The assessment and improvement of the health status of vulnerable and low income individuals in South Africa: An analysis using quantitative and experimental methods

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Dissertation presented for the degree of Doctor of Philosophy in Economics in the Faculty of Economic and Management Sciences at Stellenbosch University

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December 2016

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Nature of contribution	Extent of contribution (%)
Helped formulate research question, wrote first draft, data estimation, expanded version of paper which will be submitted for publication into PhD chapter	**60%**

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2. no other authors contributed to Chapter 2 besides those specified above, and
3. potential conflicts of interest have been revealed to all interested parties and that the necessary arrangements have been made to use the material in Chapter 2 of this dissertation.

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Abstract

More than two decades after the end of apartheid, inequalities in health across socioeconomic subgroups are still a pervasive and persistent trend. South Africa also faces a high burden of disease which is disproportionate to its level of economic development.

This dissertation contains three chapters on the contribution of demand-side factors to South Africa's health burden, focusing on the health perceptions and eventual health choices of vulnerable individuals. Vulnerable individuals assessed in this dissertation include the income and wealth poor and, in particular, women living in low-resource areas with limited access to sexual and reproductive health services. Evidence is provided on innovative interventions aimed at improving the health-seeking behaviour and health outcomes of these individuals.

Chapter two of the dissertation calculates the impact of reporting differences on the accurate measurement of health inequalities by wealth status. The analysis is performed by benchmarking the reporting behaviour of individuals using anchoring vignettes. A statistically significant difference in the reporting behaviour by wealth status is found, which will lead to an underestimation of health inequalities to the disadvantage of the poor.

Chapter three explains how a package intervention to improve the health-seeking behaviour of pregnant women living in a low-resource area in the Western Cape was designed, implemented and tested. The results from a randomized controlled trial show that a community health worker programme and an incentive jointly led to a statistically significant improvement in the timing and frequency of antenatal care-seeking behaviour. The impact of the intervention on behaviour change is explored by measuring differences in the preferences for care. This heterogeneity in preferences for antenatal care is measured by looking at differences in time preferences and prioritisation. The intervention also led to a statistically significant reduction in maternal depressive symptoms and a statistically significant improvement in the intention to exclusively breastfeed for six months.

Lastly, the fourth chapter considers the cost-efficiency of two alternative approaches to providing women with better access to urine pregnancy tests. Even though having access to these tests have been linked to improved timing of healthcare-seeking behaviour, the availability and acceptability of test distribution at public health facilities is of poor quality. Two approaches, namely

distribution at a mobile health facility and door-to-door distribution, are compared. Door-to-door distribution is found to be a more cost-effective approach.

The dissertation is aimed at establishing a better understanding of the demand-side of health, the factors driving health-seeking behaviour and the factors affecting health reporting.

Opsomming

Meer as twee dekades na die val van apartheid is gesondheidsongelykhede steeds 'n omvattendende en blywende tendens in Suid-Afrika. Suid-Afrika sukkel met die teenwoordigheid van 'n hoë siektelas wat buite verhouding is tot Suid-Afrika se vlak van ontwikkeling.

In hierdie proefskrif word die vraagkant verwante faktore as bydraers tot Suid-Afrika se gesondheidslas ondersoek deur te fokus op gesondheidspersepsies en die gesondheidskeuses van kwesbare individue. Die kwesbare individue wat in hierdie proefskrif geanaliseer word sluit groepe in wat inkomste en welvaart arm is. Daar word spesifiek gefokus op vroue wat in lae-inkomste gebiede woon en beperkte toegang tot seksuele en reproduktiewe gesondheidsdienste het. In dié proefskrif word daar ook navorsing aangebied oor innoverende intervensies wat daarop gemik is om die gesondsheidsoptrede en gesondheidsuitkomstes van bogenoemde subgroepe te verbeter.

In die tweede hoostuk word die impak van verskille in rapporteringsoptrede op die akkurate meting van gesondheidsongelykhede tussen groepe van verkillende welvaart gemeet. Statistiese vinjettes word gebruik om individue se gesondsrapportering te anker en te vergelyk. 'n Statisties beduidende verskil word gevind in die rapporteringsoptrede van verskeie welvaartgroepe. Daar word ook gevind dat dit sal lei tot 'n onderskatting van die gesondheidsverskille tussen welvaartgroepe, tot die nadeel van die armstes.

