)	YES 1 / NO 2 →		
4	Sometimes, one misses appointments with a health-service provider. What were the most common reasons that you missed an appointment with a health-service provider the last time this happened? RECORD ALL MENTIONED. DO NOT READ ANSWERS TO RESPONDENT.		LACK OF MONEY ..... A LACK OF TIME ..... B I FORGOT ..... C I FELT BETTER ..... D CANNOT TAKE TIME FROM WORK ..... E NO TRANSPORT AVAILABLE ..... F TOO ILL TO TRAVEL ..... G OTHER RESPONSIBILITIES ..... H DO NOT WANT TO GO BACK TO THE HEALTH-CARE PROVIDER ..... I HAVE NOT MISSED APPOINTMENTS ..... J OTHER_____ X (SPECIFY)	
5	Are you covered by a Medical Aid or Medical Benefit Scheme or any scheme that helps you pay for health-care/drug services?		YES ..... 1 NO 2	
6	Have you had your blood pressure measured in the past 12 months?		YES ..... 1 NO 2	
7	Do you know what your blood pressure is?		YES ..... 1 NO 2	→ 9
8	Is it high, normal or low?		HIGH ..... 1 NORMAL ..... 2 LOW ..... 3 DON'T KNOW 8	

SECTION 2: FAMILY MEDICAL HISTORY

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
9	Now I would like to ask you about your family. Do you have a **close blood relative** (father, mother, brother, sister or child) who has ever had any of the following conditions:		
9A	High Blood Pressure?	YES.....1 NO.....2 DON'T KNOW.....8	
9B	Heart attack or angina or chest pain when exerting himself/herself?	YES.....1 NO.....2 DON'T KNOW.....8	➤9D
9C	Was this relative younger or older than 50 years old when they first had a heart attack, angina or chest pain?	YOUNGER THAN 50 YEARS.....1 OLDER THAN 50 YEARS.....2 DON'T KNOW.....8	
9D	Stroke?	YES.....1 NO.....2 DON'T KNOW.....8	

SECTION 3 : QUALITY OF LIFE AND CLINICAL CONDITIONS

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
10A	Did you **grow up** in a household where people smoked cigarettes, pipe or other tobacco products every day?	YES.....1 NO.....2 DON'T KNOW.....8	
10B	Would you say your health is poor, average, good, or very good/excellent ?	POOR .....1 AVERAGE .....2 GOOD.....3 VERY GOOD/EXCELLENT 4	
10C	Do you personally think that you are underweight, normal weight or overweight?	UNDERWEIGHT.....1 NORMAL WEIGHT .....2 OVERWEIGHT.. .....3 DON'T KNOW.....8	
11	Has a **doctor** or **nurse** or **health worker** at a **clinic** or **hospital told you** that you have or have had any of the following conditions:		
11A	High Blood Pressure?	YES.....1 NO.....2 DON'T KNOW.....8	
11B	Heart attack or angina (chest pains)?	YES.....1 NO.....2 DON'T KNOW.....8	
11C	Stroke?	YES.....1 NO.....2 DON'T KNOW.....8	
11D	High blood cholesterol or fats in the blood?	YES.....1 NO.....2 DON'T KNOW.....8	
11E	Diabetes or Blood Sugar?	YES.....1 NO.....2 DON'T KNOW.....8	
11F	Emphysema/Bronchitis?	YES.....1 NO.....2 DON'T KNOW.....8	
11G	Asthma?	YES.....1 NO.....2 DON'T KNOW.....8	
11H	Sore joints, e.g. Arthritis, gout?	YES.....1 NO.....2 DON'T KNOW.....8	
11I	Osteoporosis?	YES.....1 NO.....2 DON'T KNOW.....8	
11J	Epilepsy / fits?	YES.....1 NO.....2 DON'T KNOW.....8	
11K	TB?	YES.....1 NO.....2 DON'T KNOW.....8	➤11M
11L	How many episodes of TB have you ever been treated for?	NUMBER OF TB EPISODES..... ☐☐	
11M	Cancer?	YES.....1 NO.....2 DON'T KNOW.....8	

