Demographic, socio-economic, and the lifestyle risk factor of cigarette smoking associated with asthma in South African adults in 2017.

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Declaration

I, Tanuja Singh, declare that:

1. The research reported in this dissertation, except where otherwise specified, is my original research.

2. This dissertation has not been submitted for any other degree or examination at any other university.

3. This dissertation does not contain other persons' data, figures, tables or other information, unless specifically acknowledged as being sourced from other persons.

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Abstract

The current study aimed to explore demographic factors, socio-economic factors and modifiable risk factors, mainly cigarette smoking, and the influence they had on asthma among South African adults in the year 2017. The general objective of the study was to determine the relationship of these factors on asthma and the prevalence of asthma and cigarette smoking in 2017. The study used the theoretical framework in the context of the World Health Organization's Commission on Social Determinants of Health.

The study was a quantitative research design that used the National Income Dynamics Survey dataset, wave 5 conducted in 2017 in South Africa. A sample of 15750 (aged 15-65) was used in this study, with 623 asthma diagnoses. The dependent variable was asthma and the independent variables were cigarette smoking, gender, age, race, marital status, employment status, geographic area, education attainment and household with per capita income.

The results of the study confirmed significant associations between race, geographical area, education attainment and asthma. Coloureds and Whites were more likely to be diagnosed with asthma. Those residing in urban areas were more likely than those living in rural areas to have a asthma diagnosis. Those who attended Grade 10-11 and those with no matric were less likely to report been diagnosed with asthma. It was discovered that those who had a higher socio-economic standing may be less likely to have been diagnosed with asthma.

Asthma is a major burden globally and has made its mark in South Africa. Controlling risk factors, along with the demographic and socio-economic risk factors will only help alleviate the exacerbations of the disease. Policies and health strategies have been put into place and should be practices on the daily to further treat and manage asthma. More studies on asthma should create an additional awareness and understanding of this non-communicable disease.

Key terms: risk factor, cigarette smoking, asthma, adults, socio-economic, demographic, smoker's behaviour, South Africa.

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Acronyms

AIDS	Acquired immunodeficiency syndrome
CI	Confidence Interval
CSDH	Commission on Social Determinants of Health
DALYs	Disability Adjusted Life Years
DHS	Demographic and Health Survey
DPME	Department of Planning, Monitoring and Evaluation
GBD	Global burden of disease
GDP	Gross domestic product
GHS	General Household Survey
GINA	Global Initiative for Asthma
HIV	Human immunodeficiency virus
HSSREC	Humanities and Social Sciences Research Ethics Committee
NHOPI	Native Hawaiian/Other Pacific Islanders
NIDS	National Income Dynamics Study
SA	South Africa
SDOH	Social determinants of health
SES	Socio-economic status
SSA	sub-Saharan Africa
SSD	Sample survey data
Stats SA	Statistics South Africa
UK	United Kingdom
US	United States
WHO	World Health Organization

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CHAPTER 1

INTRODUCTION

1.1) Introduction

The chapter begins with the background to the study followed by the aim, objectives and research questions for the study. It also includes the theoretical framework and structure of the study and is concluded by a summary.

1.2) Background to the study

Asthma is well-known as a chronic disorder of the airways that is multifaceted and defined by various and recurrent symptoms, such as airflow obstruction, and respiratory hyper-responsiveness inflammation (Anum, 2015). Apparent key features of asthma are the variations of an individual's airways caused by countless factors; such as allergens, respiratory viruses, tobacco smoke and occupational exposures such as dust and dampness. These various factors are associated with the development of airway inflammation (Anum, 2015).

The economic burden of asthma is the product of its prevalence (The Global Asthma Report, 2018). The disease causes lost school and work days, limits in daily routines and sleep apnea (Kant, 2013). Decreases in lung function results in decreased quality of life unless asthma control is attained, and a high annual financial burden is acquired (Kant, 2013). "Globally, asthma is ranked 16th among the leading causes of years lived with disability and 28th among the leading causes of burden of disease, as measured by disability adjusted life years (DALYs)" (The Global Asthma Report, 2018, p 6).

South Africa (SA) is classified 25th worldwide for asthma prevalence and is ranked 5th for asthma mortality, with a projected 18.5 deaths per 100,000 asthma cases (The Global Asthma Report, 2018). Hence, despite significant decreases in mortality over the past decade, mortality rates in South Africa continues being the highest in the world cases (The Global Asthma Report, 2018). The absence of proper diagnosis, treatment or access to care may be important to reflect on when it comes to undertaking asthma indisposition and mortality in South Africa cases (The Global Asthma Report, 2018).

"In South Africa, where the burden of respiratory diseases such as pneumonia, tuberculosis and HIV-associated lung disease is well known, the burden of asthma is under-appreciated" (Schellack, Truter and Ntuli, 2017, p 37). Asthma is the eighth leading contributor to the burden of disease in SA and is the second most important chronic disease after HIV and AIDS (human immunodeficiency virus, acquired immunodeficiency syndrome) (Schellack *et al*., 2017).

While differences exist between demographic subgroups (race, gender, age), there has been an increase in the prevalence of asthma across all populations (Ibrahim, 2013). For example, in 2010, asthma had been the most prevalent amongst females (9.7%) than males (5.7%) globally (Ibrahim, 2013). The prevalence rates of asthma continue to grow significantly in Africa, with SA being the highest (Anum, 2015).

Asthma-related deaths are more common in low- and middle-income countries, such as South Africa. This is because patients from low- and middle-income countries experience more severe symptoms than those in high-income countries, possibly because of incorrect and delayed diagnoses, poor access to health care amenities, expensive therapy, greater exposure to environmental aggravations and predisposition to other chronic illnesses (Kant, 2013). Socio-economic status (SES) also influences the accessibility, affordability, acceptability and actual utilization of various available health facilities, states Kant (2013). In contrast, developed countries with a high gross domestic product (GDP) can afford quality health care systems, and asthma related mortality was lower (Sinharoy, Mitra and Mondal, 2018).

Globally, the use of tobacco is among the chief causes of premature mortality (Reddy, James, Sewpaul, Yach, Resnicaw, Sifunda, Mthembu and Mbewu, 2013). The health impact of tobacco use is found in low- and middle-income countries such as SA (Reddy, James, Sewpaul, Yach, Resnicaw, Sifunda, Mthembu and Mbewu, 2013). One of the health impacts of tobacco use is asthma. Cigarette smoking is a lifestyle risk factor of asthma, and a significant number of asthmatics are smokers (Chatkin and Dullius, 2016). Asthma affects approximately 300 million people globally and is accountable for 250 000 deaths annually (Chatkin and Dullius, 2016).

Smoking, as one of the risk factors used in this research, plays a role in the development of asthma and its symptoms (Ibrahim, 2013). Thus, cigarette smoking is a key environmental and lifestyle trigger of asthma (Ibrahim, 2013). In SA, despite advanced decreases in asthma prevalence over the last few decades, asthma mortality remains high (Anum, 2015).

Although communicable diseases remain a major public health problem, certain non-communicable diseases together with asthma are progressively known as contributing significantly to the global burden of disease (GBD) (Anum, 2015).

Science has not found a cure for asthma since the causes are not well understood since there are multiple factors contributing to this disease. These factors play a role in the progress and worsening of asthma symptoms (Ibrahim, 2013). However, the rise in asthma prevalence in recent years are attributed to cigarette smoking. Although it is known that smoking aggravates asthma symptoms, a higher percentage of adults with asthma smoke in comparison to the percentage of adults without asthma that smoke (Ibrahim, 2013).

The combination asthma and active cigarette smoking results in more apparent asthma symptoms and a rapid decline in lung function (Ibrahim, 2013). Over the last decade, the prevalence of smoking reduced worldwide because of effective anti-smoking movements, hence the prevalence of asthma, attributable to cigarette smoking, is gradually decreasing (Sinharoy *et al.,* 2018). Although, the number of affected individuals with asthma is prophesied to rise to 400 million by the year 2025 (Ahmed, Robinson and Mortimer, 2017).

1.3) Introduction to the study

The study aims to investigate the associations that demographic, socio-economic and lifestyle factors, specifically cigarette smoking, has on asthmatic prevalence in adults across SA in 2017. An analysis of data using wave 5 from the National Income Dynamics Study 2017 (National Income Dynamics Study, 2017) will be used to investigate these associations mentioned. Statistically, between 6 to 10 percent of adults in SA have asthma (Statistics South Africa, 2018). According to NIDS, in 2017, 33.23% of SA's population has asthma and 2.65% were diagnosed with asthma in 2017 (National Income Dynamics Study, 2017). This study is investigated using the World Health Organization's (WHO) Commission on Social Determinants of Health (CSDH). The social determinants will be related to health outcomes of smoking such as asthma, demographic factors, socio-economic status and health status factors (Ebell, Marchello and O'connor, 2017).

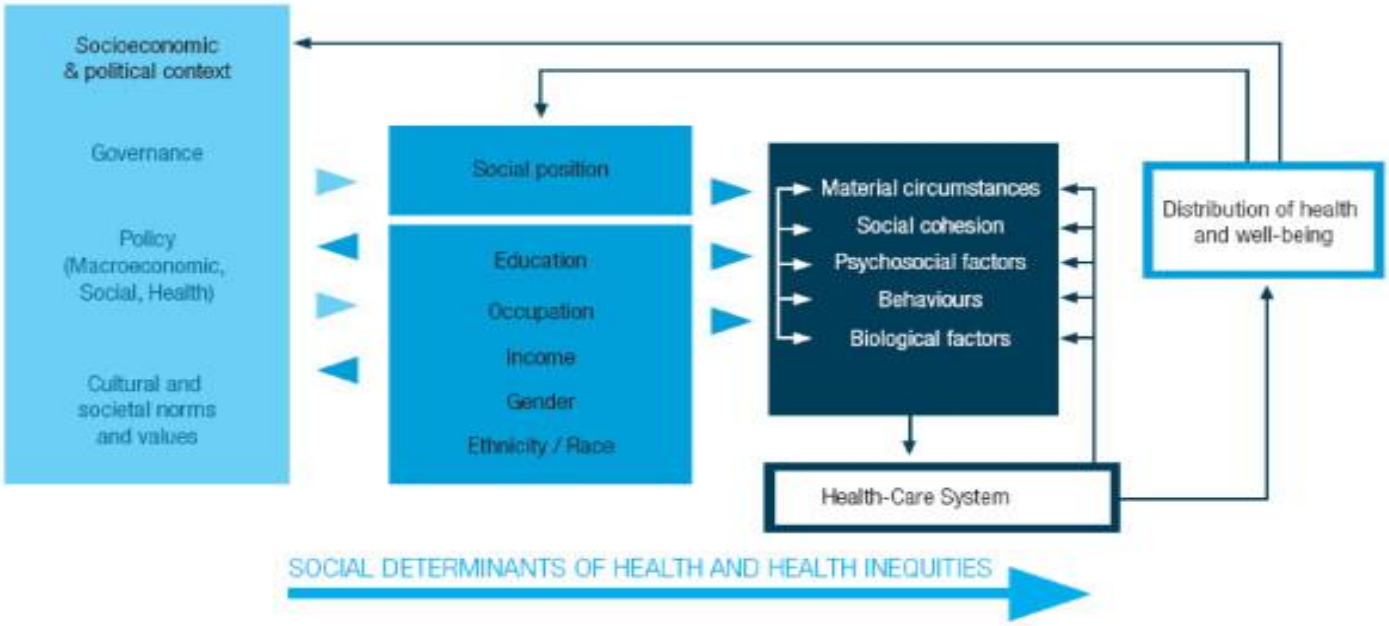
1.4) Theoretical Framework

The range of personal, social, economic, and environmental factors that influence health status are known as determinants of health. The theoretical framework used for this study will be in the context of the World Health Organization's (WHO) Commission on Social Determinants of Health (CSDH). The social determinants will be related to health outcomes of smoking such as asthma, one's gender, race, employment status and health status. This theory suggests cigarette smoking is an intermediary determinant which includes material conditions such as living and working conditions and behavioral factors (Ebell *et al.*, 2017). A person's behavior plays an important role in health outcomes. For example, if an individual quits smoking, their risk of developing asthma is significantly reduced.

Social determinants of health (SDOH) are the conditions wherein individuals are born, raised, living environments, their work and their age, states WHO (Marshall, 2012). Literature on the social determinants defines a commonly reported component, which is identified as socioeconomic determinants (Marshall, 2012). These components are age, gender and education (Marshall, 2012). These components will be recurring factors in this study. These socioeconomic components (age, gender and education) are related to one's health and welfare (Marshall, 2012).

