ADULT HEALTH OUTCOMES IN SOUTH AFRICA: A LONGITUDINAL ANALYSIS OF THE CAUSES OF DISEASE AMONG RURAL-RURAL MIGRANTS.

By

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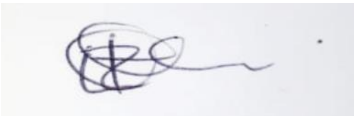
Declaration

I Thokwane Lebohang Zinhle declare that this report is my own work. It is being submitted to the Faculty of Humanities, University of the Witwatersrand, in partial fulfilment of the degree Master of Arts in Demography and Population Studies. This research report has not been submitted, in part or in whole to any other Institution or University as a requirement for any other qualification.



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Abstract

Background: Rural-rural migration refers to the process whereby people move from one rural area within a national boundary to another. This is often for the; family, retirement or economic reasons. The health and well-being of adults who participate in rural-rural migration in South Africa has become a crucial issue. It may also have an impact on the well-being of the entire population. Rural migration – migration to, from and between rural areas is a large component of both internal and international migration flows. Some 250 million people have migrated internationally during their lifetime, many originating from rural areas. Even more people have migrated internally, with more than 1 billion in developing countries alone. Moreover, in a sample of 31 developing countries, more than half of the people living in rural areas during their childhood migrated internally. 80% of internal moves involve rural areas, but less than 30% constitute rural–urban migration, while the rest are rural–rural or urban–rural movements. Many refugees and internally displaced people come from rural areas, and many are hosted in rural areas as well. For example, more than 80% of refugees in sub-Saharan Africa are found in rural areas. Not all migration is permanent or long-term.

However, little is known about the causes of diseases among older people who are mobile. Therefore, this study aimed at filling the gap on causes of diseases (diabetes, hypertension, tuberculosis) among adults who move from one rural to another in South Africa.

Objectives: To identify the levels and socio-economic determinants of disease outcome among rural-rural migrants aged 24-80 years. The study population was made of adults who were mobile.

Methodology: This longitudinal study used wave 1 (2008) and wave 5 (2017) of the South African National Income Dynamics Study (SA NIDS). Cross tabulations, regression models were used and in wave 1 adults who did not have a disease were identified and followed through to wave 5 if they have moved to another rural area and measured their diseases status. Chi-square tests were used to detect significant level in disease outcome. Results were presented with confidence intervals of 95% probability. Binary logistic regression model was used while controlling for several covariates. The choice of using the regression model was informed by that, the outcome variable was dichotomous. Four different models with different disease outcome were used.

Results: This study's findings showed that hypertension was higher among the females than males. One of the reasons for this could be behavioural risk factors such as physical inactivity. The current study indicated a high prevalence rate of diabetes among adults and those in the older age cohort. Older adults are more likely to have a diabetic, tuberculosis or hypertensive disease. This may be because older adults tend to be less attentive to their health as they grow older.

Conclusion: South Africa is confronted with several major health challenges simultaneously, including a high burden of infectious diseases and non-communicable diseases. The results show that there are differences in the causes of diseases in the study area between the rural-rural migrants. Aside from family size of migrants and smoking, the prevalence of diseases showed significant differences of in, behavioural, and personal variables. Changes in lifestyle and diet in the context of globalization have contributed to a shift in health patterns. A rigorous effort is required to change the course of the rising disease outcome burden in the country; the price of delay will otherwise be devastating.

Keywords: diabetes, hypertension, tuberculosis, migration, disease

Dedication

This work is dedicated to the Highest God, unto whom all glory and honour is due. More so, to my parents: Mr P.K Thokwane and Ms J.E Mhlongo for their immeasurable love and support during my study. I want to thank Prof Nicole De Wet-Billings my supervisor, with my most sincere gratitude, you have encouraged me and supported me throughout the entire research. Your support through the research report process was second to none! You supported me even when I had the crazy idea to switch topics and move forward! I am privileged to have had the opportunity to grow under your guidance. I believe in your approach and will continue to strive to unlock my potential. My gratitude also goes to all my loved ones and friends who stood by me and gave support during this period.

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List of acronyms

HIV: Human Immunodeficiency Virus

NCD: Non-communicable disease

NIDS: National Income Dynamics Study

SDG: Sustainable Development Goal

SDH: Social Determinants of Health

TB: Tuberculosis

UNDP: United Nations Development Programme

USAID: United States Agency for International Development

WHO: World Health Organization

Chapter 1: introduction

1.1 Background:

Rural-rural migration refers to the process whereby individuals move from one rural area within a national boundary to another, for; family, retirement or economic reasons (Beegle et al., 2011; Garlick et al., 2015). Many of the life transitions that are tied to migration, such as; entry into and completion for education, labour force participation, and marriage and childbearing, tend to occur in younger adulthood. However, some life transitions, especially retirement and widowhood, tend to occur later in life (Bernard et al., 2014; Isherwood, 2021).

In South Africa, rural-rural migration is common (Beegle et al., 2011; Garlick et al., 2015). The past few decades have been characterised by a combination of various movements together with a few leading migration patterns (Jørgensen & Makrygianni, 2020). An existing body of research suggests that the bulk of migration in South Africa is intra-district, economically motivated and increasingly female dominated.

Although rural-rural migration is common in South Africa; the health outcomes of adults and elderly who participate in rural-rural migration are rarely studied (Wineman & Jayne, 2017). Furthermore, during the 1991-1996 period, migration from rural areas to nearby towns was one of the dominant features of migration in South Africa (Biavaschi, Facchini, Mayda, & Mendola, 2018). However, by 2015 two-thirds or all movements from rural households were to another rural destination, in South Africa (Garlick et al., 2015).

The high rate of urbanisation in South Africa notwithstanding, rural-rural migration and migration to secondary towns remain common migration patterns in post-apartheid, but rural-rural migration peaked during the late to mid-1990s (Baffi & Cottineau, 2020). A study that was conducted by Adjaye-Gbewonyo., Rebok., Gallo., Gross, & Underwood (2020) using the South African Migration and Health Survey (SAMHS) data, reported that; the prevalence of rural-rural migration was 42% for black South Africans who self-reported as rural-rural migrants. These participants had moved from one rural district to another rural district.

However, rural areas lack resources and living conditions are poorer (Garlick et al., 2015). Generally, in South Africa, ageing Black Africans have poorer health outcomes than ageing populations of other racial groups. The gap in health outcomes is worse among old Black Africans living in rural areas (Beegle et al., 2011). Caldwell, Lee & Cagney (2017) mentioned that the worse health outcomes for the old Black Africans in rural areas is attributed to; isolation, poor housing, low income, poor access to healthcare facilities and the political, and economic marginalization that resulted from apartheid policies (Bernard et al., 2014).

The world's population is ageing, and projections show that this increase will continue (Bone., Gomes., Etkind., Verne., Murtagh., Evans., & Higginson, 2018). The percentage of those aged 65 and over is projected to continue with a steep increase (Kobayashi, Mateen, Montana, Wagner, Kahn, Tollman & Berkman, 2019). The growth in the world population of people aged 50 and over, was expected to increase from 21% in 2011 to 34% in 2050. This increase will affect both developed and developing countries (Geffen, Kelly, Morris, & Howard, 2019). In developing countries demographers have predicted an increase of 14% between 2006 and 2030 from 35 to more than 69 million (Bommer, Sagalova, Heesemann, Manne-Goehler, Atun, Bärnighausen, & Vollmer, 2018).

Despite a falling life expectancy at birth (Kabudula, Houle, Collinson, Kahn, Gómez-Olivé, Tollman, & Clark, 2017), there have been an increase in the older population. Information from annually updated health and socio-demographic surveillance has shown an increase of 15% in non-communicable diseases during the past 10 years, while the number of chronic conditions overall requiring long-term care has increased 2.6-fold (Komisar, Shishov, Yang, & Robinovitch, 2021). This may increase the existing high burden on health services depending on the proportion of older people seeking health care. It may also increase the demand for social support needed by individuals in their communities.

Changes in the social structure, roles and responsibilities of older people, mostly women, have already occurred (Gorman, 2017). Older women now face additional responsibilities such as nursing their sick children and being caregivers to their grandchildren (Makiwane, Alubafi, & Gumede, 2020). Given the increasing rate of unemployment in South Africa, older people have also become the main bread winners through their social pensions (Odunitan-Wayas, Faber, Mendham, Goedecke, Micklesfield, Brooks, & Lambert, 2021) . In 2006, any South African citizen (women 60 years or older and men 65 years or older), living in South Africa, could apply for the government monthly pension (the Old Age Grant). This grant depends on the person's income, considering the total amount in the family if the person is married (Thobile Zikhali, 2021). Retired people tend to migrate to rural and coastal areas for the slower more relaxed pace and the natural beauty.

For the above reasons, the health and well-being of older adults in rural South Africa has become a crucial issue, which may also impact the well-being of the entire population. However, the impacts of the changing age structure and the growth in chronic disease. Moreover, despite that there are numerous studies that are conducted on; hypertension, diabetes, tuberculosis and their link to migration, most of them rely on cross-section or single wave of the national income dynamics study (SA NIDS). Thus, most studies in this topic neglect rural-rural migration. Therefore, the current study aimed at filling the gap on rural-rural migration and, link diabetes, hypertension and tuberculosis.

1.2 problem statement

Disease prevalence in South Africa is high. The country faces a quadruple disease burden, that include poverty-related diseases, non-communicable diseases, injuries and HIV/AIDS (Basu, 2018). Poverty, violence, rapid social and economic changes, lack of education, inadequate services and urbanization contribute as much to increasing cases of non-communicable diseases as they do to HIV, tuberculosis, and other communicable diseases (Juma, 2019).

The population that is most affected by certain non-communicable and communicable diseases are adults. The presence of socio-economic factors such as crowded living conditions, poor nutrition, limited financial resources, poor housing and sanitation, are likely to increase the risk of TB and sexually transmitted infections in communities (Tadokera et al., 2020). In 2012, HIV prevalence was estimated to be at 12.2% as reported by the South African National HIV Prevalence, Incidence and Behaviour Survey (Shisana et al., 2014). The World Health Organisation (2018) statistics give an estimated incidence of 301,000 cases of active TB, which is the rate of 520 per 100,000 populations. In addition, poorer socio-economic groups have been associated with a higher prevalence of NCD risk factors, including alcohol consumption, increased salt consumption, and diabetes which affects 40% of South African adult females (Yaya et al., 2018).

The general migration patterns, along with a population that is ageing, means that rural areas will experience the greatest number of age-related problems. Thus, presents many problems including strain on the country's earnings-related pension scheme, higher healthcare costs and a shortage of working age population (Kelly, 2019). Contrary to what is often expected, it is not only youth who are highly mobile population. Migrant elderly account for about 5% of the elderly population in South Africa. The highest proportions of the elderly migrants are in Gauteng province (42.3%), and Western Cape province (21.3%); also, elderly male migrants (51.0%) are most likely to migrate than females (49.0%) (Stats SA, 2011).

The prevalence of TB varies by geographic regions. The background TB population in the general population, with a higher prevalence reported in South Asian (25.3–44%) and Latin American (14–39%) populations. In sub-Saharan Africa, prevalence in TB patients ranges from 8.5% to 16.4%. However, a large proportion of TB in sub-Saharan Africa remains undiagnosed. The health effects of this global demographic change are not yet fully known. However, estimations predict that the change in age structure in coming years, will bring an increase in mortality due to non-communicable diseases, which are changing the pattern of the most common causes of death in the different regions of the world and the world (Wang, & Wang, 2020).

The global TB burden is reported annually by the World Health Organisation (WHO) in its Global TB Report, with detailed accounts for what are known as high burdened countries, currently 30 in number, including SA. In its 2020 Global TB Report (WHO, 2020), the WHO noted that SA is one of eight countries that contributed two-thirds of the global burden of TB disease – with SA accounting for 3.6%. The report estimated that the incidence of TB in SA, based on 2019 case-finding data, was 615/100 000 (range 427 - 835), compared with 520 (range 373 - 691) reported in 2019 using 2018 case-finding data

Hypertension is one of the most potent risk factors for cardiovascular disease (CVD), with over 1 billion people affected by it worldwide (WHO, 2015). According to WHO data, approximately 27.4% of men and 26.1% of women in South Africa have hypertension (WHO,2015), though prevalence of up to 60% has been reported (Gaziano, Abrahams-Gessel, Gomez-Olive, Wade, Crowther, Alam et al, 2017).

Despite the high prevalence of hypertension in South Africa, both awareness and control are low among hypertensive individuals, with figures ranging between 19.0–56.0% and 4.0–33.0%, respectively (Palafox, McKee, Balabanova, Alhabib, Avezum, Bahonar, et al., 2016). In comparison, in high income countries awareness and control of hypertension among hypertensive individuals has been reported to be as high as 82 and 51% respectively (Cifkova, Fodor, Wohlfahrt, 2016). The low awareness and control rates in South Africa are of concern as awareness and subsequent blood pressure control have the potential to significantly decrease both morbidity and mortality due to CVD (Cifkova, Fodor, Wohlfahrt, 2016).

According to the World Health Organisation, NCDs are projected to overtake all other causes of death in Africa by the year 2030 (WHO, 2011). In the last two decades, the prevalence of diabetes has increased from 4.7% in 1980 to 8.5% of the total world population in 2014 and is expected to further increase especially in lower- and middle-income countries (WHO, 2016). Between 1990 and 2013, the years of life lost to diabetes globally have increased by 67% (Kengne, Amoah, Mbanya, 2015). Historically diabetes was a burden of developed countries, but a huge increase has now been reported in developing countries (WHO, 2016), countries that often do not have the resources for the prevention, diagnosis, treatment and management of the disease (Kengne, Amoah, Mbanya, 2015). In South Africa, the International Diabetes Federation (IDF) estimates that in 2015, almost 2.3 million people had diabetes (International Diabetes Federation, 2015). The magnitude of the diabetes burden is further reflected in the mortality and causes of death statistics, which show that diabetes has moved from being the fifth leading underlying cause of death in 2013 to being the third and second leading underlying cause of death in 2014 and 2015, respectively (Stats SA, 2017).

Obesity has become a major global health challenge. In 2010, obesity was estimated to cause 3-4 million deaths, 3-9 % of years of life lost, and 3-8 % of disability-adjusted life-years (DALYs) worldwide (Lim et al., 2012). According to the World Health Organisation (WHO), in 2014, over 600 million (13 %) people were obese (Body Mass Index- BMI ≥ 30.0 Kg/m2) (World Health Organisation, 2014). Overall, in Africa and 8% of the population was obese (WHO, 2010). The WHO estimated that obesity increased drastically in sub-Saharan African (SSA) (Abrahams et al., 2011). Among sub-Saharan African women, South Africa had the highest (42 %) and Ethiopia the least prevalence (1.8 %) (Fleming, 2013). According to Joubert et al. (2007) and Okop et al. (2015), obesity was the cause of 78% of type 2 diabetes, 68% of hypertensive disease, 45% of ischaemic stroke, and 38% of ischaemic heart disease cases among adults in South Africa.

In 2013, South Africa had the third highest burden of disease in the world, after India and China, with an estimated incidence of 450 000 cases of active TB; this was an increase of 400% from the last 15 years (WHO, 2014). An estimated 60–73% of the 450 000 incident cases had both HIV and TB infections. The incidence of multi-drug resistant (MDR) and extensively drug-resistant TB were increasing (Mbengo et al., 2014). South Africa had the second highest number of reported multi-drug resistant TB (MDR-TB) cases globally (Pietersen et al., 2014). TB remains the leading cause of death in South Africa (Stats SA, 2014).

In South Africa, the proportion of the population of people aged 50 years and over, slightly increased from 14.8% in 2006 to 15% in 2009 (Olorunfemi, Ndlovu, Masukume, Chikandiwa, Pisa, & Singh, 2018). and is predicted to be 19% in 2030 (United Nations Department of Economics and Social welfare, 2020). These results are from a study conducted in the Agincourt sub-district of rural northeast South Africa, where the proportion 50 years and over in the study population was 9.9% in 1992, 10.7% in 2000 and 11.7% in 2007. In this area the rate of labour migration, for male adults aged 35-50 years is high (approximately 60%) (Collinson et al., 2007). The rate of HIV-related mortality in young adults is also high (Kahn et al., 2007; Zwang et al., 2007). While migrants may be relatively healthier when they migrate, health status may be affected following migration as a result of; disruption, stress, behavioural change, unstable employment and possible exposure to disease in a new environment (Decosa et al,. 1995; Brockerhoff, 1990 & Lu, 2010). Migrants may encounter barriers in accessing health care or be exposed to changing lifestyle factors that negatively affect their health and well-being at destinations (Brockerhoff, 1990 & Popkin, 2004).

The movements place the elderly at a higher risk of contracting disease. When people are older, they might migrate for retirement or to be closer to family members. But being older and not financially independent, they are less able to prevent contracting disease. Therefore this study mainly focused on rural-rural migration to examine the developments of diseases on adults and elderly people as they move from one rural area to another. This is not a comparison study.

1.3 Research question and sub-questions:

Main research question: what are the levels and socio-economic determinants of disease outcome (diabetes, hypertension, tuberculosis) among rural-rural migrants (24-80 years old) in South Africa?

Sub-questions:

What are the levels of disease outcome among rural-rural migrants (24-80 years old) in South Africa?