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
12	Now I would like to ask you **about chest conditions**.		
12A	Do you feel you have less breath when exerting (exercising or moving a lot) yourself when compared to other people your age?	YES.....1 NO.....2 DON'T KNOW.....8	
12B	During the **last 12 months** have you had wheezing (difficult breathing) or tightness of your chest?	YES.....1 NO.....2 DON'T KNOW.....8	➢12D
12C	Were you also short of breath?	YES.....1 NO.....2 DON'T KNOW.....8	
12D	Do you usually get wheezing (difficult breathing) when you have a cold?	YES.....1 NO.....2 DON'T KNOW.....8	
12E	Is your sleep ever interrupted by wheezing or a tight chest?	YES.....1 NO.....2 DON'T KNOW.....8	
12F	Is your sleep ever interrupted by your coughing?	YES.....1 NO.....2 DON'T KNOW.....8	
12G	Do you usually cough (on most days)?	YES.....1 NO.....2 DON'T KNOW.....8	➢13A
12H	When you cough, do you usually bring up phlegm from your chest?	YES.....1 NO.....2 DON'T KNOW.....8	➢13A
12I	Have you brought up phlegm every day for at least three months during the last year?	YES.....1 NO.....2 DON'T KNOW.....8	➢13A
12J	For how many years have you brought up phlegm in this way?	NUMBER OF YEARS…… ☐☐	

SECTION 4: DENTAL HEALTH

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
13A	Have you **lost** all of your own teeth?	YES .....1 NO.....2	
13B	Have you had pain or problems with your mouth and/or teeth in the **last 6 months**?	YES .....1 NO.....2	–➢13E
13C	Please indicate which part of your mouth was affected. RECORD ALL MENTIONED.	TEETH ..... A GUMS ..... B ULCERS /SORES IN THE MOUTH..... C DENTURES ..... D OTHER_____ X (SPECIFY)	
13D	What did you do when you had problems in your mouth? RECORD ALL MENTIONED.	TOOK A TABLET..... A WENT TO THE DENTIST/ORAL HYGIENIST/DENTAL THERAPIST..... B WENT TO THE DOCTOR..... C WENT TO THE TRADITIONAL HEALER ..... D NOTHING ..... E OTHER_____ X (SPECIFY)	
13E	What do you usually do to look after your teeth/mouth? RECORD ALL MENTIONED. DO NOT READ ANSWERS TO RESPONDENT.	RINSE MOUTH..... A CLEAN/BRUSH/FLOSS..... B EAT LESS SWEET FOOD/DRINK LESS SWEET DRINKS... C VISIT DENTIST/DENTAL THERAPIST/ORAL HYGIENIST/ ORAL THERAPIST AT LEAST ONCE A YEAR ..... D NOTHING ..... E OTHER_____ X (SPECIFY)	

SECTION 5: OCCUPATIONAL HEALTH

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
14	In the **past 12 months**, have you worked for payment?	YES .....1 NO.....2	–➢15
14A	In the **past 12 months**, have you had any injury or health problem caused by your work?	YES .....1 NO.....2	–➢15
14B	Did you stay away from work because of this injury or problem?	YES .....1 NO.....2	–➢14D
14C	For how many days did you stay away?	NUMBER OF DAYS…… ☐☐	
14D	What was the injury or health problem? WRITE THE ANSWER.	_____ _____ _____ _____	

