UNIVERSITY OF THE WITWATERSRAND

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PREVALENCE AND DETERMINANTS OF SELF-REPORTED HYPERTENSION IN URBAN POOR SETTLEMENTS OF JOHANNESBURG

A RESEARCH REPORT SUBMITTED TO THE SCHOOL OF PUBLIC HEALTH, UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN EPIDEMIOLOGY AND BIOSTATISTICS

A RESEARCH REPORT BY

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DECLARATION

I, *Fossa Ogake Kinara*, declare that this is my own work, submitted for the degree of Master of Science in Epidemiology and Biostatistics at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.

Signature: *ogake.*

Date: 13th November 2017

DEDICATION

I dedicate my work to my parents Dr. Enock Kinara and Mrs. Eucabeth Kinara whose constant encouragement, love and support gave me the courage to follow my dreams.

ABSTRACT

Background: Hypertension is the leading risk factor for cardiovascular disease in Africa. Cardiovascular disease is rated as the number one cause of death in Africa. Previously, hypertension was known to predominantly affect the affluent population but recently the condition has been emerging even among the poorer population, rendering it a greater burden. In South Africa its prevalence level has significantly escalated, particularly in urban areas, with higher incidence among the poor. The prevalence of self-reported hypertension and its risk factors is not well documented in the urban impoverished settlements. Understanding determinants and the prevalence of self-reported hypertension in these areas will help develop improved awareness, prevention and control strategies. This study aimed to determine the prevalence and determinants of self-reported hypertension in five urban impoverished sites in Johannesburg, South Africa.

Methods: Secondary data analysis was done on data from the HEAD study which involved a sample of households from five urban poor areas. Prevalence levels of self-reported hypertension were estimated within the study areas. Summary measures of the data were computed and presented in a descriptive table. Distribution of the potential risk factors by prevalence of self-reported hypertension was also done. Lastly, binary logistic regression was used to model the unadjusted and adjusted association between the identified risk factors and self-reported hypertension.

Results: The prevalence of self-reported hypertension among households in the five urban impoverished sites was 20 percent (n=107). The independent predictors of hypertension were study area (Riverlea, Hillbrow), race, age, gender (0.25-0.49 and ≥0.75), work (0.5-0.74, and ≥0.75), monthly income (ZAR 1000-2000, 2001-5000, and >5000), presence of another non-communicable disease and socioeconomic status (middle). Results from the adjusted model showed that race, sex, age and presence of at least one other non-communicable disease are were significantly associated with self-reported hypertension

Conclusion: The study's findings strengthen the case that age, sex, race, and co-morbid non-communicable diseases are associated with self-reported hypertension. Interventions that target the urban poor population and that focus on increasing awareness and context specific risk reduction are recommended. Further, the association with these factors should be confirmed by carrying out a more robust population-based study to inform policy.

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LIST OF ACRONYMS

BMI	Body Mass Index
CVD	Cardiovascular Disease
LMIC	Low and Middle Income Countries
NCD	Non-communicable Disease
PCA	Principal component analysis
SES	Socioeconomic Status
SSA	Sub-Saharan Africa
ZAR	South African rand

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CHAPTER 1: INTRODUCTION

1.1 Description of hypertension

Hypertension is defined as a cardiovascular disease which results in blood continually flowing in the vessels at a higher pressure than normal (Rayner et al. 2014). The normal blood pressure is categorized into three groups: normal at less than 120mmHg /80mmHg, optimal at 120-129mmHg/80-89mmHg and high normal at 130-139mmHg/85-89mmHg. *The South African hypertension practice guideline 2014* classifies hypertension into 3 categories: Grade 1, 2 and 3 these are blood pressure levels of 140-159 mmHg/90-99mmHg, 160-179mmHg/100-109mmHg and ≥ 180mmHg/160mmHg, respectively (Rayner et al. 2014).

Hypertension can also be classified into two groups based on its causes. The first group is comprised of about 5 percent of the population with hypertension, with the causes presumably linked to underlying diseases such as renal and adrenal diseases. The second group is comprised of 95% of the population with hypertension and is known to be having essential hypertension. Essential hypertension is attributed to environmental and genetic factors. However, these factors and their role in causing hypertension are neither precisely described nor known (Beevers et al. 2014).

1.2 Background

Hypertension has become one of the world's most popular public health concerns. It is considered a global health concern because of its contribution to the burden of cardiovascular diseases (CVD) (Awuah et al. 2014). Cardiovascular diseases are known to be responsible for

approximately 30 percent of all deaths worldwide with an overall, 80% of these deaths occurring in low and middle income countries (Deaton et al. 2011; Abegunde et al. 2015). Abegunde et al. (2015) has projected that by 2020 the non-communicable CVDs will become the leading cause of deaths and disability globally (Abegunde et al. 2015). Taking into consideration that hypertension is a significant modifiable risk factor for CVD, Sliwa et al. (2011) and Abegunde et al (2015)'s suggested that addressing the hypertension issue would probably be the most effective way to stifle the increasing burden of CVD (Sliwa et al. 2011; Abegunde et al. 2015).

The global burden of diseases attributed to hypertension was seen to increase from 4.5 percent in 2000 to 7 percent in 2010 (van de Vijver et al. 2013). According to the World Health organization (WHO), 45 percent of the deaths caused by heart disease and 51 percent of deaths caused by stroke are due to hypertension (Anon 2013). Most of these deaths are occurring in low and middle income countries (LMIC) (Addo et al. 2007; Abegunde et al. 2015).

Hypertension is disproportionately affecting the low and middle income countries. The prevalence of hypertension in the year 2000 was shown to be increasing in LMIC but remaining steady or decreasing in high-income countries (Addo et al. 2007). Hypertension has also been estimated to affect at least one in every five adults in LMIC (van de Vijver et al. 2013). Whilst it was barely existent in the early 20th century, Van der Vijver et al (2013) state that the prevalence is as high as 40 percent in some African settings (van de Vijver et al. 2013). Kearney et al. (2005) predicted that the prevalence of hypertension in SSA would increase over a span of 25 years between 2000 and 2025. A contradictory investigation in a systematic review done in 2011 showed that the highest increase in systolic blood pressure values by the year 2008 was in the Sub-Saharan Africa (Danaei et al. 2011).

Hypertension is affecting about 74.4 million people in Sub-Saharan Africa (SSA), currently particularly high in urban population similar to the levels seen in developed countries (Addo et al. 2007; Ogah & Rayner 2013). South Africa like most of the other SSA countries is also highly affected by hypertension. Kandala N-B, Tigbe W, Manda SO (2013) report that the prevalence of hypertension in South Africa is as high as 30.4 percent in the adult population (Kandala N-B, Tigbe W, Manda SO 2013). This extensively high proportion is of concern because just like many SSA countries the prevention is rarely prioritized on the health agenda, since the country is highly burdened by communicable diseases such as HIV and TB (Mathers & Loncar 2015). Addo et al. (2007) claim that hypertension is already a health concern in SSA particularly in the urban population and there is under-diagnosis and lack of effective strategies towards its prevention, detection and treatment (Addo et al. 2007).

1.3 Statement of problem

The world is rapidly becoming more urbanized with the UN Population Fund (UNFPA) noting that a turning point was in 2008 when the population in urban areas became greater than that in rural areas (Shetty 2011). This increase in population in urban areas comes with problems, especially human health related challenges caused by the burden on infrastructure as the cities are not entirely designed to cater for the great magnitudes that they have to host (Shetty 2011). Most of the migrants therefore end up living in areas with poor housing structures, inadequate water supplies, lack of electricity and extreme overcrowding (Miraftab & Kudva n.d.). In addition, the migrant population tends to be neglected because on one hand the government does not pay attention to environmental and health issues of urban slums or informal settlements and on the other, the non-governmental organizations (NGO) focus a lot of attention on the rural

populations (Miraftab & Kudva n.d.; Shetty 2011). Notwithstanding that health needs of this population are high, they are not addressed because of many factors, for example, the fact that most of the slums are considered illegal structures and are not included in government health planning and budgeting (Shetty 2011).