In hoofstuk 3, word die ontwerp en implementering van 'n multi-komponent intervensies beskryf en word die impak daarvan op die gesondheidsoptrede van lae-inkomste swanger vroue in die Wes-Kaap getoets. 'n Ewekansigbeheerde proef is ingespan om die impak te meet. Die resultate toon dat 'n gemeenskapswerkerprogram en insentief gesamentlik swanger vrouens kan motiveer om vroeër en meer gereeld antenatale sorg te besoek. Die bevinding is statisties beduidend. Die impak van die intervensie op die verandering in gesondheidsoptrede word gemeet deur die heterogeniteit van individue se voorkeure te analiseer. 'n Poging word aangewend om vrouens se heterogene voorkeure vir antenatale sorg te verstaan deur te kyk na die gewig wat hulle op huidige, teenoor toekomstige, voordele en kostes plaas. Heterogene voorkeure word ook bestudeer deur te meet of vroue anders reageer op die intervensie indien hulle oorweldig word deur hulle daaglikse pligte, en dus besoeke aan antenatale sorg uitstel.

In die laaste hoofstuk word die koste-effektiwiteit van twee alternatiewe benaderings tot die verspreiding van urine swangerskaptoetste bereken. Die beperkte literatuur dui aan dat vroue wat toegang het tot swangerskaptoetse meer geneig is om vroeër sorg te besoek. Ten spite van die

literatuur is dié toetse weinig beskikbaar by openbare gesondheidsfasiliteite. In hierdie hoofstuk word die koste-effektiwiteit van twee alternatiewe benaderings ondersoek, naamlik deur-tot-deur verspreiding en verspreiding deur 'n mobiele uitreikkliniek. Die bevindings dui daarop dat deur-tot-deur verspreiding oor die algemeen meer koste-effektief is.

Die proefskrif is daarop gemik om die vraagkant van gesondheid beter te verstaan, asook om vas te stel watter faktore affekteer gesondheidsrapportering en gesondheidsoptrede.

Acknowledgement

Firstly, I would like to thank my academic supervisors, Professors Ronelle Burger and Servaas van der Berg, for their guidance, support and funding over the last four years. Thank you for providing me with countless opportunities and for creating a research environment in which I was able to finish this dissertation. I also acknowledge and thank the National Research Foundation and the Margaret McNamara Memorial Fund for providing the funding that allowed me to work on this dissertation full-time.

Thank you to the various individuals who dedicated their personal time to assist me with matters related to this dissertation. Your generosity, sincerity and passion for improving the health of all South Africans inspired me. This includes Dr. Miemie du Preez, Dr. Lungiswa Nkonki, Professor Mark Tomlinson, the Philani Health and Nutrition project (specifically Kwanie Mbewu and Dr. Ingrid le Roux), Masincedane Community Service, Masikhule and members of the Western Cape Department of Health, especially members of the PICH group.

A special thank you to my team who assisted me with fieldwork, Busisiwe Sokutu, Koleka Sibeko, Ntombizukile Marhobobo and Thabisa Peter for your dedicated work and assistance during implementation. Funding for the randomised controlled trial in Chapter 3 was received from the Abdul Latif Jameel Poverty Action Lab (JPAL), Broadreach Healthcare and REDI3x3. Several smaller sponsorships were also obtained from Ackermans, Agrimark SA and Jonssons. A special thank you to Laura Poswell and Emmanuel Bakirrdijan from JPAL for advice and support on implementation of the Thula Baba Box study.

I would like to acknowledge inputs from my colleagues and friends at the Economics Department, most notably Anja Smith, Carmen Christian and Nic Spaull, who were always eager and enthusiastic to assist and motivate. I would also like to express gratitude to my co-authors, Professors Teresa Bago D'Uva, Eddy van Doorslaer, Rulof Burger and Ronelle Burger.