Social conditions are fundamental causes of disease (Farrants and Kristin, 2016). Though a disease or the risk factors for a disease may be of biological origin, it is the social construction that ultimately determines who are and who are not exposed to diseases and the risk factors thereof (Farrants and Kristin, 2016). Therefore, the association between SES and health remains even when disease prevalence and risk factors change (Farrants and Kristin, 2016). The study's focus identifies several determinants of health pertaining to asthma, namely education, housing, employment, income and gender. Certain SDOH may be intermediate, for example, the type of housing people inhabit may well determine their level of exposure to mould, contagions and pollution that then effect their health status (Parry, 2011).

Figure 1 Diagram of the Commission on Social Determinants of Health



Source: adapted from the World Health Organization, 2008, p. 43 (WHO, 2008)

The above diagram demonstrates the multifaceted social interpretation of health. Since it is a complex one, the study focuses on education, occupation, income, gender and race. Such structures influence and determine a person's health status (Parry, 2011). Addressing health using the CSDH model "embraces the social changes… needed to be addressed to improve health outcomes for the population" (Parry, 2011, p 18). These social factors understand the multifaceted combination of socioeconomic impacts on health (Parry, 2011). Rather than the SDOH being regarded as isolated contributing factors, other influences like taxation policies influence SDOH and health outcomes (Parry, 2011).

Income is an indicator of SES, measuring the amount of money a family has, to consume goods and services (Parry, 2011). Income has a linear relationship with health, since income helps to improve health outcomes. People in lower income quintiles have a higher rate of chronic illnesses as opposed to people in higher income quintiles (Parry, 2011). Occupation is a refection of a family's income and social standing built on employment (Parry, 2011). Occupation highlights the exposure to risk factors, level of education, housing and income (Parry, 2011). Education as an SDOH influences health outcomes that depend on levels of education.

Gender is a social construct, therefore intercedes health (Parry, 2011). Women have less access to healthcare, income, employment, housing and education. These have implications for a woman's quality of life and health status (Parry, 2011). Like gender, race is also a social construct. Race as an SDOH influences one's social ranking, resulting in either favorable or unfavorable health outcomes.

Asthma is a serious chronic health condition which certain social determinants affect the prevalence of this disease. There are associations between these social determinants such as income, age, sex, geography, employment and risk factors that increase the prevalence of asthma (Ebell *et al.,* 2017). Innumerable social determinants affect the burden of asthma that may be disproportionate to women (Ebell *et al*., 2017). These include tobacco use, smoking behavior, household air pollution, SES and rurality (Ebell *et al*., 2017). These factors influence the prevalence of asthma and its complications. Positive changes in an individual's behavior reduces the rates of chronic illness worldwide.

Action on the SDOH is mandatory to reduce health inequalities (Donkin, Goldblatt, Allen, Nathanson and Marmot, 2018). It is evident that there is widespread support for an SDH approach globally, from worldwide political assurance to within country action (Donkin *et al*., 2018). Measuring progress on the SDOH globally will be important to future development of successful policies and implementation plans of smoking. WHO works to bring into line the actions with the sustainable development goals that helps to advance progress measurement (Donkin *et al.*, 2018). There is commitment and action at national and local level to improve the social determinants of health.

In this study, SDOH are noteworthy as these notions offer a means of understanding variances in health outcomes for the different population groups (Parry, 2011). Additionally, SDOH outlines the various factors in society by creating a theoretical framework that allows for social change and favorable health outcomes (Parry, 2011). SDOH also provides "an accessible framework for exploring differences in health" among them population (Parry, 2011, p 28).

1.5) Research Aim and Objectives

The aim of this study is to explore the Demographic, socio-economic, and the lifestyle risk factor of cigarette smoking associated with asthma in South African adults in 2017. Cigarette smoking is further explored as the lifestyle risk factor associated with asthma. The main objectives in the study are:

1. To report on the prevalence of asthma in adults in 2017 in South Africa.
2. To investigate the association of cigarette smoking with asthma in adults.
3. To investigate the association of demographic factors with asthma in adults.
4. To investigate the association of socio-economic factors with asthma in adults.
5. To investigate the association of cigarette smoking with asthma, controlling for significant demographic and socio-economic factors.

The present study aims to answer the following research questions that are directly correlated to the objectives:

Objective 1:

What was the prevalence of reported asthma among adults?

Objective 2:
Was asthma significantly more in particular geographic areas or among particular race, gender, age and marital groups?

Objective 3:
Was asthma significantly more likely among those who were less educated, unemployed or from poorer households?

Objective 4:
Was asthma significantly more likely among those who smoked cigarettes?

Objective 5:
What was the association of cigarette smoking to asthma, when controlling for demographic and socioeconomic factors?

1.6) Structure of the study

Chapter 1- Introduction:

This chapter introduces the fundamentals of the study and the background to the study, the aim, objectives, research questions and theoretical framework.

Chapter 2- Literature Review:

This chapter explores research that has been reviewed in the past which relates to the topic, therefore, making the study more enlightening.

Chapter 3- Research Methodology:

This chapter describes the method of research, variables used in the analysis and the data analysis method of this research study.

Chapter 4- Results:

This chapter presents the results of the research in much detail in the form of tables and graphs.

Chapter 5- Discussion and Conclusion:

This chapter discusses the results of the study in the context of the existing literature. This chapter also includes limitations and recommendations for future research. Finally, the conclusion is drawn from the present-day study.

1.7) Summary

This chapter gave a background to the research study and introduced the topic. The research aim, objectives and research questions were visibly stated. The chapter also explained the theoretical framework that is supported by a diagram, structure and division of the chapters that this research study comprises of.

CHAPTER 2

LITERATURE REVIEW

2.1) Introduction

The purpose of this chapter is to provide an overview of general academic literature on demographic, socio-economic, and the lifestyle risk factor of cigarette smoking associated with asthma among adults in South Africa. This chapter begins with discussing the prevalence of asthma among adults worldwide, and the relationship between smoking and asthma. The association of cigarette smoking as a lifestyle risk factor associated with asthma will be deliberated along with the significant demographic and socio-economic factors. The demographic factors are race, gender, age, and marital status. Thereafter, the association of socio-economic factors with asthma will be acknowledged. The socio-economic factors used in this study are geographic area, education attainment, employment status, and household income.

2.2) Prevalence of reported asthma among adults

The Global Initiative for Asthma (GINA) approximates there will be an added 100 million people diagnosed with asthma by the year 2025 (Loftus and Wise, 2016). Even though asthma affects people of all ages and socioeconomic levels and exists in populations of all countries, the prevalence of asthma is unequally distributed (Mauban, 2016). Asthma seems to be more common among those with a lower SES in high income, westernized countries (Mauban, 2016, p 3).

In a developed country like the United States (US), the prevalence of asthma is seen as the highest rate compared to other countries worldwide (Mauban, 2016). Recent reports in US documents the prevalence of asthma to be 8.2% among current asthmatics in all age groups (Loftus and Wise, 2016). However, it was reported as 7.4% among the adults (Chaudhary, Kapagunta and Datt, 2016). Other developed countries like the United Kingdom (UK) and Australia display a high prevalence of asthma (as high as 36.6%) (Mauban, 2016).

The prevalence of asthma has increased significantly over the last five decades (Patel, Henderson, Jeffreys, Smith and Galobardes, 2012), In SA and globally (Loftus and Wise, 2016). The prevalence of asthma can vary by certain modifiable (weight and smoking status) and non-modifiable (race and age) risk factors (Zhang, Morrison-Carpenter, Holt and Callahan, 2013).

More of these factors include income, education level and geographic area (Furman, 2007). People with lower levels of education and lower incomes, irrespective of their race, have been reported to experience more symptoms of asthma (Furman, 2007). Residing in urban settings is an imperative risk factor for asthma but may be more influenced by socioeconomic status (SES) or race rather than residence (Furman, 2007).

In India, very few national studies have been conducted on asthma prevalence and risk factors among adults (Agrawal, Pearce and Ebrahim, 2013). However, the little evidence from studies provides a unique opportunity to learn the prevalence of asthma based on social, environmental, lifestyle and dietary determinants (Agrawal *et al*., 2013). Certain studies show a substantial difference of asthma prevalence between the Indian states (Agrawal *et al*., 2013). Probable reasonings for these differences are that north-eastern Indian states have a very high prevalence of smoking and alcohol consumption (Agrawal *et al.*, 2013). In Tripura, a study reported malnutrition as associated with high rates of respiratory problems in the adult population (Agrawal *et al*., 2013).

A study of the prevalence of asthma in sub-Saharan Africa (SSA) presented a constant increase, predominantly in urbanized regions (van Gemert, 2017). There was a wide variation of 5.7 -20.3%, with the highest prevalence among 'westernized' urban areas (van Gemert, 2017). In SSA, asthma has become an increased burden owing to tobacco smoking and exposure to biomass fuels (van Gemert, 2017). Asthma appears to be more severe in SSA than in affluent countries, even though the latter have the highest prevalence of asthma symptoms (van Gemert, 2017). The prevalence of asthma is the highest in urban countries that have become westernized with time (van Gemert, 2017). However, with the expected increase in urbanization in SSA, it is projected that there may be a rise of no less than 35% of people with asthma in the year 2025 (van Gemert, 2017).

2.3) The association of cigarette smoking with asthma in adults

"Active cigarette smoking has been associated with the development of asthma in some, but not all studies" (Thomson, Chaudhuri and Livingston, 2004, p 822). In a research of risk factors associated with asthma and the onset of cigarette smoking, asthma that developed before starting smoking had an association with atopy, while asthma that developed subsequently initiating smoking was associated with a lower forced expiratory volume in one second (Thomson *et al.*,

2004). Asthma-related morbidity and mortality from asthma are increased in persons who smoke cigarettes. Asthmatic smokers have particularly severe asthmatic symptoms, greater dependence for rescue medication and a poorer health status (Thomson *et al.*, 2004).

A study in rural India was conducted to study the association of active tobacco smoking and respiratory asthma (Parasuramalu, Huliraj, Rudraprasad, Kumar and Masthi, 2010). The prevalence of asthma was reported higher among current smokers who are both men and women (Parasuramalu *et al.,* 2010). A Scandinavian study hypothesizes that cigarette smoking is a risk factor for asthma (Parasuramalu *et al.*, 2010). Parasuramalu and the co-authors evidently suggested that tobacco smoking is a major risk factor for respiratory asthma (Parasuramalu *et al.*, 2010). This augments the need to create cognizance concerning the risks of tobacco smoking which can support the reduction of asthma prevalence (Parasuramalu *et al.*, 2010).

A study by Moazed and Calfee (2015) has acknowledged an association between cigarette smoke and asthma exacerbations in adults, nevertheless, whether cigarette smoke is related to the development of new incidences of adult-onset asthma is not as clear (Moazed and Calfee, 2015). Understanding and enumerating the association between cigarette smoke and incidences of asthma has momentous inferences for public health (Moazed and Calfee, 2015). Signifying the strength of this association has an indistinct and important outcome on tobacco product regulation and on the evaluation of the global burden of disease and health expenses related to tobacco products (Moazed and Calfee, 2015).

Individuals might assume asthmatics would avoid smoking as it can aggravate asthmatic symptoms (Hublet, Bacquer, Boyce, Godeau, Vereecken, Baets and Maes, 2007). Researchers discover that many adults participate in health risk behavior such as smoking because they do not believe they are at risk from their smoking behavior (Thomson *et al.*, 2004 and Hublet, *et al.*, 2007). Individuals might assume asthmatics would avoid smoking as it can aggravate asthmatic symptoms (Hublet *et al.,* 2007). The researchers find that among adults, asthmatic patients are likely to quit or continue smoking, but under moderation (Hublet *et al.*, 2007). Even though quitting smoking can improve asthmatic symptoms and lung function, the low rates of smoking cessation points out the need for enhanced policies for asthma management (Polosa and Thomson, 2013).

These researchers state that strategies, for smoking, are applied because there is a great fraction of asthmatics who smoke (Chatkin and Dullius, 2016). Clinicians are confronted with challenges to control asthma in smokers and to present coping methods and smoking treatments to circumvent relapses (Chatkin and Dullius, 2016). Chatkin and Dullius discover unmet needs to improve smoking cessation schemes for asthmatics (Chatkin and Dullius, 2016). Strategic treatment campaigns are vital to support those who are incapable to and do not want to quit smoking (Chatkin and Dullius, 2016). Schemas must also be implemented for asthmatics who choose to quit smoking (Chatkin and Dullius, 2016).