What are the socio-economic determinants of disease outcomes among rural-rural migrants (24-80 years old) in South Africa?

1.4 Research objective and sub-objectives

Main research objective: To identify the levels and socio-economic determinants of disease outcomes (diabetes, hypertension, tuberculosis) among rural-rural migrants (24-80 years old) in South Africa

1.4.1. Sub-objectives:

To examine the levels of disease outcomes among rural-rural migrants (24-80 years old) in South Africa

To identify the socio-economic determinants of disease outcomes among rural-rural migrants (24-80 years old) in South Africa

1.5 justification

South Africans life expectancy has currently dropped especially during this pandemic period. The significant rise in deaths in 2021 approximately 34%, meant a drop in the 2021 Life expectancy at birth for South Africa. Life expectancy at birth for males declined from 62,4 in 2020 to 59,3 in 2021 (3,1 year drop) and from 68,4 in 2020 to 64,6 for females by 3,8 year drop (Stats SA, 2021).

Adults are especially important to the socio-economic development of the country. They bring substantial benefits to advance economies in a country in terms of higher per capita GDP and standard of living (Jaumotte, Koloskova & Saxena, 2016). For these reasons, and many others, it is important to protect the health of the elderly (WHO, 2018).

Adults' health is recognised under Sustainable Development Goals (SDGs). Meeting the needs of the adult population in South Africa will be critical for achieving goal number 3 of the SDGs, ensuring healthy lives and promoting well-being at all ages (United Nations, 2016). In addition, the National Health Act of 2003 requires that the department provides a framework for a structured and uniform health system for South Africa. National Health Insurance aims to ensure that all citizens and residents of South Africa, irrespective of socio-economic status, have access to good-quality health services provided by the public and private sectors, thereby eradicating financial barriers to health access (Department of Health, 2018).

From a public health perspective, a comprehensive view of acute and chronic diseases that affect the population, will allow a global assessment of health and societal needs (Hyder, Puvunachandra, & Morrow, 2018), combined with the most appropriate interventions or services for the best protection health (Gamache, Kharrazi, Weiner, 2018). Such a system will ensure a measure of overall health improvement, while it will facilitate the identification of new health challenges that can be overlooked with the independent disease monitoring method. For such a dynamic health system to exist, the provision of and timely access to comprehensive health information is essential.

It is important to understand the health of the older people because as population continues to age, along with millions living in rural settings; it will become increasingly important for health and social services to adapt and improve in order to provide effective care for a growing population that lives in rural areas (United Nations, 2015). Due to the unique genetic diversity and enormous heterogeneity in lifestyles, the burden of the outcomes of the diseases such as tuberculosis, hypertension and diabetes, need to be studied. Up-to-date information about levels and trends in diabetes is essential both to quantify the resultant health effects and to prompt decision makers to prioritise action and assess progress. Furthermore, there is a need to increase research among rural populations because this will enhance the development of effective and population-based interventions for the prevention of tuberculosis, diabetes and hypertension.

Several studies have concluded that rural-urban, urban-urban, urban-rural and rural-rural migration improves economic well-being for migrants in sub-Saharan Africa, thereby establishing rural-urban migration as a pathway out of poverty. For example, Beegle et al. (2011) tracked migrants by examining data of over 13 years in Tanzania and found that migration results in a 36% increase in consumption growth, relative to remaining in the community. Circular migration has been further linked to the spread of health conditions or behaviours between origin and destination areas. Studies have revealed that infectious diseases such as HIV may be diffused through a population via migration (Coffee, 2007; Lurie, 1997). As noted by Beegle et al. (2011), it matters where people move, but moving seems to matter too. However, little is known about the causes of diseases on adults who are involved in rural-rural migration.

People who are over working age are currently excluded from this study. However, many older people live in precisely the family-sized housing that is in such high demand. The social benefits of supporting and encouraging mobility among older people are catching the eye of policymakers (Pannell et al., 2012), and a growing band of critics are arguing that older people should be encouraged to move in order to free up precious housing stock (Griffiths 2011, Willetts 2011, Pannell et al 2012). Despite this growing interest, little is known about the extent of mobility among older people. There is a tendency to assume that older people are firmly rooted in the communities they have spent their lives in (Pannell et al., 2012, ODPM 2005), or that if they do move it is to warmer climes in Spain or the South Coast (King et al., 1997, 1998 and 2000; Atterton 2009). There is no clear consensus on whether migration among older groups a sign of policy failure for is primarily example; the inability of local areas to provide the care that people need or whether it rather indicate that a highly mobile group is taking the initiative to improve their lives by moving into more peaceful and manageable spaces.

Chapter 2: Literature Review and Theoretical Framework:

2.1 Brief review of most recent literature

A tabular presentation of some of the reviewed articles is presented in **Appendix B**.

2.1.1 To examine the levels of disease outcomes (diabetes, hypertension, and tuberculosis) among rural-rural migrants (24-80 years old) in South Africa.

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 behavioural, 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% 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).

South Africa is one of 6 countries accounting for 60% of the global tuberculosis burden (World Health Organization, 2016). In 2015 there were an estimated 454 000 incident cases, at a rate of 834 cases per 100 000 populations. Estimated tuberculosis incidence rates and mortality appear to be decreasing, the current rate of decline is too slow to meet the 2030 Sustainable Development Goals or 2035 End TB Strategy targets (WHO, 2015). Extrapolating from World Health Organization estimates (WHO, 2016), by 2030 and 2035, tuberculosis incidence rates for South Africa would need to decrease to 167 and 83 cases per 100 000 populations, respectively, and mortality would need to decrease to 9800 and 4900 cases, respectively.

The prevalence of diabetes is rapidly increasing in South Africa. In 2009, approximately 2 million (9%) people aged 30 years and older had diabetes (Bertram, 2013), increasing almost twofold since 2000 when Bradshaw et al., (2007) reported a prevalence of 5.5%.

2.1.2 To identify the socio-economic determinants of disease outcomes (diabetes, hypertension, and tuberculosis) among rural-rural migrants (24-80 years old) in South Africa.

South Africa has shown that prominently rural sending areas experience an excess mortality due to people returning home to die (Le Vay, Fraser, Byass, Tollman, Kahn, D'Ambruoso, & Davies, 2021). The assumption is that new migrants will be attracted to places with better economic opportunities and living conditions, generally in urban areas, but that some migrants may partake in high-risk behaviour (smoking, drinking, unhealthy diets, risky sexual encounters, violence) and may have difficulty accessing health services in these destinations, if they reside in slums. This phenomenon is referred to as the segmented adaptation effect (Anyanwu, 2018). Consequently, the migrants will return to their place of origin when their health deteriorates to seek health care and support, thus contributing to higher mortality in rural areas (Anyanwu, 2018).

In addition to black African populations, there are established Europid and Indian populations living in Africa (AFR). Also, in South Africa, the previously defined official population groups classified people of mixed ancestry as ‘‘coloured’’. Although recent diabetes studies among minority population groups in Africa are lacking, studies conducted over two decades ago in Tanzania and South Africa reported lower diabetes prevalence in black African than Indian communities (South Africa: 5.3% vs. 13.0%; Tanzania: 1.1% vs. 9.1/7.1%, respectively (Atun, Davies, Gale, Bärnighausen, Beran, Kengne, & Werfalli, 2017). Black African populations also had lower diabetes prevalence compared to populations with mixed Egyptian ancestry in Sudan (3.4% vs. 10.4%) and the coloured population in South Africa (8.0% vs. 10.8%), respectively (D). The prevalence in Europid populations in Africa was relatively high (6–10%) and like those of their European counterparts (Tuei et al., 2010). Studies conducted recently in 2008–2009 reported markedly higher age-adjusted diabetes prevalence in Cape Town in coloureds (26.3%) (Esmarus et al., 2012) compared to black Africans (13.1%) (Peer et al., 2012).

Literature suggests that type 2 diabetes is associated with an interplay of multiple factors such as socio-economical, health behaviours and anthropometric (Maimela, Alberts, & Modjadji, 2016; Kyrou, Tsigos, & Mavrogianni, 2020). Socio-economic factors such as income, education, occupation and marital status were found to be associated with diabetes prevalence (Mutyambizi, Booysen, Stokes, Pavlova, & Groot, 2019; Maimela, Alberts, & Modjadji, 2016). Indicating that people who are less likely to develop diabetes and to experience its complications are those who earn higher income with the highest level of education attained.

Health behaviours such as smoking, alcohol use, physical inactivity, low fruit and vegetable intake were found to be risk factors associated with diabetes (Mutyambizi, Booysen, Stokes, Pavlova, & Groot, 2019; Amberbir, Lin, Berman, 2019). A large household NCD risk factor survey conducted in the North Indian state of Punjab found that hypertension is significantly associated with diabetes (Tripathy, Thakur, & Jeet, 2017). Previous studies suggest that diabetes is associated with multiple anthropometric factors such as increasing obesity indexes, body mass index (BMI), waist circumference and waist-height ratio (Erzse, Stacey, Chola, Tugendhaft, Freeman, & Hofman, 2019). These are much more strongly related to insulin resistance and as such, the higher they are the more prone is an individual to insulin resistance (Liu, Feng, & Zhang, 2018).

Several factors such as the ageing population, economic transition and urbanisation associated with nutrition transition and obesity have contributed to the increased diabetes prevalence (Steyn et al., 1997; Vorster et al., 2005; Kengne et al., 2013; Peer et al., 2007). In 2018, it was estimated that 87% of diabetes cases in South Africa were attributed to excess body weight (Joubert et al., 2020) This is concerning since in 2013 ~38% of men and ~69% of women in South Africa were considered overweight or obese (Fleming et al., 2014). In 2015, the global burden of disease study estimated that high body mass index and hyperglycaemia, ranked as the second and third leading risk factors, respectively, after unsafe sex, for early death and disability in South Africa (Global Burden of Disease, 2015).

One cannot exclude that the migration may have no effect at all on the migrant's health. The health conditions acquired in the place of origin could persist after migration. This is the socialisation effect whereby conditions and behaviours acquired at the place of origin, during childhood, persist in later life whatever the new environment the migrant is exposed to (Kulu, 2005). Adaptation effect may still exist but may not be sufficient to counterbalance the socialisation effect, i.e., the persisting effect of exposure prior to migration. The two effects, adaptation and socialisation, are therefore opposed.

Health is likely to be strongly tied to migration in older age (Gushalek & MacPherson, 2011). Research has shown that older adults might move to be nearer to health facilities or traditional healers, or to return home for palliative care or death near the family (Chimwaza & Watkins, 2004; S. J. Clark et al., 2007; Collinson et al., 2003, 2007). On the other hand, migration is a taxing process and may affect both mental and physical health. In rural Tanzania, girls are more likely to have left the household in their youth for other rural areas, whereas the opposite is true in Indonesia; gender does not appear to be correlated with rural-urban migration when other variables are held constant (Diao, 2018). As in Nepal, however, there are strong correlations between education level and migration. In Tanzania, rural- urban migration is strongly correlated with all levels of education from completing primary school up, with the slight exception of individuals with more than secondary education, which is rare (Kweka et al., 2017). Rural-rural migration, on the other hand, is not correlated with education level. In Indonesia, there are broader correlations between education level and both types of migration; in particular, individuals completing secondary education or more appear quite likely to migrate to either location relative to others (De Brauw, Mueller, & Lee, 2014). There is also an increase in rural-rural migration among those with less than a primary education relative to no education. Finally, age is particularly correlated with both types of migration in Indonesia. As with international versus internal migration, household demographic variables have little correlation with different migration types in either country.

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% while those aged 40 and above was 15-91.8% (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).

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 like 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 transition1. 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 must 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, like 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.

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).

Whilst the causes of type 1 diabetes are unknown, the risk of type 2 diabetes is determined by interplay of factors such as ethnicity, age, socio-economic status and various lifestyle factors (WHO, 2016). Lifestyle factors such as unhealthy diets, smoking, alcohol consumption and physical inactivity are particularly important for the prevention of type 2 diabetes (WHO, 2016; Pan et al, 2015; Baliunas et al., 2009), which is more common globally (Kengne et al., 2005; International Diabetes Federation, 2015). The role of modifiable risk factors in explaining the inequality in diabetes has been previously investigated (Mukong et al., 2017; Stringhini et al., 2012; Agardh et al., 2004). Health behaviours such as smoking and alcohol consumption explain between 33–45% of inequalities in the incidence of type 2 diabetes in the United Kingdom (Stringhini et al., 2012) and a third of socioeconomic inequalities in type 2 diabetes in a Swedish based study (Agardh et al., 2004). Using data from the South Africa National Income Dynamics Survey, Mukong et al (2017), finds that smoking and alcohol consumption account for -2.4% and 2.2% of self-reported diabetes inequality in 2014–2015. Current evidence indicates that obesity is a multifactorial condition influenced by many variables which include genetic, demographic and lifestyle factors. Al-Hazzaa et al., (2012) posited that genetic and demographic variables such as family history of obesity, age, ethnicity and sex cannot be modified, but obesity-associated lifestyle factors such as physical inactivity, unhealthy dietary choices, smoking and alcohol intake are often modifiable. In rural Ghana the prevalence of obesity in women was seven times that in men (Agyemang et al., 2016). The sex disparity in obesity appears independent of urbanicity with females in rural and peri-urban Uganda being 4.3 times as likely to be obese as males (Kirunda et al., 2015) and the prevalence of obesity in females 20–75 years of age in urban Cameroon being 4 times that of their male counterparts (Pasquet et al., 2003). This female preponderance of obesity may be due to several factors including female perceptions of 'ideal' body weight, differential effects of childhood under-nutrition and adult socioeconomic status (Case &Menendez, 2009), although in our study, socioeconomic status did not attenuate the relationship between sex and BMI.

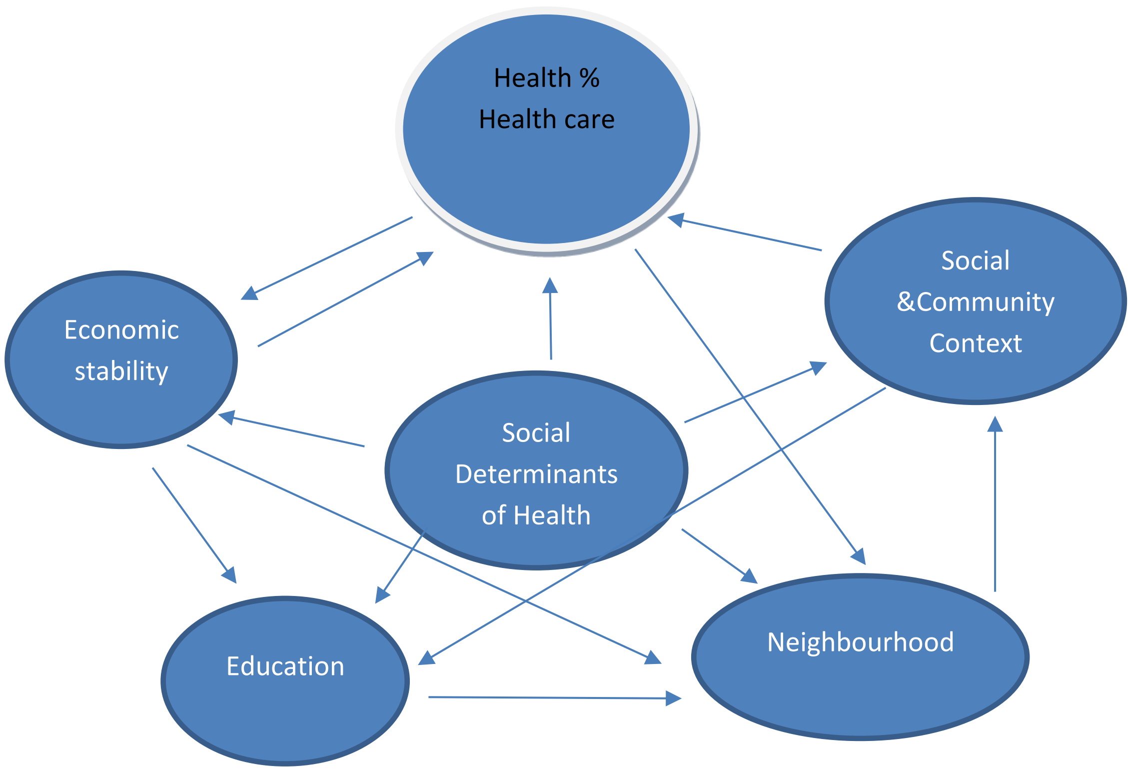
2.2 Theoretical frameworks for the study

Social determinants of health

The World Health Organization first introduced the concept "determinants of health" to illustrate the idea that an individual's health status is determined by many factors together (Wilkinson & Marmot, 2003). Based on the social determinants of health model, factors that influence health status include but are not limited to 1) the social and economic environment (e.g., income, education), 2) the physical environment (e.g., clean water, safe housing), and 3) the individual's characteristics and behaviours (e.g., access to healthcare, smoking). The social determinants of health model have been widely embedded in studies related to disease and functional status (Marmot, 2005; Havranek et al, 2015; Dyck et al, 2015).