A final thank you to the four constants in my life, my parents, my "twin" Renée Rossouw and Beer Adriaanse, for your sweet and selfless support. To my parents, Koos and Laureen Rossouw, who always told me to study less and enjoy life more. Writing this dissertation has been my final act of rebellion. Thank you for your bottomless support and patience. Renée, when we were children you would help me pack my backpack when I wanted to run away, but brought me coffee

and kind words when I wanted to do so as an adult. You remain the smarter sister. To Beer, who has only ever known me as an economics student, but still has not run away, thank you for being my harmonious parallel. *"Jy is my gunstelling mens."*

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List of Abbreviations

ANC = Antenatal care

ARV = anti-retroviral

BMI = Body mass index

CCT = Conditional Cash transfer

CHW = Community Health Worker

CI = confidence intervals

CM = centimetre

DHIS = District Health Information Systems

DHS = Demographics and health survey

FGD = Focus group discussion

HBP = High blood pressure

HCT = HIV counselling and testing

HOPIT = Hierarchical Ordered Probit

HIV = Human immunodeficiency virus

IFI = Infant feeding intention

LBW = Low birth weight

LPM = Linear probability model

ME = Marginal effects

MMR = Maternal mortality ratio

MNCWH&N = Strategic Plan for maternal, new-born, child and women's health and nutrition

MUAC = Middle upper arm circumference

NDoH = National Department of Health

NHI = National Health Insurance

NIDS = National Income Dynamics Study

OP = Ordered Probit

PMTCT = Prevention of Mother to child transmission

Q = Quintile

QALY = Quality adjusted life years

RCT = Randomised controlled trial

SADHS = South African Demographics and Health Survey

SA = South Africa

SSA =Sub-Saharan Africa

SE = Standard error

SES = Socio-economic status

TA = Treatment arm

TBB = Thula Baba Box

TB= Tuberculosis

ToP = Termination of Pregnancy

UNDP = United Nations Development Programme

UPT = Urine Pregnancy Test

USAID = United States Agency for International Development

WCDoH = Western Cape Department of Health

WHO = World Health Organization

List of Definitions

Wealth = In this dissertation, wealth refers to a composite of an individual's income, durable assets, characteristics of their household and access to basic services such as sanitation and water.

Demand-side factors of health = These are factors that operate at an individual, household or community level and influence the demand for health.

Self-reported health = Self-reported health refers an individual's own assessment of health, as opposed to having health assessed by a clinician or medical professional.

Chapter 1

Introduction

Health inequalities are a pervasive and persistent trend in South Africa, a consequence of an array of factors including the relationship between current population health and the country's history of racial segregation, income inequalities, widespread poverty and the unequal access to and inadequate quality of public healthcare. South Africa is also challenged by an extreme burden of disease that is disproportionate to its level of development, which includes the high prevalence of HIV/AIDS, tuberculosis (TB), maternal and infant mortality and morbidity, high occurrence of violence and injuries and the increasing diagnoses of non-communicable diseases (NCDs) (Chopra *et al.*, 2009). Large strides have been made since 2009 with regard to strengthening the leadership of the health department, creating and implementing radical policy changes, increased roll-out of the anti-retroviral programmes and increased emphasis on health research. This has translated in a turn-around of increasing mortality rates (Mayosi *et al.*, 2012). Nevertheless, the stubbornness and extent of the impact of the aforementioned burdens of disease are apparent when observing key health outcomes, such as the high prevalence of HIV among pregnant women and the persistence of TB infections among the population (Mayosi *et al.*, 2012).[1]