2.4) The association of cigarette smoking with asthma, controlling for significant demographic and socio-economic factors

Previously, it was discussed how demographic and socio-economic factors have been associated with asthma. Using those same factors, the association of cigarette smoking with asthma, controlling for significant demographic and socio-economic factors will be elucidated. People of low SES are more likely to be unhealthier than those of higher SES, hence increasing their risk of NCDs like asthma and accelerating other diseases (Sahan, Gunay, Simsek, Soysal and Ergor, 2018).

Masindi, a district if Uganda, is a tobacco-growing area where most men and elderly women smoke tobacco (van Gemert, 2017). It is their culture to smoke tobacco daily (van Gemert, 2017). Men, who could afford it, would smoke cigarettes as they believed it was the safer option (van Gemert, 2017). However, men would start having a chronic cough, a symptom linked to asthma (van Gemert, 2017). Men smoked indoors in the company of children and their wives, exposing their families to tobacco smoke (van Gemert, 2017).

Most adults in the district was exposed to tobacco smoke for more than 30 years, increasing their risk of asthma (van Gemert, 2017). Societal roles are mainly determined by gender, resulting in women becoming more exposed to cigarette smoke, starting at young age (van Gemert, 2017). Growing tobacco in Masindi is the main source of income, henceforth is accessible without difficulty, resulting in a high smoking prevalence (van Gemert, 2017).

On a social basis, smoking is more socially acceptable among the male population than the female population (Reddy *et al*., 2015). In South African communities, men have more disposable incomes than women to purchase cigarettes (Reddy *et al.*, 2015). Although the prevalence of smoking is equivalent among males across countries, "the female smoking rate is diverse and is greatly influenced by cultural backgrounds of that society" (Sinharoy *et al*., 2018, p.2).

Research shows that tobacco use is often introduced and established through adolescence and young adulthood, with almost 90% smokers starting the habit by the age of 18 years (Reddy *et al.*, 2015). Typically, between the ages of 20-21, smokers become regular or daily smokers (Hammond, 2005). Young adults are, to some extent, dissimilar from older smokers (Hammond, 2005). Young adults tend to smoke occasionally, smoke fewer cigarettes and smoke their first cigarette much later in the day (Hammond, 2005). This reveals that the consumption of cigarettes in a day increases over the age of 29 (Hammond, 2005). As consumption continues to rise after age 44, tolerance of smoking is often recognized (Hammond, 2005).

SA is a developing economy that is experiencing rapid socio-economic and sociocultural transitions (Reddy *et al.*, 2013). Economically, in SA, smoking is the most widespread among the poorly educated, urban men and women who have low incomes (Reddy *et al.*, 2015). These are the social and demographic groups more prone to asthma. Over the last decade, the prevalence of smoking reduced worldwide because of effective anti-smoking movements (Sinharoy *et al.*, 2018).

However, tobacco use is still significantly high in poorer societies, exacerbating the prevalence of asthma. Single participants in both rural and urban settings are more likely to use tobacco products, increasing the risk of asthma (Kant, 2013). Though research has shown a global downward trend in levels of smoking in SA in the recent years, there is a limited number of statistics available on smoking patterns at disaggregated household levels (Teare, Naicker, Albers and Mathee, 2018). This is particularly relevant to the fast-changing urban setting in SA, where cities for instance Johannesburg have seen rapid development associated with urbanization (Teare *et al.*, 2018).

A study in Johannesburg states that age, gender, race and socio-economic status are amid the factors in association with smoking prevalence (Teare *et al.*, 2018). There seems to be a contrary association between one's social status and smoking, in that approximately 82% of the world's smokers are living in low- and middle-income countries (Teare *et al.*, 2018). In SA, the most recurrent tobacco users have been recognized as poor men and women with low levels of education

attainment, low income levels and staying in urban areas (Teare *et al.*, 2018). In low and middle-income countries, rate of smoking increases as economies progress, but is still associated to poverty and low levels of education (van Gemert, 2017).

Those with less education and less income are more likely to smoke, exacerbating asthma-related symptoms and lung function (Adler and Newman, 2002). Neither education nor income is associated with smoking onset, however, the more educated are more likely to try to quit, and among those who try to quit, those with higher incomes are more likely to succeed (Adler and Newman, 2002). The success in quitting smoking reduces the severity of asthma, if those are currently asthmatic.

Those who do not have asthma lessens their likelihood when they quit smoking. This suggests that efforts encouraging quitting need to be geared more strongly toward those with less education attainment (Adler and Newman, 2002). The means of quitting also needs to be made more reachable to those with lower incomes (Adler and Newman, 2002). Higher taxes on cigarettes, as a resultant to higher cigarette prices, can reduce consumption and the onset of asthma (Adler and Newman, 2002).

2.5) The association of demographic factors with asthma in adults

2.5.1) Race

The apparent racial and ethnic differences in the prevalence of asthma reflect underlying hereditary variations such as where one resides but also significant inequalities in socioeconomic and environmental conditions of different race groups (Kant, 2013). Studies in the US, and other countries, are undertaken to demonstrate racial gradients for asthma consequences among adults (Bhan, Kawachi, Glymour and Subramanian, 2015). Certain racial or ethnic minorities are at a greater risk for disease (Bhan *et al.*, 2015). Racial disparities in income and standards of living influences one's exposure to environmental allergens in and out of households (Bhan *et al*., 2015). Within certain racial households, one may have a greater chance of household air pollution that increases their chances of becoming asthmatic because of racial inequalities (Bhan *et al.,* 2015).

Race, together with SES, may influence asthma through exposures to environmental allergens. The increases in the prevalence of asthma in the US has been attributed to low SES and racial inequality, especially in the non-Hispanic Black and Hispanic populations (Bhan *et al*., 2015).

In the US, current asthma prevalence is higher in black persons (11.2%) than in white persons (7.7%) and is highest in the Puerto Rican population (17.0%) and lowest in the Mexican-American population (3.9%), states Loftus and Wise (2016). These groups tend to have a low income and have a habit of viewing this health condition as unimportant in comparison to other day-to-day struggles such as safeguarding food and shelter (Mauban, 2016).

Hawaii is racially diverse, with a demographic composition that is unique in the US (Jessop, Li, Katz and Hurwitz, 2019). Hawaii has the largest proportion in the nation of Native Hawaiian/Other Pacific Islanders (NHOPI) and those who identify as Asians (Jessop *et al.,* 2019). Between the predominant racial groups in Hawaii, those identifying as NHOPI had the highest crude asthma prevalence approximations for both lifetime (20.9%) and current (12.2%) asthma (Jessop *et al*., 2019). The subpopulation of NHOPI has noticeably high proportions of modifiable risk factors associated with asthma, which includes lower SES, smoking, and obesity (Jessop et al., 2019).

The overall lifetime asthma prevalence approximations were not noticeably different between Asians (13.3%), Whites (14.0%), and those of another race (14.7%) (Jessop *et al*., 2019). However, Asians had the lowest current asthma prevalence (6.6%), while current asthma prevalence approximations were alike among Whites (8.1%) or individuals of another race (8.2%) (Jessop *et al.,* 2019). This may be partly explained by data from the Asian subpopulation which reported remarkably low proportions of known asthma modifiable risk factors such as smoking and obesity (Jessop *et al*., 2019).

SA is also known for its economically and racially segregated communities. People living in such communities, similarly to the US, face extreme stressors, including poverty, substandard housing, malnourishment and lack of health care (Uwanaka, 2014). These social stressors can harm people's capability to ward off illnesses, however environmental and social burdens can jeopardize an individual's health (Uwanaka, 2014).

2.5.2) Gender

Overall, adult females are more likely to be reported having current asthma than adult males (National Department of Health (NDoH), Statistics South Africa (Stats SA), South African Medical Research Council (SAMRC), and ICF, 2018). This is true across all adult age groups. The prevalence of asthma is higher for females than males, and increases with age (Gray and Vawda, 2017). Gender differences in asthma prevalence and severity are reported internationally (Zein and Erzurum, 2015). After puberty, asthma becomes more prevalent and severe in women (Zein and Erzurum, 2015). Asthma is highest in women with early menarche or with many pregnancies (Zein and Erzurum, 2015). This suggests that hormones may play a role in the development of asthma (Zein and Erzurum, 2015).

The reasons for the gender difference in asthma is also linked to gender-specific responses to environmental or work-related exposures (Zein and Erzurum, 2015). While employed women smoke less than men, they are at a higher risk of being diagnosis with asthma (Zein and Erzurum, 2015). Potential sex differences for asthma was related to obesity in the US (Wang, Wang, Gao, Paul, Cai and Wang, 2015). The prevalence of asthma was higher in women than men, also showing that obesity has a positive association with asthma (Wang *et al.,* 2015). Obesity is likely to occur before the new onset of asthma but may differ between men and women (Wang *et al*., 2015). In comparison to men, women have smaller airways which may be subject to further airway obstruction because of smaller reductions in airway by increasing weight (Wang *et al.,* 2015).

Asthma has a moderately high mortality burden among the poor, particularly poor women (Bradshaw and Steyn, 2001). About 3% of women report symptoms of asthma, while 4% of men have symptoms of asthma in SA (National Department of Health (NDoH), Statistics South Africa (Stats SA), South African Medical Research Council (SAMRC), and ICF, 2018).

2.5.3) Age

Characteristics of asthma such as coughing, wheezing, chest tightness, and difficulty breathing can begin at any age and may continue through one’s life (Mirabelli, Beavers, Chatterjee and Moorman, 2013).

However, there is little evidence about the degree to which the age at which asthma first begins (Mirabelli *et al.,* 2013) since asthma varies with age (Cox, 2017). This study will mainly discuss asthma among adults.

Amongst adults with active asthma, the age at which asthma initiated may be related with successive exacerbations of asthma (Mirabelli *et al.,* 2013). Positive respiratory health outcomes may differ in age since adults are more likely to able to recognize and avoid symptom triggers of asthma (Mirabelli *et al.,* 2013). However, this does not mean that adults who do not involve themselves in physical activity and healthy diets are not susceptible to asthma. In the same way, adults who drink and smoke are equally as susceptible to becoming asthmatic.

In the US risk of ever having been diagnosed with asthma declines with age and is greater for women than for men (Cox, 2017). In Canada, among Aboriginal adults, the prevalence of asthma was significantly lower in the older age group, higher among females and lower among Inuit adults (Chang, Beach and Senthilselvan, 2012). In Southern Taiwan, a study found that air pollution, a trigger of asthma symptoms, has a different effect on the late-onset of asthma among adults (Wu, Wu, Chen, Lee and Guo, 2016). The study aimed to determine the relationship of asthma severity outcomes and air pollution with regards to age at onset of asthma (Wu *et al.,* 2016).

Enduring exposure to air pollution is a risk factor for asthma among adults in late-onset asthma of greater than 20 years of age (Wu *et al.,* 2016). Despite asthma being regarded a disease of younger populations, asthma morbidity is also high among people over the age of 55 (Gillman and Douglass, 2012). Furthermore, morbidity data suggest that older people suffer unduly from the burden of asthma and respirational disease (Gillman and Douglass, 2012). In this age cohort, asthma is a common disease that affects more than 10% of the population (Gillman and Douglass, 2012). History of cigarette smoking is a common trend in older people, causing obstructive airways and consequently increasing the risk of asthma (Gillman and Douglass, 2012).

Global prevalence of asthma over the life-span shows that the prevalence of current asthma points towards the age group of 10 to 24-year old with a reported prevalence of an estimated 3 and 18% (Gillman and Douglass, 2012). While many children outgrow asthma, asthma occurring between adults is less likely outgrown (Gillman and Douglass, 2012). For example, prevalence of current asthma in those over 65 years has been reported in Australia as between 7.5 and 12.5%, predominantly among females (Gillman and Douglass, 2012). Statistics in US proposes a prevalence between 4 and 10%, yet again with a predominance among females (Gillman and Douglass, 2012).

2.5.4) Marital status

Marital status, along with the variations in marital status in mid-life and older ages, has inferences on a person's health (Robards, Evandrou, Falkingham and Vlachantoni, 2012). Research on health by marital status has constantly acknowledged that single people usually account for poorer health, therefore having a higher mortality risk than their married counterparts, with males being predominantly affected in this respect (Robards *et al.,* 2012). With evidence of rising changes in relationships, in older ages, with rising divorce rates among younger partners counterweighing the lower risk of widowhood, it is vital to deliberate the consequences of such changes for health in old age (Robards *et al.,* 2012).