Recent studies have been showing a rise in the burden of non-communicable diseases in urban poor populations (Brashier et al. 2012; Mills et al. 2016). Urbanization came with lifestyle changes such as increased alcohol intake, increased smoking, and reduced physical activity. These behaviors have contributed to the evolving NCD epidemic (Ayah et al. 2013). Hypertension is one of the leading NCDs and is shown to have a prevalence of as high as 25 percent in South Africa's urban areas compared to 10.5 percent in rural areas. This should be concerning considering 64% of South Africans live in urban areas (Ibrahim & Damasceno 2014; Kandala N-B, Tigbe W, Manda SO 2013). South Africa's large urban population comes with disparities specifically experienced within the urban poor population. Studies done in similar population groups show that the prevalence of hypertension in these areas is high whilst the level of awareness and control are very low (Vijvera et al. 2013; Awuah et al. 2014). The study by Vivjera (2013) is noteworthy in that it notes that the prevalence in a similar setting, a slum in Nairobi, is as high as 18.4% (Vijvera et al. 2013).

Currently, there is paucity of information on the risk factors responsible for the high prevalence of hypertension in urban impoverished communities of South Africa. This study, therefore, will determine the prevalence and identify determinants of self-reported hypertension in five urban impoverished settlements in Johannesburg.

1.4 Justification

Hypertension has traditionally been viewed as a disease of the affluent yet recent studies show that it is greatly affecting the impoverished population (Vijvera et al. 2013; Doulougou et al. 2014). The disease has a major impact on the poor population because they have deficient dietary habits and limited access to health care as well as lack of awareness (Vijvera et al. 2013). Increased knowledge in the prevalence of self-reported hypertension and determining the risk factors of hypertension in these urban impoverished sites can help develop programs that target the primary prevention of hypertension by the implementation of strategies of prevention, awareness and access to effective treatment.

1.5 Aim and objectives of the study

Research question

What is the prevalence and risk factors of self-reported hypertension within households in urban poor settlements of Johannesburg?

Aim

To estimate the prevalence and identify the risk factors of self-reported hypertension within households in urban poor settlements of Johannesburg

Objectives

1. To describe the distribution of self-reported hypertension and its potential risk factors among five urban poor settlements in Johannesburg in 2012.
2. To estimate the prevalence of self-reported hypertension in households of five urban poor settlements in Johannesburg in 2012.

3. To identify the risk factors of self-reported hypertension in five urban poor settlements in Johannesburg in 2012.

1.6 Literature review

1.6.1 Prevalence of hypertension

An estimated 20% of South Africa's population is living with hypertension (Mills et al. 2016). The prevalence varies across different population groups within the country. The variations are due to behavioral, genetic, socioeconomic and demographic factors. According to a study done in South Africa, the prevalence is higher in the urban areas compared to the rural population with a 15 percent difference (urban 25%, rural 10.5%) (Ibrahim & Damasceno 2014). In addition, there are great disparities in the urban areas with the poor settlements having a higher prevalence than middle class and affluent communities (Vijvera et al. 2013).

Variations are also seen across age groups with the older population having a higher prevalence than the younger generation. According to a systematic review by Mills et al. (2016), the prevalence of hypertension worldwide when classified by age 40 and below was 8.5-30.9 percent while those aged 40 and above was 15-91.8 percent (Mills et al. 2016). Hypertension prevalence has also been known to differ according to sex. According to various studies done in South Africa, hypertension has been noted to be more common in women than in men (Lloyd-sherlock et al. 2014; Mills et al. 2016; Peltzer & Phaswana-mafuya 2013). The prevalence of hypertension is also noted to vary across racial/ethnic groups. According to a study done on the older population of South Africa, hypertension was seen to be more prevalent among the Coloured

population compared to the other racial groups (Peltzer & Phaswana-mafuya 2013). Hypertension is also known to be more prevalent among individuals who had a lower education level, lower household income and had other conditions such as diabetes and stroke (Peltzer & Phaswana-mafuya 2013).

Most studies in South Africa used the measure of blood pressure levels to estimate the prevalence of hypertension in a population. This is the preferred and most effective method to estimate the population prevalence of hypertension. Since this method is considered costly and complex, various studies employ the self-reported measure of morbidity (Moreira et al. 2013; Thawornchaisit et al. 2014). Though the prevalence of specific self-reported hypertension in South Africa is not known the approximated prevalence of hypertension in general is at 20% similar to that of other SSA countries (Mills et al. 2016).

1.6.2 Risk factors

Studies have been done to find an association between different factors and hypertension. Studies on the risk factors of hypertension are focused on averting CVD mortality sub-Saharan African countries such as Kenya and Cameroon(Kingue et al. 2015; Joshi et al. 2014). Hypertension is often associated with factors such as age, ethnicity/race, sex, body mass index, occupation, socioeconomic status, education level, geographical region, cardiovascular diseases and family history (Sliwa et al. 2011; Addo et al. 2007; Kearney et al. 2005).

Socio-demographics

Studies done in a Kenyan slum and Ouagadougou informal setting highlights the factors that are associated with hypertension in recent years in similar impoverished communities (Hulzebosch

et al. 2015; Doulougou et al. 2014). It has been found that various socio-demographic factors such as age, sex, race, urban/rural settings, education, employment and socio-economic status are associated with hypertension (Ibrahim & Damasceno 2014; Maimela et al. 2016). A study done in the Limpopo Province of South Africa showed that the prevalence of hypertension increased significantly with age (Ntuli et al. 2015). Similar trends of high prevalence of hypertension among older adults were reported by Peltzer and Phaswana-Mafuya on a study done on older South Africans (Peltzer & Phaswana-mafuya 2013). This study also further states that hypertension is associated with females, similar to other studies around the world (Peltzer & Phaswana-mafuya 2013; Kaplan et al. 2010; Agyemang 2006; Li et al. 2016).

Socio-economic factors such as education, employment and income levels are known to be determinants of health based on their influence on access to health, decision making and healthy lifestyle. According to a study done in China and another done in the USA the risk of hypertension was higher among those with a lower level of education (Meng et al. 2010; Frieden 2011). This is similar to studies done in SSA in 4 urban and rural communities (Hendriks et al. 2012). which found that individuals with lower socioeconomic status had higher blood pressure levels (Hendriks et al. 2012). According to WHO's *a global brief on hypertension*, being unemployed is indirectly associated with hypertension owing to stress levels being high among the unemployed which in turn increases their blood pressure. Unemployment can also mean lack of financial resources and access to early diagnosis and treatment (World Health Organisation 2013).

Many population groups in the Sub-Saharan region are undergoing epidemiological transition[1]. This has led to socioeconomic and demographic diversities. Hypertension is known to be associated with demographic factors such as living in a rural or urban area. A study done in South Africa investigating the geographic distribution of hypertension showed that it was higher in provinces that were generally remote and had poorer access to facilities (Kandala N-B, Tigbe W, Manda SO 2013). Based on this finding, the conclusion could be that hypertension is associated with rural areas, although other factors have to be considered. This is also true for race/ethnicity when socioeconomic status and education are considered as its proximate factors. Results from a study done in the U.S.A. showed that Black people had a significantly higher prevalence of self-reported hypertension, similar to a study done in South Africa that showed that it was higher among the Coloured people (Frieden 2011). Both these communities are generally considered less affluent as they predominantly live in impoverished areas.

Co-morbidities

A small percentage of hypertension is attributed to genetic factors and underlying diseases, with the higher percentage being due to environmental and lifestyle factors (Beevers et al. 2014). The prevalence of non-communicable cardiovascular diseases such as diabetes is also high and is often associated with hypertension as a primary or secondary factor. A study done by Steyn et al. postulated that family history of stroke and obesity is associated with a higher risk of hypertension (Steyn et al. 2008). Another study done in Namibia by Hendriks et al. also showed an association between other CVD risk factors such as obesity and diabetes with hypertension (Hendriks et al. 2012).

[1] Epidemiological transition is defined by McKeown as "a description of changing patterns of population age distributions, mortality, fertility, life expectancy, and causes of death" (McKeown 2010).

1.6.3 Hypertension in urban areas

The world's urban population is presently estimated to constitute about 50 percent of the total population and is projected to increase to about two-thirds of the population in the next 30 years (Vlahov et al. 2007). Most of this growth is expected to occur in the economically poor regions of the world, with most of the rapid growth being in Africa and Asia. In addition, most of the growth is expected to occur in developing countries with a large proportion of it being projected to be in slums. This points to the notion that urbanization is generally linked with development which in turn leads to growth of slums that are linked to poor health conditions (Vlahov et al. 2007).