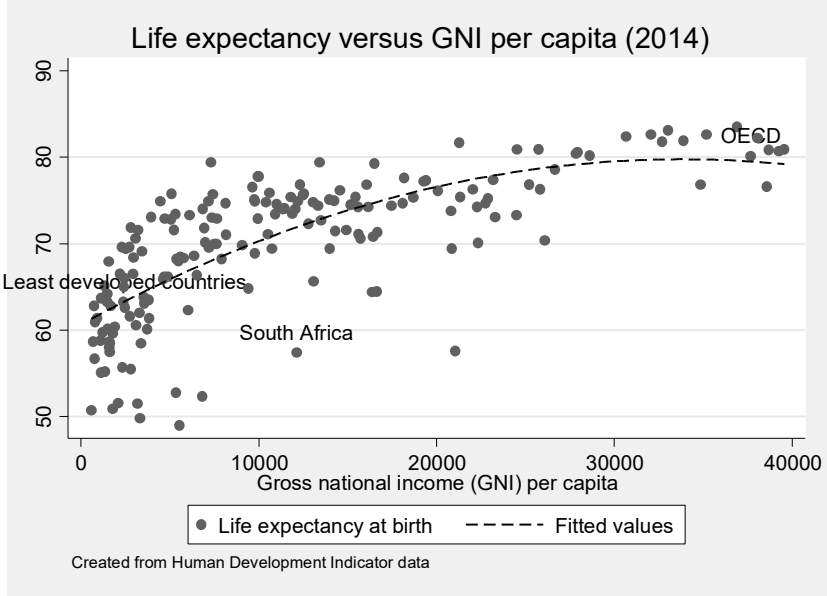
When analysed by economic factors (such as gross national income), South Africa is classified as a middle-upper income country by international development agencies (The World Bank, 2014a). However, this classification fails to capture the differences in living conditions, health and education amongst South Africans and is predominantly driven by a small group of high income earners (Van der Berg, 2014).

The scenario described above becomes apparent when other indicators of South Africa's level of development are observed, such as life expectancy. Using data of the United Nations Development Programme (UNDP), I compare the gross national income (GNI) and life expectancy across countries in Figure 1.1 in a scatterplot with a fitted line revealing the aggregate trend across included countries. The figure clearly illustrates the variability of South Africa's development

[1] In 2012, HIV prevalence among South African pregnant women was still 29.7%, relatively unchanged from the rate in 2004 (National Department of Health, 2013b). Tuberculosis also remains a persistent threat, with 401,048 cases reported in 2010, making South Africa the fifth highest incidence countries in the world (Day *et al.*, 2011; Mayosi *et al.*, 2012).

status, depending on the indicator used. In 2014, South Africa had a much lower life expectancy than other countries with a similar level of income, a result partially driven by the prevalence of HIV (Mayosi *et al.*, 2012). While South Africa had a life expectancy of 57.4 years on average, countries with a similar level of GNI per capita had a life expectancy of just over 70.

Figure 1. 1: Life expectancy versus GNI per capita across countries



The use of aggregate data to reflect South Africa's progress proves difficult. While life expectancy at birth (Figure 1.1) reveals that South Africa's is comparatively worse off, it still does not illustrate the large disparities within South Africa especially for the poorest and most vulnerable subgroups. These inequalities are particularly pronounced in South Africa, given the country's history of racial segregation during apartheid, which led to large disparities in wealth, health and education among the population.

Understanding the demand-side of health and the corresponding health behaviour is crucial in alleviating the remaining burdens of disease. For instance, in the case of HIV, one of the biggest obstacles to prevention and treatment is still stigma and poor knowledge of HIV which deter people from getting tested (Mayosi *et al.*, 2012). Economists are increasingly focusing on the importance of individuals' taste, perceptions and reference groups, access to information and opportunity costs as drivers of health behaviour. This has contributed to a body of research which may inform policymakers on optimal ways to effectively invest government expenditure, such as in specific education programmes or subsidies that target vulnerable groups (Feldstein, 1995).

Understanding demand-side barriers to prudent health behaviour is crucial in order to implement targeted policy that will help to alleviate the current burden of disease.

Explaining the heterogeneity of individual preferences: Health perceptions and eventual health behaviour

The focus of this dissertation is on health perceptions and eventual health choices of vulnerable South African individuals, as contributors to poor health outcomes and health inequalities in South Africa. There is heterogeneity in individual preferences which affect health reporting, behaviour and eventually, health outcomes. It is the role of economists and researchers to establish and quantify this heterogeneity as best as possible, keeping in mind that there is a level of heterogeneity which will always remain unexplained. Feldstein (1995) contextualises the uncertainty of health outcomes relative to heterogeneity of individual preferences and health choices: The uncertain relationship between an individual's health behaviour and eventual health outcomes leads to substantial differences in individuals' attitudes towards uncertainty and willingness to take health risks. This uncertainty of whether health choices will lead to improved health outcomes affects the trade-offs and decisions individuals are willing to make to reach a certain level of health.