Many studies in demographic research have highlighted that health outcomes for married people are better than that of unmarried people, particularly among men (Robards *et al.,* 2012). Succeeding research has pursued to discover the degree of 'marriage selection' by which healthier individuals are selected into marital unions, even though less healthy individuals either stay single or are more likely to become separated, divorced or widowed (Robards *et al*., 2012). Research has also observed the degree to which marriage offers 'protection' in contradiction of adverse health outcomes, through modified health behaviors and social nets rising from the union (Robards *et al*., 2012).

In India, it was found that widowed/divorced/separated persons were more likely to report asthma than those who were married (Agrawal *et al*., 2013). Divorce and separation are commonly regarded as stressful, hence the rising evidence highlighting the possible role of emotional stress in asthma development (Agrawal *et al.,* 2013). Most factors link marital status to social status and health.

2.6) The association of socio-economic factors with asthma in adults

The well-being of people and populaces are powerfully influenced by SDOH (Raphael, 2006). The chief determinant which has been identified as contributing to the health outcomes of individuals is the SES and factors associated with one's health. An individual's health is highly interrelated with their social standing. Asthma, amongst many other diseases, is influenced by socio-economic factors. The relation between SES and asthma is multifaceted (Kant, 2013).

Asthma continues to be a major source of global economic burden (The Global Asthma Report, 2018). Studies differ with respect to whether low socioeconomic status is associated with an increased risk, reduced risk or no risk associated with asthma burden (The Global Asthma Report, 2018). Additionally, to changes over time, there is significant distinctions in the pervasiveness of asthma worldwide and socioeconomic conditions within a country (Patel *et al.,* 2012). Understanding factors that increase social inequalities assist to identify possible underlying exposures to asthma (Patel *et a*l., 2012). Remarkably, in developed countries, for instance Australia, asthma is more common among the economically disadvantaged, yet in developing countries an asthma diagnosis is more common among those who are from wealthier households (Loftus and Wise, 2016).

In the face of the accessibility of medicines, asthma remains poorly controlled in many patients (Schellack *et al.,* 2017). A significant number of patients have not until now benefited from the advances in asthma treatment and are still unsatisfactorily controlled (Schellack *et al.,* 2017). This places severe constraints on standard of living and puts them at risk for asthma-related morbidity and mortality (Schellack *et al.,* 2017). Given that asthma cannot be cured or effectively prevented, attempts at reducing costs should focus on better disease management (The Global Asthma Report, 2018).

2.6.1) Geographic area

The importance of place of residence to health status has become progressively apparent as places where people reside, and work has a great deal of effect on their healthiness (Oluwole, 2018). To discuss the association of place of residence with asthma, it is important to note the types of geographic area types in SA, according to the NIDS Questionnaire. Rural/traditional areas, urban areas and farms are categorized as the household geotypes in the questionnaires. Informal settlements will be classified as rural in this chapter. Examples from worldwide regions will also show the association between geographic setting and asthma.

Rural refers to zones not contained within the central city and its environments (Valet, Perry and Hartert, 2009). The Bureau of Census in 2000 defined urban areas "as those census blocks with a population density of at least 1,000 people per square mile, plus the adjacent blocks with a density of at least 500 people per square mile; furthermore, an urbanized area had to include at least 2500 people" (Valet *et al*., 2009). Apparent from this definition is that rural areas are heterogeneous by their proximity to urban resources, with those areas on the outskirts of a city typically with better socioeconomic conditions than isolated rural areas (Valet *et al.*, 2009). Overall, nevertheless, rural areas suffer from a greater deal of poverty and health disparities than urban areas (Valet *et al*., 2009).

The question regarding the impact of asthma in rural communities is, what is the relative prevalence of asthma in rural versus urban areas? Surprisingly, there is insufficient data addressing this question since most of the literature is international (Valet *et al*., 2009). Asthma is the most prevalent in more populous and industrialized areas than in rural areas (Valet *et al.*, 2009). This higher asthma prevalence does not seem to be associated to urbanization per se but could be linked with the increase of population vulnerability rather than variations in exposure to allergens (El-Sharif, Abdeen, Qasrawi, Moens and Nemery, 2002).

Studies found a high prevalence of asthma in rural India, in opposition to results in industrialized countries, where a lower prevalence of asthma is found in persons raised in rural farming environments (Agrawal *et al*., 2013). In India there is a significant burden of asthma-associated symptoms among adults in rural India (Agrawal *et al*., 2013). Moreover, indoor air pollution because of the consumption of biomass fuels is high in rural India which increases the burden of asthma among India's rural population (Agrawal *et al.*, 2013).

A momentous consequence of biomass fuel consumption on asthma among women is constant with preceding studies relating cooking smoke to asthma (Agrawal *et al.*, 2013). In the poorer regions of India, as well as other lower income regions, majority of household heating systems are reliant on burning coal or firewood (Mauban, 2016).

In Bangladesh, asthma is perceived as one of the most serious diseases among adults (Bartlett, Parr, Lindeboom, Khanam and Koehlmoos, 2013). Overall, a higher prevalence of asthma was reported in the urban population of Bangladesh than in the rural population (5.0% vs. 3.5%) (Bartlett *et al.*, 2013). Urban Bangladeshis attained a higher level of education in comparison to rural Bangladeshis (Bartlett *et al.*, 2013). Most of the population were reported as non-smokers and on no occasion chewing tobacco (Bartlett *et al.*, 2013). In both urban and rural areas, a larger proportion of people identified with asthma reported previously being smokers (Bartlett *et al.*, 2013). Also, a lack of physical activity in urban areas of Bangladesh was common among asthmatics (Bartlett *et al.*, 2013).

A rise in urbanization in Bangladesh and environmental changes in both pollutants and allergens have shifted the distribution of asthma prevalence within the population (Bartlett *et al.*, 2013). Factors such as vehicle exhaust and household material for cooking exacerbates asthma symptoms, therefore increasing the incidences of asthma in Bangladesh (Bartlett *et al.*, 2013). By understanding the prevalence of asthma in Bangladesh, it makes it vital in notifying policy decisions for the management of asthma (Bartlett *et al.*, 2013).

Studies point to a "Westernized lifestyle", a term referring largely to a range of environmental and lifestyle factors (El-Sharif *et al.*, 2002). Rural patients have an increased struggle gaining access to healthcare amenities generally, and inadequate data suggesting that they receive substandard care for asthma (Valet *et al.*, 2009). Research of the prevalence of asthma have constantly revealed lower rates in farmlands and an increasing prevalence with urbanization since lifestyle factors, like industrial pollution are worse (van Gemert *et al.*, 2011). Technologies that arises with urbanization such as natural gas, electricity and vehicles contribute to the rise in asthma prevalence (Mauban, 2016).

At face value, and in the context of Africa, it was suggested that there was something asthma-genic about living in an African city (Cullinan, 1998). In circumstances where a large proportion of the population was at risk of asthma, quite small changes in one or more important exposure-presumably environmental could result in large changes in disease incidence (Cullinan, 1998). In SA, since there is a clear majority of people living in rural settings, households utilize biofuels and burn wood (National Income Dynamics Study, 2017) etcetera that can increase the prevalence of asthma.

On the contrary, two decades ago, urban areas were surrounded by industries, motor vehicle fumes and exposure to tobacco smoke that made those populations susceptible to asthma (Cullinan, 1998). An impressive amount of studies has been gathered presenting that the exposure to outdoor air pollution levels in global cities is a significant cause of morbidity like asthma (Antó, 2012). Effects of air pollution is a major concern in many developing countries wherein the expanding economies of megacities are related with growing levels of traffic air pollution (Antó, 2012).

Environmentally, urban areas of Africa would have been a fertile ground for asthma - bearing in mind the existence of common risk factors such as high humidity, high incidence of respiratory infections, overpopulation, poverty, malnutrition and low SES. South-central Durban is greatly industrialized and seen as one of the most polluted areas in southern Africa. Households surrounding these Durban industries are prone to air pollution making them vulnerable to asthma. Durban has been put on the growing list of urban areas where asthma among adults are recognized. Therefore, asthma is known as an imperative public health problem in Durban.

Since the triggers of asthma exacerbation, in addition to poverty and health disparities are common in rural communities, urban-rural differences in diagnosing trends or admittance to healthcare amenities for symptoms reporting may well also contribute to the reported asthma prevalence difference between both rural and urban communities (Oluwole, 2018). It is also then important to note that risk factors may too be distributed inversely across rural and urban residents such that the geographical variation in the prevalence of asthma and its related symptoms may be meticulously associated to the differential distribution of these factors (Oluwole, 2018).

2.6.2) Education attainment

Education is a frequently used measure of SES and a strong analyst predictor of standards of living and long-term health (Low, Low, Baumler and Huynh, 2005). "The outcome of asthma is influenced by the level of education, as greater awareness helps to seek timely medical attention" (Sinharoy *et al*., 2018, p 2). A higher level of education attainment is commonly associated with more favorable outcomes of diseases (Kim and Nam, 2017) because it seems to lead to improved well-being by increasing knowledge about health and encouraging behaviors to maintain health and take part in prevention activities (Uwanaka, 2014).

The higher one's level of education, there is a greater possibility that people are to involve themselves in a variety of health-enhancing and self-maintenance activities (Uwanaka, 2014). Level of education becomes an important determinant of a person's economic and work situation, whereby people will work in favorable conditions that pay well (Uwanaka, 2014). Subsequently, a person has better health outcomes (Uwanaka, 2014).

In Shiraz, Iran, more than two-thirds of asthmatic patients were enrolled in primary and secondary/high school education (Masoompour, Mahdaviazad and Ghayumi, 2018). Adults who have completed tertiary education at college are less likely to be reported as diagnosed with asthma. Educational inequalities often lead to healthcare disparities (Kim and Nam, 2017). A reduction in asthma incidences is due to higher levels of education (Sinharoy *et al.,* 2018). In a Boston study, asthma incidence increased as level of education decreased (Coogan, Castro-Webb, Yu, O'Connor, Palmer and Rosenberg, 2016).

Among college graduates, the incidence of asthma increased among those whom completed some level of tertiary education and was still higher among those who had completed no more than high school (Coogan *et al.,* 2016). Those who have attained higher levels of education may have better knowledge of health-promoting behaviors and will most likely integrate them into their lives than people with low levels of education attainment (Coogan *et al.,* 2016).

2.6.3) Employment status

A key measure of socio-economic status is the employment rate, reported on a periodical basis by Stats SA (Gray and Vawda, 2017). "Lack of educational attainment has an increasingly important effect on employment status, as unskilled and semi-skilled jobs are lost from the economy" (Gray and Vawda, 2017, p 254). Being employed allows one to afford the financial burdens asthma imposes on those living with the disease. Asthma patients require admissions, follow-ups, treatment and access to medication which are expensive.

However, it is vital to exercise caution when interpreting geographical differences and trends over time in asthma admissions since children with asthma and adults with asthma require various care (The Global Asthma Report, 2018). Changes in medical care for asthma, especially the introduction of new asthma medications, potentially contributed to these epidemics of asthma deaths when one is not working and cannot afford these advanced medicines (The Global Asthma Report, 2018). South Africa has a high unemployment rate which means most people are living below the poverty line (Stats SA, 2018). Weak workforces create a low income for those who are suffering with asthma, hence asthmatics cannot cope (van Gemert, van der Molen, Jones and Chavannes, 2011).

Asthma developed in the workplace is a diagnosis that commonly goes unnoticed (Global Initiative for Asthma, 2006). Detecting asthma in one's work-related origin entails an efficient investigation about the work history and exposure to contaminants in the air; an absence of asthma symptoms before beginning employment; or a definite worsening of asthma after employment (Global Initiative for Asthma, 2006). A relationship between the workplace and symptoms helps to establish a connection between suspected air contaminants and asthma (Global Initiative for Asthma, 2006). The impact of asthma on work productivity is challenging since asthmatics may have reduced work performance even if they attend the workplace (The Global Asthma Report, 2018). The SES of people and where they live, and work can strongly influence their health.