Specific examples of Social Determinants of Health include income, education, employment, and social support (Lowcock, Rosella, Foisy, McGeer, & Crowcroft, 2012). Simply put, they are conditions into which one is born, grows, lives, works, and ages (Chapman, 2010). They look at the person. Altogether, these conditions impact health status of individuals and communities. Disparities in any of these conditions are translated into a measure of social hierarchy called socioeconomic status (SES). The lower individuals are on the spectrum of SES, the poorer health outcomes they face. Due to poor outcomes, life expectancy decreases for those at the lower end of the spectrum (Lowcock, Rosella, Foisy, McGeer, & Crowcroft, 2012). Socioeconomic inequality piles health complications on top of the financial woes already burdening disadvantaged segments of the population.

The factors of Social Determinants of Health are interrelated and played major role in the causes of diseases. For example, education level of an individual can impact his or her occupation, which determines economic stability and income level, which can impact the type of healthcare the individual is eligible for and what neighbourhood the individual lives in, which then impacts the social and community context the individual is surrounded by, and those factors played important role in the current disease one has. Therefore, one example to consider is from the perspective of an elderly growing up in a family that does not have much economic stability. The other family members living with that elderly having low-income jobs, which forces them to live in poverty-stricken neighbourhoods that may not have a great school system. The social determinants can be thought of as a cycle of events that impact one another rather than as individual entities even in the causes of diseases.



Push and pull theory

The push-pull theory has been widely used in geography and economics research to examine factors that influence people's decision to migrate (Dorigo & Tobler, 1983; Ravenstein, 1885). To illustrate, this theory emphasizes the interplay between sending- and receiving place factors that govern the migration process. Push factors often include dissatisfying conditions (e.g., political instability, heavy taxation) in the sending places that motivate people to migrate. In contrast to push factors, pull factors are favourable conditions (e.g., less polluted environment, health care system) in receiving countries that facilitate the migration process. Although the push-pull theory emphasizes that factors in both sending- and receiving places are important to the migration decision, whether these factors can cause accumulation of disease risks and whether migration is associated with certain health outcomes are only vaguely implied in this theory.

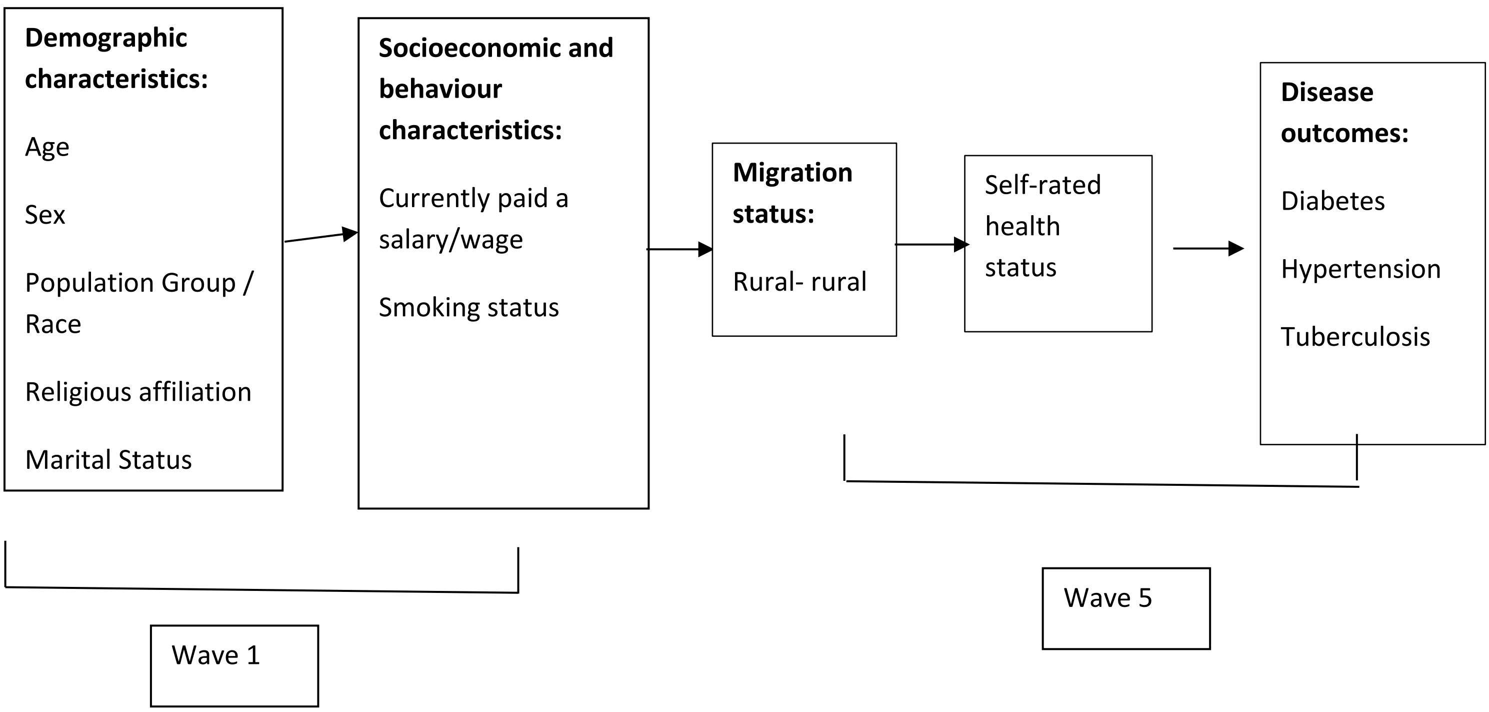
The motivation for migrants has been less analysed under the rural push versus rural pull theory. Rural push factors include poverty, inequitable land distribution, environmental degradation, high vulnerability to natural disasters, and violent conflicts while rural pull factors include land ownership and education opportunities, employment (agriculture), and diverse services.

2.3 Conceptual framework for the study

Researchers have historically examined the relationship between push and pull motivations but have mainly focused on international travel destinations rather than internal travel decisions. Existing research has identified the "social, cultural, personal, and psychological" factors influencing's motivation, which in turn influences 's travel decisions (Seyidov & Adomaitienė, 2016). In addition, the nature of push-pull factors and their relationship patterns have changed in socio-demographic subgroups (Kim et al., 2003).

The conceptual framework in Figure 2.1 guides the analysis using both the push and pull theory as well as the social determinants of Health. The variables included in the framework below drives the choice in the empirical models, and explicitly recognizes the interplay of societal and individual level on how it causes diseases. Therefore, the social determinants of health and push and pull theory were used to develop a new theoretical framework. Age refers to health status in each age and not only included current situation, but also considers the fatal, early life condition and later. Socio-economic status includes education, and currently paid regular salary. Currently paid regular salary. Usually, educated people have better knowledge about risky health behaviours, relevant healthcare and use health care services effectively. People with high education levels are more likely to be socialized in health promoting behaviours, lifestyles and currently being paid regular salary and economic situation. Contrary, others migrate to other rural areas to take care of their family members, regardless of their education status. Health behaviour: behavioural factors are the reason for more than half of premature death and can be varied according to SES. Smoking is part of healthy lifestyle and behaviour's factors.

Figure 2:1 Conceptual Framework Adapted from social determinants of health and push and pull theory



2.4 Research hypothesis

Ha: levels and socio-economic determinants of disease outcomes are associated with rural-rural migration among adults (24-80 years old) in South Africa.

Ho: levels and socio-economic determinants of disease outcomes are NOT associated with rural-rural migration among adults (24-80 years old) in South Africa.

Chapter 3: Methodology

3.1 Study area

South Africa was selected as the country of study for this research. South Africa is located on the tip of the South part of the Africa continent. South Africa's neighbouring countries are Namibia, Botswana, Zimbabwe, Eswatini, Lesotho and Mozambique (Statistics South Africa, 2016). The country consists of nine provinces: Mpumalanga, Limpopo, Gauteng, North-West, Free State, Northern Cape, Kwazulu-Natal, Eastern Cape and Western Cape.

3.2 Study design and data source

The data that was used in this study was drawn from wave 1 and wave 5 of the nationally representative South African National Income Dynamics Study (SA-NIDS) for 2008 and 2018 (SA-NIDS, 2016). The longitudinal panel data includes information on pre- and post-migration events, a substantial sample of adults and measures of diabetes, hypertension and tuberculosis disease outcome and socio-economic characteristics. These waves constitute a rich panel data conducted every two years since its first wave in 2008.

NIDS employs stratified sampling procedures (Chinhema et al. 2016; De Villiers et al 2013; Brown et al 2013) and is currently the sole nationally representative panel data source in South Africa. The survey was designed with a key objective to analyse various dimensions of the well-being of South Africans over time. The data obtained from the adult's questionnaire provided enough information on the socio-economic variables that were required and necessary to examine the levels, and socio-economic determinants of disease outcomes among rural-rural migrants (aged 24-80 years old) in South Africa. The analysis in this study examined the disease outcomes of rural-rural migrants for adults. The study focused on how health outcomes differ as migrants move from one rural area to another: in various socio-economic characteristics, both before and after migration.

3.3 Study population and sample size

The inclusion criteria for this study were adult migrants in South Africa aged 24-80 years. The study population were adults who were mobile and economically active, thus; in search of employment opportunities or the elderly who moved after retirement. Adults who did not have a disease were identified in wave 1 and followed through to wave 5 if they had moved to another rural area and measure their diseases status.

The exclusion criteria included rural-rural migrants who were younger than 24 years of age and those who did not have at least one disease outcome at baseline. The study population was also 5894. Demographic and socioeconomic variables were included for all disease outcomes in the study. The sample size for this study was 309 (6.90%) for diabetes, 1149 (19.49%) for those with hypertension and 284 (4.84%) for that tuberculosis.

3.4 Variables

3.4.1 Outcome/ dependent variables

The study used three dependent/outcome disease outcome variables of diabetes, hypertension and tuberculosis. These was identified as the most prevalent for the selected diseases and most likely to contribute to health outcomes among rural-rural migrants. Respondents were classified as hypertensive, diabetic and having tuberculosis if they acknowledged having ever been diagnosed with diabetes, hypertension, and tuberculosis by a health care professional (self-reported measure). The composite variable measured at least one disease versus no disease.

3.4.2 Independent variables

Independent variables included **age** 24-80 years; treated as a categorical variable, 1= 24-34; 2= 35-44; 3= 45-54; 4= 55-64; 5= 65-74; 6= 75-80. Socioeconomic and demographic variables were **Gender**: 1= male; 2=female, marital status respondents were asked ‘what is your current marital status?’ 1=married; 2= living with partner; 3= widow/widower; 4= divorced/separated; 5= never married. Concerning their **race**, respondents were asked, ‘what population group would you describe yourself as belonging to?’ 1= black African; 2= coloured; 3= Asian/Indian; 4= White. Concerning **health status**, respondents were asked the following: ‘how would you describe your health at present? Would you say it is excellent, very good, good, fair or poor?’ self-rated health was dichotomised to ‘poor health’ = 1 (fair or poor) and ‘good health’ = 0 (excellent, very good, or good), as done in previous studies (Kawachi, Kennedy, Glass, 1999; & Lamarca, Leal, Sheiham, Vettore, 2013), it is noted that NIDS study primarily relies on self- reporting of health condition. **Smoker** respondents were asked ‘do you smoke cigarettes?’ 1= yes; and 2=No. With regards to their regular wage, respondents are asked if they **are being paid a wage or salary** to work on a regular basis for an employer (that is not yourself) whether full time or part time, 1=yes; and 2= no. For their religious affiliation, the main category of interest on **religious affiliation** was no religion, and African traditional, while Christians, Jewish, Muslim, Hindu were combined as other and also due to smaller sample. 1= no religion, 2= African traditional, and 3= other.

Table 3.1: Independent variables to be used in this study

Study Variable name	Survey Variable name	Survey categorisation	Study categorisation
Age group	w1_a_dob_y	Continuous 24-80 years	Categorical: (1) 24-34 (2) 35-44 (3) 45-54 (4) 55-64 (5) 65-74 (6) 75-80
Gender	w1_a_gen	Categorical	(1) Male (2) Female
Smoker	w1_a_ hllfsmk	Dichotomous	(1) Yes (2) No
Health status	w1_a_hldes	Dichotomous	(1) Good (2) Poor

Population group	w1_a_popgrp	Categorical	(1) Black Africa (2) Coloured (3) Asian/Indian (4) White
Currently paid regular wage	w1_a_em	Dichotomous	(1) Yes (2) No
Religious affiliation	w1_a_rel	Categorical	(1) No religion (2) African traditional (3) Other

3.5 Ethical issues

This study used secondary data from South African National Dynamics Study. Therefore, there was no issue of confidentiality as identifying information and names of the respondents were not included in the dataset. The use of the SA-NIDS data in the current analysis was approved by the University of the Witwatersrand school of Social Science Ethics Committee, ethic number **WDEMG2020/07/07**.

3.6 Data management

The first step was to download the data set of the National Income Dynamics Study 2008 & 2017 and convert it to STATA using version 14. The second step was to merge wave 1 and wave 5 of the NIDS dataset and recode the variables. The third step involved obtaining the number of respondents who responded to the rural-rural migration module on Stata.

3.5 Data Analysis plan

The analysis examined the disease outcomes of adult rural-rural migrants. The particular focus was on how health outcomes differed as migrants moved from one rural area to another in various socioeconomic characteristics, both before and after migration. To be able to address the research question in the study, each of the research objectives were addressed. The **First Objective** which was to examine the levels of disease outcomes among rural-rural migrants (24-80 years old) in South Africa, was addressed using a table presentation of frequency and percentage distributions. The results for this objective were presented using graphs and a cross-tabulation table. Chi-square test was used to detect significant level in hypertension status. Results were presented with confidence intervals of 95% probability.

Disease prevalence formula

$$\frac{number\ of\ cases\ of\ disease\ at\ aspecific\ time}{population\ exposed\ at\ a\ time} \times 100$$

The **Second Objective** was, to identify the socioeconomic determinants of disease outcomes among rural-rural migrants (24-80 years old) in South Africa. For this objective, Binary logistic regression model was used while controlling for several covariates. The choice of using the regression model was informed by that, the outcome variable was dichotomous. Three different models with different disease outcome were used. The models are as described below:

Model 1: Characteristics of migrant in 2008 by Diabetes outcome in 2017

Model 2: Characteristics of migrant in 2008 by Hypertension outcome in 2017

Model 3: Characteristics of migrant in 2008 by Tuberculosis outcome in 2017

Binary logistic regression expression

Logit [P(y = 1)|Xi…Xk] = βo + β1X1 + β2X2.....βkXk

Where:

Bo= Intercept

B1= Regression Coefficient

Xi…Xk=Independent Variables

Xi= Independent Variable

The formula for the binary logistic is indicated above by (Warner, 2008). Confidence intervals will be set at 95% and values will be considered statistically significant if p = <0.05. All variables that will show a statistically significant association with the outcome, Stata version 14.0 will be used for all analysis.

Goodness of fit

Data is first regrouped by ordering the predicted probabilities and forming the number of groups, g. The Hosmer-Lemeshow test statistic is calculated with the following formula:

Hosmer-Lemeshow Test

Where:

X2 = chi squared.

nj = number of observations in the jth group.

Oj = number of observed cases in the jth group.

Oj = number of expected cases in the jth group.

The output returns a chi-square value (a Hosmer-Lemeshow chi-squared) and a p-value (e.g., Pr > ChiSq). Small p-values mean that the model is a poor fit.

3.6 Limitations

The data on rural-rural migration has the deficiency of not providing information on repeat or circular migration while there are cases of missing values where respondents did not answer correctly to the questions. The study attempted to ascertain whether respondents suffer from diabetes, hypertension and tuberculosis during their rural-rural migration. One of the limitations of this stems from self-reporting which introduces bias. The second limitation occurs when looking at the question used from the survey regarding health outcomes. If there is a differentiation in who presents themselves to a medical centre with these illnesses, then this will impact on the results of the study. thirdly, if the South African population tend to be diagnosed with these illnesses when some symptoms are presented, that is, when the illness has reached a certain level of severity, then there will be a bias associated with the study referring to more severe cases rather than prevalence of the disease.

Chapter 4: Results

4.1 introduction

4.1 Introduction the chapter presents the results of the study in three stages. The first stage is the univariate analysis which involved conducting background characteristics of the adults and a diagnosis of the levels of disease outcomes (diabetes, hypertension and tuberculosis) among rural-rural migrants aged 24-80 years in South Africa. The second stage of the analysis is the bivariate, which examined the socio-economic determinants of disease outcomes (diabetes, hypertension and tuberculosis) among rural-rural migrants aged 24-80 years in South Africa and other independent variables of the study, using the chi-square test and cross tabulation. The results of the unadjusted binary logistic regression of each independent variable and the outcome variables are presented in the bivariate analysis. The chapter ends by focusing on the last stage of the analysis multivariate, which examined the adjusted binary logistic regression to determine whether an association, using four models.

4.2 sample characteristics

The first objective of the study was to examine the levels of disease outcomes (diabetes, hypertension and tuberculosis) among rural-rural migrants aged 24-80 years in South Africa. The levels are presented in table 4.2 below:

Table 4.2: Baseline (wave 1) and wave 5 percentage distribution of respondents by demographic and socioeconomic background characteristics in South Africa.