Urbanization and industrialization have caused a shift from majorly infectious diseases and nutrition deficiencies to degenerative diseases such as CVD. Hypertension is categorized as the leading risk factor for CVD and its prevalence is increasing with the shift (Yusuf et al. 2001). Urbanization and change in lifestyle in many African countries have brought about an increase in the prevalence of hypertension (Ratovoson et al. 2015). The increased prevalence of hypertension specifically in urban areas in SSA areas is believed to be due to the transition to a more westernized lifestyle (Hendriks et al. 2012).

Studies also show that there are great regional differences in the prevalence of hypertension, especially in SSA. In South Africa, particularly the increase in non-communicable diseases including hypertension is greater in urban areas than in rural areas (Bradley & Puoane 2007). Gaziano states that this high prevalence is in turn disproportionately affecting the impoverished (Gaziano et al. 2014). Therefore, there is need to further study the risk factors of hypertension that predispose people who live in impoverished urban settings, as they are at a higher risk than others, as evidenced from the literature reviewed. Despite there being an evident association

between hypertension and lifestyle factors, few studies have been done to identify the major determinants of self-reported hypertension in impoverished urban settings particularly.

CHAPTER 2: METHODOLOGY

This chapter describes the methods of the study. It is divided into five sections: Study design and setting; study population; sampling and data collection; variables and their descriptions; statistical analysis and ethical consideration.

2.1 Study design and setting

This is a cross-sectional secondary data analysis of the Health, Environment and development (HEAD) study which was conducted in Johannesburg, South Africa in 2012. The data was collected from five study sites; Braamfischerville, Bertrams, Riverlea, Hospital Hill and Hillbrow. The HEAD study is an annual household level cross-sectional survey that assesses trends in environmental conditions and health status of poor communities (Naicker et al. 2015). The HEAD study collected information on socio-demographic status, perceptions of housing, neighborhood conditions, behavioral risk factors, air quality and health status.

The five study sites represent the main housing types for the poor in Johannesburg. These sites are relatively poor suburbs ranging from the so-called “apartheid era suburbs” to post-apartheid informal and formal high-density suburbs (Naicker et al. 2015).

Table 1 Characteristics of the five study sites

Study site	Description
Bertrams	A mixed residential-commercial inner city suburb located east of central Johannesburg. It is characterized by young and transient residents.
Braamfischerville	A post-apartheid low-cost housing development built following the transition from apartheid to a democratic government in South Africa. It is characterized by relatively established older residents.
Hillbrow	A high-rise inner city suburb which was originally an apartheid-designated "White only" area in the 70s but became a "grey area" around the 80s. It is now a densely populated cosmopolitan area and is characterized by degradation. The population is older and has more established residents.
Hospital Hill	An informal settlement on the western boundary of the city, characterized by a relatively mobile population.
Riverlea	An apartheid era low-cost housing development that was constructed in the 60s for the Colored community. It is characterized by older residents.

2.2 Study population, sampling and data collection

The study population consisted of 548 households from the five urban impoverished sites in the year 2012 (73 in Bertrams, 147 in Braamfischerville, 66 in Hillbrow, 138 in Hospital Hill, and 124 in Riverlea).

The households were randomly selected from these five study sites in the primary study. In Bertrams, Riverlea and Braamfischerville, dwellings were randomly selected and any non-residential or vacant dwellings were excluded. Hospital Hill dwellings were selected according to convenience. Hillbrow apartment buildings were randomly selected, and within those, floors were randomly selected from these apartment buildings. Individual apartments were subsequently randomly selected from these floors. Data was collected from the selected households for the study. A household member of at least 18 years completed a questionnaire following his/her written consent.

2.3 Variables and their descriptions

Descriptions of the variables' categorizations and transformations are summarized in Table 2-2.

2.3.1 Response variable

Hypertension: It is defined as self-reported hypertension in our study. The question posed in the questionnaire was, "does anyone in this household have any of the following conditions?" The categories were: Cancer, Asthma, Tuberculosis, Diabetes, Frequent headaches in the past 3 months, Hypertension, Heart disease, High cholesterol, Stroke, HIV/AIDS, Obesity, Psychiatric/ Mental health illness, a Disability or other. The response to hypertension was used and categorized as follows:

- 1-Yes
- 0-No

2.3.2 Explanatory variables

Race: This variable is considered because of the difference in prevalence across different races as well as an association reported in previous studies (Steyn 2005, Peltzer and phaswana 2013).

This information was obtained from the respondents by posing the following question "what is the main population group in this household?" It was originally categorized as follows:

- 1 Black African
- 2 Colored
- 3 Indian
- 4 White

For purposes of analysis, the three categories; Colored, Indian, and White were combined into the same group due to small numbers. The variable was then categorized as:

- 1 Black African
- 2 non-black African

Other self-reported non-communicable diseases (excluding hypertension): this variable was selected because non-communicable diseases have been found to have an association with hypertension according to arguments by authors such as Hendriks et al. (2012) and Awoke et al. (2012).

The variable's information was based on the question posed as follows: "does anyone in this household have any of the following conditions?" The categories were: Cancer, Asthma, Tuberculosis, Diabetes, Frequent headaches in the past 3 months, Hypertension, Heart disease, High cholesterol, Stroke, HIV/AIDS, Obesity, Psychiatric/ Mental health illness, a Disability or other. The responses for diabetes, heart disease, obesity and stroke were used to create a new variable that represented the presence of at least one other NCD in the household. The variables were initially categorized as

- Diabetes (0-no, 1-yes)
- Heart disease (0-no, 1-yes)
- Obesity (0-no, 1-yes)
- Stroke (0-no, 1-yes)

These variables were used to generate a new variable with information on the presence of other non-communicable diseases. This variable was categorized as:

- 0- no presence of other NCD
- 1- presence of at least one other NCD

Sex, age, level of education and work: information on these variables were obtained by posing the question: "Starting with the respondent, followed by the head of the household please state the first name, age, sex, achieved education qualification and main activity during weekdays for each member of the household". The information was on each member of the household. To be able to analyze the data on a household level, new variables were generated.

Sex: the household members' sex variable was considered because of the documented hypertension disparities between the sexes(Sandberg & Ji 2012).

The sex variable was coded as:

- 0 - Male
- 1 - Female

The variable of each member's sex was combined to generate a new variable representing the proportion of the females in the household.

Age: This variable was considered because it is a known non-modifiable factor that is associated with high blood pressure (Joshi et al. 2014; Tsai et al. 2007). The research used the cut-off of 40 years based on literature that shows the prevalence of hypertension is 35 percent higher in individuals aged 40 and above than in younger age groups in Sub-Saharan countries (Kearney et al. 2005).

The variables were first categorized into a dichotomous variable as follows:

- $0 < 40$
- $1 \geq 40$

These categorized age variables were then used to generate a variable that combines all the household members' age data. The variable generated was the proportions of the household members aged 40 and above.

Education: This variable was selected because of a known relationship between the level of education and hypertension according to previous studies done (Frieden 2011). Frieden (2011) postulates that the prevalence of hypertension was lower among individuals with an education level above high school compared to those with lower education. The education variable was grouped as:

- 1 - None
- 2 - Primary
- 3 - High
- 4 - Tertiary

Owing to the fact that the numbers of those with secondary education or higher were low, education variables were categorized as:

- 0 < primary education
- 1 ≥ primary education

These variables were then used to generate a household level variable that was the proportions of the household members that had at least a primary education.

Daily activity: this variable was selected based on the kind of activities an individual involves themselves in. This variable was originally grouped as:

- 1 - Full-time
- 2 - Part-time
- 3 - Unemployed
- 4 - House person
- 5 - Informal job
- 6 - Tertiary education
- 7 - School
- 8 - Crèche
- 9 - Other

This variable of daily activity was then regrouped into the following:

- 0 - working
- 1 - not working

The group ‘working’ was derived from the groups: 1-full-time, 2-part-time and 5-informal job. The group ‘not working’ was from the groups: 3-unemployed, 4-house person, 6-tertiary education, 7-school, 8-crèche, and others. The variables were then aggregated to form a variable that represented the proportion of those who work in the household.