Trying to systematically explain the heterogeneity of individual preferences in health is especially important in the South African context where there are already large inequalities in health outcomes. Systematically heterogeneous health preferences between the vulnerable and the non-vulnerable will lead to differences in health-seeking behaviour, which may perpetuate existing inequalities in illness and life expectancy. I therefore attempt to measure the role of heterogeneous preferences on the health reporting and health behaviour of vulnerable individuals and subgroups. Individuals and subgroups assessed in this dissertation include the income and wealth poor and, in particular, women living in low-resource areas with limited access to sexual and reproductive health services.

Ten to twenty years ago, research on the improvement of health outcomes had been largely focused on improving the supply-side of healthcare, such as focusing on health technology, prices and management (Ensor & Cooper, 2004). There had been much less emphasis placed on the demand-side of health. Demand-side factors are defined as the factors that operate at an individual, household or community level and influence the demand for health, like the level of education or cultural influence. While a well-functioning healthcare system should be able to improve the health

of the population, it is not likely to occur when demand-side barriers to access[2] exist: Individuals cannot benefit from a healthcare system if they do not utilise it (O'Donnell, 2007).

However, more recently, there has been considerable work done on the demand-side factors. Dupas (2011) provides a holistic summary of demand-side related research, drawing largely from examples of experimental and behaviour research. In her article, she addresses how credit constraints, information asymmetry and present bias may affect non-optimal health-seeking behaviour in developing countries. More recently, Dupas and Miguel (2016) summarise and discuss evidence from field experiments that have addressed the barriers to household health investments. These have included randomised controlled trials where the price of health care is varied or liquidity constraints (such as poor access to credit) addressed. Other experiments addressing demand-side factors include information, schooling and incentive experiments. Some of these more recent experiments, specifically relating to incentive programmes, are discussed in more detail in section A 3.3 in the appendix.

The demand-side factors which lead to barriers to care are usually more prominent among vulnerable populations (Ensor & Cooper, 2004). This pertains to barriers related to vulnerable individual's socioeconomic status (SES), and particularly income, as well as their health preferences, which are to a large extent determined by their SES. For instance, individuals who are unable to afford private healthcare in South Africa will have to rely on the public healthcare system, but may be deterred from utilising it due to their perception of its poor quality. Demand-side barriers are not only likely to influence access to medical healthcare, but will also influence individuals' ability to make prudent health choices, such as the decision to use contraception or breastfeed. That is not to say that demand- and supply-side interventions are separate, but that they should be considered jointly, as the two concepts are very much interrelated, and policy targeted towards improving health outcomes should take both into consideration.

The highly correlated relationship between income and health remains complex and multi-causal. Studies focusing on socioeconomic health inequalities in South Africa have consistently found worse health outcomes amongst the poor relative to the wealthier (Ardington & Gasealahwe, 2014; Ataguba *et al.*, 2011; Ataguba & McIntyre, 2013; Ataguba, 2013; Cockburn *et al.*, 2012; Khaoya, 2015; Myer *et al.*, 2008; Zere & McIntyre, 2003).

[2] Access is a loaded concept, often refers to the acceptability, geographic availability and affordability of care (McIntyre *et al.*, 2009).

Despite the high correlation between income and health, there are also a range of other socioeconomic factors directly and indirectly related to income which also influence health. Writing about the determinants of health inequality, Marmot reports on a three-pronged response to alleviating health inequalities, namely (a) poverty alleviation, (b) improved access to quality healthcare and (c) addressing the various social determinants of health (Marmot, 2005). Speaking to the second point, access to quality healthcare in South Africa is marred by several factors. This includes the bimodality of the healthcare system, with large differences in the resources allocated to the private compared to public healthcare system (Ataguba & McIntyre, 2012). The disparity is perpetuated by the low percentage of South Africans who have access to private health insurance and are able to financially access private healthcare.