2.6.4) Household size

Housing as a determinant of health is regarded as important (Uwanaka, 2014). In an American study, it was stated that those living in the slums, combined with other adverse housing factors, give rise to many chronic illnesses (Uwanaka, 2014). A house that lacks convenience and comfort makes those living in it vulnerable to adverse health conditions (Uwanaka, 2014). The quality of housing is an important determinant of morbidity such as asthma (Uwanaka, 2014). Substandard housing features such as overcrowded houses may exacerbate risks of asthma symptoms where cooking fuels are easily transmitted from one person to the another. Smaller house size makes it difficult to avoid such risk factors, increasing one's chance of living in asthma-related conditions (Uwanaka, 2014).

With larger families in rural areas, households tend to have more members in houses than in urban (Phaswana-Mafuya, Peltzer, Schneider, Makiwane, Zuma, Ramlagan, Tabane, Davids, Mbelle, Matseke and Phaweni, 2012). With many members in rural households, there is maximum use of biofuels and household fuels, thus making household members more prone to a decrease in lung functions and chances of having asthma households (Phaswana-Mafuya *et al.*, 2012). Most rural families cannot afford medical attention, thus increasing their prolonged asthma. Even though urban households have fewer people, it does not mean they are at a lower risk of becoming asthmatic. Members of these kinds of households have a higher income and can afford to indulge in cigarette smoking, living closer to industrial zones and involving themselves in other lifestyle activities that make them prone to asthma (Phaswana-Mafuya *et al*., 2012).

2.6.5) Household income

There is a strong association amid current asthma and income levels. Influences like poor housing conditions, scarce access to healthcare, and exposure to triggers of asthma, all have a part in the progress or worsening of asthma. Household income levels can directly affect an individual's capability to circumvent these asthma risk factors. People from low-income households have a greater possibility to account for having poor health than people with medium or high-incomes (Phaswana-Mafuya *et al.*, 2012).

Generally, in SA, household income has a great underlying effect on a person's overall health status. Income is also associated with adequate housing which is an important predicator of health (Winkelby, 1992). People with a lower income per capita cannot afford suitable residences that free them from the hazards of illnesses. Also, this indicates they lack the affordability to healthier lifestyles (Phaswana-Mafuya *et al.*, 2012). SA has a few informal settlements where inadequate housing suggests they do not earn enough incomes to support their health needs.

2.7) Summary

This chapter discussed the prevalence of asthma among adults. Following that, the chapter elaborated on the association of various demographic factors with asthma in adults. Subsequently, the association of socio-economic factors with asthma was recognized. The association of cigarette smoking as a lifestyle risk factor associated with asthma was reflected upon, along with the demographic and socio-economic factors as mentioned in the introduction. Examples from international studies were used as case studies to additionally understand the various associations between demographic, socio-economic and lifestyle risk factors associated with asthma among adults.

With the above heavily discussed throughout the chapter, it was made apparent how SES influences the health outcomes of individuals in the context of asthma and its prevalence. In the African context, several literatures exhibited that education attainment, employment status, household income and place of residence, which are measures of socioeconomic status, have a momentous influence on people's health.

In the last number of decades, the increase in asthma prevalence contributed significantly to demographic, socioeconomic and lifestyle risk factors globally (Patel *et al.*, 2012*)* and in the South African context. Throughout the chapter's literature, factors such as income, levels of education and geographic settings and their relationship with asthma were thoroughly discussed. Urban settings may have been influenced by SES while rural settings may have been influenced by environmental risk factors (biofuels and tobacco smoke). Examples of both developed and developing regions across the world discussed such patterns of asthma and its associations with the variables mentioned throughout the chapter. It was made apparent of the crucial role that SES and demographic factors played as influences on both cigarette smoking and asthma.

Even though there is a scarcity of studies on asthma in the South African context unambiguously, it is without doubt that asthma is an unfavorable health condition among South Africans who are of various demographical and socioeconomic positions. It is evident that more research should be established to determine asthma's associations to demographic, socioeconomic and lifestyle factors. Since cigarette smoking was the main lifestyle risk factor, more studies should be conducted in the South African context to determine the current state on the association between cigarette smoking and asthma since it has a significant prevalence.

CHAPTER 3

METHODOLOGY

3.1) Introduction

The methodology discusses certain tools and techniques used in research (Musakwa, 2008). The first part of the chapter introduces the location of the study and explains the main source of data used in the study, wave 5 of the 2017 National Income Dynamic Study (NIDS). This chapter also concentrates on the research and sample design that explains the type of method used for data collection to produce the results of the study. Non-response rates and refusal rates are defined and interpreted in table forms, thereafter the weighting measures are discussed. The research hypothesis is also identified in this chapter. The dependent and independent variable is outlined and the different types of demographic and socio-economic variables used in the data analysis will be explored the data analysis is further explored and the chapter is concluded by the ethical considerations and the validity, reliability and rigour of the study.

3.2) Location of the Study

SA is Africa's southernmost tip, bordered by the Atlantic Ocean on the west and he Indian Ocean on the south and east. According to Statistics South Africa (2018), South Africa's current population estimate is 57.8 million (Statistics South Africa, 2018). The urban population comprises of 63% of the population and the rural population comprises of the remaining 37% (Statistics South Africa, 2018). South African blacks are most of the population, making up 79.2% of the country's total population (Statistics South Africa, 2018). Coloureds and whites make up 8.9% of the population, with Indians standing at 2.5% (Statistics South Africa, 2018). "Other", which is included in the 2011 Census accounts for 0.5% of the total population (Statistics South Africa, 2018). The life expectancy is 64 years, estimated in 2018 (Statistics South Africa, 2018). Males live up to 61 years and females live up to 67 years (Statistics South Africa, 2018). A decrease in poverty and a growing middle class are desirable attributes in South Africa's economy. SA's GDP growth is 1.4% (Statistics South Africa, 2018). Although there is a decline in poverty, 66.6% of the population is below the poverty line (Statistics South Africa, 2018).

3.3) The National Income Dynamic Study

The research method that will be used in this study is a quantitative methods approach based on secondary data from NIDS. The NIDS survey had a nationally representative sample, initially comprising of 28 000 people from 7300 households across SA. Adult and Household Surveys from the 5th wave of 2017 will be used to answer the study's research questions. The data from the questionnaires will be limited to adults. On average, the NIDS dataset interviews 4 people per household (National Income Dynamic Study, 2017).

Unlike other household data, NIDS offers a more precise interpretation of SA. NIDS is a panel survey sponsored by the Department of Planning, Monitoring and Evaluation (DPME), Government of South Africa (Brophy, Branson, Daniels, Leibbrandt, Mlatsheni and Woolard, 2018). This sponsorship of the NIDS panel survey means that policy research in SA has access to timely and accurate national data (Brophy *et al.,* 2018). As per the first national panel study of individuals in SA, NIDS offers inimitable understandings into the lives of individual South Africans over time (Brophy *et al.,* 2018).

The Demographic and Health Survey (DHS) is a household survey that is limited to the population, health and nutrition. The General Household Survey (GHS) measures the living circumstances of South African households. In comparison to these household surveys, NIDS is an all-inclusive survey that covers the subjects of poverty and welfare, household composition and structure, fertility and mortality, migration, labour market participation, and economic activity, human capital formation, health, education, vulnerability and social capital (Brophy *et al.,* 2018). NIDS is better in that it takes every member of the household into account. One is also provided with the understanding of individual level variables when conducting research.

3.4) Research and sample design

The quantitative research design was selected for this study because it was able to elicit the statistical nature of results that were required to conduct the study on the demographic, socio-economic and the lifestyle risk factor of cigarette smoking associated with asthma among adults in South Africa. At wave 5, 15750 respondents were successfully interviewed, with 623 reporting an asthma diagnosis.

This study uses the NIDS panel survey using sample survey data (SSD) from both individuals and households analyzed on Stata version 12. More of this will be explained in data analysis.

3.5) Non-response rates and refusal rates

In sample surveys, failure to gain information from individuals for any reason such as absenteeism, death or refusal to respond is referred to as non-response (Lavrakas, 2008). The proportion of such individuals of the sample intended at is identified as the "non-response rate" (Lavrakas, 2008). The estimations from the indicators that represents the South African population may appear to be biased due to a high non-response rate. Non-response may occur for various reasons such as a household refusing to participate, the household may not have been interviewed all together or when individuals refuse to reveal certain information that might be confidential or sensitive. Refusal rates for this study was observed using the variable *w5_a_refexpl*.

Table 3.1 and 3.2 below shows the results:

Table 3.1 Reasons for refusals

Reason for refusal	**Frequency**	**Percentage**
Too busy	440	38.36
Not interested/waste of time	425	37.05
Questionnaire too personal	59	5.14
Don't trust surveys	16	1.39
Never do surveys	26	2.27
Too old	23	2.01
Other (specify)	54	4.71
Sickness/recent death/recent childbirth	23	2.01
It took too long last time	27	2.35
Entry refused by security	3	0.26
Offered proxy but refused	21	1.83

No contact to get proxy permission	30	2.62
Total	**1147**	**100**

Refusal rates unweighted

The total number of refusals was 1147, with majority of the refusals being that individuals were too busy (38.36%). Closer to this rate was 37.05% of the individuals thought the survey was a waste of time and showed no interest in answering it. The less likelihood for individuals to refuse was because of entry refused by security. This meant that 99.74% would respond if security was not an issue. Being too old, sick, deaths and births had the same refusal rate of 2.01%.

Table 3.2 Refusal rates by gender and age

Gender	**Frequency**	**Percentage**
Male	678	59.11
Female	469	40.89
Age	**Frequency**	**Percentage**
15	17	1.48
16	13	1.13
17	16	1.39
18	19	1.66
19	29	2.53
20-24	103	8.98
25-29	105	9.15
30-34	121	10.56
35-39	105	9.15
40-44	100	8.72
45-49	105	9.15
50-54	105	9.16
55-59	78	6.8
60-64	68	5.93

Refusal rates unweighted

As can be seen from this table, males had a greater refusal rate of 59.11% than females who had a 40.89%. The economically active age group (20-54) participants were more likely to refuse to respond than the younger adults of 15-19 years of age. The working and older participants are either too busy, too old or see the survey as time consuming.

3.6) Weighting Measures

Weights are used to make interpretations about the population from a sample by adjusting for unequal probabilities of selection and for non-response (Branson and Wittenberg, 2019). Weighting includes giving certain responses more weight. This might be required, for instance, a population contains 50% males and 50% females, but the sample contains 70% males and 30% females. In such an instance, female responses would be weighted more with the purpose of reducing the oversampled male population. In this study, post-stratification weights were used in the bivariate analyses and multivariate logistic regression analysis to reduce the non-response bias. The data was weighted as: *svyset [pweight= w5_pweight]*.

To lessen the effect of households with very high weights, the weights were trimmed to the 95th percentile of the weights (Branson and Wittenberg, 2019). Regarding calibration, post-stratification was used to adjust the weights, which allows the sample to reflect the population to a certain degree (in terms of demographic characteristics for example). Often samples are uneven, and down-weighting over-representative variables, or weighting up under-representative variables may offer a more precise measure of the variable (Branson and Wittenberg, 2019). Missing responses or non-responses are indicated in the data with negative numbers. When data for a specific variable was not collected, the missing value is generally coded -3. All analyses for this study were done inclusive of the missing data and non-responses, and all statistics reported includes the missing data and non-responses.

3.7) Research hypothesis

This study aimed to measure whether a relationship exists between demographic, socio-economic and the lifestyle risk factor of cigarette smoking and asthma. The null hypothesis states that there is no significant relationship between demographic, socio-economic and the lifestyle risk factor of cigarette smoking and asthma.

The following key questions asked to test the hypothesis are:

1. What was the prevalence of reported asthma among adults?
2. Was asthma significantly more in particular geographic areas or among particular race, gender, age and marital groups?
3. Was asthma significantly more likely among those who were less educated, unemployed or from poorer households?
4. Was asthma significantly more likely among those who smoked cigarettes?
5. What was the association of cigarette smoking to asthma, when controlling for demographic and socioeconomic factors?

3.8) Variables

3.8.1) Dependent / outcome variable

The outcome variable in this study was asthma. Asthma forms the dependent variable; the variable being triggered by or affected by the various demographic, socio-economic and the lifestyle risk factor of cigarette smoking.

w5_a_hlast: Respondent was diagnosed with asthma?