Variables	Baseline (wave 1) independent characteristics		Wave 5 independent characteristics	
	Frequency (N)	Percentage (%) distribution	Frequency (N)	Percentage (%) distribution
Age				
24-34	2777	33.85	245	3.84
35-44	2119	25.83	1863	29.18
45-54	1737	21.17	1658	25.97
55-64	1104	13.46	1380	21.62
65-74	438	5.34	904	14.16

75-80	30	0.37	334	5.23
Total	**8205**	**100**	**6384**	**100**
Currently being paid a regular wage	2848	34.71	2170	33.99
Yes	5357	65.29	4214	66.01
No	**8205**	**100**	**6384**	**100**
Total				
Smoking status				
Yes	1935	23.58	1201	18.81
No	6270	76.42	5183	81.19
Total	8205	**100**	**6384**	**100**
Population group				
African	6130	74.71	5069	79.40
Coloured	1346	16.40	1035	16.21
Asian/Indian	139	1.69	78	1.22
White	590	7.19	202	3.16
Total	**8205**	**100**	**6384**	**100**
Sex				
male	2920	35.59	2107	33.00
Female	5285	64.41	4277	67.00
Total	**8205**	**100**	**6384**	**100**
Marital status				
Married	3140	38.27	132	23.49
Living with partner	999	12.18	-	-
Widow/widower	639	7.79	134	23.84
Divorced/separated	305	3.72	296	52.67
Never married	3122	38.05	-	-
Total	**8205**	**100**	**562**	**100**
Health status				
Good health	6380	77.76	5177	81.09
Poor health	1825	22.24	1207	18.91
Total	**8205**	**100**	**6384**	**100**

Religious				
affiliation	751	9.15	486	7.61
No religion	6903	84.13	5274	82.61
Christian	551	6.72	624	9.77
Other religion	**8205**	**100**	**6384**	**100**
Total				

Table 4.2 provides a detailed representation of the demographic and socioeconomic background characteristics of the respondents who took part in this study. At baseline (wave1): respondents aged 24-34 years made up the majority (33.85% [N=2777]) of the population and the percentage distribution of respondents declined as follows: those aged 35-44 (25.83% [N=2119]), 21.17% (N=1737) for age 45-54. Those aged 55-64 contributed 13.46% (N=1104), and those aged 65-74 and 75-80 contributing the least at 5.34% (N=438) and 0.37% (N=30), respectively. Over half (65.29% [N=5357]) of the respondents in table 4.1 were not paid a regular wage, while 34.71% (N=2848) were paid a regular wage. With reference to smoking status, the results obtained in the study shows that majority (76.42% [N=6270]) of the respondents were not smoking and 23.58% (N=1935) were smoking.

In terms of race/population group, table 4.2 shows that majority (74.71% [N=6130]) of respondents were Black African, followed by Asian/Indian at 1.69% (N=139), and, Coloured (16.40% [N=1346]) and White (7.19% [N=590]) contributing the least, more than half (64.41% [N=5285]) of the respondents in table 4.2, were females and males were 35.59% [N=2920]). In terms of marital status, the majority (38.27% [N=3140]) of respondents were married, followed by respondents who were never married (38.05% [N=3122]). Subsequently, 12.18% (N=999) of respondents in table 4.2 were living with partners and 7.79% (N=639) were widowed/widower, with a mere 3.72% (N=305) divorced/separated.

Health status indicates that majority (77.76% [N=6380]) of respondents were in poor health, while 22.24% (N=1825) of respondents were in good health. In terms of religion, majority (84.13% [N=6903]) of respondents in table 4.2, were Christian, while 9.15% (N=751) had no religion and only 6.72% (N=551) were affiliated to other religions.

At wave 5, respondents aged 35-44 made up the majority (29.18% [N=1863]) of the population, followed by 25.97% (N=1658) of respondents who were between the age cohorts 45-54. In addition, respondents in the age cohort 55-64 made up 21.62% (N=1380) of the population, followed by 14.16% (N=904) of respondents in the 65-74 age cohorts, 5.23% (N=334) in the 75-80 age cohort, and the lowest percentage of the sample of respondents (3.84% [N=245]) was 24-34 age cohort. Additionally, approximately 67% (N=4277) of the respondents were females, followed by 33% (N=2107) who were males.

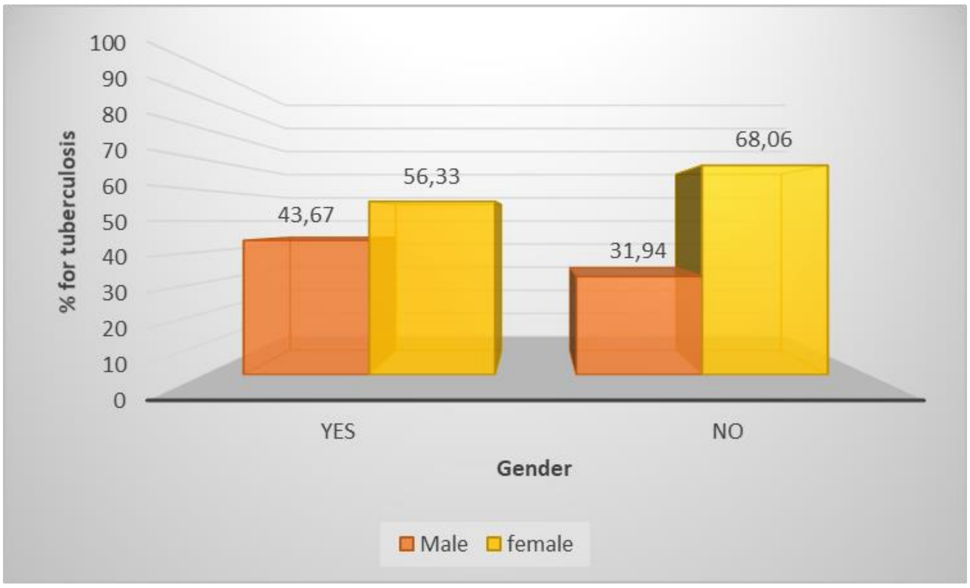
Conversely, the percentage distributions for population group showed that majority of the respondents were Black African 79.40% (N=5069) followed by Coloured 16.21% (N=10.35), while only 3.16% (N=202) are Whites and 1.22% (N=78) Asian/Indian. In terms of marital status, the majority (52.67% [N=296]) of the respondents were divorced/separated, followed by those who were widow/widower (23.84% [N=134]), with 23.49% (N=132) of respondents being married. Subsequently, approximately 81.09% (N=5177) of respondents were in good health, while a mere 18.91% (N=1207) were in poor health. In terms of religious affiliation, majority of respondents were Christian, followed by respondents from other religious affiliations and lastly, those who had no religion (782.61% [N=5274]), 9.77% (N=624), and 7.61% (N=486) respectively. With regards to respondents being paid a regular wage; 66.01% (N=4214) were not paid a regular wage, and 33.99% (N=2170) were paid a regular wage.

Relationship between wave 5 respondent characteristics and disease outcome (diabetes, hypertension and tuberculosis)

A presentation of some figures is presented in **Appendix A**.

Relationship between tuberculosis by sex

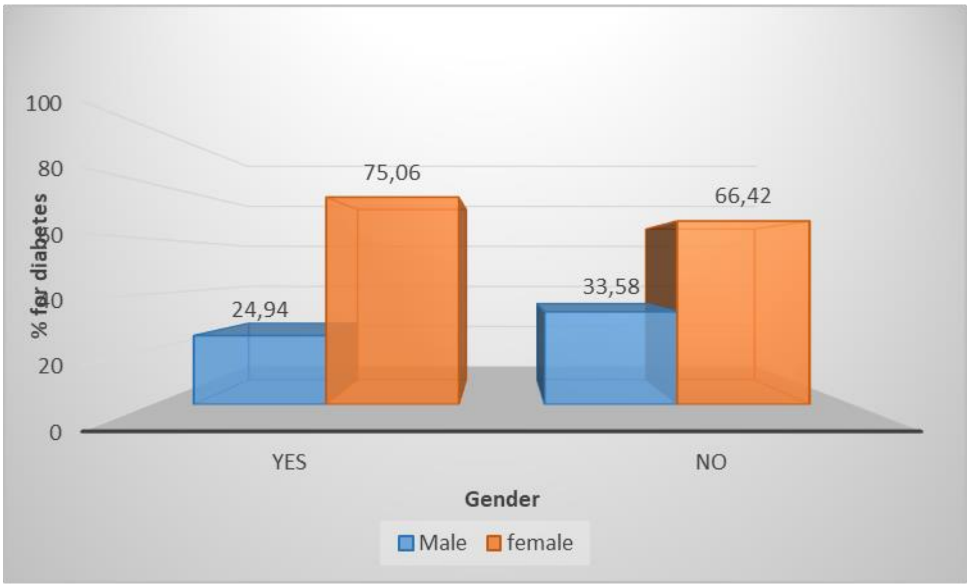
Figure 4.1, below, illustrates wave 5 percentage distribution of diabetes by sex among rural-rural migrants who were aged 24-80 years, in South Africa. 43.67% males reported to have diabetes, while 56.33% of females had diabetes. Only 31% of males and 68.06% of females did not have diabetes.



Relationship between tuberculosis by sex

Relationship between diabetes by sex

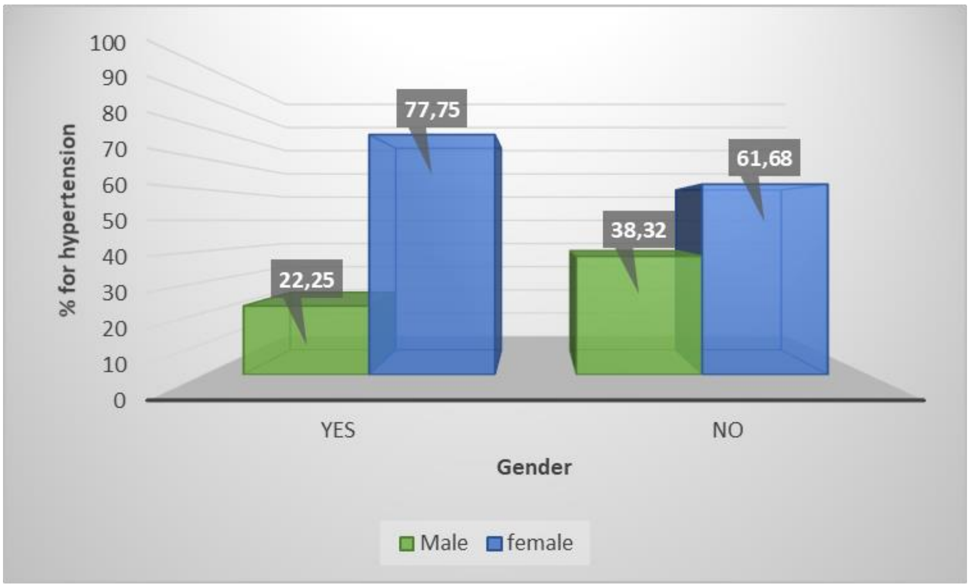
Figure 4.2, below, illustrates wave 5 percentage distribution of diabetes by sex among rural-rural migrants who were aged 24-80 years, in South Africa. About 24.94% of males reported to have diabetes compared to 75.06% females. Only 33.58% of males and 66.42% females were not diagnosed with diabetes.



Relationship between diabetes by sex

Relationship between hypertension by sex

Figure 4.3, below, illustrates the wave 5 percentage distribution of hypertension among rural-rural migrants who were aged 24-80 years, in South Africa. 22.25% of males reported to have been diagnose with hypertension and 77.75% of them were females with hypertension. Only 38.32% of males and 61.68% of females did not have diabetes.



Relationship between hypertension by sex

Bivariate analysis

Relationship between respondent characteristics and disease outcomes (diabetes, hypertension and tuberculosis)

Table 4.3: Characteristics by type of disease outcome (diabetes, hypertension and tuberculosis) at (wave5).

Independent characteristics	**Wave 5**		
	Diabetes	**Tuberculosis**	**Hypertension**
	N (%)	**N (%)**	**N (%)**
Age (Wave 5)			
24-34	1 (0.41)	7 (2.97)	7 (2.86)
35-44	32 (1.74)	97 (5.44)	92 (4.94)
45-54	89 (5.53)	99 (6.26)	250 (15.08)
55-64	138 (10.57)	66 (5.00)	365 (26.45)
65-74	116 (13.62)	50 (5.69)	346 (38.27)
75-80	37 (12.13)	13 (3.94)	142 (42.51)
Total	**413 (6.71)**	**332 (5.42)**	**1202 (18.83)**
p-value	**0.000**	**0.225**	**0.000**
Pearson chi2 (5)	**201.7994**	**6.9429**	**690.0563**
Currently being paid a regular wage			
Yes	85 (4.02)	91 (4.33)	244 (11.24)

No	328 (8.12)	241 (5.98)	958 (22.73)
Total	**413 (6.71)**	**332 (5.42)**	**1202 (18.83)**
p-value	**0.000**	**0.007**	**0.000**
Pearson chi2 (1)	**37.1986**	**7.3422**	**123.7223**
Smoking			
Yes	43 (3.67)	107 (9.43)	149 (12.41)
No	370 (7.43)	225 (4.50)	1053 (20.32)
Total	**413 (6.71)**	**332 (5.42)**	**1202 (18.83)**
p-value	**0.000**	**0.000**	**0.000**
Pearson chi2 (1)	**21.3872**	**43.7523**	**39.9189**
Population group			
Black African	285 (5.81)	260 (5.36)	895 (17.66)
Coloured	102 (1.26)	71 (7.1)	245 (23.67)
Asian/Indian	11 (15.94)	0 (0.00)	11 (14.10)
White	15 (8.02)	1 (0.50)	51 (25.25)
Total	**413 (6.71)**	**332 (5.42)**	**1202 (18.83)**
p-value	**0.000**	**0.000**	**0.000**
Pearson chi2 (3)	**36.2794**	**19.5103**	**27.0265**
Sex			
Male	103 (5.07)	145 (7.26)	224 (10.63)
Female	310 (7.52)	187 (4.52)	578 (27.07)

Total	**413 (6.71)**	**332 (5.42)**	**1202 (18.83)**
p-value	**0.000**	**0.000**	**0.000**
Pearson chi2 (1)	**13.0019**	**19.6800**	**138.2680**
Marital status			
Married	69 (4.72)	5 (3.85)	20 (15.15)
Living with partner	Omitted	Omitted	Omitted
Widow/widower	8 (6.40)	4 (3.08)	46 (34.33)
Divorced/separated	18 (6.340	17 (5.92)	53 (17.91)
Never married	Omitted	Omitted	Omitted
Total	**32 (5.97)**	**26 (4.75)**	**119 (21.17)**
p-value	**0.794**	**0.385**	**0.000**
Pearson chi2 (4)	**0.4607**	**1.9111**	**18.6552**
Health status			
Poor health	261 (5.20)	230 (4.61)	813 (15.70)
Good health	152 (13.36)	102 (8.94)	389 (32.23)
Total	**413 (6.71)**	**332 (5.42)**	**1202 (18.83)**
p-value	**0.000**	**0.000**	**0.000**
Pearson chi2 (1)	**98.5351**	**33.9778**	**174.8791**
Religious affiliation			
No religion	13 (2.74)	38 (8.26)	52 (10.70)
Christian	359 (7.07)	265 (5.22)	1045 (9.81)

Other	41 (6.80)	29 (4.87)	105 (16.83)
Total	**413 (6.71)**	**322 (5.42)**	**1202 (18.83)**
p-value	**0.002**	**0.018**	**0.000**
Pearson chi2 (2)	**12.9761**	**7.9829**	**26.0013**

Table 4.3 shows that at wave 5 as age increases: diabetes 0.41% (N=1); 1.74% (N=32); 5.53% (N=89); 10.57% (N=138); 13.62 (N=116); 12.13% (N=37) tuberculosis and hypertension also increase. The results for diabetes and hypertension were statistically significant ($p<0.05$), while the results for tuberculosis were not statistically significant ($p>0.05$). Interestingly, adults not currently paid a regular income, showed a higher proportion for all the disease outcome (diabetes, tuberculosis and hypertension). The results for; currently paid a regular wage were statistically significant ($p<0.05$). In terms of smoking status, adults not smoking (7.43% [N=370]), were more diabetic than those who were smoking (3.67% [N=43]). Surprisingly, table 4.2 shows that adults, not smoking, had higher proportion (4.50% [N=107])) for tuberculosis compared to those who were smoking (9.43% [N=43]). Also, adults, not smoking, showed higher proportion (20.32% [N=1053]) for hypertension compared to those smoking (12.41% [N=149]).

Based on race/population group, majority (5.81% [N=285]) of adults who were diabetic were Black Africans, followed by coloured (1.26% [N=102]), White (8.02% [N=15]) and Asian/Indian (15.94% [N=11]) were the least. Also, a great percentage (17.66% [N=895]) of adults who were Black African were hypertensive, followed by Coloured (23.67% [N=245]), then White (25.25% [N=51]), and Asian/Indian (14.10% [N=11]). Majority (5.36% [N=260]) of Black Africans had tuberculosis, followed by Coloured 7.1% (N=71). None of the Asian/Indian race had tuberculosis as shown in table 4.3 above, while only 0.50% (N=1) of White adults had tuberculosis.

Table 4.3 above also shows that more females (7.52% [N=310]) were diabetic than males (5.07% [N=103]). Conversely, the majority (27.07% [N=578]) of females had hypertension compared to males (10.63% [N=224]). Interestingly, more females (4.52% [N=187]) had tuberculosis than their male (7.26% [N=145]) counter parts. Based on marital status, married adults (4.72% [N=69]) were more diabetic. The results for those who were never married were omitted as shown in table 4.2 above. Only 6.40% (N=17) of those who were widow/widower had diabetes. The table show that the results for adults who were living with a partner were also omitted, and the divorced/separated with diabetes were 6.34% (N=18).