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
15	CHECK COL 11 AND LAST PAGE OF HOUSEHOLD QUESTIONNAIRE TO SEE IF RESPONDENT IS ELIGIBLE FOR THIS SECTION. CHECK FOR PRESENCE OF OTHERS: **DO NOT CONTINUE UNTIL RESPONDENT IS ALONE**. RESPONDENT ALONE ☐ AND ELIGIBLE FOR Qs. 15A-15I ☐ RESPONDENT NOT ALONE ☐ RESPONDENT NOT ELIGIBLE FOR Qs. 15A-15I ☐		→16 →16
15A	Now I would like to ask you some questions about violence. In the **last 12 months,** has anyone, someone you know or a stranger, physically attacked you in any of the following ways: a) By pushing, shaking or throwing something at you? b) By slapping you or twisting your arm? c) By punching you with their fist or something that could hurt you? d) By kicking or dragging you? e) By trying to strangle or burn you? f) By threatening you with a knife, gun, or other type of weapon? g) By shooting or stabbing you? h) In any other way?	**YES** **NO** a) ..... 1 2 b) ..... 1 2 c)..... 1 2 d) ..... 1 2 e) ..... 1 2 f) ..... 1 2 g) ..... 1 2 h) 1 2	
15B	CHECK 15A: AT LEAST ONE "YES" CIRCLED ☐ NOT ONE SINGLE "YES" CIRCLED ☐		→16
15C	In the **last 12 months**, how many times did this (TYPE OF ATTACK FROM 15A) happen to you? RECORD THE NUMBER OF ALL KINDS OF ATTACK EVENTS IN THE LAST 12 MONTHS.	NUMBER OF TIMES..... ☐☐	
15D	Where were you attacked **the last time** it happened? DO NOT READ ANSWERS TO RESPONDENT.	PUBLIC ROAD .....01 PLACE OF WORK.....02 PLACE OF EDUCATION.....03 CLUB/SHEBEEN/DISCO/BAR .....04 CROWDED VENUE (E.G. SOCCER GAME, CONCERT, ETC.) .....05 HOME.....06 OTHER _____ 96 (SPECIFY)	
15E	As a result of this attack did you have any of the following: a) Aches and pains? b) Bruises or cuts that bled? c) Broken bones or other types of injuries? d) Collapsed or went into a coma?	**YES** **NO** a) ..... 1 2 b) ..... 1 2 c) ..... 1 2 d) 1 2	
15F	CHECK 15E: AT LEAST ONE "YES" CIRCLED ☐ NOT ONE SINGLE "YES" CIRCLED ☐		→16
15G	On the **last occasion** you had (INJURY FROM 15E), did you seek medical attention?	YES .....1 NO 2	→15I
15H	Were you admitted to hospital for more than one day due to injuries from this attack?	YES .....1 NO	

		2	
15I	In your view, did alcohol or drugs contribute to this attack?	YES ……1 NO ……. 2 DON'T KNOW/NOT SURE…… 8	

SECTION 7: MEDICATION

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
16	Now I want to ask you about any medication you take.		
16A	Do you use any medicine regularly or daily that a doctor or nurse has prescribed?	YES .....1 NO.....2 DON'T KNOW.....8	➢17
16B	How many different medicines do you use regularly (more than once a month)?	NUMBER OF MEDICINES…… ☐☐	
16C	Who pays for most of the medication, prescribed by a doctor or nurse, that you use? READ THE ANSWER CATEGORIES TO RESPONDENT.	RESPONDENT.....01 FAMILY.....02 MEDICAL AID.....03 PROVIDED AT CLINIC OR PUBLIC HOSPITAL.....04 EMPLOYER.....05 OTHER_____ 96 (SPECIFY)	

CONTINUE WITH COMPLETING THE CHART ON THE NEXT PAGE. RECORD ALL THE DRUGS MENTIONED AND WHAT THEY ARE TAKEN FOR.