The outcome was also generated in the regression as *w5_asthma*: (0 = no asthma, 1 = asthma)

3.8.2) Key independent / associated variable

The main associated variable used in this study was cigarette smoking. Cigarette smoking was generated as *w5_smoke*: (1= never smoke, 2 = previously smoked, 3 = current smoking)

Other factors that might have impacted asthma were accounted for during Chi-square test and regression. These variables were contained in the adult questionnaire. These variables were:

Demographic variables:

The individual derived database contained the following variables:

w5_best_gen: Best gender (1 = Male, 2 = Female)

w5_best_age_yrs: Best age categories (1= 15-24, 2= 25-34, 3= 35-44, 4= 45-54, 5= 55-64, 6= 65+)

w5_best_race: Best population group (1 = African, 2= Coloured, 3= Asian/Indian, 4=White)

w5_best_marstt: Best marital status (1= Married, 2= Living with partner, 3= Widow/Widower, 4= Divorced or Separated, 5= Never married)

Socio-economic variables:

The individual derived database contained the following variables:

w5_empl_stat: Employment status (0= Not Economically Active, 1= Unemployed, 2= Employed)

The household derived database contained the following variables:

w5_geo2011: Geographic Area (1=Rural/traditional, 2= Urban, 3= Farm)

w5_lo_edu: Best education last observed (1= No Schooling, 2 = Grade 1-5 junior primary, 3 = Grade 6-7 senior primary, 4= Grade 8-9 junior high, 5= Grade 10-11 senior high, 6= Grade 12-matric, 7= Post school, no matric, 8= Degree/diploma/postgraduate)

w5_hhq_incb: Household income from Household questionnaire

w5_hhsizer: Number of household members

The second and third variables were used to determine per capita household income (hhincome/hhsizer): Per capita household income: [1 = (R0 – R1500 per capita) 2 = (R1501 – R2500 per capita) 3 = (R2501 – R3000 per capita) 4 = (R3001- R4500 per capita) 5 = (R4501+ per capita)]

The variables were used to derive income quintiles by dividing the per capita household income into 5 categories.

3.9) Data analysis

Data for the study was captured using a software called Stata (version 12) to perform the statistical analysis. Secondary data analysis of the NIDS wave 5 Adult (15+) Questionnaire dataset was arranged to measure the risk factor of smoking on asthma among adults. This was conducted by including the effects of variables such as race, gender, age, marital status, education, employment status, household income and geographic geotype.

The study used both descriptive and inferential statistic methods to reach conclusions about the population, based on the set of data. This technique was used to observe the associations between the associated variables and the outcome variable.

Firstly, Chi-square test was an appropriate method used since there were categorical variables. This was used to see if there was a significant difference between the outcome (dependent) and associate (independent) variable, amongst the other variables in the initial bivariate analysis. Secondly, a multivariate logistic regression was applied in the study to examine how successfully one or more variable allowed for the prediction of the values for the other variables. Since the outcome variables were categorical, it was appropriate to use logistic regressions. Variables that were significantly associated with the outcome variable in the bivariate logistic regression analysis ($p<0.05$) were included in the multivariate logistic regression. Results were presented as odds ratios.

The equation for the multivariate logistic regression is given below:

$$y = \beta 0 + \beta 1 \cdot x1 + \beta 2 \cdot x2 + \ldots + \beta p \cdot xp + \epsilon$$

y – dependent variable (asthma)

β1 – coefficient of the independent variable

x1 – independent variable (age, race, income etc.)

ϵ - error

3.10) Ethical Considerations

It is often assumed that secondary data analysis does not require any ethical considerations. However, this study was taken up by the University of KwaZulu-Natal Humanities and Social Sciences Research Ethics Committee (HSSREC). The nature of the data set was a quantitative data set that extracted data from household and adult questionnaires. It can be definite that the NIDS questionnaires was conducted with honesty and integrity. To render the study ethical, the rights to anonymity, confidentiality and consent would have been registered from the questionnaires used. Permission to conduct the study was obtained by the HSSREC.

3.11) Validity, Reliability and Rigour

NIDS is a valid and reliable dataset as the study's main source of data uses a great sample size. Quantitative research methods provide a rigorous and accurate representation of results without being bias. NIDS is a longitudinal study, conducted every two years, making it up to date and reliable. The NIDS data was collected systematically and consistently, refining the rigour of the data. In terms of the validity of the secondary study, the research questions are strongly associated to the variables that will be studied and a wide variety of measures are used to calculate the study's results, increasing the validity. As a result, NIDS is considered reliable and valid because of the high response rates and the representative sample.

3.12) Summary

NIDS, the main sources of data used in the study was discussed. The purpose of this chapter was to offer a comprehensive explanation of the research and sample design that were used for this study. The non-response rates and refusal rates were well-defined and interpreted in table forms, thereafter the weighting measures were also discussed. The research hypothesis was acknowledged followed by the different types of variables used in the study. In the latter part, data analysis was provided. The chapter was concluded by the ethical considerations, the validity, reliability and rigour of the study.

CHAPTER FOUR

RESULTS

4.1) Introduction

The chapter begins with a description of the study sample. Thereafter, an overview of the prevalence of asthma and cigarette smoking will be tabulated. The results of the bivariate analysis investigating the association between the demographic, socioeconomic and the lifestyle risk factor of cigarette smoking and asthma are then presented. This chapter concludes with the presentation of the multivariate analysis results. In the bivariate analysis, the Chi-square test was an appropriate method since both the dependent variable and the independent variables were categorical variables. The independent variables significantly associated with asthma were entered into a multivariate logistic regression model to provide adjusted estimates.

4.2) Demographics

Table 4.1 Demographics of sample

Demographics	**Percentage (n=15750)**	**95% CI**
Gender		
Male	46.1	(44.9 - 47.3)
Female	53.9	(52.7 - 55.1)
Age		
15-24	26.8	(25.8 – 27.8)
25-34	24.8	(23.8 – 25.9)
35-44	17.8	(16.9 – 18.8)
45-54	13.6	(12.8 – 14.5)
55-64	9.0	(8.3 – 9.6)
65+	8.0	(7.4- 8.7)
Race		
African	82.1	(81 - 83.2)
Coloured	8.9	(8.3 - 9.6)
Asian/Indian	2.1	(1.7 – 2.6)
White	6.9	(6.1 – 7.9)

Marital status		
Married	27.2	(26.1 – 28.3)
Living with partner	5.3	(4.8 – 5.9)
Widow/Widower	7.6	(7.0 – 8.2)
Divorced/Separated	3.5	(3.0 - 4.0)
Never married	56.4	(55.2 – 57.6)
Employment status		
Not economically active	43.3	(42.1 - 44.5)
Unemployed	11.8	(11.1 – 12.6)
Employed	44.9	(43.7 - 46.1)
Geographic area		
Rural/traditional	33.0	(32.0 – 34.0)
Urban	62.4	(61.4 – 63.5)
Farms	4.5	(4.1 – 5.0)
Education attainment		
No schooling	4.7	(4.4 - 5.2)
Grade 1-5 junior primary	5.7	(5.3 - 6.3)
Grade 6-7 senior primary	7.8	(7.2 - 8.4)
Grade 8-9 junior high	16.9	(16.0 – 17.8)
Grade 10-11 senior high	25.3	(24.3 - 26.3)
Grade 12- matric	17.6	(16.7 - 18.6)
Post school, no matric	18.3	(17.4 - 19.3)
Degree/diploma/postgraduate	3.7	(3.2 - 4.3)
Household per capita income		
R0 – R1500	30.6	(29.4 - 31.7)
R1501 – R2500	20.6	(19.7 - 21.5)
R2501 – R3000	20.2	(19.3 - 21.1)
R3001 – R4500	19.0	(18.1 – 20.0)
R4500+	9.7	(8.9 - 10.5)

**Weighted percentages*

Table 4.1 shows the demographics of the sample whereby the data analysis, drawn from NIDS wave 5, focus on South African adults (15-64). The sample size from wave 5 is 15750 (n=15750). Just over half (53.9%) of the sample were females. Reflecting SA's overall demographic profile, most of the sample's population were African (82.1%). Of those sampled, the majority were never married (56.4%) with only 27.2% of the sample married, 5.3% live with a partner, 7.6% are widows/widowers and 3.5% were divorced/separated.

Only 44.9% of the sample were employed, 43.3% were not economically active, and 11.8% were unemployed. Most of the sample resided in urban areas (62.4%), 33% resided in rural/traditional settings and 4.5% of the sample lived in farms. While 4.7% of the sample had no schooling attainment, almost one in five (17.6%) had completed matric and 3.7% had a tertiary qualification. About 30.6% and 20.6% of the sample lived in households where per capita household income was between R0-R1500 and R1501-R2500 respectively. One in five (20.2%) resided in households with per capita incomes of R2501-R3000 and 19.0% in households with per capita income R3001-R4500. Only 9.7% of the sample resided in households with per capita incomes R4500 and more.

4.3) Prevalence of asthma and cigarette smoking

4.3.1) Report on asthma

Table 4.2 Asthma diagnosed among adults

	Percentage	CI 95%
Diagnosed with asthma		
Yes	2.5	(2.1 - 3.0)
No	97.5	(97.0 - 97.9)

Weighted percentages

Table 4.2 indicates the diagnoses of asthma among adults. Only 2.5% of the sample reported having been diagnosed with asthma in 2017.

4.3.2) Report on cigarette smoking

Table 4.3 Cigarette smoking among adults

	Percentage	CI 95%
Smoking behavior		
Never smoked	77.5	(76.4 - 78.5)
Previously smoked	4.2	(3.7 – 4.8)
Current smoking	18.3	(17.4 – 19.3)

Weighted percentages

Table 4.3 reports the prevalence of cigarette smoking among adults. The majority of the sample (77.5%) did not smoke, 4.2% previously smoked and 18.3% reported they were current smokers.

4.3.3) Report on the prevalence of asthma and cigarette smoking

Table 4.4 Association of asthma and cigarette smoking among adults

	Percentage	CI 95%	P value
Cigarette smoking			0.424
Never smoked	2.4	(2.0 – 2.9)	
Previously smoked	3.3	(1.8 – 6.2)	
Current smoking	2.9	(2.0 – 4.2)	

Weighted percentages

P-values reported are from Chi-square test

Table 4.4 reports the association of asthma and cigarette smoking among adults. There was no significant association between reporting an asthma diagnosis and cigarette smoking.

4.4) Chi-square test between demographic and socio-economic factors and asthma

Table 4.5 Demographic and socio-economic factors and asthma

	Percentage	**95% CI**	**P value**
Demographic variables			
Gender			0.031
Male	2.0	(1.5 – 2.7)	
Female	2.9	(2.4 – 3.6)	
Age			0.001
15-24	2.1	(1.5 – 2.9)	
25-34	2.1	(1.4 – 3.0)	
35-44	1.6	(0.9 – 2.6)	
45-54	3.7	(2.5– 5.5)	
55-64	3.6	(2.4 – 5.4)	
65+	4.5	(2.9- 6.8)	
Race			< 0.001
African	1.9	(1.6 – 2.3)	
Coloured	4.8	(3.2 – 7.2)	
Asian/Indian	3.3	(0.9 – 11.7)	
White	6.3	(3.6 – 10.7)	
Marital status			0.006
Married	2.6	(1.9 – 3.6)	
Living with partner	3.1	(1.5 – 6.4)	
Widow/Widower	4.0	(2.7 – 5.7)	
Divorced/Separated	6.2	(2.9 – 13.0)	
Never married	2.0	(1.6 – 2.5)	
Socio-economic variables			
Employment status			0.054
Not economically active	3.1	(2.4 – 3.8)	
Unemployed	1.9	(1.2 – 3.0)	

Employed	2.1	(1.6 – 2.8)	
Geographic area			< 0.001
Rural/traditional	1.5	(1.2 – 1.9)	
Urban	3.1	(2.6 – 3.8)	
Farms	1.6	(0.9 – 3.0)	
Education attainment			0.054
No schooling	4.5	(2.8 – 7.4)	
Grade 1-5 junior primary	3.0	(1.9 – 4.6)	
Grade 6-7 senior primary	2.8	(1.7 - 4.4)	
Grade 8-9 junior high	3.1	(2.2 – 4.4)	
Grade 10-11 senior high	1.8	(1.2 – 2.5)	
Grade 12- matric	2.8	(1.8 – 4.2)	
Post school, no matric	1.8	(1.1 – 3.1)	
Degree/diploma/postgraduate	4.1	(1.9 – 8.7)	
Household per capita income			0.968
R0 – R1500	2.3	(1.6 – 3.3)	
R1501 – R2500	2.7	(2.0 – 3.7)	
R2501 – R3000	2.5	(1.8 – 3.5)	
R3001 – R4500	2.6	(1.8 – 3.6)	
R4500+	2.7	(1.5 – 4.9)	

Weighted percentages

P-values reported are from Chi-square test

Table 4.5 represents the Chi-square test of the association between the various demographic and socio-economic factors and asthma. Where $p < 0.05$, there is a significant association between the variable and asthma, thus, rejecting the null hypothesis that there is no significant difference. Where $p > 0.05$, there is no association between the variables and asthma.