In terms of tuberculosis, most (5.92% [N=17]) adults who were divorced or separated had tuberculosis, then those who were married (3.85% [N=5]). Adults who were never married and those who were living with a partner were omitted. Only 3.08% (N=4) of widow/widower had tuberculosis. Concerning hypertension; the majority (17.91% [N=53]) of adults who were divorced or separated had tuberculosis, followed by 34.33% (N=46) for the widow/widower, the married (15.15% [N=20]) were the least. The results for those living with a partner and never married were also omitted.

With regards to health status, adults with poor health were more (5.20% [N=261]) diabetic than those with good health (13.36% [N=152]). Conversely, the percentage of adults with hypertension was higher (15.70% [N=813]) among those with poor health than those with good health (32.23% [N=389]). Additionally, the majority (4.61% [N=230]) of adults who had tuberculosis was those with poor health compared to those with good health (8.94% [N=102]). In terms of religious affiliation, the results showed that a greater proportion (7.07% [N=359]) of adults with diabetes were Christians, followed by 6.80% (N=41) of adults with other religious affiliations. Lastly, those with no religious affiliation (2.74% [N=13]) showed the least of adults with diabetes, on the other hand, majority of Christians had hypertension 9.81% (N=1045), followed by those with other religious affiliations at 16.83% (N=105), and adults with no religion 10.70% (N=52) and had hypertension showed the lowest results when compared to all the categories of religion.

Multivariate analysis

Table 4.4: un-adjusted Odds Ratios for the binary Logistic regression of the association between all the baseline (wave1) independent variables with disease outcome (diabetes, hypertension, and tuberculosis) at wave 5.

	Diabetes				Tuberculosis				Hypertension			
	Odds ratio	**p>(z)**	**Confidence interval**		**Odds ratio**	**p>(z)**	**Confidence interval**		**Odds ratio**	**p>(z)**	**Confidence interval**	
Age												
24-34	RC											
35-44	0.353**	0.000	0.21688	0.57615	0.634**	0.001	0.48789	0.82564	0.302**	0.000	0.24356	0.37528
45-54	0.141**	0.000	0.09010	0.22129	0.676**	0.006	0.51133	0.89566	0.137**	0.000	0.11165	0.16900
55-64	0.091**	0.000	0.05818	0.14400	0.743**	0.007	0.53502	1.03256	0.078**	0.000	0.06298	0.09681
65-74	0.086**	0.000	0.05173	0.14544	1.570	0.159	0.83768	2.94536	0.058**	0.000	0.04522	0.07585
75-80	0.034**	0.000	0.01307	0.09297	Omitted	omitted	Omitted		0.048**	0.000	0.02311	0.10100
Currently being paid a regular wage												

Yes	RC								
No	0.621**	0.000	0.48051 0.80418	0.774**	0.023	0.62207 0.96543	0.561**	0.000	0.49425 0.63727
Smoking									
Yes	RC								
No	0.551**	0.000	0.40257 0.75433	1.774**	0.000	1.43526 2.19453	0.717**	0.000	0.62334 0.8251674
Race									
Black African	RC								
Coloured	0.716	0.024	0.53593 0.95799	0.892	0.381	0.69160 1.15152	0.720**	0.000	0.62348 0.83337
Asian/Indian	0.286**	0.000	0.16442 0.49752	7.575	0.044	1.05617 54.33756	0.977	0.922	0.62674 1.52583
White	0.532**	0.000	0.36971 0.76678	10.741**	0.000	3.43506 33.58737	0.615**	0.000	0.50448 0.74980
Sex									
Male	RC								
Female	0.607**	0.000	0.47025 0.78532	1.253**	0.030	1.02176 1.53838	0.438**	0.000	0.38446 0.50060
Marital status									
Married	RC								

Living with	2.616**	0.000	1.6522 4.14193	0.441**	0.000	0.322356 0.60350	1.644**	0.000	1.35873 1.98985
partner	0.608**	0.002	0.44216 0.83750	0.890	0.621	0.56132 1.41146	0.529**	0.000	0.44143 0.63461
Widow/widower	1.657	0.127	0.86576 3.17167	0.690	0.205	0.38998 1.22365	0.952	0.729	0.72280 1.25485
Divorced/separat	2.600**	0.000	1.94734 3.47390	0.504**	0.000	0.39438 0.64504	2.578**	0.000	2.23818 2.97170
ed									
Never married									
Health status									
Poor health	RC						0.217	0.000	0.19299 0.24529
Good health	0.210**	0.000	0.16755 0.26425	0.281	0.000	0.23005 0.34548	32.568	0.000	27.30753 38.84375
Religious affiliation									
No religion	RC								
Christian	0.591	0.033	0.36516 0.95927	1.208	0.251	0.87464 1.67059	0.537**	0.000	0.42634 0.67859
Other	0.516	0.036	0.27901 0.95674	1.742	0.048	1.00570 3.01933	0.729**	0.000	0.52742 1.00815

RC = Reference Category, **p < 0.05 represents significant results at 95% level of confidence

Table 4.4, above, presents the results of the unadjusted odds ratios of, diabetes, tuberculosis and hypertension. For wave 1: adults aged 35-44 years were significantly less likely to have diabetes (OR: 0.35 $p < 0.05$ CI: 0.21-0.57) for tuberculosis (OR: 0.63 $p < 0.05$ CI: 0.48-0.82) and hypertension (OR: 0.30 $p<0.05$ CI: 0.24-0.37) than adults aged 24-34 years old. Interestingly, although not statistically significant, the results show that, the adults aged 65-74 years had higher odds (OR: 1.57 $p>0.05$ CI: 0.83-2.94) of having tuberculosis than those aged between 15-19 years. For adults aged 75-80 years old; the results of having either tuberculosis or hypertension were omitted.

Table 4.4 shows that all other age groups were significantly less likely (OR: 0.14 $p<0.05$ CI:0.90-0.22) to have diabetes and hypertension. Concerning regular wages; adults who were not currently paid a regular wage, were statistically less likely (OR: 0.62 $p<0.05$ CI: 0.48-0.80) to have diabetes, tuberculosis (OR: 0.77 $p<0.05$ CI: 0.62-0.96), and hypertension (OR: 0.56 $p<0.05$ CI: 0.49-0.63) than their counter parts. Smoking status revealed that adults who were not smoking were significantly less likely (OR: 0.56 $p<0.05$ CI: 0.40-0.75) to have diabetes and hypertension (OR: 0.71 $p<0.05$ CI: 0.62-0.82), unlike tuberculosis the results showed a higher likely to having tuberculosis to adults not smoking (OR: 1.77 $p<0.05$ CI: 1.43-2.19).

As illustrated in Table 4.4, the odds of having diabetes, tuberculosis and hypertension differed per race/population groups. The odds of having diabetes were all significantly less likely (OR: 0.71 $p<0.05$ CI: 0.53-0.95) for coloured, Asian/Indian (OR: 0.28 $p<0.05$ CI: 0.16-0.49), and Whites (OR: 0.53 $p<0.05$ CI: 0.36-0.76) than black African. The odds of having tuberculosis were significantly 10 times likely among whites (OR: 10.74 $p<0.05$ CI: 3.43-33.58) compared to Asian/Indian (OR: 7.57 $p<0.05$ CI: 1.05-54.33). The odds of having tuberculosis were less likely for Coloureds (OR: 0.89 $p>0.05$ CI: 0.69-1.15) compared to Black African and they were not statistically significant. On the other hand, the odds of having hypertension among Whites (OR: 0.61 $p<0.05$ CI: 0.50-0.74) were significantly less compared to Coloured (OR: 0.72 $p<0.05$ CI: 0.62-0.83). The odds for the Asian/Indian race to have hypertension were low (OR: 0.72 $p>0.05$ CI: 0.62-1.52) compared to Black African and thus not significant.

Furthermore, the results indicated that, females had lower likelihood (OR: 0.60 $p<0.05$ CI: 0.47-0.78) to having diabetes and hypertension (OR: 0.43 $p<0.05$ CI: 0.38-0.50) statistically significant. However, females' likelihood to have tuberculosis were higher (OR: 1.25 $p<0.05$ CI: 1.02-1.53) and the results showed a statistically significant association. Concerning marital status, adults living with partners were significantly (OR: 2.61 $p<0.05$ CI: 1.65-4.14) more likely to have diabetes than divorced/separated adults (OR: 0.1.65 $p>0.05$ CI: 0.86-3.17). Also, the never married adults were more likely (OR: 2.6 $p<0.05$ CI: 1.94-3.4) to have diabetes than widow/widower (OR: 0.60 $p<0.05$ CI: 0.44-0.83). For tuberculosis, the never married adults were less likely (OR: 0.50 $p<0.05$ CI: 0.32-0.60) to have tuberculosis compared to living with a partner (OR: 0.44 $p<0.05$ CI: 0.39-0.64).

Divorced/separated adults had less likelihood (OR: 0.89 $p>0.05$ CI: 0.56-1.41) to have tuberculosis than widow/widower (OR: 0.69 $p>0.05$ CI: 0.38-1.22). with reference to hypertension, never married adults showed higher likelihood (OR: 2.57 $p<0.05$ CI: 2.23-2.97) to have hypertension compared to living with a partner (OR: 1.64 $p<0.05$ CI: 1.35-1.98). Conversely, divorced/separated adults were less likely (OR: 0.52 $p<0.05$ CI: 0.44-0.63) to have hypertension compared to widow/widower (OR: 0.95 $p>0.05$ CI: 0.72-1.24). The results also revealed that adults with good health were significantly less likely (OR: 0.21 $p<0.05$ CI: 0.16-0.26) to have diabetes, tuberculosis (OR: 0.28 $p<0.05$ CI: 0.23-0.34) and hypertension (OR: 0.21 $p<0.05$ CI: 0.19-0.24) than those with poor health. As shown by table 4.4, above, the odds of adults from other religions show significantly less likelihood (OR: 0.51 $p<0.05$ CI: 0.27-0.95) to have diabetes and hypertension (OR: 0.72 $p<0.05$ CI: 0.52-1.00) than Christian adults (OR: 0.59 $p<0.05$ CI: 0.36-0.95) for diabetes, and (OR: 0.53 $p<0.05$ CI: 0.42-0.67) for hypertension. Concerning tuberculosis; Christians showed higher (OR: 1.20 $p>0.05$ CI: 0.87-1.67) likely than adults from other religions (OR: 1.74 $p>0.05$ CI: 1.00-3.01) to have tuberculosis and the results found no statistical association.

Table 4.5: Un-adjusted Odds Ratios for the binary Logistic regression of the association between all the wave 5 independent variables with disease outcome (diabetes, hypertension, and tuberculosis) at wave 5.

Independent variables	**Diabetes**			**Tuberculosis**			**Hypertension**		
	Odds ratio	**p>(z)**	**Confidence interval**	**Odds ratio**	**p>(z)**	**Confidence interval**	**Odds ratio**	**p>(z)**	**Confidence interval**
Age									
24-34	RC								
35-44	0.234	0.154	0.03189 1.72345	0.655	0.291	0.29920 1.43611	0.566	0.153	0.25946 1.23545
45-54	0.070**	0.009	0.00983 0.51135	0.453	0.046	0.20824 .98720	0.165**	0.000	0.07719 0.35546
55-64	0.035**	0.001	0.00488 0.25231	0.484	0.070	0.22088 1.06210	0.081**	0.000	0.03820 0.17507
65-74	0.026**	0.000	0.00365 0.18949	0.513	0.104	0.22947 1.14773	0.047**	0.000	0.022105 0.10177
75-80	0.030**	0.001	0.00409 0.22072	1.062	0.906	0.39002 2.89221	0.039**	0.000	0.01818 0.08695
Currently being paid a regular wage									
Yes	RC								
No	0.474**	0.000	0.37132 0.60564	0.869	0.255	0.68342 1.10631	0.430**	0.000	0.37007 0.50097

Smoking									
Yes	RC								
No	0.474**	0.000	0.34397 0.65551	1.595**	0.000	1.23655 2.05872	0.555**	0.000	0.46195 0.66801
Race									
Black African	RC								
Coloured	0.539**	0.000	0.42553 0.68390	0.851	0.271	0.64042 1.13324	0.691**	0.000	0.58889 0.81176
Asian/Indian	0.325**	0.001	0.16886 0.62653	4.179	0.156	0.57909	1.306	0.415	0.68749 2.48105
White	0.707	0.210	0.41177 1.21511	10.91**	0.017	30.17053	0.634**	0.006	0.45845 0.87913
						1.52349			
						78.13463			
Sex									
Male	RC								
Female	0.657**	0.000	0.52247 0.82686	1.233	0.075	0.97919 1.55374	0.401**	0.000	0.34337 0.46893
Marital status									
Married	RC								
Living with partner	Omitted	Omitted	Omitted	Omitted	Omitted	Omitted	Omitted	Omitted	Omitted
Widow/widower	0.725	0.563	0.24417 2.15390	2.445	0.202	0.61857 9.66689	0.341**	0.000	0.18849 0.619103

Divorced/separated	0.732	0.521	0.28379 1.89211	0.864	0.751	0.35227 2.12343	0.818	0.485	0.46722 1.4346
Never married	Omitted	Omitted	Omitted	Omitted	Omitted	Omitted	Omitted	Omitted	Omitted
Health status									
Poor health	RC								
Good health	0.355**	0.000	0.28814 0.43979	0.675	0.003	0.52174 0.87505	0.391	0.000	0.33987 0.45154
Religious affiliation									
No religion	RC								
Christian	0.370**	0.001	0.21140 0.64994	1.238	0.282	0.83906 1.82844	0.484**	0.000	0.36083 0.65157
Other	0.386**	0.003	0.20465 0.73006	1.349	0.263	0.79866 2.28130	0.592**	0.000	0.414856 0.84544

RC = Reference Category, **p < 0.05 represents significant results at 95% level of confidence

Table 4.5 presents the results of the unadjusted odds ratios of, diabetes, tuberculosis and hypertension. For wave 5, adults aged 35-44 years were less likely (OR: 0.23 $p > 0.05$ CI: 0.03-1.72) to have diabetes for tuberculosis (OR: 0.65 $p > 0.05$ CI: 0.29-1.43) and hypertension (OR: 0.56 $p>0.05$ CI: 0.25-1.23) than adults aged 24-34 years old. Interestingly, the results further show that the adults aged 75-80 years, had higher odds of having tuberculosis than those aged 15-19 years, the results were not statistically significant (OR: 1.06 $p>0.05$ CI: 0.39-2.89). For adults aged 75-80 years old, the results of having either tuberculosis or hypertension were omitted. Table 4.5 shows that, all other age groups were significantly less likely to have diabetes (OR: 0.14 $p<0.05$ CI:0.90-0.22) and hypertension.

With regards to currently being paid a regular wage; adults not currently paid a regular wage were statistically less likely to have diabetes (OR: 0.47 $p<0.05$ CI: 0.37-0.60), tuberculosis (OR: 0.86 $p>0.05$ CI: 0.68-1.10), and hypertension (OR: 0.43 $p<0.05$ CI: 0.37-0.50) than their counter parts. Smoking status revealed that; adults who were not smoking, were significantly less likely to have diabetes (OR: 0.47 $p<0.05$ CI: 0.34-0.65), and hypertension (OR: 0.55 $p<0.05$ CI: 0.46-0.66). However, the results show that there was a higher likelihood (OR: 1.59 $p<0.05$ CI: 1.23-2.05) for adults who were smoking to have. As illustrated in Table 4.5, the odds of having diabetes, tuberculosis and hypertension differed per race/population groups. The odds to having diabetes were all significantly low for Coloured (OR: 0.53 $p<0.05$ CI: 0.42-0.68), Asian/Indian (OR: 0.32 $p<0.05$ CI: 0.16-0.62), and Whites (OR: 0.70 $p>0.05$ CI: 0.41-1.21) than Black African. The odds of having tuberculosis were significantly 10 times likely for Whites (OR: 10.91 $p<0.05$ CI: 1.52-78.13) compared to Asian/Indian (OR: 4.17 $p>0.05$ CI: 0.57-30.17). Meanwhile, the odds of having tuberculosis among Coloureds were less likely (OR: 0.85 $p>0.05$ CI: 0.64-1.13) than Black African, and they were not statistically significant. On the other hand, the odds of Whites to have hypertension were significantly less likely (OR: 0.63 $p<0.05$ CI: 0.45-0.82) compared to Coloureds (OR: 0.69 $p<0.05$ CI: 0.58-0.81). The odds to have hypertension were more likely (OR: 1.30 $p>0.05$ CI: 0.68-2.48) for Asian/Indians compared to Black African and thus not significant.

The results further indicated that, females' likelihood to have diabetes was low (OR: 0.65 $p<0.05$ CI: 0.52-0.82), and hypertension (OR: 0.40 $p<0.05$ CI: 0.34-0.46) statistically significant. However, the likelihood for females to have tuberculosis were higher (OR: 1.23 $p>0.05$ CI: 0.97-1.55), and the results found no statistically significant association. In terms of marital status, widow/widower adults were significantly more likely (OR: 1.32 $p>0.05$ CI: 0.41-4.21) to have diabetes than divorced/separated adults (OR: 0.70 $p>0.05$ CI: 0.25-1.92). The adults living with a partner and never married were omitted.