Income: This is the average income of the household. The question posed was “what is the average income of this household excluding grants and pensions?” These were grouped into:

- 0 - No income
- 1 <1000
- 2 - 1000-2000
- 3 - 2001-5000
- 4 - 5001-10000
- 5 >10000
- 9 - refused to answer
- 10 - don’t know

The variable was then regrouped as:

- No income
- R <1000
- R1000-2000
- R 2001-5000
- R>5000
- Didn’t answer

SES (socioeconomic status): This information was derived from a number of variables using principal component analysis (PCA). PCA was used to construct the SES index using the variables from the question on household items, "state whether members of this household own any of the items: Radio, television, satellite television, refrigerator, washing machine, microwave, car, computer, telephone". The first principal component explained 33 percent of the variability in the data. This principal component was considered for construction of the socioeconomic status. The lowest group was low = 1, the next group was medium = 2 and the highest group was high =3.

Table 2 Variables of the study[2]

Variable	Initial categories	Categories in analysis
Response variable		
Hypertension	1 Yes 0 No	1 Yes 0 No
Explanatory variables		
Race	1 Black African 2 Coloured 3 Indian 4 White	1 Black African 2 Non-black African
Sex	0 male (every household member) 1 female (every household member)	These variables of the gender sex of individual household members were used to generate a new variable of the proportion of females in the household
Age	The age of each household members	Proportion of individuals aged 40 and above
Other non-communicable diseases	Diabetes (0 no, 1 yes) Obesity (0 no, 1 yes) Stroke (0 no, 1 yes) Heart disease (0 no, 1 yes)	0 No presence of other NCD 1 Presence of other NCD
Education level	Education of every household member 1 none 2 primary 3 high 4 tertiary	Regrouped to (0= none, 1= primary, high and tertiary). These variables were used to generate a variable of the proportion of individuals in the household with an education level equivalent to or higher than primary school
Daily activity of every household member	Daily activity of every household member 1 fulltime 2 part time 3 unemployed 4 house person 5 informal job 6 tertiary education	Regrouped to (0= unemployed, house person, tertiary education, school, crèche, other, 1= full-time, part-time, informal job). These variables of individual work status were used to generate a variable with the proportion of individuals in the household who are employed

[2] Initial categories- this is how the variables were categorized in the raw data from the primary study
Categories in analysis- this is how the variables were categorized for this study's analysis

Variable	Initial categories	Categories in analysis
	7 school 8 creche 9 other	
Monthly income	0 No income 1 <1000 2 1000-2000 3 2001-5000 4 5001-10000 5 >10000 9 refused to answer 10 don't know	0 No income 1 <1000 2 1000-2000 3 2001-5000 4 >5000 5 No answer
Socioeconomic status	Household items: Radio, television, satellite television, refrigerator, washing machine, microwave, car, computer, telephone	A continuous variable from the score derived from the analysis of household items using principal component analysis. It was then regrouped into three categories. 1 Low 2 Middle 3 High
Area	1 Bertrams 2 Braamfischerville 3 Hillbrow 4 Hospital Hill 5 Riverlea	1 Bertrams 2 Braamfischerville 3 Hillbrow 4 Hospital Hill 5 Riverlea

2.4 Statistical analysis

2.4.1 Data management

Data from the primary study was stored in an Excel spreadsheet. The data was imported into STATA 13.0 for analysis (StataCorp 2013). Cleaning of the data involved dropping variables

that were not relevant for the study. For the purpose of analysis, some variables were recategorized and others generated as illustrated in Table 2.

2.4.2 Descriptive analysis

Distribution of self-reported hypertension by sites (Objective 1)

To describe the distribution of hypertension and its risk factors across the five study sites, bivariate descriptive analysis was conducted for categorical variables while median was computed for continuous variables.

Prevalence of self-reported hypertension (Objective 2)

The site-specific prevalence, as well as the overall prevalence of hypertension, was estimated by selected characteristics. Pearson chi-squared analysis was performed as well as a graphical presentation in the form of a bar graph to achieve this objective.

2.4.3 Inferential analysis

Factors associated with self-reported hypertension (Objective 3)

To identify the factors associated with self-reported hypertension, a binomial logistic regression model was built using the variables age, area, race, other NCDs, education level, work status, income, SES, and sex. The variables were first checked for independent association to the outcome variable. The adjusted model was then fitted with all the variables.

2.5 Limitations

The study had a few limitations with regards to the variables used. All the variables were "self-reported" and the use of self-reported hypertension did not include individuals who were unaware of their status. There was also an underrepresentation of other races and employed

people in these sites. Additionally, the study analyzed secondary data which lacked information on important determinants such as consumption of alcohol, diet, and physical activity and most variables that were available were transformed in order to be analyzed.

2.6 Ethical consideration

The primary study obtained ethical approval from the Human Research Ethics Committee of the University of the Witwatersrand and participants completed informed consent forms prior to participation in the research. Ethical permission was obtained from the beginning of the study in 2006 with the most recent ethics renewal obtained on 9 April 2010 as seen in Appendix 1.

The protocol for this study was submitted to the Human Research Ethics Committee (HREC) of the University of the Witwatersrand. Permission was obtained on the 7 March 2016, protocol number M160239 as seen in Appendix 2.

The confidentiality of the participants was kept by keeping the identifiers anonymous. The data was kept under lock and key throughout the research period with only the researcher and the supervisors having access to it.

CHAPTER 3: RESULTS

This section presents the results from secondary data analysis of the HEAD cross-sectional study on Prevalence and Determinants of Self-Reported Hypertension in Urban Poor Settlements of Johannesburg. It is structured according to the specific objectives of the study and consists of three parts. The first part describes the characteristics of the population and makes a comparison across the five study sites. The second part gives a graphical presentation of the prevalence of self-reported hypertension as well as a detailed table of the prevalence of self-reported hypertension by selected characteristics. The final part shows the factors associated with self-reported hypertension.

3.1. Characteristics of the study population

From the 2012 data, a total of 548 households were included in the study. Data on hypertension status was available in 534 of the households and these households were used for statistical analysis. Table 3 gives a general description of the study variables. The total number of the households that had at least one member who reported having hypertension was 107(20%), while 80% (n=427) of the households reported having no member with hypertension. The percentage of households with hypertensive members varied by area of study: Riverlea area had 33% (n=39), Bertrams 24.3% (n=17), Braamfischerville 17.1% (n=25), Hospital Hill 16.9% (n=23) and Hillbrow 4.7% (n=3).

The majority of households were predominantly Black African, while only 25.5% (140) of the households were non-Black African. The dominant race across the sites was Black African, apart from Riverlea that had 90.3% (112) of the households being non-Black.

Since all the continuous variables were skewed, they were summarized as medians with interquartile ranges (IQR). The overall median proportion of households with household members aged 40 and above was 0.25(IQR=0.5) i.e. there were more households with a higher proportion of members below the age of 40. Hillbrow had no household where household members were 40 years or older, while Riverlea had the highest proportion of households with members above 40 years 0.33(IQR=0.5). Most of the households had a lower proportion of females 0.33 (IQR=0.3) and had high proportion of household members with a primary school education or higher 0.67(IQR=0.6). Hillbrow had the highest median proportion of its members with more than a primary school education 1 (IQR=0.33), while Hospital Hill had the lowest 0.5(IQR=0.67).

Generally, the proportion of the households members who were not working was low (0.33, IQR=0.57), though high proportion of household members in Hillbrow were working 0.67(IQR=0.5). Above a quarter of households fell in the ZAR2001-5000 per month income bracket 24.5% (n=131) while about 10% of households had no income. A total of 109(20.3%) households had at least one member who reported having another non-communicable disease. Overall, 28.3% (150), 40.1% (n=213), and 31.6% (n=168) of the households fell under the first, second and third categorization of the socioeconomic grouping.