The multidimensional nature of health makes the relationship between economic outcomes and health outputs difficult to measure (Strauss & Thomas, 1998). Deaton briefly discusses the complex relationship between income and health, and the historical view economists have taken on the causal relationship between the two concepts. While economists have historically been sceptical about the role that income plays in creating health, predominantly due to the overemphasised role of access to medical care in health, they have conceded that income acts as a "marker" for an underlying concept of socioeconomic status. The differences in socioeconomic status is what leads to the differences in health in a population (Deaton, 2003).[3]

Health status is also a function of various social determinants of health. Policy aimed at improving population health should also address these factors. Understanding the social determinants and context of detrimental health behaviour should be the first step in the design and implementation of interventions to improve health (Marmot, 2005). Given this, I define vulnerability in health outcomes not solely as individuals residing in poverty, but also individuals who are affected by social determinants of poor health, including previously disadvantaged race groups. Coinciding with health inequalities by income status are health inequalities by race groups in South Africa. Race plays an important role in exacerbating health-income inequalities in South Africa, since race itself is such a large determinant of income and socioeconomic status. Despite 21 years passing since the political transition, the composition of income groups still largely coincides with the previous division imposed by the apartheid government. Using the 2008 wave of the National Income Dynamics Study (NIDS), May and Timaeus show that while stunting is between 25 and

[3] As a result, concepts of socioeconomic status, such as education or asset wealth, have been used interchangeably with income, despite literature increasingly showing that they operate separately (Deaton, 2003).

30% amongst Black African and Coloured children aged between six and 59 months, it was less than half of that for White South African children of that age category (around 10%) (May & Timaeus, 2014).[4]

In the remainder of this chapter I shall continue the discussion on contributors to health inequality in South Africa as an introduction to identifying the vulnerable individuals and subgroups in South Africa. I then frame the health choices of vulnerable subgroups within the Grossman demand for health model, as a way of illustrating what may drive the heterogeneous health choices and decisions of individuals. I conclude with a summary of the remaining chapters of the dissertation.

Context: Contributors to health inequality in South Africa

One of the largest contributors to inequality in South Africa is the difference in quality of education, which in turn enlarges the gap in potential labour market earnings. Although the South African social grant system has helped to alleviate poverty, it has not directly addressed the wealth inequalities resulting from differences in labour market earnings, which can be improved upon by improving the education system (Armstrong & Burger, 2009; Van der Berg, 2014). While acknowledging the large role that education plays in contributing to these inequalities, the focus of this dissertation is on the contributing role of health.

An alternative to using national indicators of health to analyse population health (such as illustrated with life expectancy in Figure 1.1) is to use nationally representative health data sets, such as the Demographics and Health Survey,[5] to calculate a more nuanced picture of health outcomes in South Africa. Since the collection of these data sets are expensive and availability is limited, an alternative is to rely on nationally representative household surveys that usually collect a range of self-reported health indicators, and which prove useful. One such survey is NIDS.[6] NIDS provides us with a range of anthropometric biomarkers and a wide range of self-reported health measures which can be used to examine the nutrition and health status of South Africans.