For tuberculosis; the widow/widower (OR: 2.98 $p>0.05$ CI: 0.68-12.99) adults had higher likelihood to have tuberculosis than divorced/separated (OR: 0.99 $p>0.05$ CI: 0.37-2.59). Adults living with partner and never married were omitted. With reference to hypertension, widow/widower adults were less likely (OR: 0.341 $p<0.05$ CI: 0.18-0.61) to have hypertension compared to divorced/separated (OR: 0.81 $p>0.05$ CI: 0.46-1.43). The results also revealed that adults with good health were significantly less likely to have diabetes (OR: 0.35 $p<0.05$ CI: 0.28-0.43), tuberculosis (OR: 0.67 $p<0.05$ CI: 0.52-0.87), and hypertension (OR: 0.39 $p<0.05$ CI: 0.33-0.45) than those with poor health. As shown by table 4.5 above, the odds of adults from other religions (OR: 0.38 $p<0.05$ CI: 0.20-0.73) show significant less likelihood to having diabetes and hypertension (OR: 0.59 $p<0.05$ CI: 0.41-0.84) than Christian adults (OR: 0.59 $p<0.05$ CI: 0.36-0.95) for diabetes and (OR: 0.53 $p<0.05$ CI: 0.42-0.67) for hypertension. As for tuberculosis, Christians (OR: 1.23 $p>0.05$ CI: 0.83-1.82) showed higher likelihood than adults from other religions (OR: 1.34 $p>0.05$ CI: 0.79-2.28) to have tuberculosis and the results found no statistical association.

Table 4.6: Adjusted model for the binary Logistic regression of the association between all the wave 1 independent variables with disease outcome (diabetes, hypertension, and tuberculosis) at wave 5.

Independent variables	**Diabetes**			**Tuberculosis**			**Hypertension**		
	Odds ratio	**p>(z)**	**Confidence interval**	**Odds ratio**	**p>(z)**	**Confidence interval**	**Odds ratio**	**p>(z)**	**Confidence interval**
Age									
24-34	RC								
35-44	0.313**	0.000	0.20619 0.47643	0.579**	0.000	0.43839 0.76525	0.363**	0.000	0.29018 0.45564
45-54	0.174**	0.000	0.11486 0.26436	0.671*	0.014	0.48855 0.92345	0.194**	0.000	0.15493 0.24345
55-64	0.148**	0.000	0.09588 0.23037	0.778	0.196	0.53235 1.13826	0.122**	0.000	0.09660 0.15640
65-74	0.177**	0.000	0.10401 0.30330	1.40	0.327	0.71300 2.75817	0.094**	0.000	0.07055 0.12689
75-80	Omitted	Omitted	Omitted	Omitted	Omitted	Omitted	Omitted	Omitted	0.03923 0.19070
Currently being paid a regular wage	RC								
Yes	0.900	0.413	0.70016 1.15762	0.851	0.182	0.67264 1.07836	0.926	0.311	0.80049 1.07343
No									

Smoking									
Yes	RC								
No	0.430**	0.000	0.31060 0.59572	1.595**	0.000	1.23053 2.06949	0.860	0.092	0.72201 1.02493
Race									
Black	RC								
African	0.409**	0.000	0.31310 0.53538	0.970	0.836	0.72861 1.29178	0.659**	0.000	0.55356 0.78510
Coloured	0.380**	0.013	0.17686 0.81872	4.769	0.127	0.64010 35.53188	0.987	0.962	0.57600 1.69140
Asian/Indian	0.715	0.246	0.40569 1.26016	7.345**	0.001	2.31941 23.26023	0.664**	0.001	0.52780 0.83704
White									
Sex									
Male	RC								
Female	0.918	0.521	0.70921 1.19020	1.259	0.064	0.98624 1.6081	0.499**	0.000	0.42723 0.58489
Marital									
status	RC								
Married	1.868**	0.005	1.20635 2.89521	0.490**	0.000	0.35194 0.68347	0.955	0.677	0.77031 1.18477
Living with	1.253	0.195	0.89050 1.76500	0.991	0.971	0.61286 1.60304	1.095	0.386	0.89169 1.34519
partner	1.249	0.423	0.72426 2.15548	0.652	0.152	0.36322 1.17041	1.060	0.699	0.78810 1.42675
Widow/wido	1.156	0.294	0.88153 1.51736	0.456*	0.000	0.34641 0.60124	1.218**	0.021	1.02969 1.44170
wer									

Divorced/separated									
Never married									
Health status									
	RC								
Poor health	0.506**	0.000	0.40435 0.63404	0.270**	0.000	0.21610 0.33874	0.328**	0.000	0.28685 0.37551
Good health									
Religious affiliation									
No religion	RC								
Christian	0.663	0.100	0.40733 1.08183	0.893	0.520	0.63358 1.25981	0.723**	0.014	0.55882 0.93791
Other	0.651	0.183	0.34705 1.22325	1.356	0.294	0.76733 2.39721	1.089	0.657	0.74708 1.58819

RC = Reference Category, **p < 0.05 represents significant results at 95% level of confidence

Table 4.6 describes the adjusted Model 1: Characteristics of migrant in 2008 by Diabetes outcome in 2017, Model 2: Characteristics of migrant in 2008 by Hypertension outcome in 2017, and Model 3: Characteristics of migrant in 2008 by Tuberculosis outcome in 2017 at baseline (wave1). After controlling for variables, adults aged 45-54 years had significantly low odds (AOR: 0.17 p< 0.05 CI: 0.11-0.26) to have diabetes than adults aged 35-44 years (AOR: 0.31 p< 0.05 CI: 0.20-0.47). Consequently, adults aged 65-74 years (AOR: 0.17 p< 0.05 CI: 0.10-20.30) showed less likelihood to have diabetes than adults aged 55-64 years (AOR: 0.14 p< 0.05 CI: 0.09-0.23). This was found to be statistically significant, except for age 75-80 years whose results were omitted.

The table shows that adults aged 35-44 years were significantly less likely (AOR: 0.57 $p < 0.05$ CI: 0.43-0.76) to have tuberculosis than adults aged 45-54 years (AOR: 0.671 $p < 0.05$ CI: 0.48-0.92). Adults aged 65-74 years had higher likelihood (AOR: 1.40 $p < 0.05$ CI: 0.71-2.75) to have tuberculosis than adults aged 55-64 years (AOR: 0.77 $p > 0.05$ CI: 0.53-1.13) and found to be not statistically significant, except for age 75-80 years whose figures were omitted, as shown in table 4.6, above. As shown by table 4.6, above adults aged 45-54 years were significantly less likely (AOR: 0.19 $p < 0.05$ CI: 0.15-0.24) to have hypertension than adults aged 35-44 years (AOR: 0.36 $p < 0.05$ CI: 0.29-0.45).

Furthermore, table 4.6 shows that, adults who were aged 65-74 years were less likely (AOR: 0.09 $p < 0.05$ CI: 0.07-0.12) to have hypertension than adults who were aged 55-64 years (AOR: 0.12 $p < 0.05$ CI: 0.09-0.15) and found to be statistically significant. The results of the adults who were aged 75-80 years were omitted. Adults who were not currently being paid a regular wage had lower likelihood (AOR: 0.90 $p > 0.05$ CI: 0.70-1.15) to have diabetes, tuberculosis (AOR: 0.85 $p > 0.05$ CI: 0.67-1.07), and hypertension (AOR: 0.92 $p > 0.05$ CI: 0.90-1.07). The results for the adults who reported to be currently being paid a regular wage, were found not to be significantly associated with diabetes, tuberculosis and hypertension.

On the other hand, the odds of have diabetes for adults who were not smoking, were significantly low (AOR: 0.43 $p < 0.05$ CI: 0.31-0.59), and hypertension (AOR: 0.86 $p > 0.05$ CI: 0.72-1.02), the results were not statistically significant. Except for tuberculosis, the odds for adults who were not smoking were 1 time likely to have tuberculosis (AOR: 1.59 $p > 0.05$ CI: 1.23-2.06), thus found to be statistically significant. As illustrated in Table 4.6, the odds of have diabetes, tuberculosis and hypertension differed per race/population group. The odds of having diabetes were all significantly less likely for Coloured (AOR: 0.40 $p < 0.05$ CI: 0.31-0.53), Asian/Indian (AOR: 0.38 $p < 0.05$ CI: 0.17-0.81) and Whites (AOR: 0.71 $p > 0.05$ CI: 0.40-1.26) than Black African.

The odds of having tuberculosis were significantly 7 times likely (AOR: 7.43 $p < 0.05$ CI: 2.21-23.26) among Whites compared to Asian/Indian (AOR: 4.76 $p > 0.05$ CI: 0.64-35.53). Meanwhile, the odds of having tuberculosis among Coloured were less likely (AOR:

0.97 $p>0.05$ CI: 0.72-1.29) than for Black African, and they were not statistically significant. On the other hand, the odds of having hypertension were significantly low (AOR: 0.66 $p<0.05$ CI: 0.52-0.82) for of Whites than Coloureds (AOR: 0.65 $p<0.05$ CI: 0.56-0.78). The odds of having hypertension were higher (AOR: 0.96 $p>0.05$ CI: 0.57-1.69) for Asian/Indians compared to Black African and thus not significant. The odds to have diabetes were significantly low (AOR: 0.91 $p>0.05$ CI: 0.70-1.19) for females compared to males (AOR: 0.49 $p<0.05$ CI: 0.42-0.58). However, females showed a higher likelihood to have tuberculosis (AOR: 1.25 $p>0.05$ CI: 0.98-1.60) compared to males.

In relation to marital status, the results presented in table 4.6 indicate that the odds of having diabetes for adults who lived with their partners were 1.86 higher and 1.25 times higher for widow/widower than married adults. The differences were statistically significant for living with partner and not statistically significant for widow/widower ($p< 0.05$ CI: 1.20-2.89; $p>0.05$ CI: 0.89-1.76). Additionally, the odds to have diabetes for the adults who were divorced/separated were 1.24 times higher and 1.15 times higher for never married adults. The differences were not statistically significant ($p>0.05$ CI: 0.72-2.15; $p>0.05$ CI: 0.88-1.51). The odds of having tuberculosis for adults living with a partner were 0.49 times lower and 0.99 times lower for widow/widower than married adults. The differences were not statistically significant ($p>0.05$ CI: 0.35-0.68; $p>0.05$ CI: 0.61-1.60).

The odds of having tuberculosis for the divorced/separated adults were 0.15 times lower and 0.00 times lower for never married adults. The differences were not statistically significant ($p>0.05$ CI: 0.36-1.17; $p<0.05$ CI: 0.34-0.60). Consequently, the odds of having diabetes for adults with good health were 0.50 significant times less likely, 0.27 times less likely for tuberculosis and 0.32 times less likely ($p<0.05$ CI: 0.40-0.63; $p<0.05$ CI: 0.21-0.33; $p<0.05$ CI: 0.28-0.37). As shown by the table 4.6, above, the odds of adults from other religions (AOR: 0.65 $p>0.05$ CI: 0.34-1.22) to have diabetes and hypertension were low (AOR: 1.08 $p>0.05$ CI: 0.74-1.58) show higher likely among other religion than Christian adults (AOR: 0.66 $p>0.05$ CI: 0.40-1.08) for diabetes and (AOR: 0.72 $p<0.05$ CI: 0.55-0.93) for hypertension. As for tuberculosis, adults from other religion (AOR: 1.36 $p>0.05$ CI: 0.76-2.39) show higher likely than Christian adults (AOR: 0.89 $p>0.05$ CI: 0.63-1.25) to having tuberculosis, and the results found no statistical association.

Table 4.7: Adjusted model for the binary Logistic regression of the association between all the wave 5 independent variables with disease outcome (diabetes, hypertension, and tuberculosis) at wave 5.

Independent variables	**Diabetes**			**Tuberculosis**			**Hypertension**		
	Odds ratio	**p>(z)**	**Confidence interval**	**Odds ratio**	**p>(z)**	**Confidence interval**	**Odds ratio**	**p>(z)**	**Confidence interval**
Age									
24-34	RC								
35-44	3.259	0.227	0.47884 22.18116	3.591	0.189	0.53238 24.22329	3.742*	0.035	1.09597 12.77706
45-54	3.136	0.217	0.51100 19.25118	2.139	0.403	0.36056 12.69417	*	0.504	0.49647 4.15147
55-64	1.708	0.536	0.31344 9.31118	6.236	0.057	0.94415 41.19272	1.435	0.863	0.32793 2.54660
65-74	0.917	0.920	0.16894 4.97918	3.906	0.181	0.53020 28.78849	0.913	0.357	0.21644 1.73660
75-80	Omitted	Omitted	Omitted	Omitted	Omitted	Omitted	0.613		
Currently being paid a regular wage									
Yes	RC								
No	0.739	0.518	0.29683 1.84373	0.894	0.805	0.37004 2.16355	0.752	0.267	0.45546 1.24362
Smoking									

Yes	RC								
No	0.747	0.640	0.22141 2.52688	2.019	0.174	0.73233 5.56769	0.638	0.210	0.31615 1.28819
Race									
Black African	RC								
Coloured	0.766	0.611	0.27525 2.13609	0.731	0.554	0.25946 2.06135	0.885	0.725	0.44996 1.74282
Asian/Indian							0.728	0.792	0.06940 7.65200
White									
Sex									
Male	RC								
Female	0.480	0.180	0.16435 1.40381	1.572	0.322	0.64204 3.85276	0.529	0.033	0.29556 0.94934
Marital status									
Married	RC								
Living with partner	1.321	0.638	0.41411 4.21734	2.985	0.145	0.685719 12.99665	0.606	0.130	0.31763 1.15832
Widow/widower	0.701	0.491	0.25577 1.92282	0.990	0.984	0.37782 2.596111	0.897	0.728	0.48877 1.64856
Divorced/separated									
Never married									

Health status									
Poor health	RC								
Good health	0.615	0.252	0.26844 1.41135	0.694	0.452	0.26868 1.79566	0.819	0.454	0.48599 1.38032
Religious affiliation									
No religion	RC								
Christian	0.368	0.344	0.04640 2.92026	0.635	0.556	0.14042 2.87616	0.338	0.087	0.09788 1.17089
Other	0.318	0.342	0.02995 3.38211				0.368	0.171	0.08838 1.53834

RC = Reference Category, **p < 0.05 represents significant results at 95% level of confidence

Table 4.7 presents the adjusted odds ratios of having Model 1: Characteristics of migrant in 2008 by Diabetes outcome in 2017, Model 2: Characteristics of migrant in 2008 by Hypertension outcome in 2017, and Model 3: Characteristics of migrant in 2008 by Tuberculosis outcome in 2017 at wave 5. After controlling for variables, the odds of having diabetes for adults aged 35-44 years were 3.25 times higher (P>0.05 CI: 0.47-22.18) and adults aged 45-54 years (p>0.05 CI: 0.51-19.25). Consequently, adults aged 55-64 years (AOR: 1.70 p> 0.05 CI: 0.31-9.31) showed higher likelihood to have diabetes than adults aged 65-74 years (AOR: 0.91 p>0.05 CI: 0.16-4.97) and found not to be statistically significant, except for age 75-80 years whereby the results showed omission.

Adults aged 35-44 years (AOR: 3.59p>0.05 CI: 0.53-24.22) were likely to have tuberculosis than adults aged 45-54 years (AOR: 2.13 p>0.05 CI: 0.36-12.69). Additionally, adults aged 55-64 years had a higher likelihood (AOR: 6.23 p>0.05 CI: 0.94-41.19) to have tuberculosis than adults aged 65-74 years (AOR: 3.90 p>0.05 CI: 0.53-28.78), and found to be not statistically significant, except for age 75-80 years whose results were omitted, as shown by the table above. Adults aged 45-54 years (AOR: 3.74 p<0.05 CI: 1.09-12.77) were significantly higher likely to have hypertension than adults aged 35-44 years (AOR: 1.43p>0.05 CI: 0.49-4.15). Adults aged 65-74 years (AOR: 0.61 p>0.05 CI: 0.21-1.73) showed less likelihood to have hypertension than adults aged 55-64 years (AOR: 0.91p>0.05 CI: 0.32-2.54) and found not to be statistically significant, unlike adults aged 75-80 years whereby the results showed omission.

Adults not currently being paid a regular wage, had less likelihood to have diabetes (AOR: 0.73 p>0.05 CI: 0.29-1.84), tuberculosis (AOR: 0.89 p>0.05 CI: 0.37-2.16) and hypertension (AOR: 0.75 p>0.05 CI: 0.45-1.24). The results for currently being paid a regular wage, were found not to be significantly associated with diabetes, tuberculosis and hypertension. On the other hand, the odds of adults who were not smoking showed less likelihood to having diabetes (AOR: 0.74 p> 0.05 CI: 0.22-2.52), and hypertension (AOR: 0.63 p>0.05 CI: 0.31-1.28), results not statistically significant. Except for tuberculosis, the odds for adults not smoking were 2.01 times higher likely to have tuberculosis (p>0.05 CI: 0.73-5.56), thus found not to be statistically significant. As illustrated in Table 4.7, the odds of having diabetes, tuberculosis and hypertension differed per race/population groups.