Table 3 Distribution of selected characteristics of the study households

Characteristics	Categories	Study sites					
		Braamfischerville	Riverlea	Hospital Hill	Bertrams	Hillbrow	Total
Presence of Self-reported Hypertension	Yes	25(17.1%)	39(33.0%)	23(16.9%)	17(24.3%)	3(4.7%)	107(20.0%)
	No	121(82.9%)	79(67.0%)	113(83.1%)	53(75.7%)	61(95.3%)	427(80.0%)
Race	Black African	146(99.3%)	12(9.7%)	38(100%)	47(64.4%)	65(98.5)	408(74.5%)
	Others	1(0.7%)	112(90.3%)	0(0.0%)	26(35.6%)	1(1.5%)	140(25.5%)
Age – proportion ≥40 in household	Median (IQR)	0.2(0.39)	0.33(0.5)	0.18(0.4)	0.25(0.5)	0(0.33)	0.25(0.5)
Sex: proportion female in household	Median (IQR)	0.43(0.17)	0.33(0.3)	0.33(0.33)	0.33(0.33)	0.33(0.3)	0.33(0.3)
Education: proportion with a primary school education or higher	Median (IQR)	0.75(0.5)	0.67(0.6)	0.5(0.67)	0.75(0.5)	1.00(0.33)	0.67(0.6)
Work: proportion working in the household	Median (IQR)	0.33(0.5)	0.33(0.5)	0.33(0.5)	0.50(0.47)	0.67(0.5)	0.33(0.57)
Monthly Income	No income	14(9.8%)	14(11.8%)	21(15.7%)	3(4.2%)	3(4.6%)	55(10.3%)
	ZAR<1000	19(13.3%)	22(18.5%)	36(26.9%)	5(6.9%)	1(1.5%)	83(15.5%)
	ZAR1000-2000	28(19.6%)	27(22.7%)	38(28.4%)	17(23.6%)	8(12.1%)	118(22.1%)
	ZAR2001-5000	43(30.1%)	25(21.0%)	20(14.9%)	23(31.9%)	20(30.3%)	131(24.5%)
	ZAR>5000	11(7.7%)	14(11.8%)	5(3.7%)	11(15.3%)	24(36.4%)	65(12.2%)
	No answer	28(19.6%)	17(14.3%)	14(10.5%)	13(18.1%)	10(15.2%)	82(15.4%)
Presence of other NCD	No	122(83.6%)	85(70.8%)	109(80.7%)	52(73.2%)	59(92.2%)	427(79.7%)
	Yes	24(16.4%)	35(29.2%)	26(19.3%)	19(26.8%)	5(7.8%)	109(20.3%)
Socioeconomic status (SES)	Low	31(21.1%)	23(20.0%)	69(51.1%)	19(27.1%)	8(12.5%)	150(28.3%)
	Middle	67(45.6%)	46(40.0%)	50(37.0%)	18(25.7%)	32(50.0%)	213(40.1%)
	High	49(33.3%)	46(40.0%)	16(11.9%)	33(47.1%)	24(37.5%)	168(31.6%)

3.2 Prevalence of self-reported hypertension

Figure 1 shows the prevalence of self-reported hypertension in the different study areas. Riverlea had the highest prevalence of self-reported hypertension at 33.1% while Hillbrow had the lowest prevalence at 4.7%.

Table 4 shows the total prevalence of self-reported hypertension across the five sites as well as the prevalence by selected characteristics. A total of 534 households were analyzed of which 20% (n=107) had at least one member who reported having hypertension.

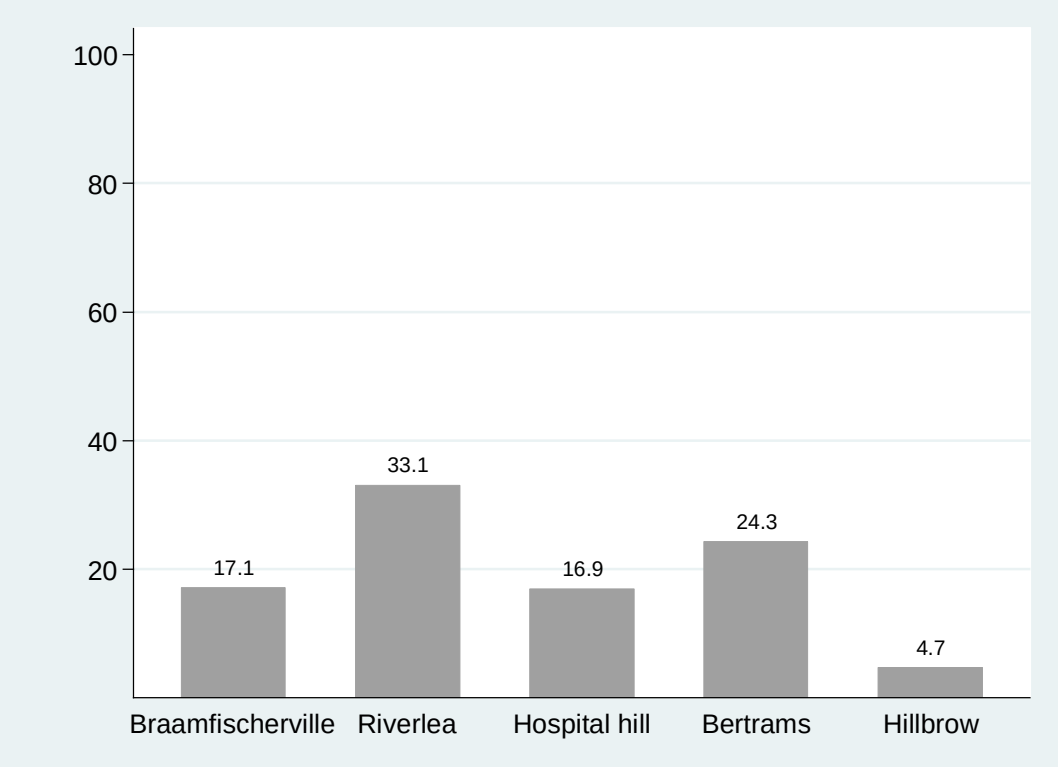

Figure 1: Prevalence of self-reported hypertension across the five study sites

The households with non-Black African members had a higher prevalence of self-reported hypertension 38.5% (n=52) compared to households with Black Africans 13.8% (n=55). The prevalence of self- reported hypertension increases with the increase in proportion of household members who were 40 years old and above, with prevalence ranging from 9.9% to 36.7%. The prevalence of self-reported hypertension decreases with the increase in proportion of females in the household, with prevalence ranging from 12.9% to 28.0%.

The prevalence of self-reported hypertension decreases with increase in the proportion of household members with primary school education or higher. This prevalence rate ranged between 18.1% and 24.6%. The prevalence of self-reported hypertension does not follow a particular trend across the households with differing proportions of working members though it was highest among the households with at least 75% of its members working 35.3% (n=6) and lowest in the households with 25% or less of the household members working 12.9%(n=18). In terms of income levels, the presence of self-reported hypertension was lowest among households with highest monthly income of ZAR 5000 or more 15.9% (n=10) and highest among the households with no income 35.2% (n=19). Similarly, the prevalence of self-reported hypertension was highest among the households in the low SES category 22.5% (n=33). Self-reported hypertension was also highest in households that had at least a member with one other reported non-communicable disease at 47.6% (n=50).