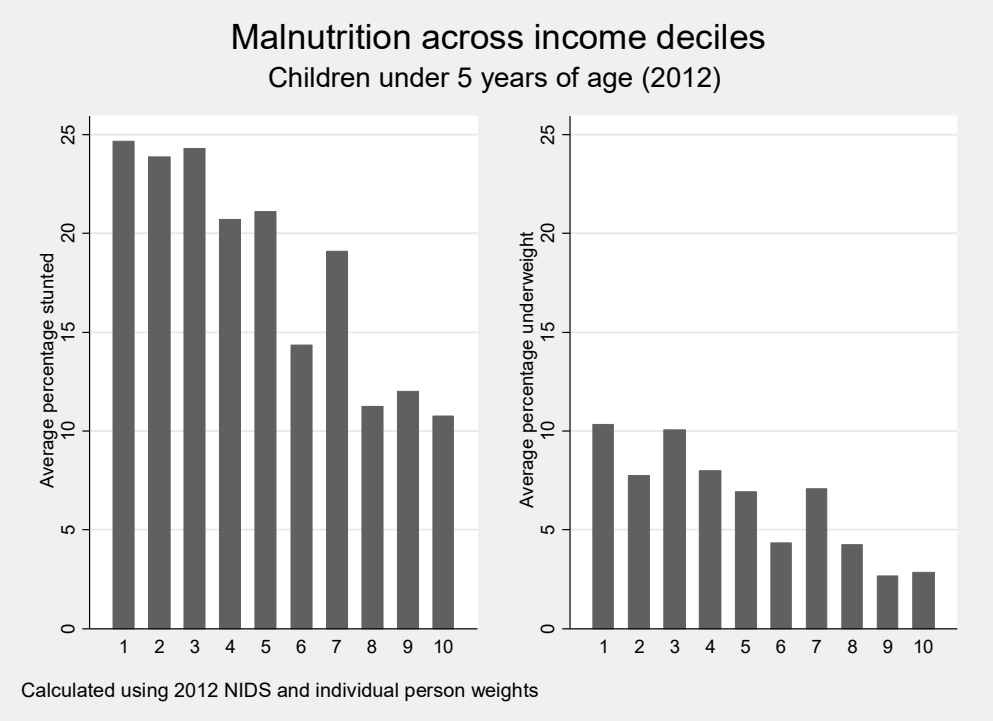
[4] The use of racial subgroups in my dissertation is done in an attempt to explore the contributing role of the unjust, institutionalised divisions imposed by the apartheid government as a contributor to health inequalities in South Africa, and to monitor whether there has been any progress in reversing this. It is by no means intended on perpetuating a divide in the population, but rather corresponds with the key focus of this dissertation, which is to identify vulnerability and improve the health status of vulnerable subgroups. The race categories used in this analysis corresponds with the categories used in the household level survey data analysed and the race categories listed by Statistics South Africa.

[5] Data funded by United States Agency for International Development (USAID) and collected by the South African National Department of Health.

[6] NIDS is collected by the Southern Africa Labour and Development Research Unit.

In Figure 1.2, I depict the rate of stunting (left) and underweight[7] (right) of children under five years of age in South Africa in 2012 using NIDS data, as measured using anthropometric data. Underweight measures whether individuals weigh too little for their age, while stunting is the result of poor nutrition over a long period of time, exposure to frequent infections and disease, and vitamin deficiencies, and can be irreversible. Stunting is therefore a good indicator of long-term exposure to deprived circumstances. The figure depicts the prevalence of stunting and undernutrition across income deciles, and confirms the vulnerability of the poor compared to the more affluent: stunting and undernutrition is highest amongst the poorest deciles compared to the most affluent deciles. Stunting amongst children in decile 1 is about 25%, while it is around 10% for children in decile 10. The same starkness in results is visible in underweight statistics.

Figure 1. 2: Stunting and underweighted among children under five, aggregated by income decile



In the General Household Survey[8] (2002-2007), medical scheme coverage is estimated to be approximately 14% in South Africa, and this is heavily skewed towards the rich (Econex, 2009).

[7] Anthropometric data was used to calculate stunting and underweight, by comparing it to the WHO international child growth standards. Stunting and underweight is defined as a height-for-age and weight-for-age z-score which falls below two standard deviations of the WHO international reference mean respectively.

[8] The General Household Survey is a nationally representative survey collected by Statistics South Africa.

The limited medical aid coverage means that poor South Africans have to rely on the public healthcare system, which, according to Havemann & Van der Berg (2003), is an inferior good in South Africa. Ataguba & McIntyre (2012) show that even though healthcare financing is broadly progressive in South Africa, the rich still largely benefit from the system and have relatively better health than the poor. Even though public health spending has become significantly more pro-poor since 1994 (Burger *et al.*, 2012), the distribution of benefits remains inequitable (Ataguba & McIntyre, 2012) and the quality of public healthcare to which the poor have access remains inadequate (Burger *et al.*, 2012).