Name of drug	WHAT IS IT FOR? (UNPROMPTED)														OFFICE USE	
	High Blood Pressure	Heart attack or angina	Stroke	High cholesterol or other Blood fats	Diabetes, Blood sugar	Emphysema, Bronchitis	Asthma	Sore joints (arthritis)	Osteoporosis	TB	Epilepsy	Cancer	Don't know	Other	ATC Code	Correct = 1 Incorrect = 2 N/A = 3
	01	02	03	04	05	06	07	08	09	10	11	12	13			
	01	02	03	04	05	06	07	08	09	10	11	12	13			
	01	02	03	04	05	06	07	08	09	10	11	12	13			
	01	02	03	04	05	06	07	08	09	10	11	12	13			
	01	02	03	04	05	06	07	08	09	10	11	12	13			
	01	02	03	04	05	06	07	08	09	10	11	12	13			
	01	02	03	04	05	06	07	08	09	10	11	12	13			
	01	02	03	04	05	06	07	08	09	10	11	12	13			
	01	02	03	04	05	06	07	08	09	10	11	12	13			
	01	02	03	04	05	06	07	08	09	10	11	12	13			
	01	02	03	04	05	06	07	08	09	10	11	12	13			
	01	02	03	04	05	06	07	08	09	10	11	12	13			

SECTION 8: HABITS AND LIFESTYLE

8A: PHYSICAL ACTIVITY

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
17	The next questions are about the time you spend doing different types of physical activities. This includes activities you do **at home, at work, travelling from place to place and during your spare time**. You are requested to answer the questions even if you don't consider yourself to be an active person.		
	Occupation-Related Physical Activity (paid or unpaid work): When answering the following questions, think back over the **past 12 months** and consider (think of) **a usual week**.		
18	Does your work involve mostly sitting or standing still, **OR** walking for very short periods (less than 10 minutes)?	MOSTLY SITTING .....1 MOSTLY STANDING STILL .....2 MOSTLY WALKING FOR VERY SHORT PERIODS.....3 MOSTLY DOING MODERATE/VIGOROUS ACTIVITY.....4 NONE OF THE ABOVE 5	➢21 ➢22A
19A	Does your work involve vigorous activities, (like heavy lifting, digging, or heavy construction) for **at least 10 minutes** at a time?	YES .....1 NO.....2	➢20A
19B	In **a usual week**, how many days do you do vigorous activities as part of your work?	DAYS ..... ☐☐	
19C	On **a usual day** on which you do vigorous activities, how much time do you spend doing such work?	HOURS ..... 1 ☐☐ MINUTES..... 2 ☐☐☐	
20A	Does your work involve moderate-intensity activities (like brisk walking or carrying light loads) for **at least 10 minutes** at a time?	YES .....1 NO.....2	➢21
20B	In **a usual week**, how many days do you do moderate-intensity activities as part of your work?	DAYS ..... ☐☐	
20C	On **a usual day** on which you do moderate-intensity activities, how much time do you spend doing such work?	HOURS ..... 1 ☐☐ MINUTES..... 2 ☐☐☐	
21	How long is your usual workday?	HOURS ..... 1 ☐☐ MINUTES..... 2 ☐☐☐	