Table 4: Prevalence of self-reported hypertension by selected characteristics of the study households

Characteristics	Category	Presence of self-reported hypertension	No presence of self-reported hypertension
Total		**N=107(18%)**	**N=427(82%)**
Study area	Braamfischerville	25(17.1%)	121(82.9%)
	Riverlea	39(33.1%)	79(66.9%)
	Hospital Hill	23(16.9%)	113(83.1%)
	Bertrams	17(24.3%)	53(75.5%)
	Hillbrow	3(4.7%)	61(95.3%)
Race	Black African	55(13.8%)	344(86.2%)
	Non-Black	52(38.5%)	83(61.5%)
Age: proportion ≥40 in the household	<0.25	26(9.9%)	237(90.1%)
	0.25-0.49	31(26.1%)	88(74.0%)
	0.50-0.74	22(27.5%)	58(72.5%)
	≥0.75	22(36.7%)	38(63.3%)
Sex: proportion female in the household	<0.25	52 (28.0%)	134(72.0%)
	0.25-0.49	23(19.6%)	94(80.3%)
	0.50-0.74	20(14.8%)	115(85.2%)
	≥0.75	12(12.9%)	81(87.1%)
Education: proportion with a primary school education or higher in the household	<0.25	18(24.6%)	55(75.3%)
	0.25-0.49	14(20.9%)	53(79.1%)
	0.50-0.74	30(19.6%)	123(80.4%)
	≥0.75	41(18.1%)	185(81.9%)
Work: proportion working in the household	<0.25	18(12.9%)	122(87.1%)
	0.25-0.49	49(25.4%)	144(74.6%)
	0.50-0.74	34(18.5%)	150(81.5%)

Characteristics	Category	Presence of self-reported hypertension	No presence of self-reported hypertension
	≥0.75	6(35.3%)	11(64.7%)
Monthly Income:	No income	19(35.2%)	35(64.8%)
	R<1000	18(21.9%)	64(78.1%)
	R1000-2000	18(21.9%)	64(78.1%)
	R2001-5000	25(21.7%)	90(78.3%)
	R>5000	10(15.9%)	53(84.1%)
	No answer	7(8.8%)	73(91.2%)
Presence of other NCD:	No	55(12.9%)	372(87.1%)
	Yes	50(47.6%)	55(52.4%)
Socioeconomic status (SES):	Low	33(22.5%)	114(77.5%)
	Middle	36(17.3%)	172(82.7%)
	High	31(19.0%)	132(81.0%)

[1]The total percentages may vary due to missing values

3.3 Factors associated with self-reported hypertension

Unadjusted regression models

Table 5 Column 3 shows the unadjusted odds ratio and confidence intervals of the risk factors of self-reported hypertension. Study area (Riverlea, Hillbrow), race, age, gender (0.25-0.49 and ≥0.75), work (0.5-0.74, and ≥0.75), monthly income (ZAR 1000-2000, 2001-5000, and >5000), presence of another non-communicable disease and socioeconomic status (middlewere all independently associated with self-reported hypertension.

The results from the analysis show that Black African households were almost four times as likely to have a member with self-reported hypertension compared to non-Black African households (OR=3.92, 95% CI=2.50-6.14). The households with higher proportion of members

aged forty and above had higher risk of having a hypertensive member compared to households with lower proportion of members aged forty and above showing positive relationship between self-reported hypertension and age. The highest risk was among households that had a proportion of ≥ 0.75 of its members older than 40 years of age (OR=5.28, CI =2.72-10.24).For sex there was no significant association in the households with about 50-74% of the members being female. The highest risk was in the households with at least 75% of its members being female (OR=3.70, CI=1.22-11.23) compared to households with less than 25 percent of its members being female. Working was protective as self-reported hypertension was reduces with increase in proportion of household members working. The odds of self-reporting hypertension in household with 0.25-0.49; 0.50-0.74 and ≥0.75 of members working were 0.63 0.45 and 0.38 times, respectively the odds of self-reporting hypertension in households with 0.25 proportions of members working.

Household income was also protective, with self-reported hypertension being less likely among household members in households with higher income. Self-reported hypertension was least likely in households with an income greater than ZAR 5000 (OR=0.26, 95% CI=0.14-0.84). Households with at least one member having another non-communicable disease were 5.5 times as likely to have a member with self-reported hypertension compared to households without any member having any other NCD. Negative association of education with self-reported hypertension was also noted although, the relationship was not significant.

Adjusted regression models

Multivariable logistic regression analysis (adjusted models) is an important tool in predicting the effect of multiple independent variables on a single binary dependent variable. Table 5 Column 4

shows the adjusted odds ratios and 95% confidence intervals of all the variables entered into the model.

Race, age, presence of another self-reported NCD, and sex were noted to be significantly associated with self-reported hypertension in the adjusted model. Black African households were 4.49 times as likely (95% CI=1.32-15.23) to have a member who reported having hypertension compared to non-black African households. The positive relationship of age with self-reported hypertension observed in the unadjusted model remains the same in the adjusted model. Sex and presence of other NCD in households also maintained the effect observed at the unadjusted models with self-reported hypertension highest in the households with the highest proportion of females (AOR=4.45, 95%CI=1.04-19.08) and being about four times as likely in households with a member having another self-reported non-communicable disease compared to households with no household member reporting another NCD (AOR=3.84, 95%CI=2.09-7.07).

Table 5: Results from the unadjusted and adjusted regression models

Characteristics	Category	Unadjusted analysis OR (95% CI)	Adjusted analysis AOR (95% CI)
Study area			
	Braamfischerville	Ref	Ref
	Riverlea	2.39(1.34-4.25)*	0.44(0.11-1.73)
	Hospital Hill	0.99(0.53-1.83)	0.88(0.37-2.09)
	Bertrams	1.55(0.77-3.11)	0.79(0.25-2.44)
	Hillbrow	0.24(0.07-0.82)*	0.33(0.08-1.37)
Race			
	Black African	3.92(2.50-6.14)*	4.49(1.32-15.23) *
	Non-Black African	Ref	Ref
Age: proportion ≥40 in household			
	<0.25	Ref	Ref
	0.25-0.49	3.21(1.81-5.71)*	2.98(1.49-5.96) *
	0.50-0.74	3.46(1.83-6.53)*	3.51(1.59-7.76) *
	≥0.75	5.28(2.72-10.24)*	3.22(1.35-7.71) *
Gender: proportion female in household			
	<0.25	Ref	Ref
	0.25-0.49	2.31(1.28-4.17)*	2.87(1.34-6.09) *
	0.50-0.74	1.54(0.83-2.86)	1.54(0.70-3.37)
	≥0.75	3.70(1.22-11.23)*	4.45(1.04-19.08) *
Education: proportion with a primary school education or higher in the household			
	<0.25	Ref	Ref
	0.25-0.49	0.81(0.36-1.79)	0.85(0.29-2.47)
	0.50-0.74	0.75(0.38-1.45)	0.92(0.37-2.26)
	≥0.75	0.68(0.36-1.27)	0.93(0.37-2.34)
Work: proportion working in the household			
	<0.25	Ref	Ref
	0.25-0.49	0.63(0.36-1.10)	0.71(0.33-1.54)
	0.50-0.74	0.45(0.25-0.79)*	0.75(0.34-1.65)
	≥0.75	0.38(0.19-0.76)*	1.09(0.43-2.73)
Monthly Income			
	No income	Ref	Ref
	R<1000	0.50(0.24-1.11)	0.72(0.28-1.86)

Characteristics	Category	Unadjusted analysis OR (95% CI)	Adjusted analysis AOR (95% CI)
	R1000-2000	0.46(025-1.04)*	0.59(0.24-1.48)
	R2001-5000	0.37(0.20-0.84)*	0.52(0.18-1.46)
	R>5000	0.26(0.14-0.84)*	0.59(0.16-2.09)
	No answer	0.21(0.07-0.46)*	0.18(0.05-0.64) *
Presence of other NCD			
	No	Ref	Ref
	Yes	5.47(3.81-9.90)*	3.84(2.09-7.07)*
Socioeconomic status (SES):			
	Low	Ref	Ref
	Middle	0.56(0.32-0.99)*	1.14(0.57-2.29)
	High	0.72(0.40-1.32)	0.97(0.43-2.20)

*significant at p-value <0.05

CHAPTER 4: DISCUSSION

4.1 Introduction

In this study, the prevalence of self-reported hypertension and its risk factors were examined in households in urban impoverished communities in Johannesburg, South Africa.

The prevalence of self-reported hypertension in this study was 20%. Self-reported hypertension in households was significantly associated with black African households, households with high proportion of females, households with high proportion of members aged 40 years and above, and households that reported the presence of other non-communicable diseases among their members.

4.2 Prevalence of self-reported hypertension

One of the focus areas of preventing hypertension is increasing awareness. It is noted that the awareness of hypertension especially in developing countries and African countries is very low (Ibrahim & Damasceno 2014; Kayima et al. 2013b; Pereira et al. 2007). Overall, our analysis showed that the prevalence of self-reported hypertension was 20% across the five study sites. In a similar study conducted in South Africa by Sanet et al. in 2012 the overall prevalence of self-reported hypertension among the selected urban population was 48.3% which is significantly higher than the indicated prevalence in our study (van Zyl et al. 2012). The lower prevalence in our study may be explained by the fact that it focuses on the urban poor population only. There are known differences in access to healthcare across different socio-economic status; the impoverished are known to make fewer medical visits due to factors such as lack of financial

resources and access to health facilities in their localities. This could account for the lower number of individuals knowing their blood pressure levels. A systematic review done on the awareness of hypertension in Africa also found that the awareness levels in urban areas were lowest in slums (Kayima et al. 2013).