Though there was an association between gender and asthma, 2.9% of the females were reported having been diagnosed with asthma and only 2% of the males were diagnosed with asthma. There was also an association between age and asthma.

Only 2.1% of the younger population aged 15-34 were diagnosed with, whereas 1.6% of the population aged 35-44 were reported having been diagnosed with asthma Approximately 3.7% of the respondents between 45-54 were asthmatic, 3.6% of the respondents aged 55-64 were reported having been diagnosed with asthma and 4.5% of the respondents aged 65 and over were diagnosed with asthma. Race and asthma had an association, with those in the African population group being the least likely to report an asthma diagnosis (1.9%). Among the Coloured population, 4.8% of them were reported an asthma diagnosis, and only 3.3% of the Indian population were reported an asthma diagnosis. Those in the White population group were the most likely to report an asthma diagnosis (6.3%). Only 2.6% of the married respondents were reported an asthma diagnosis, 3.1% of those living with a partner reported an asthma diagnosis. Those who were never married were the least likely to report an asthma diagnosis (2.0%) while 4.0% of the widows/widowers reported an asthma diagnosis. The table shows that of 6.2% of those who were divorced or separated reported an asthma diagnosis. However, there was no significant differences between the marital status groups and reported asthma diagnosis.

Those who were not economically active were most likely to report an asthma diagnosis (3.1%). Only 2.1% of the employed respondents were reported an asthma diagnosis. Respondents who were unemployed were the least likely to report an asthma diagnosis (1.9%). In terms of geographic area, 1.5% of the respondents who resided in rural/traditional areas reported an asthma diagnosis as did 1.6% of those residents on farms. Of those who resided in urban areas, 3.1% reported an asthma diagnosis. There was an association between geographic area and asthma. Among the respondents without any formal education, 4.5% reported being diagnosed with asthma. In the primary level of education, Grade 1-5 junior primary were most likely reported an asthma diagnosis (3%). Thereafter, Grade 6-7 senior primary were least likely reported an asthma diagnosis (2.8%). In the secondary level of education, Grade 8-9 junior high were most likely reported an asthma diagnosis (3.1%), Grade 10-11 senior high were least likely reported an asthma diagnosis (1.8%) and Grade 12 matriculants were reported an asthma diagnosis at 2.8%. Among those who had no matric, post school, 1.8% were reported an asthma diagnosis. At a tertiary level, 4.1% of the respondents' who attained a Degree/diploma/postgraduate were reported an asthma diagnosis.

Least of respondents who were residents in households with per capita income R0 – R1500 reported being diagnosed with asthma (2.3%). Those who resided in households with per capita income R1501 – R2500, 2.7% were reported an asthma diagnosis. Among respondents who were residents in households with per capita income R2501-R3000, 2.5% reported being diagnosed with asthma. Residents in households with per capita income R3001-4500, 2.6% reported being diagnosed with asthma. Among respondents who were residents in households with per capita income R4500 and more, 2.7% reported being diagnosed with asthma. However, there was no association between households with per capita income.

4.5) Bivariate logistic regression

Table 4.6 Bivariate logistic regression analysis between demographic and socio-economic factors and asthma

	Odds ratio	**95% CI**	**P value**
Demographic variables			
Gender			
Male	1.00		
Female	1.47	(1.0 – 2.1)	0.032
Age			
15-24	1.00		
25-34	1.00	(0.6 – 1.7)	0.996
35-44	0.76	(0.4 – 1.4)	0.373
45-54	1.84	(1.1– 3.1)	0.023
55-64	1.78	(1.0 – 3.1)	0.041
65+	2.24	(1.3- 3.9)	0.005
Race			
African	1.00		
Coloured	2.56	(1.6 – 4.1)	< 0.001
Asian/Indian	1.72	(0.4 – 6.8)	0.438
White	3.36	(1.8 – 6.2)	< 0.001
Marital status			

Married	1.00		
Living with partner	1.22	(0.5 – 2.8)	0.635
Widow/Widower	1.55	(0.9 – 2.6)	0.094
Divorced/Separated	2.50	(1.0– 6.0)	0.038
Never married	0.77	(0.5 – 1.2)	0.212
Socio-economic variables			
Employment status			
Not economically active	1.00		
Unemployed	0.62	(0.4 – 1.1)	0.076
Employed	0.69	(0.5 – 1.0)	0.048
Geographic area			
Rural/traditional	1.00		
Urban	2.12	(1.5– 2.9)	< 0.001
Farms	1.09	(0.6 – 2.1)	0.804
Education attainment			
No schooling	1.00		
Grade 1-5 junior primary	0.64	(0.3 – 1.3)	0.204
Grade 6-7 senior primary	0.59	(0.3 – 1.2)	0.418
Grade 8-9 junior high	0.67	(0.4 – 1.3)	0.216
Grade 10-11 senior high	0.38	(0.2 – 0.7)	0.003
Grade 12- matric	0.60	(0.3 – 1.2)	0.132
Post school, no matric	0.39	(0.2 – 0.8)	0.013
Degree/diploma/postgraduate	0.90	(0.3 – 2.3)	0.823
Household per capita income			
R0 – R1500	1.00		
R1501 – R2500	1.17	(0.7 – 1.9)	0.515
R2501 – R3000	1.08	(0.7 – 1.8)	0.768
R3001 – R4500	1.11	(0.7 – 1.8)	0.671
R4500+	1.17	(0.6 – 2.4)	0.662

Weighted percentages

Table 4.6 contains the unadjusted odds ratios from the bivariate logistic regression of the individual independent variables and the dependent variable.

Demographic variables

Gender

Females were 47% more likely than males to have reported an asthma diagnosis.

Age

People between the ages of 45-54 were 84% more likely than the 15-24-year olds to have been diagnosed with asthma. Those aged 55-64 were 78% more likely than the 15-24-year olds to have been diagnosed with asthma. Those who were 65 years old and older were 124% more likely than the 15-24-year olds to have reported an asthma diagnosis.

Race

Coloureds were 156% more likely to have reported an asthma diagnosis than the African population group. Whites were 236% more likely than Africans to have been diagnosed with asthma.

Marital status

People who were divorced/separated were 150% more likely than married people to have reported an asthma diagnosis.

Socio-economic variables

Employment status

Those who were employed were 31% less likely than those who were not economically active to have been diagnosed with asthma.

Geographic area

Those residing in urban areas were 112% more likely to have been diagnosed with asthma than those residing in rural/traditional areas.

Education attainment

People who attended Grade 10-11, senior high, were 62% less likely to have been diagnosed with asthma than those without any formal education. People with post school, no matric were 61% less likely to have been diagnosed with asthma than those without any formal education.

Household per capita income

Households with per capita income were not significantly associated with an asthma diagnosis.

4.6) Multivariate logistic regression

Table 4.7 Multivariate logistic regression analysis between demographic and socio-economic factors and asthma

	Odds ratio	**95% CI**	**P value**
Demographic variables			
Gender			
Male	1.00		
Female	1.32	(0.9 – 1.9)	0.134
Age			
15-24	1.00		
25-34	1.16	(0.7 – 2.0)	0.582
35-44	0.87	(0.5 – 1.7)	0.667
45-54	1.72	(0.9– 3.4)	0.119
55-64	1.41	(0.7– 2.8)	0.323
65+	1.38	(0.6- 3.2)	0.444
Race			
African	1.00		
Coloured	1.89	(1.2 – 3.0)	0.006
Asian/Indian	1.90	(0.4 – 8.1)	0.383
White	2.65	(1.3 – 5.4)	0.007
Marital status			
Married	1.00		

Living with partner	1.23	(0.5 – 2.9)	0.638
Widow/Widower	1.07	(0.6 – 2.0)	0.817
Divorced/Separated	2.21	(0.9– 5.2)	0.067
Never married	1.16	(0.7 – 1.9)	0.546
Socio-economic variables			
Employment status			
Not economically active	1.00		
Unemployed	0.78	(0.5 – 1.4)	0.386
Employed	0.71	(0.5 – 1.1)	0.128
Geographic area			
Rural/traditional	1.00		
Urban	1.91	(1.3– 2.7)	< 0.001
Farms	0.86	(0.4 – 1.8)	0.692
Education attainment			
No schooling	1.00		
Grade 1-5 junior primary	0.62	(0.3 – 1.2)	0.162
Grade 6-7 senior primary	0.50	(0.2 – 1.0)	0.061
Grade 8-9 junior high	0.61	(0.3 – 1.2)	0.170
Grade 10-11 senior high	0.37	(0.2 – 0.7)	0.004
Grade 12- matric	0.52	(0.3 – 1.1)	0.077
Post school, no matric	0.34	(0.1 – 0.8)	0.008
Degree/diploma/postgraduate	0.56	(0.2 – 1.5)	0.265

Weighted percentages

Table 4.7 represents the selected demographic and socio-economic variables significant for asthma where $p < 0.05$ in the Chi-square bivariate analysis.

Demographic variables

Gender

In the multivariate regression model, there was no significant association between females and the reference gender being male and the diagnosis of asthma.

Age

There was no significant association between the age groups and the reference age group of 15-24 and the reported diagnosis of asthma.

Race

Coloureds were 89% more likely to have reported an asthma diagnosis than the African population group. Whites were 165% more likely to have reported an asthma diagnosis than the African population group.

Marital status

There was no significant association between the various marital statuses, the reference marital status of those who are married and the diagnosis of asthma.

Socio-economic variables

Employment status

There was no significant association between the various employment statuses, the reference employment status of those who are not economically active and the diagnosis of asthma.

Geographic area

Those residing in urban areas were 91% more likely to have reported an asthma diagnosis than those from the rural/traditional areas.

Education attainment

People who attended Grade 10-11, senior high, were 63% less likely to have reported an asthma diagnosis than those without any formal education. People with post school, no matric were 66% less likely to have reported an asthma diagnosis than those without any formal education.

4.7 Summary

This chapter has provided the description of the study sample. The overview of the prevalence of asthma and cigarette smoking was provided. The results of the bivariate analysis investigating the association between the demographic, socioeconomic and the lifestyle risk factor of cigarette smoking and asthma were presented.

This chapter was completed with the presentation of the multivariate analysis results. In the bivariate analysis, the Chi-square test was performed. To conclude, the independent variables significantly associated with the reported asthma diagnosis were entered into a multivariate logistic regression model that provided the adjusted estimates. From the various variables, race, geographical area and education attainment appeared to be the most significant factors in association to asthma.

CHAPTER 5

DISCUSSION

5.1) Introduction

This chapter aims to discuss the results of this study within the context of previous research from the literature review. There were various social determinants used in this study in association to asthma. Although not all determinants had an association to asthma, they will be individually discussed. Thereafter, the limitations of the study will be outlined. The latter part of the chapter will suggest recommendations and conclusions for future studies in this field of research.

5.2) Discussion

The study was set in the context of South Africa where it is the norm for increasing levels of non-communicable disease prevalence. However, asthma varies according to one's SES and certain risk factors such as weight and smoking behaviors (Zhang *et al.*, 2013). According to this study, there were only 623 adults who were diagnosed with asthma from a total 15750 of the sample. In SSA, asthma has become an increased burden owing to tobacco smoking and exposure to biomass fuels (van Gemert, 2017). In most of the SSA countries, 90% of the rural households rely on biomass fuel for cooking and heating (van Gemert, 2017). Therefore, affecting these populations with asthma. The prevalence of asthma varies broadly between countries, for instance, Ethiopia 9.1%, Kenya 15.8%, Nigeria 13.0%, Mozambique 13.3% and South Africa 20.3% (van Gemert, 2017).

The wide variation in the prevalence of asthma is partially described by socioeconomic factors, exposure to tobacco smoke, air pollution, and diet (van Gemert, 2017). Even though a study by Moazed and Calfee (2015) showed a significant association between cigarette smoking and asthma among adults, whether cigarette smoking and the association of new asthma incidences was unclear (Moazed and Calfee, 2015).