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
	Travel-Related Physical Activity: Other than activities that you've already mentioned, I would like to ask you about the way you travel to and from places (to work, to shopping, to market, to church, etc.).		
22A	Do you walk or use a bicycle (pedal cycle) for **at least 10 minutes** at a time to get to and from places?	YES .....1 NO 2	➢23
22B	In **a usual week**, how many days do you walk or cycle for at least 10 minutes to get to and from places?	DAYS ..... ☐☐	
22C	On **a usual day,** how much time do you spend walking or cycling for travel?	HOURS ..... 1 ☐☐ MINUTES ..... 2 ☐☐☐	
	Non-Work Related and Leisure Time Physical Activity: The next questions ask about activities you do in your leisure or spare time, for recreation or fitness**.** Do not include the physical activities you do at work or for travel already mentioned.		
23	In your leisure or spare time do you do any vigorous or moderate-intensity physical activity lasting **more than 10 minutes** at a time?	YES .....1 NO 2	➢26
24A	In your leisure or spare time, do you do any vigorous activities (like running or strenuous sports, weightlifting) for **at least 10 minutes** at a time?	YES .....1 NO 2	➢25A
24B	In **a usual week**, how many days do you do vigorous activities as part of your leisure or spare time?	DAYS ..... ☐☐	
24C	How much time do you spend doing this on **a usual day?**	HOURS ..... 1 ☐☐ MINUTES ..... 2 ☐☐☐	
25A	In your leisure or spare time, do you do any moderate-intensity activities (like brisk walking, cycling or swimming) for **at least 10 minutes** at a time?	YES .....1 NO 2	➢26
25B	In **a usual week**, how many days do you do moderate-intensity activities as part of your leisure or spare time?	DAYS ..... ☐☐	
25C	How much time do you spend doing this on **a usual day?**	HOURS ..... 1 ☐☐ MINUTES ..... 2 ☐☐☐	
	Sitting / Resting Activity: Now I would like to ask you about the time spent sitting or resting, not including sleeping, **in the past 7 days**. This may include time sitting at a desk, visiting friends, reading, or sitting down to watch television **during working hours and leisure or spare time**.		
26	Over the **past 7 days,** how much time did you spend sitting or reclining (lying) on **a usual day (excluding sleeping)?**	HOURS ..... 1 ☐☐ MINUTES ..... 2 ☐☐☐	

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
	Now, I would like to ask you some questions about the foods that you eat. There are no right or wrong answers so please feel free to give us your information as it is.		
27	Which of the following do you **USUALLY** eat? MARK ONE PER COLUMN.		
27A	Chicken/Poultry	WITH SKIN ..... 1 WITHOUT SKIN ..... 2 NONE 3	
27B	Red Meat	FATTY MEAT ..... 1 LEAN MEAT ..... 2 NONE 3	
27C	Spread: (Butter/ Margarine)	BUTTER ..... 1 HARD MARGARINE (BRICK) ..... 2 SOFT MARGARINE (TUB) ..... 3 NONE 4	
27D	Milk/Milk Products in powder form	FULL CREAM ..... 1 2% OR LOW FAT ..... 2 SKIM/FAT FREE ..... 3 BLENDS ..... 4 NONE 5	
28	How often do you **USUALLY** eat the following?		
28A	Fried foods, e.g. chips, fish, potatoes, doughnuts, eggs	OCCASIONALLY/NEVER ..... 1 WEEKLY (AT LEAST ONCE A WEEK) ..... 2 DAILY 3	
28B	Chips, e.g. packet of 'Simba' chips or other salty snacks	OCCASIONALLY/NEVER ..... 1 WEEKLY (AT LEAST ONCE A WEEK) ..... 2 DAILY 3	
28C	Processed meat, e.g. polony, viennas, meat pies, sausage rolls	OCCASIONALLY/NEVER ..... 1 WEEKLY (AT LEAST ONCE A WEEK) ..... 2 DAILY 3	
29	Do you usually eat your food very salty, lightly salted or not salted?	VERY SALTY ..... 1 LIGHTLY SALTED ..... 2 NOT SALTED ..... 3 DON'T KNOW 8	
30	Do you usually add salt or Aromat/Fondor to your serving of food? IF YES, ASK: Before or after tasting the food?	NO, I NEVER ADD SALT/AROMAT ..... 1 YES, BUT I TASTE FIRST AND THEN ADD ..... 2 YES, EVEN BEFORE HAVING TASTED FOOD ..... 3 DON'T KNOW 8	
31	Do you eat salty snacks more often than three times per week (Such as chips, niknaks, salted peanuts, salty biscuits, biltong, dried sausage, dried fish)?	YES ..... 1 NO 2	

	We are interested in how often people eat certain kinds of foods. Now think about your food intake…	
32	During the **PAST 7 days (1 week),** did you eat any of the following? IF YES, ASK HOW OFTEN. IF NO, CIRCLE 'NEVER'. **DO NOT READ ANSWER CATEGORIES TO RESPONDENT.**	