This study also showed a lower prevalence than a study done in the slums of Lagos Nigeria that showed a prevalence of 38.2% and a study done in a slum in Nairobi with a prevalence of 22.8% (Joshi et al. 2014; Daniel et al. 2013). This may be because this study used self-reported hypertension compared to measured hypertension used by the other two referenced studies.

The prevalence of self-reported hypertension was highest in Riverlea area that is characterized with the highest percentage of non-black households. Our study also showed that the prevalence was highest in the non-black households. According to a study done in South Africa, the prevalence of hypertension was observed to be highest among the Colored population compared to the other races (Matooane et al. 2011). These findings concur with our study's findings. The higher prevalence of self-reported hypertension in Riverlea, a community that was predominantly non-Black Africans and had the highest percentage of its population reporting having other non-communicable diseases could be explained by its similarity in characteristics to the population in Matooane's study.

Having older members in a household increased the chances of members of these households having other diseases and being more likely to visit a health facility and have their blood pressure measured, unlike households with younger members. This may explain the higher prevalence of self-reported hypertension in households that reported having other non-communicable diseases. This is supported by a study done in a section of the Chinese population

that showed that hypertension awareness was higher among the populations that had other acute conditions (Ahn et al. 2011).

This study's findings showed that the prevalence of self-reported hypertension was higher among the predominantly male households than female ones. This differs from most studies that show that awareness is higher among females than males because men tend to have a less enthusiastic health seeking behavior (Everett & Zajacova 2016).

4.3 Determinants of self-reported hypertension

This study showed that education level, race, age, sex, and the presence of other non–communicable diseases have significant association with the presence of self-reported hypertension in households in the five urban poor settlements sampled in South Africa after adjusting for other potential risk factors.

Age is a very important factor that is associated with self-reported hypertension. The households with older adults were more likely to have a hypertensive member. This may be because older members tend to be more attentive to their health compared to younger people. In addition, age has been known to directly play a part in the occurrence of hypertension due to biological changes that occur in the body in the process of aging. This study's results are consistent with that of another done in eMbalenhle, South Africa that showed that the prevalence of self-reported hypertension was significantly higher among the older adults (Matooane et al. 2011).

It has been argued that biologically, race does not have any influence on health but rather that social constructs tend to make an artificial association between the two (Frieden 2011). This has been supported by studies that have noted certain unhealthy behaviors being predominant in

specific racial groups compared to others, which however have no relationship with the natural differences in skin pigmentation or color among races (Frieden 2011). These unhealthy behaviors have led to differences in levels of self-reported hypertension in different ethnic groups. Factors such as obesity, unemployment and low-income levels were higher in the Black and Coloured communities and NCDs were higher among the Coloured and Indian communities (Matooane et al. 2011). These factors may have effect on the prevalence of hypertension as well as its awareness. This study for instance observed that although prevalence of hypertension was higher in non-black households, black households were more likely to have hypertensive members in the fitted models. This higher likelihood among the Black population may be explained by the differing racial characteristics, thereby, making race a confounder or an effect modifier in the relationship between self-reported hypertension and the other factors (Cois & Ehrlich 2014). Whilst this study does not have strong evidence in support of this claim, the variations could be in relation to the fact that the focus was on household income instead of individual earnings (Frieden 2011). This study's findings are also similar to various studies showing that females were more likely to be hypertensive (Wandera et al. 2015; Everett & Zajacova 2016).

Our findings are also similar with findings from other studies that show that hypertension is associated with other NCDs (Oliveira et al. 2016). This is explained by the fact that it is likely for an individual to have hypertension if they have other non-communicable diseases since some of the associated risk factors are similar. Having other NCDs means that the individual will have frequent visits to a health facility and are more likely to get their blood pressure measured.

The study had several limitations. First, the study was cross-sectional in design and hence the researcher cannot ascribe causality because the information on the outcome and the risk factors were collected at the same point in time. Second, it was a study that was done on a household level, which makes it difficult to associate the risk factors directly to the individual hypertensive members. In addition, the characteristics were self-reported which may have led to an underestimation of values particularly for the hypertension variable. Another limitation is that the study was done in urban poor settlements. Hence, the results may not hold in other context.

The underrepresentation of other races and employed people in this study did not allow a detailed understanding of hypertension with regards to these two characteristics. Additionally, the study analyzed secondary data which lacked information on important determinants such as consumption of alcohol, diet, and physical activity. This largely limited the research's ability to ascribe lifestyle factors' contribution to hypertension in this study population.

4.4 Conclusion and Recommendations

4.4.1 Conclusion

The results of this study are consistent with what has been found in various other studies in Sub-Saharan Africa. To the best of our knowledge, this was the first study in South Africa with a focus on self-reported hypertension in urban poor populations. The findings strengthen the case that age, sex, race and co-morbid non-communicable diseases are associated with self-reported hypertension and that impoverished communities are also highly affected by hypertension. Thus, interventions to increase awareness and reduce the risk should be prioritized.

4.4.2 Recommendations

While this study has made a valuable contribution to knowledge in the subject area regarding urban poor population in South Africa, it is important to use a more robust data and representative sample to identify the factors that influence self-reported hypertension or even better, measured hypertension in the setting for a well-informed policy on the condition for the population. Having noted that, The findings from this study suffice for some immediate interventions that target the urban poor population and that focus on increasing awareness and context specific risk reduction to be taken.

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APPENDICES

Appendix 1: Ethical clearance from Human Research Ethics Committee(Medical) for primary study

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG
Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Dr Nisha Naiker

CLEARANCE CERTIFICATE	**M10471**
PROJECT	The Johannesburg Health, Environment and Development (HEAD) Project
INVESTIGATORS	Dr Nisha Naiker.
DEPARTMENT	Environmental & Health Research Institue
DATE CONSIDERED	
DECISION OF THE COMMITTEE*	Renewal Approved

Unless otherwise specified this ethical clearance is valid for 5 years and may be renewed upon application.

DATE 09/04/2010 **CHAIRPERSON** .....
(Professor PE Cleaton-Jones)

*Guidelines for written 'informed consent' attached where applicable
cc: Supervisor :

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10004, 10th Floor, Senate House, University.
I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to a completion of a yearly progress report.**

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES...

Appendix 2: Ethical clearance from Human Research Ethics Committee(Medical) for this study

R14/49 Miss Fossa Ogake Kinara

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M160239

NAME: (Principal Investigator)	Miss Fossa Ogake Kinara
DEPARTMENT:	School of Public Health Epidemiology and Biostatistics
PROJECT TITLE:	Prevalence and Determinants of Hypertension in Households in Urban Poor Settlements of Johannesburg
DATE CONSIDERED:	26/02/2016
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Dr Latifat Ibisomi

APPROVED BY: Professor P Cleaton-Jones, Chairperson, HREC (Medical)

DATE OF APPROVAL: 07/03/2016

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary in Room 10004, 10th floor, Senate House/2nd Floor, Phillip Tobias Building, Parktown, University of the Witwatersrand. I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report**. The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. In this case, the study was initially reviewed in February and will therefore be due in the month of February each year.