"History of cigarette smoking is a common trend in older people, causing obstructive airways and consequently increasing the risk of asthma" (Gillman and Douglass, 2012). In this study, there was not a high prevalence of cigarette smoking and contrary to the hypothesis, there was no association with cigarette smoking and asthma among adults. This finding needs for further research in future studies on this topic.

Females were more likely than males to have an asthma diagnosis as shown in the bivariate logistic regression analysis. This is also true across all age groups among females (National Department of Health (NDoH), Statistics South Africa (Stats SA), South African Medical Research Council (SAMRC), and ICF, 2018). Innumerable social determinants affect the burden of asthma that may be disproportionate to women (Ebell et al., 2017). These include tobacco use, smoking behavior, household air pollution, SES and rurality (Ebell et al., 2017). After a female's first early occurrence of menstruation, puberty and pregnancies; the release of hormones plays "a role in the development of asthma" (Zein and Erzurum, 2015). Females respond differently to "environmental or work-related exposures" (Zein and Erzurum, 2015) than males. Compared to men, "women have smaller airways which may be subject to further airway obstruction because of smaller reductions in airway by increasing weight" (Wang *et al.,* 2015). However, one's weight may differ between men and women (Wang *et al.,* 2015). When controlling for other variables in the multivariate logistic regression, gender was reduced to non-significance. Yet, women face adversities in healthcare, income, employment, housing and education (Parry, 2011).

Age had a strong association with asthma, specifically the elderly who were older than 65. They were more likely than the rest of the adults to have been diagnosed with asthma. From the study, it was perceptible that the diagnosis of asthma among the respondents increased with age. The prevalence of current asthma in those over the age of 65 in Australia has been reported between 7.5 and 12.5%, predominantly among females (Gillman and Douglass, 2012). Although, the data showed that those who were in their forties and fifties were more likely to have asthma compared to younger adults between the ages of 15-24. "Despite asthma being regarded a disease of younger populations, asthma morbidity is also high among people over the age of 55" (Gillman and Douglass, 2012).

It is difficult to determine when asthma first begins among adults since it varies among the age groups and there is paucity of evidence (Mirabelli *et al.,* 2013 and Cox, 2017). In the multivariate logistic regression, age was reduced as non-significant.

Throughout the data analysis, race appeared to have a significant association with asthma, controlling for other variables in the multivariate logistic regression. In both the bivariate and multivariate logistic regression, Coloureds and Whites were more likely to be diagnosed with asthma. "In the US, current asthma prevalence is higher in black persons (11.2%) than in white persons (7.7%)" (Loftus and Wise, 2016). This is due to socioeconomic disparities such as low income, poor housing and lack of food (Mauban, 2016). Similarly, to the US, SA faces the same inequalities among race groups and jeopardizing their health status (Uwanaka, 2014). The White population in SA are regarded as affluent and are more likely to afford living in higher income areas where vehicle emissions may be higher than those in lower income areas, thus, exacerbating the risk of asthma.

Data from the study showed an association between marital status and asthma, with those who were divorced/separated as more likely than those who were married to be diagnosed with asthma. A rise in divorce rates among younger partners counterweighs lower risks of widowhood resulting in bad health outcomes among older people (Robards *et al.,* 2012). "Many studies in demographic research have highlighted that health outcomes for married people are better", especially among men (Robards *et al.,* 2012). A study in India found that "widowed/divorced/separated persons were more likely to report asthma than those who were married" (Agrawal *et al.,* 2013). Divorce and separation were linked to emotional stress that caused the development of asthma among these individuals (Agrawal *et al*., 2013). In another study, it was discovered that the lifetime diagnosis of asthma and current asthma was recently reported to be higher among same-sex relationships among both males and females (Zein and Erzurum, 2015). Such increased risk may have been mediated by a higher prevalence of obesity among same-sex partnered women and by the higher prevalence of cigarette smoking among same-sex partnered men (Zein and Erzurum, 2015). In the multivariate logistic regression, one's marital status was not significantly associated to asthma.

The Chi-square test showed an association between employment status and asthma whereby those not economically active were more likely to have an asthma diagnosis than those who were employed. Research showed that asthmatics who do have a job are able to afford taking care of themselves since asthma does cause "financial burdens" (Gray and Vawda, 2017) with the numerous visits to the hospital. Being unemployed or not being economically active only limits one's access to medical care (The Global Asthma Report, 2018). In the multivariate logistic regression, employment status was reduced to insignificant which contradicts the hypothesis because research also showed that "a relationship between the workplace and (asthma) symptoms helps to establish a connection between suspected air contaminants and asthma (Global Initiative for Asthma, 2006)."

In line with the hypothesis, education attainment was significantly associated with an asthma diagnosis throughout the data analysis. Those who did not have a formal education were more prone to being diagnosed with asthma and those with a higher attainment in their education would have "favorable outcomes of diseases (Kim and Nam, 2017)". Those in senior high were less likely to have an asthma diagnosis than those with no formal education. An Iranian study contradicted these results and showed that "more than two-thirds of asthmatic patients were enrolled in primary and secondary/high school education (Masoompour, Mahdaviazad and Ghayumi, 2018)." There was no specific relation between those with asthma and attainment in tertiary education in this study, however previous research stated that adults who had achieved a tertiary education at college were less likely to have been reported as diagnosed with asthma.

Geographic area remained significantly associated with asthma throughout the data analysis and the study showed that those residing in urban settings were more likely to report they had been diagnosed with asthma than those who lived in rural areas. Even though, in past studies, there have been little data that addressed the prevalence of asthma in rural versus urban areas, a study stated that asthma was more prevalent in urban areas than in rural areas (Valet et al., 2009). A reason behind this was that there was an increase in industrial pollution, motor vehicle fumes and the exposure to tobacco smoke in urban settings. Industrialized areas, such as Durban, has been one of the most polluted areas in southern Africa and has been listed as a hub for asthma (Naidoo, Gqaleni, Batterman and Robins, 2006).

A study in Bangladesh had also shown "a higher prevalence of asthma…in the urban population…than in the rural population (Bartlett et al., 2013)." On the contrary, "studies found a high prevalence of asthma in rural India, in opposition to results in industrialized countries" (Agrawal et al., 2013) such as Bangladesh. This is because households in rural India have an increased consumption in biomass fuels, resulting in an increase in indoor air pollution "which increases the burden of asthma among India's rural population (Agrawal et al., 2013 and Phaswana-Mafuya *et al*., 2012)."

While results from the study showed no association between households with per capita income and asthma in the data analyses, previous studies specified that those who earn higher incomes may afford to indulge in cigarette smoking and live nearer to urban and industrial which would make them susceptible to asthma (Phaswana-Mafuya *et al*., 2012). Phaswana-Mafuya *et al* (2012) stated there was a strong association between income levels and asthma whereby lower levels of income may increase the risk of asthma. The CSDH stated that "people in lower income quintiles have a higher rate of chronic illnesses as opposed to people in higher income quintiles (Parry, 2011).", thus influencing the prevalence of asthma.

5.3) Limitations

Limitations found in this study can be missing data through refusals and nonresponses and misreporting by those in the NIDS surveys which may have created biasness by nonresponse. There can be a sense of biasness found in the adult and household questionnaires. Misreporting may have come from a respondent's smoking behavior, employment statuses, household conditions and their current smoking and asthmatic statuses. Though there is a scarcity of data on reported asthma in South Africa, it is believed that the true prevalence of asthma may be underestimated because diagnosing asthma is complex. Those with a higher SES may be less likely to have asthma, those who do are more likely to be diagnosed. Jindal (2014) states that cigarette smoking is a common cause and risk factor for asthma. In his epidemiological study, Jindal (2014) reported the exposure of second-hand smoking increases one's risk on asthma (Jindal, 2014). Since second-hand smoking was not deliberated in smoking behavior, this created a limitation in the study.

This study was purely quantitative, therefore was limited to a more thorough exploration of the 'human lived experience,' such as a person's psychosocial determinants of asthma (emotional stress) and the motivation for their smoking behavior. Other independent variables of interest were not available because this study was a secondary analysis. Such variables included second-hand cigarette smoke, same-sex relationships and air pollution. The study was limited to the association of race, geographic area, education attainment and asthma.

5.4) Recommendations

The findings in the study discovered a significant association exists only between race, geographic area, education attainment and asthma. However, in South Africa policies should be implemented to maintain social equalities in healthcare, income distribution and new strategies to control the burden of asthma among those of different race groups, geographic settings and the educated. An example of such strategies is the National Tobacco Control Program started in the 1980s on Brazil. After recognizing smoking as a major risk factor and health problem, Brazil created this strategy (Xavier, Del-Ponte and Santos, 2018). The first public health treaty in the world was held in 2005- the Framework Convention on Tobacco Control which Brazil contracted (Xavier *et al.,* 2018). WHO, negotiating this treaty, adopted resolutions to curb global demands for tobacco (Xavier *et al.,* 2018). Thus, smoking was banned in public spaces and transport. Tax was charged on tobacco and warnings was included on cigarette packs. A strategy such as this should be adopted in SA to prevent cigarette smoking as a great risk factor to other diseases.

In addition to the strategy, both private and public health strategies and interventions are required to reduce the burden of asthma in those who already have developed the disease (Beasley, Semprini and Mitchell, 2015). Such strategies and interventions include improved lung functions, reducing environmental tobacco exposure, reducing indoor and outdoor air pollution, reducing occupational exposures to allergens and reducing obesity by controlling diet (Beasley *et al.*, 2015). More studies on second-hand cigarette smoking will allow for the overall understanding of how cigarette smoking may associate itself to asthma and whether a relationship exists at all with asthma.

Psychological interventions may be advantageous for asthma prevention and treatment when it comes to emotional stresses, while it is important to explore how injurious social conditions hinder access and adherence to appropriate asthma medication and treatment (Yakubovich, Cluver and Gie, 2016). “It is to be anticipated that future public health programs will need to develop multidisciplinary interventions, including psychosocial interventions, to counter SA’s rising asthma epidemic” (Yakubovich *et al.*, 2016, p 412). Psychosocial interventions may help researchers understand how dissolution of marriages and other “lived human experiences” may cause the development of asthma. Even though there is literature on gender an asthma, it is vital to provide more evidence on the effect of same-sex marriages and asthma since there is a prevalence of asthma among homosexual couples.

5.5) Conclusion

Demographic, socioeconomic and modifiable risk factors have created the burden of asthma and its prevalence worldwide. In SA, the burden of asthma has been owed to the disparities caused socially among people of different race, economic status and their social standings (The Global Asthma Report, 2018). Cigarette smoking may have not been associated with asthma in this study, however, a few cigarette smokers were asthmatic. To lower the future risks of cigarette smoking on asthma, SA needs to implement strategies to help reduce the consumption of cigarette smoking which in hand decreases asthma symptoms and chances of becoming diagnosed with asthma. With the increase in urbanization, diet and lifestyles change which have shifted health patterns. Consequently, increasing the prevalence of asthma across SA. Evidence from countries like Brazil is proof that approaches to reduce risks are effective and mandatory.

Guidelines set out by GINA will serve to educate South Africans with asthma on how to keep to their correct treatments and manage their disease (Global Initiative for Asthma, 2006). Asthma that affects millions of people worldwide, GINA has aimed to control the burden of the disease among those who are living with it. The diagnosis and the treatment of asthma may be inadequate and challenging in a country like SA, therefore is important to be educated and adhere to treatment plans that come with asthma (The Global Asthma Report, 2018). The burden of asthma on governments, healthcare organizations and families are growing global, particularly in SA, hence keeping all factors in mind will result in an all-inclusive cognizance of the disease.

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UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

05 September 2019

Miss Tanuja Singh (215013396)
School of Built Env & Dev Stud
Howard College

Dear Miss Singh,

Protocol reference number: HSSREC/00000303/2019
Project title: Demographic, socioeconomic, and life style risk factors associated with asthma in adults in South Africa in 2017

Full Approval – Expedited Application

This letter serves to notify you that your application received on 11 June 2019 in connection with the above, was reviewed by the Humanities and Social Sciences Research Ethics Committee (HSSREC) and the protocol has been granted **FULL APPROVAL**

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number. PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

This approval is valid for one year from 05 September 2019.
To ensure uninterrupted approval of this study beyond the approval expiry date, a progress report must be submitted to the Research Office on the appropriate form 2 - 3 months before the expiry date. A close-out report to be submitted when study is finished.

Yours sincerely

[redacted]

Dr Rosemary Sibanda (Chair)

/spm