	Food item	NEVER	NOT DAILY		EVERY DAY			CODE
			1-3 TIMES PER WEEK	4-6 TIMES PER WEEK	1 TIME A DAY	2 TIMES A DAY	3+ TIMES A DAY	
A1	Red meat (any type)	0	1	2	3	4	5	
B1	Chicken (any type)	0	1	2	3	4	5	
C1	Tinned fish	0	1	2	3	4	5	
D1	Organ meat, e.g. liver, tripe	0	1	2	3	4	5	
E1	Eggs (any type)	0	1	2	3	4	5	
F1	Milk / yoghurt / maas to drink on cereals	0	1	2	3	4	5	
G1	Milk in tea / coffee	0	1	2	3	4	5	
H1	Cheese (except cottage cheese)	0	1	2	3	4	5	
I1	Legumes, e.g. baked beans, lentils	0	1	2	3	4	5	
J1	Peanuts and nuts	0	1	2	3	4	5	
K1	Brown / whole wheat bread or rolls	0	1	2	3	4	5	
L1	Breakfast cereal (instant, not cooked)	0	1	2	3	4	5	
M1	Oat-porridge	0	1	2	3	4	5	
N1	Soft margarine (tub)	0	1	2	3	4	5	
O1	Broccoli, cauliflower, Brussels sprouts	0	1	2	3	4	5	
P1	Spinach and/or morogo	0	1	2	3	4	5	
Q1	Carrots	0	1	2	3	4	5	
R1	Tomato (raw / cooked)	0	1	2	3	4	5	
S1	Green peas	0	1	2	3	4	5	
T1	Green beans	0	1	2	3	4	5	
U1	Mixed vegetables	0	1	2	3	4	5	
V1	Pumpkin / butternut	0	1	2	3	4	5	
W1	Sweet potato	0	1	2	3	4	5	
X1	Potato (any preparation)	0	1	2	3	4	5	
Y1	Citrus fruit, e.g. orange, grape fruit	0	1	2	3	4	5	
Z1	Pure orange / guava juice (not others) (sweetened/unsweetend)	0	1	2	3	4	5	
A2	Bananas	0	1	2	3	4	5	
B2	Mangoes	0	1	2	3	4	5	
C2	Apples / pears	0	1	2	3	4	5	
D2	Avocado	0	1	2	3	4	5	

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
33A	Do you **currently smoke** any tobacco products, such as cigarettes, cigars, or pipes?	YES .....1 NO.....2	–➢36
33B	Do you currently smoke tobacco products **daily**?	YES .....1 NO.....2	–➢36
34A	**How old** were you when you first **started** smoking daily?	YEARS OLD…… ☐☐ DON'T REMEMBER/NOT SURE.....98	–➢35
34B	Do you remember how long ago it was when you first **started** to smoke daily?	WEEKS AGO……1 ☐☐ MONTHS AGO……2 ☐☐ YEARS AGO……3 ☐☐	
35	On average, how many of the following items do you smoke each day? Manufactured cigarettes? Hand-rolled cigarettes? Pipes full of tobacco? Cigars/Cheroots/Cigarillos? IF NONE, RECORD '00'.	MANUFACTURED CIGARETTES…… ☐☐ HAND-ROLLED CIGARETTES…… ☐☐ PIPES FULL OF TOBACCO…… ☐☐ CIGARS/CHEROOTS/CIGARILLOS…… ☐☐	–➢38A
36	**In the past,** did you ever smoke daily?	YES .....1 NO.....2	–➢38A
37A	**How old** were you when you **stopped** smoking daily?	YEARS OLD…… ☐☐ DON'T REMEMBER/NOT SURE.....98	–➢38A
37B	Do you remember how long ago it was when you **stopped** smoking daily?	WEEKS AGO……1 ☐☐ MONTHS AGO……2 ☐☐ YEARS AGO……3 ☐☐	