The odds of having diabetes were low for Coloureds (AOR: 0.76 p>0.05 CI: 0.27-2.13), the results for Asian/Indian and Whites were omitted. The odds of having tuberculosis were less times likely (AOR: 0.73 p>0.05 CI: 0.25-2.06) for Coloured, the results for Asian/Indians and Whites were omitted thus not statistically significant. On the other hand, the odds for Coloureds (AOR: 0.88 p>0.05 CI: 0.44-1.74), the results for Asian/Indians and Whites were omitted. The odds of having diabetes (AOR: 0.48 p>0.05 CI: 0.16-1.14) and hypertension (AOR: 0.52 p>0.05 CI: 0.29-0.94) for females were low compared to males. However, females had higher likelihood to have tuberculosis (AOR: 1.57 p>0.05 CI: 0.64-3.85) compared to males.

Concerning the adults' marital status; the odds of having diabetes among the adults who were a widow/widower were 1.32 times higher and 0.70 times lower for divorced/separated, than married adults. The differences were not statistically significant (p> 0.05 CI:

0.41-4.21; p>0.05 CI: 0.25-1.92). The results for never married and living with partner were omitted as shown in table 4.7. The odds of having tuberculosis among adults who were a widow/widower were 2.98 times higher and 0.99 times lower for divorced/separated, than married adults. The differences were not statistically significant (p>0.05 CI: 0.68-12.99; p>0.05 CI: 0.37-2.59). The results for living with a partner and never married were omitted. Conversely, the odds of adults who were a widow/widower (AOR: 0.13 p>0.05 CI: 0.31-1.15) were less likely to have hypertension and divorced/separated (AOR: 72 p>0.05 CI: 0.48-1.64) were less likely to have hypertension, thus not statistically significant.

The odds of adults with good health were 0.61 significant times less likely to have diabetes, with 0.69 times less likely for tuberculosis and 0.81 times less likely (p<0.05 CI: 0.26-1.41; p<0.05 CI: 0.26-1.79; p>0.05 CI: 0.48-1.38). As shown in table 4.7, above, the odds of adults from other religions (AOR: 0.31 p>0.05 CI: 0.02-3.38) show less likelihood of having diabetes than Christian adults (AOR: 0.36 p>0.05 CI: 0.04-2.92). As for tuberculosis, Christian adults (AOR: 0.55 p>0.05 CI: 0.14-2.87) show less likelihood than Christian adults to have tuberculosis and the results found no statistical association. Lastly, table 4.7, above shows that, the odds of Christian adults (AOR: 0.33 p>0.05 CI: 0.09-1.17) had less likelihood to have hypertension than no religion adults (AOR: 0.36 p>0.05 CI: 0.08-1.53).

CHAPTER 5: Discussion

Disease prevalence in South Africa is high. The country faces a quadruple disease burden, including poverty-related diseases, non-communicable diseases, injuries and HIV/AIDS (Basu, 2018). Poverty, violence, rapid social and economic changes, lack of education, inadequate services and urbanisation, contribute to increasing cases of non-communicable diseases, as they do to other communicable diseases such as HIV and tuberculosis (Juma, 2019). The general migration patterns, along with a population that is ageing, means that rural areas will experience the greatest number of age-related problems. Thus, presents many problems including strain on the country's earnings-related pension schemes, higher healthcare costs and a shortage of working age population (Kelly, 2019).

The aim of this study was to identify the level and socioeconomic determinants of disease outcomes for rural-rural migrants aged 24-80 years. The study population was composed of the elderly population, who were mobile in South Africa. Rural-to-rural migration is the most common type of movement in many parts of sub-Saharan Africa (Anglewicz, 2012; Oucho,1993; Schuyler,2015), thus it is important to understand the health of this growing proportion of the population, as population continues to age, along with millions living in similar rural settings, it will become increasingly important for health and social services to adapt and improve in order to provide effective care for a growing population living in rural areas. Therefore, older adults in the rural areas should not be neglected from receiving health related information. There is a need for establishing programmes and policies to improve the health of older adults, particularly for those residing in the rural areas.

Up-to-date information about levels and trends in diabetes is essential both to quantify the resultant health effects and to prompt decision makers to prioritise action and assess progress. The study found that rural-rural migration in South Africa, is strongly associated with adults' health outcome (Pheiffer, 2021). But the exact relationship between rural-rural migration and disease outcome differs by sex. It is difficult to make comparisons with other studies as this is one of the few longitudinal studies to utilise this approach (rural-rural migration in South Africa) (Pheiffer, 2021; Sudharsanan, N., & Geldsetzer, 2019), but the findings are consistent with the mostly cross-sectional literature that has found that females are nearly one times more likely to have tuberculosis than their male counterparts. However, men who participate in rural-rural migration are less likely to have diabetes and hypertension.

This study's findings showed that hypertension was higher among the females than males. This is in line with previous studies on chronic illness in South Africa, that show that women have higher prevalence rates of hypertension and diabetes (Puoanei, et al., 2008). One of the reasons for this could be behavioural risk factors such as physical inactivity. For instance, data from a comparative study of 51 countries showed that women (47.6%) were more physically inactive than men (44.7%) (Guthold, et al., 2008). From a socio-cultural viewpoint these findings are not surprising since gender is often highlighted as one of the most significant factors influencing health (Evans, Frank, Oliffe, and Gregory, 2011). For instance, masculinity is believed to play an important role in men reporting better health status than women since men ascribe to a masculine role of being strong (Evans, et al., 2011; Holroyd, 2005). This is similarly to a study which showed that health awareness is higher among females than males because men tend to have a less enthusiastic health seeking behaviour (Everett & Zajacova 2016).

It has been argued that biologically, race does not have any influence on health, rather that, social constructs tend to make an artificial association between the two (Frieden 2011). These unhealthy behaviours have leads to differences in levels of diabetes and hypertension in different ethnic groups. The levels of; diabetes, tuberculosis and hypertension obtained from this study were higher than those found in other studies conducted in other parts of South Africa. For instance, in a study conducted by Mills et al. (2016) an estimated 20% of South Africa's population was living with hypertension, approximately 2 million (9%) people aged 30 years and older had diabetes (Bertram, 2013). The study found that hypertension increases as age increase, which is like the finding from a study conducted in the Limpopo Province of South Africa which showed that the prevalence of hypertension increased significantly with age (Ntuli et al. 2015).

The current study also shows 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). In addition, age has been known to directly play a part in the rate of hypertension and diabetes due to biological changes that occur in the body as a person age. The current study's results are consistent with those of another study conducted in eMbalenhle, South Africa, that showed that the prevalence of hypertension was significantly higher among the older people (Matooane et al. 2011). The findings of this study suggest that age is an important factor in relation to diabetes, hypertension and tuberculosis. Older adults are more likely to have a diabetic, tuberculosis or hypertensive member. This may be because older adults tend to be less attentive to their health as they grow older.

The current study agrees with findings from previous studies that indicated a high prevalence rate of diabetes among adults and those in the older age cohort (Motala and Ramaiya, 2010). Using the data derived from South Africa, Tanzania, Ghana, Cameroon and Sudan the Diabetes Atlas (WHO, 2011) estimated that 10.4 million people, constituting 3.1 % of the adult population, had diabetes in the African Region in 2007. The rates among those aged 35 to 44 years in this study are concerning since many of these people are in their productive years. This reduces productive labour and earning capacity at a household level (Puoanei, et al., 2008).

The most interesting finding from the current study relates to the effects of age. The results contradicted the researcher's expectation that receipt of, or anticipation of old-age pensions would influence transitions, particularly into productive roles. This suggests that social markers, such as providing care for older persons, may be more important at the oldest age than economic value derived from pension access. However, it would be premature to dismiss the pension effect outright, because there are likely to be several indirect effects that are not captured, including the positive effects on health and well-being of all members of the household.

Therefore, in the long term, investing in interventions that aim to control the burden of diseases can benefit the country. At the same time there is a need for health initiatives that target the older population. Existing evidence suggests that as a result of a changing population age structure the proportion of adult population is expected to increase (Joubert and Bradshaw, 2005). With a growing adult population, South Africa will be faced with a cumulative burden of communicable and chronic diseases. As a result of reduced ability to generate resources, the adult population lacks basic needs, that affects their health status and are often faced with the burden of health issues. Existing studies suggest that traditional caring and social support systems are also becoming increasingly strained (Robinson, et al., 2007). Providing insight into the causes of health disease can help guide policy development and strengthen institutions to respond effectively to population aging.

The current study, for instance, observed that although prevalence of hypertension was higher in Black adults; they were not likely to be hypertensive or diabetic in the fitted models. This less 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 diabetes and hypertension (Cois & Ehrlich 2014).

The results from the current study are in contrast with previous research such as self-reported data based on the 1998 and 2003 South Africa Demographic and Health Surveys, which showed that the Indian and White race groups had higher chronic disease prevalence rates while the Black/African race group had the lowest prevalence rates (Puoanei, et al., 2008). One the key reasons for this is the change in lifestyle patterns among the Black/African race group. Studies show that in the past when the African population followed a traditional lifestyle, diabetes was virtually absent (Bourne, Lambert, and Steyn, 2002). Whilst the current study does not have strong evidence in support of this claim, the variations could be in relation to that, the focus was on household income instead of individual earnings (Frieden 2011).

The Social Determinants of Health framework portrays the health care system as a social determinant of health. From the findings of the current study this has been exposed through the socioeconomic determinants of adult's health outcomes to change institution in the future because of hearsay or personal experiences with the institutions. The SDH framework by the CSDH (2010) through its stance on viewing health as a social phenomenon and its provision as a matter of moral or social justice is well articulated, as the stories reveal that socioeconomic factors contribute to adult's health outcomes such as diabetes, tuberculosis and hypertension. Therefore, the proposed framework is valid. A limited set of variables used from the current longitudinal data with regards to migration status is sufficient and effective in interpreting the data at hand.

As reflected in the theoretical framework model there are various pathways through which the socioeconomic status of individuals indirectly influences their patterns of health. The results of the current study also reiterate that these dimensions of socioeconomic status are interrelated. However, at the same time, each reflects differently in the individual and societal forces associated with disease outcome. For instance, the relationship between many of these determinants and disease outcomes was not as simplified as the model highlights. There are many external influences including the context in which the model is used that draw attention to the need to modify the model and its causal pathways.

This NIDS Study features longitudinal panel data for migrants (before and after migration). These data are used to examine key issues in migration research, such as migration health selection, the effect of migration on health and the health status of return migrants. Although the NIDS study includes migrants to different destinations (rural, town, urban). The NIDS Study addresses several key methodological challenges in research on migration and health. Longitudinal data enables the study to use statistical methods that reduce bias which distorts the estimation of causal effects of migration on health outcomes and measure, and control for the selection effects that are missing from much of the existing research on health and migration, differences in health outcomes between non-migrants and migrants prior to migration. The current study adds to the existing literature by examining and testing multiple life course models in the same sample, which is the best approach to testing the theories that best describe the links between exposures and outcomes across life course.

Conclusion and recommendation

South Africa is confronted with several major health challenges simultaneously, including a high burden of infectious diseases and non-communicable diseases (Motsoaledi, 2016). Until recently, South African health policy and spending have prioritised infectious and communicable diseases over non-communicable diseases. However, the recent launch of the national Strategic Plan for the Prevention and Control of Non-Communicable Diseases, reflects shifting national priorities as South Africa aimed to reduce, by at least 25%, the relative premature mortality from NCDs by 2020 (Department of Health of the Republic of South Africa, 2013).

Though the socioeconomic circumstances of individuals still significantly impact on their disease outcomes, the data obtained also reaffirms that diseases are no longer the preserve of the wealthy. Changes in lifestyle and diet in the context of globalization have contributed to a shift in health patterns. Consequently, there has been an increase in the prevalence of diseases such as diabetes and hypertension across all sectors of the South African society. In a country burdened with multiple diseases, there is a need for further research and data. This will serve as a basis for health and policy initiatives towards reaching people at risk of illnesses while reducing socioeconomic inequalities. Evidence from other countries reveal that population wide approaches to reducing the risk throughout the whole population are effective. Unlike most approaches, these interventions address the causes as opposed to the consequences of chronic diseases.

With regards to disease outcomes among the elderly population, cognitive decline is another important age-related condition that older South Africans are facing in increasing numbers. HAALSI has shown that one in four adults over has cognitive impairment, or difficulties with memory, thinking and judgement, that can affect their daily lives. Even more importantly, many of these people report that this decline limits their ability to perform usual activities at home, thus contributing to worsening their health.

The South African government needs to recognise the main role and responsibility to respond to the challenges of diabetes, tuberculosis and hypertension. However, national policies for the control of diabetes are absent. Also, primary healthcare systems have not adapted to cope with the new additional challenges and many lack the most basic equipment (Ibrahim & Damasceno, 2012). There needs to be a sustained response and political commitment to the prevention, detection and control of diabetes. The harnessing political will for governments to develop national action plans for the adequate delivery of diabetes, hypertension and tuberculosis care and to promote community awareness of the diseases as well as introduce school and workplace health programmes, among other initiatives (International Diabetes Federation, 2008).

The rising number of individuals with these diseases has important implications for healthcare provision (Mbanya et al, 2006). Resources must be prioritised efficiently using cost-effective strategies. The emphasis on early treatment and prevention of these disease outcomes is an excellent, cost-saving economic investment as well as an established way to improve outcomes (World Health Organization, 2012; Noble, 2011). Programmes must be developed for health systems in South Africa which align with this evidence.

Further research is required to build the evidence base, design and implement an optimal strategy for early diagnosis and treatment, and to identify appropriate population-based prevention programmes. A rigorous effort is required to change the course of the rising disease outcome burden in the country; the price of delay will otherwise be devastating. Healthcare policies and programmes that aim to reduce the incidence of diseases among the elderly people, should be aware of the social determinants of disease outcomes. Further research which examines the more indicators of independence such as access to healthcare should be added to the social independence measure for a more holistic view of independence and its relationship to disease development among elderly people in South Africa.

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Appendix: A

Figure 1 Percentage distribution of hypertension among rural-rural migrants (24-80 years) in South Africa.

Figure 1 below illustrates the percentage distributions of hypertension among rural-rural migrants (24-80 years) in South Africa. 81% of rural-rural migrants (24-80 years) in South Africa reported not to have been diagnosed with hypertension, while 19% of them reported to have been diagnosed with hypertension.

Figure 1 Percentage distribution of hypertension among rural-rural migrants (24-80 years old) in South Africa.

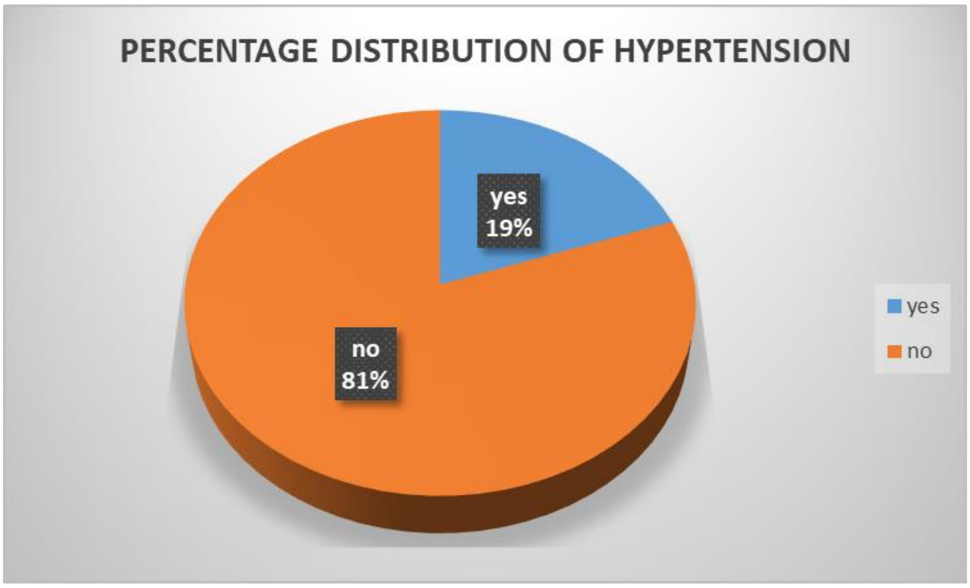


Figure 2 Percentage distribution of diabetes among rural-rural migrants (24-80 years) in South Africa.

Figure 2 below illustrates the percentage distributions of diabetes among rural-rural migrants (24-80 years) in South Africa. Out of 5894 respondents, 93% of rural-rural migrants (24-80 years) in South Africa reported not to have been diagnosed with diabetes, while 7% of them reported to have been diagnosed with diabetes.

Figure 2 Percentage distribution of diabetes among rural-rural migrants (24-80 years old) in South Africa.