Principal Investigator Signature Date

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

Appendix 3: Analysis do-file

DATA CLEANING

Generating age variable

```
order q9p1age q9p2age q9p3age q9p4age q9p5age q9p6age q9p7age q9p8age q9p9age q9p10age
q9p11age q9p12age q9p13age q9p14age q9p15age q9p16age q9p17age q9p18age q9p19age q9p20age
```

```
foreach v of varlist q9p1age-q9p20age {
    gen age`v' = .
          replace age`v' =0 if (`v'<40)
          replace age`v' =1 if (`v'>=40) & (`v'<.)
  }
```

```
    foreach v of varlist ageq9p1age-ageq9p20age {
    local i = `i' + 1
      rename `v' Age`i'
          }
```

```
egen nmissage= rowmiss(Age1 Age2 Age3 Age4 Age5 Age6 Age7 Age8 Age9 Age10  Age11 Age12 Age13
Age14 Age15 Age16 Age17 Age18 Age19 Age20)
gen rowtotalage=20
replace rowtotalage= rowtotalage-nmissage
```

```
egen age= rowtotal(Age1 Age2 Age3 Age4 Age5 Age6 Age7 Age8 Age9 Age10 Age11 ///
    Age12 Age13 Age14 Age15 Age16 Age17 Age18 Age19 Age20)
gen ageprop= age/rowtotalage
label var ageprop "proportion aged >40"
```

```
gen agepropcat=.
replace agepropcat=0 if (ageprop<0.25)
replace agepropcat=1 if (ageprop>=0.25) &(ageprop<0.5)
replace agepropcat=2 if (ageprop>=0.5) & (ageprop<0.75)
replace agepropcat=3 if (ageprop>=0.75) &(ageprop<=1)
label define agepropcat 0"<0.25" 1"0.25-0.49" 2"0.5-0.749" 3"0.75-1"
label values agepropcat agepropcat
```

generating sex variable

```
egen nmisssex= rowmiss( q9p1sex q9p2sex q9p4sex q9p5sex q9p6sex q9p7sex  q9p8sex q9p9sex
q910sex q9p11sex q9p12sex q9p13sex q9p14sex q9p15sex  q9p16sex q9p17sex q9p18sex q9p19sex
q9p20sex )
```

```
gen rowtotal = 20
replace rowtotal = rowtotal - nmisssex
```

```
egen femalenum=rowtotal(q9p1sex q9p2sex q9p4sex q9p5sex q9p6sex q9p7sex ///
   q9p8sex q9p9sex q910sex q9p11sex q9p12sex q9p13sex q9p14sex q9p15sex ///
   q9p16sex q9p17sex q9p18sex q9p19sex q9p20sex )
gen propfemale= femalenum/rowtotal
order propfemale, after(area)
order ageprop, after(propfemale)
```

```
gen propfemalecat=.
replace propfemalecat=0 if (propfemale<0.25)
replace propfemalecat=1 if (propfemale>=0.25) &(propfemale<0.5)
replace propfemalecat=2 if (propfemale>=0.5) & (propfemale<0.75)
replace propfemalecat=3 if (propfemale>=0.75) &(propfemale<=1)
```

```
label define propfemalecat 0"<0.25" 1"0.25-0.49" 2"0.5-0.749" 3"0.75-1"
label values propfemalecat propfemalecat
```

Education variable

```
order q9p1educ q9p2educ q9p3educ q9p4educ q9p5educ q9p6educ q9p7educ q9p8educ q9p9educ
q9p10educ q9p11educ q9p12educ q9p13educ q9p14educ q9p15educ q9p16educ q9p17educ
q9p18educ q9p19educ q9p20educ
```

```
foreach v of varlist q9p1educ-q9p20educ {
    gen educ`v' = .
          replace educ`v' =0 if (`v'<=2)
          replace educ`v' =1 if (`v'>2) & (`v'<.)

  }
```

```
foreach v of varlist educq9p1educ-educq9p20educ {
    local i = `i' + 1
      rename `v' edu`i'
          }
```

```
egen nmissedu= rowmiss(edu1 edu2 edu3 edu4 edu5 edu6 edu7 edu8 edu9 edu10 edu11 edu12 edu13
edu14 edu15 edu16 edu17 edu18 edu19 edu20)
gen rowtotaledu=20
replace rowtotaledu= rowtotaledu-nmissedu
```

```
egen education= rowtotal( edu1 edu2 edu3 edu4 edu5 edu6 edu7 edu8 edu9 edu10 edu11 edu12 edu13
edu14 edu15 edu16 edu17 edu18 edu19 edu20)
gen eduprop= education/rowtotaledu
label var eduprop "proportion with education > than primary school"
```

```
gen edupropcat=.
replace edupropcat=0 if (eduprop<0.25)
replace edupropcat=1 if (eduprop>=0.25) &(eduprop<0.5)
replace edupropcat=2 if (eduprop>=0.5) & (eduprop<0.75)
replace edupropcat=3 if (eduprop>=0.75) &(eduprop<=1)
label define edupropcat 0"<0.25" 1"0.25-0.49" 2"0.5-0.749" 3"0.75-1"
label values edupropcat edupropcat
```

Race variable

```
replace race=0 if (  race<=1)
replace race=1 if ( race >1) & ( race<.)
label variable race "race"
label define race 0"Black African" 1"others"
label values race race
```

Work variable

```
order q9p1job q9p2job q9p3job q9p4job q9p5job q9p6job q9p7job q9p8job q9p9job q9p10job
q9p11job q9p12job q9p13job q9p14job q9p15job q9p16job q9p17job q9p18job q9p19job q9p20job
```

```
foreach v of varlist q9p1job-q9p20job {
    gen work`v' = .
          replace work`v' =0 if (`v'>=3) & (`v'<=4)
          replace work`v' =0 if (`v'>=6) & (`v'<.)
          replace work`v' =1 if (`v'>=1) & (`v'<=2)
          replace work`v' =1 if (`v'>=5) & (`v'<=5)
  }
```

```
foreach v of varlist workq9p1job-workq9p20job {
    local i = `i' + 1
      rename `v' work`i'
          }
```

```
egen nmisswork= rowmiss( work1 work2 work3 work4 work5 work6 work8 work7 work9 work10
work11 work12 work13 work14 work15 work16 work17 work18 work19 work20 )
gen rowtotalwork=20
replace rowtotalwork= rowtotalwork-nmisswork
```

```
egen work= rowtotal( work1 work2 work3 work4 work5 work6 work8 work7 work9 work10 work11
work12 work13 work14 work15 work16 work17 work18 work19 work20  )
gen propwork= work/rowtotalwork
label var propwork "proportion working in the household"
```

```
gen propworkcat=.
 replace propworkcat=0 if (propwork<0.25)
replace propworkcat=1 if (propwork>=0.25) &(propwork<0.5)
replace propworkcat=2 if (propwork>=0.5) & (propwork<0.75)
replace propworkcat=3 if (propwork>=0.75) &(propwork<=1)
label define propworkcat 0"<0.25" 1"0.25-0.49" 2"0.5-0.749" 3"0.75-1"
label values propworkcat propworkcat
```

Presence of other NCD variable

```
egen NCD= rowmax( diabetes obesity stroke heart)
```

Income variable

```
replace income=6 if (income>=6)&(income<.)
replace income=4 if (income>=4) &(income<6)
```

SES variable using Principal component analysis

```
corr q121rad q121tel q122sat q121ref q122wash q122video q122micro q122car q122comp q121telorcel
pca q121rad q121tel q122sat q121ref q122wash q122video q122micro q122car q122comp q121telorcel
```

```
screeplot, yline(1)
```

```
pca q121rad q121tel q122sat q121ref q122wash q122video q122micro q122car q122comp q121telorcel,
mineigen(1) blanks(.3)
```

```
pca q121rad q121tel q122sat q121ref q122wash q122video q122micro q122car q122comp q121telorcel,
comp(1) cov
predict newses
summa newses , det
```

```
recode newses (min/1.012333=1) (1.012334/2.024666=2) (2.024667/max=3), gen(ses)
```

DATA ANALYSIS

```
tab hypertension area, column chi
```

```
tab hypertension race, column chi
```

```
tab hypertension income, column chi
```

```
tab hypertension NCD, column chi
```

```
tab hypertension ses, column chi
```

```
tab agepropcat hypertension, row chi
```

```
tab edupropcat hypertension, row chi
```

```
tab propworkcat hypertension, row chi
```

tab propfemalecat hypertension, row chi
Unadjusted model
logit hypertension i.propfemalecat, or
logit hypertension i.agepropcat,or
logit hypertension i.edupropcat,or
logit hypertension i.propworkcat,or
logit hypertension race,or
logit hypertension i.income,or
logit hypertension i.area,or
logit hypertension i.NCD,or
logit hypertension i.ses,or
Adjusted model
xi:logit hypertension ib0.propfemalecat ib0.agepropcat ib0.edupropcat i.race ib0.NCD ib0.income ib1.area ib0.propworkcat i.ses, or
estat gof, g(10) table linktest