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
38A	Do you **currently use any** smokeless tobacco, such as snuff or chewing tobacco?	YES .....1 NO.....2	➢40
38B	Do you currently use smokeless tobacco **daily**?	YES .....1 NO.....2	➢40
39	On average, how many times do you use each of the following items per day? Snuff (by mouth)? Snuff (by nose)? Chewing tobacco? IF NONE, RECORD '00'.	SNUFF (BY MOUTH)…… ☐☐ SNUFF (BY NOSE)…… ☐☐ CHEWING TOBACCO…… ☐☐	➢41
40	**In the past,** did you ever use smokeless tobacco, such as snuff or chewing tobacco daily?	YES .....1 NO.....2	
41A	Do you live in a house where other people smoke cigarettes regularly?	YES .....1 NO.....2	
41B	Do you currently work in a job where other people smoke cigarettes around you?	YES .....1 NO.....2	
41C	Have you ever worked in a job where you were regularly exposed to smoke, dust, fumes or strong smells?	YES .....1 NO.....2	➢42A
41D	How long did you work in that job? IF LESS THAN 1 YEAR, WRITE '00''.	YEARS…… ☐☐	

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
42A	Have you **ever consumed** a drink that contains alcohol such as beer, wine, spirits or sorghum beer?	YES .....1 NO.....2	–➢46
42B	Was this within the **past 12 months**?	YES .....1 NO.....2	–➢46
43	In the **past 12 months**, **how frequently** have you had at least one drink? READ ANSWER CATEGORIES TO RESPONDENT. USE SHOWCARD.	5 OR MORE DAYS A WEEK .....1 1-4 DAYS PER WEEK .....2 1-3 DAYS A MONTH.....3 LESS THAN ONCE A MONTH 4	
44A	When you drink alcohol, **on average,** how many drinks do you have during one day?	DRINKS…… ☐☐ DON'T KNOW.....98	
44B	During the **past 7 days**, how many standard drinks of any alcoholic drink did you have each day? RECORD FOR EACH DAY. USE SHOWCARD. IF NONE, RECORD '00'.	MONDAY…… ☐☐ TUESDAY…… ☐☐ WEDNESDAY…… ☐☐ THURSDAY…… ☐☐ FRIDAY…… ☐☐ SATURDAY…… ☐☐ SUNDAY…… ☐☐	
45A	Have you ever felt that you should cut down on your drinking?	YES .....1 NO.....2	
45B	Have people annoyed you by criticizing your drinking?	YES .....1 NO.....2	
45C	Have you ever felt bad or guilty about your drinking?	YES .....1 NO.....2	
45D	Have you ever had a drink first thing in the morning to steady your nerves or get rid of a hangover?	YES .....1 NO.....2	
46	How old were you at your last birthday?	AGE IN COMPLETED YEARS…… ☐☐ DON'T KNOW.....98	
47	Which population group do you consider yourself?	BLACK/AFRICAN .....1 COLOURED.....2 WHITE .....3 ASIAN/INDIAN .....4 NO REPLY/NOT SURE 8	

ADULT DEMOGRAPHIC AND HEALTH SURVEY
ANTHROPOMETRIC DATA SHEET

48	DATE	d d m m y y y y 2 0 0
49	FIELDWORKER NUMBER	
50	WEIGHT (KG)	
51	HEIGHT (CM)	
53	WAIST CIRCUMFERENCE (CM)	
54	HIP CIRCUMFERENCE (CM)	
55	SYSTOLIC BLOOD PRESSURE 1	
56	DIASTOLIC BLOOD PRESSURE 1	
57	PULSE 1	
58	SYSTOLIC BLOOD PRESSURE 2	
59	DIASTOLIC BLOOD PRESSURE 2	
60	PULSE 2	
61	SYSTOLIC BLOOD PRESSURE 3	
62	DIASTOLIC BLOOD PRESSURE 3	
63	PULSE 3	
64	PEAK EXPIRATORY FLOW RATE (1)	
	(2)	