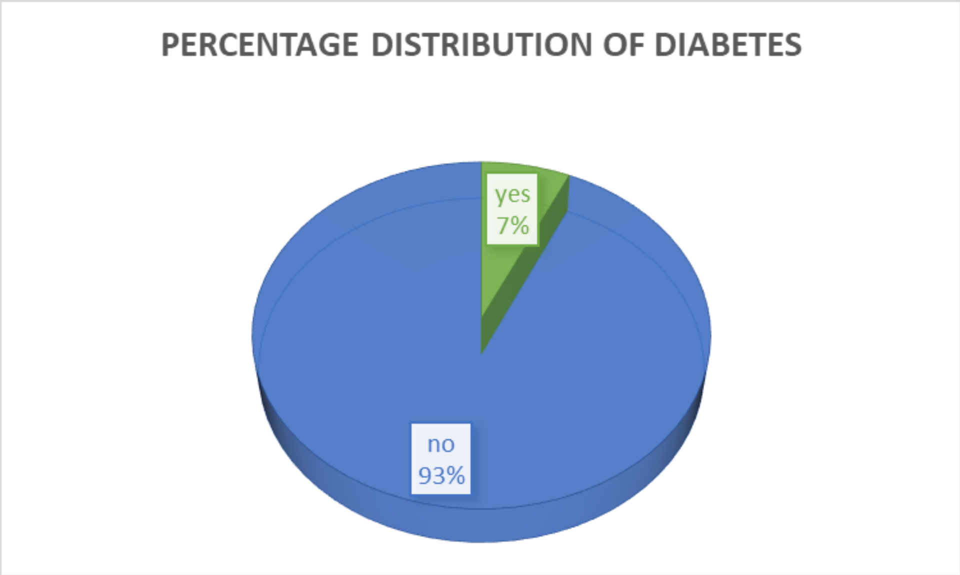


Figure 3 Percentage distribution of tuberculosis among rural-rural migrants (24-80 years) in South Africa.

Figure 3 below illustrates the percentage distributions of tuberculosis among rural-rural migrants (24-80 years) in South Africa. 95% of rural-rural migrants (24-80 years) in South Africa reported not to have been diagnosed with tuberculosis, while 5% of them reported to have been diagnosed with tuberculosis.

Figure 3 Percentage distribution of tuberculosis among rural-rural migrants (24-80 years old) in South Africa.

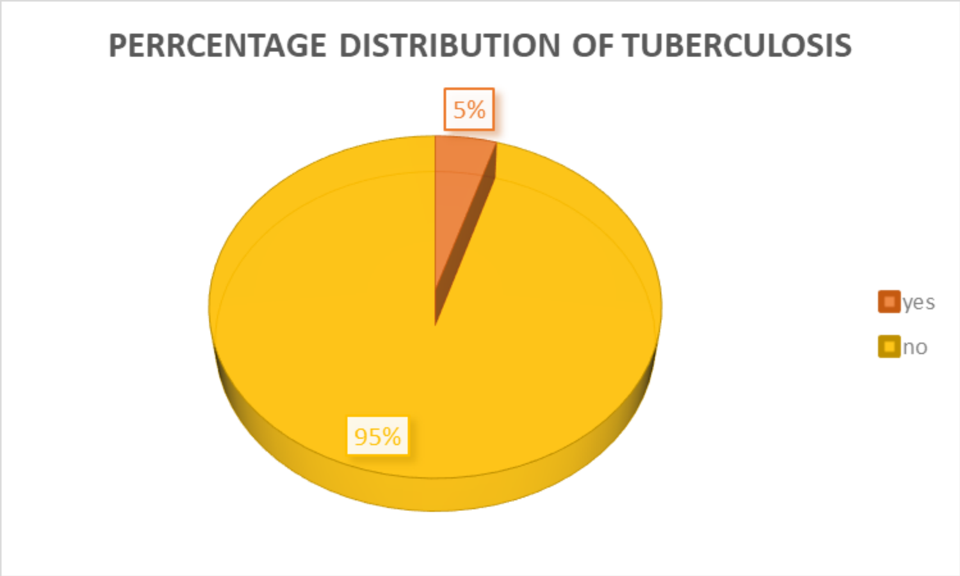
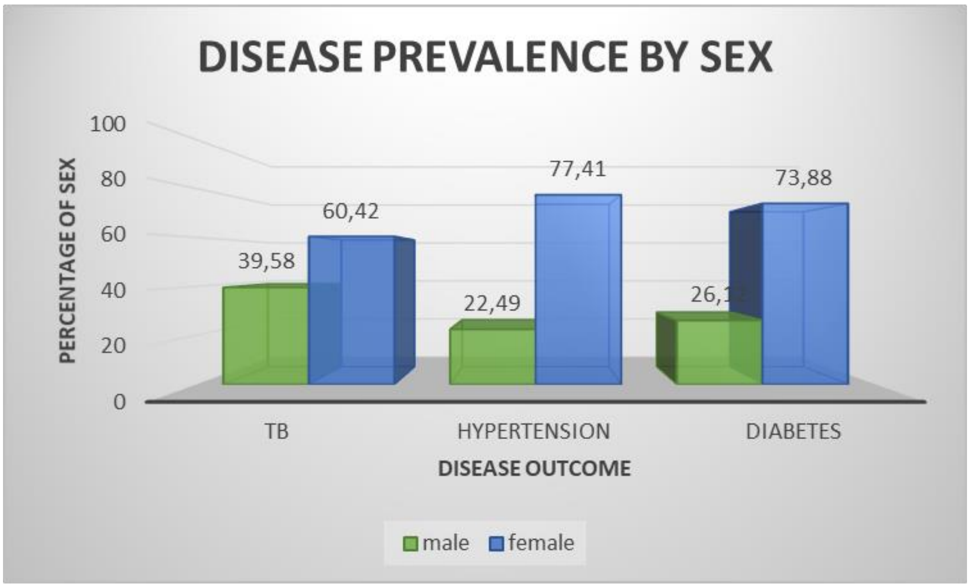


Figure 4 Disease prevalence by sex

Figure 4 below illustrate that the prevalence of tuberculosis is higher among female than males (60.42%, 39.58 respectively). Conversely, the disease prevalence for hypertension among males is lower (22.49%) when compared to their female counter parts (77.41%). In addition, approximately majority of female respondents are 73% disease prevalent to diabetes when compared to merely 26% of male's respondents.

Figure 4 Disease prevalence by sex among rural-rural migrants (24-80 years old) in South Africa.



Appendix: B

Section A:

Student Name and Surname: Lebohang Zinhle Thokwane

Student Number: 2126198

Date of Submission: 18 May 2020

Proposed title of Research Project: Adult health outcomes in South Africa: a longitudinal analysis of the causes of disease among rural-rural migrants.

Table 1: Literature Review Matrix

Title	Author(s) and Year	Journal	Data Source and Methods of Analysis	Main Results	Gaps in the study

Migration and the epidemiological transition: insights from the Agincourt sub-district of northeast South Africa.	Mark A. Collinson, Michael J. White, Philippe Bocquier, Stephen T. McGarvey, Sulaimon A. Afolabi, Samuel J. Clark, Kathleen Kahn1, and Stephen M. Tollman (2014).	Global Health Action Journal	The paper used the Agincourt HDSS data collected between 2000 and 2011. In addition to collecting information about births, death, migrations, unions, and household membership, specialized census modules are employed to capture different socioeconomic data in each annual census round	In rural, northeast South Africa, temporary migration involving migrants that relocate mainly for work purposes and remain linked to the rural household is more important than age and sex in explaining variations in mortality, the changing relationship between temporary migration and communicable disease	Further research is needed in examining the migration-health relationship for different socio-economic categories and also for specific diseases

				mortality is primarily affected by reduced exposure of the migrant to unhealthy conditions. . The study suggests that the changing relationship between temporary migration and non-communicable disease mortality is mainly affected by increased livelihood benefits of longer duration migration.	
Pensions and the health of older	Peter Lloyd-Sherlock and Sutapa	J Dev. Stud	The study used newly-available data from the World	The study found that there is a relationship	A longitudinal study is needed to

people in South Africa: is there an effect?	Agrawal (2014).		Health Organization (WHO) survey of Global Ageing and Adult Health (SAGE), which included detailed information on health behaviours, use of health services and health outcomes, as well as a varied set of socioeconomic items. SAGE comprises nationally representative household surveys for people aged 50 or older in six countries: the People's Republic of China, Ghana, India, Mexico, the Russian	between household pension status and the health of their oldest members. Household pension status was associated with higher rates of health service utilisation, hypertension awareness and treatment, but not with control.	be done, to further understand the health of pensioners in the long run

			Federation and South Africa, conducted between 2008 and 2010. The selected covariates for the multivariate analysis are: rural/urban status, level of education, household wealth quintile, sex and five year age groups (for oldest household member).		
Migration status and prevalence of diabetes and hypertension in Gauteng province, South Africa:	Melitah Motlhale, and Jabulani Ronnie Ncayiyan (2018).	British medical Journal	A Quality of Life survey conducted in 2015 collected data on migration status and morbidity from a sample of 28 007 adults in 508	Migration status is associated with prevalence of two non-communicable conditions. The association	This calls for more research on migration status and morbidities, as well as validity studies of self-

effect modification by demographic and socioeconomic characteristics			administrative wards in Gauteng province (GP). Migration status was divided into three groups: non-migrant if born in Gauteng province, internal migrant if born in other South African provinces, and external migrant if born outside of South Africa. Diabetes and hypertension were defined based on self-reported clinical diagnosis. We applied a recently developed original, stepwise-	was modified by age, race and SES. Ward-level effects also explain differences in association.	reported morbidities in the South African setting.

			multilevel logistic regression of discriminatory accuracy to investigate the association between migration status and hypertension and diabetes. Potential effect modification by age, sex, race, socioeconomic status (SES) and ward-level deprivation on the association between migration status and morbidities was tested.		
Continued very high prevalence of HIV infection in rural KwaZulu-Natal,	Tanya Welza Victoria Hosegooda Shabbar Jaffarc, Jorg Batzing-Feigenbaum	AIDS	A household-based HIV sero-survey of a population that has been under longitudinal demographic	A total of 8325/11505 male and 11542/14396 female residents were traced. Of	Studies needs to be done on non-resident members of rural household

South Africa: a population based longitudinal study	a Kobus Herbsta and Marie-Louise Newell (2007).		surveillance since 2000. All residents (women aged 15–49 years; men aged 15–54 years) and a sample of non-residents ('migrants') who return periodically to their households in the area were identified and approached for finger-prick HIV testing. Analyses were performed using Stata 8.0 (College Station, Texas, USA). Categorical data were compared with chi-squared tests. Unconditional logistic regression	these, 4692 men and 6859 women consented to HIV testing. Overall, 27%offemale and 13.5% of male residents were HIV infected. HIV prevalence peaked at 51% among resident women aged 25–29 years and 44% among resident men aged 30–34 years, with the highest infection rates of	s especially among female migrants

			was used for multivariable analyses. Variables associated with HIV infection at a significance level of P<0.15inunivariable analyse	57.5% among 26-year-old women. The female to male infection ratio for residents aged 15–19 years was 13.0. Many factors, including increased mobility, associated with an increased risk of HIV infection among residents, were also associated with non-participation. Among non-residents, 34% of men aged 15–54 years and	

				41% of women aged 15–49 years were HIV infected.	
Characteristics Associated With Migration Among Older Women and Men in Rural Malawi	Jacob Kendall and Philip Anglewicz (2017).	SAGE Journal	Migration in older age by using two related datasets with several key components: longitudinal panel data with information on pre- and post-migration events; a substantial sample of older adults; and measures of mental and physical health, HIV status, and various family and socioeconomic characteristics. The datasets	Migration at older ages in Malawi is associated with health. HIV status is closely tied to migration for women, although the relationship is weaker after migration and after controlling for other characteristics. Both men and women have significantly higher HIV status after	There's a need to do a comparative study on how does household size at origin compare with that at destination is associated with migration among women.

			are the Malawi Longitudinal Study of Families and Health (MLSFH) and the Migration and Health in Malawi (MHM) Study. examine the migration patterns of older adults, with a particular focus on how migrants differ from non-migrants in various behaviours and characteristics, both before and after migration. Another aspect of our analysis involved identifying differences	migration. A negative relationship between migration and physical health is observed for women, but only after migration. There is a positive relationship between migration and physical health before but not after migration for older men. There are no findings for mental health, and the relationship between	

			between older female and male migrants. To achieve these tasks, we used pre-migration data from the 2008 wave of the MLSFH survey and data from the 2013 MHM.	migration and age is attenuated when controls are added	
Cohort profile: internal migration in sub-Saharan Africa—The Migration and Health in Malawi (MHM) study	Philip Anglewicz, Mark VanLandingham, Lucinda Manda-Taylor, Hans-Peter Kohler (2017).	British medical Journal	The MLSFH is a longitudinal panel survey that examines how families and individuals in rural Malawi cope with the high morbidity and mortality caused by the HIV/AIDS epidemic. The MLSFH study team returned to re-interview the same respondents (along with	Migrants in Malawi have a significantly higher HIV prevalence than non-migrants, which is primarily due to the selection of HIV-positive individuals into migration. We find evidence for health	Further research is needed to examine other research topics related to migration and health, including differences by age specifically focusing on older respondents, for

			new spouses for respondents who remarried between the two waves) for five additional waves of survey data collection in 2001, 2004, 2006, 2008 and 2010.	selection; physically healthier men and women are more likely to move, partly because migration selects younger individuals. However, we do not find differences in physical or mental health between migrants and non-migrants after moving.	reproductive health measures and other health measures, distance of migration and the relationship between migration and transfers.
A cohort study of elderly people in Bloemfontein, South Africa, to	A M Gerber; R Botes; A Mostert; A Vorster; E Buskens,	SAMJ (2016).	Used utility- and capability-based questionnaires EQ-6D and a modified ICECAP-O to	Diseases result in pain and affect mobility and cognition in	There's a need for more research in this topic, to expand

determine health-related quality of life and functional abilities			identify chronic and comorbid diseases that contribute to reduced QoL and functioning in the elderly. An information leaflet was supplied to respondents, along with an informed consent form that each signed and dated. The respondents participated voluntarily and anonymously. Structured interviews were conducted. No algorithm for the EQ-6D or ICECAP-O is available for the SA population. Statistical	old age. Access to healthcare and services for older people involves recognition of the importance of health promotion and activities that will help prevent disease, and there should be a focus on maintaining independence, prevention and delay of disease, and disability treatment. This includes	specific disease types and their individual effects on health-related QoL

			Package for the Social Sciences version 16 was used to perform the sum score calculations. Data were presented using standard descriptive statistics (frequencies, medians, means, standard deviations and standard errors).	improving QoL in elderly people with existing disabilities. Reform of medical care services is essential to improve healthcare for the elderly and thus improve their QoL.	
"They don't care about us": older people's experiences of primary healthcare in Cape Town, South Africa	Gabrielle Kelly, Lindeka Mrengqwa and Leon Geffen	BMC Geriatrics (2019).	The paper presents findings of nine focus groups conducted with community-dwelling older adults in three areas (high, medium and low-income) in Cape Town, South Africa	Findings showed that while participants in the high-income area had few challenges accessing quality care or support services,	Much research is needed in understanding the factors influencing health care access in

			over 2 months in 2017. These discussions addressed primary health services available to older persons, their ability to access these services and their expectations and experiences of care.	services available in lower-income areas were much less responsive and participants displayed low trust in the healthcare system, feeling that their needs were overlooked. Participants who experienced poor doctor-patient communication often failed to comply with treatment, while those who experienced patient-	South Afria.

				centered communication, either through the private sector or NGO-public sector partnerships had better perceptions of care.	
Assessing health and well-being among older people in rural South Africa	F. Xavier Gómez-Olivé, Margaret Thorogood, Benjamin D. Clark, Kathleen Kahn & Stephen M. Tollman (2010).	Global Health Action	Cross-sectional survey of 6,206 individuals aged 50 and over. We used multivariate analysis to examine relationships between demographic variables and measures of self-reported health (Health Status), functional	Women were 30% more likely than men to report a poor state of health (low Health Status). Other factors associated with a worse Health Status were aged above 70 years, lower levels	A longitudinal analysis is needed to monitor the health levels from baseline of older people

			ability (WHODASi) and quality of life (WHOQoL).	of formal education, being single and currently not working.	
Migration, sexual behaviour, and HIV risk: a general population cohort in rural South Africa	Nuala McGrath, Jeffrey W Eaton, Marie-Louise Newell, Victoria Hosegood	Lancet (2015)	In a mainly rural demographic surveillance area in northern KwaZulu-Natal, South Africa, collected a longitudinal demographic, migration, sexual behaviour, and HIV status data through household surveillance twice per year and individual surveillance once per year. All resident household members and	Results show that the previously identified increased levels of sexual risk behaviours in non-residents and those who spend few nights in their household in this study population have persisted in the post-ART rollout period, 2005–11. HIV prevalence	There's a need to reassess whether the types of migration investigated as risk factors in the early studies of the HIV epidemic are still the most important in the ART era. Quantitative and qualitative studies and surveys to describe

			a sample of non-resident household members (stratifi ed by sex and migration patterns) were eligible for participation. Participants reported sexual risk behaviours, including data for multiple, concurrent, and casual sexual partners and condom use, and gave a dried blood spot sample via fingerprick for HIV testing. Investigated population-level differences in sexual HIV risk behaviours and HIV	in the population was not strongly related to any of our migration indicators (irrespective of residential status) or to residential status (regardless of migration history) in the post-ART era.	HIV infection and sexual behaviour in migrants, especially those with circular migration patterns, should examine the social, behavioural, and situational risk factors present in the multiple environments to which migrants are exposed both origin and destination

			prevalence with respect to migration indicators using logistic regression models.		communiti es

Section B:

What is the outcome that you are studying?

Health outcomes (diabetes, hypertension and tuberculosis)

State your possible research question and two sub-questions:

What are the levels and associated socio-economic factors influencing health outcomes of adult's migration in South Africa.

List 3- 4 theories that are related to your project:

Social determinants of health

Push and pull theory