In Figure 1.3, I illustrate the presence of inequalities across socioeconomic status (SES)[9] groups in access to care for pregnant women using concentration curves[10] and the 2003 South African Demographics and Health Survey.[11] On the y-axis, I plot the cumulative percentage of individuals who had access to the service and on the x-axis the cumulative percentage of the population of pregnant women ranked by SES status. I depict inequalities in access to early antenatal care (left) and access to a skilled attendant at birth (right).

The South African Department of Health recommends that pregnant women access care before five months' gestation for optimal health of the mother and the infant, and late access to antenatal care (ANC) is defined as access after five months (Pattinson, 2012). The concentration curve in the figure on the left is situated above the diagonal line, revealing that poor pregnant women are more likely to access antenatal care later (after 5 months) than the affluent. Access to antenatal care can be influenced by a range of factors, including being discouraged by long waiting times and poor staff attitudes, and also demand-side factors such as not identifying pregnancy status early enough. These factors are discussed in Chapters 3 and 4. However, the Figure 1.3 (left) does depict that whatever the barriers to accessing care earlier, they appear to be more prevalent amongst women from lower SES groups.

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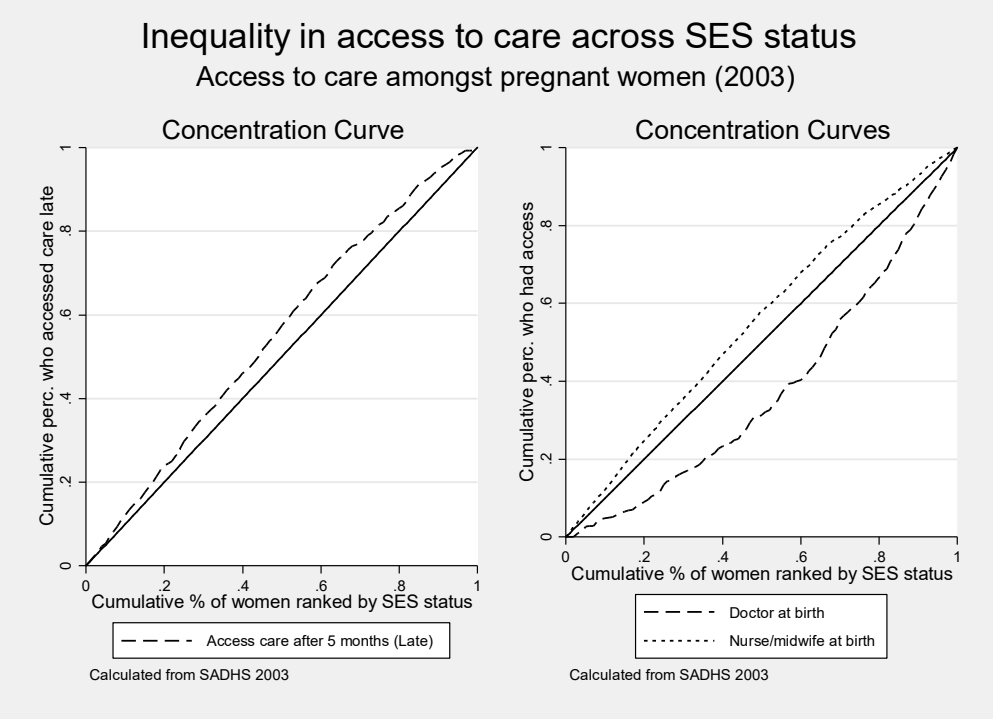
[9] Socioeconomic status is measured using an asset index.

[10] Concentration curves and indices have been suggested as good tools to measure health inequalities across socioeconomic groups (Wagstaff *et al.*, 1991). A concentration curve plots the cumulative percentage of a population (from the lowest SES to highest SES) against the cumulative percentage of health/ill-health (the outcome variable). If the curve lies above (below) the diagonal, this means that the outcome variable is concentrated amongst the poorest (richest) percentage of the population. The curve should coincide with the diagonal line if health/ill-health is equally distributed across all socioeconomic groups (Wagstaff *et al.*, 1991).

[11] The most recent South African demographic and health survey (SADHS) was collected in 2003, but contains several variables on health and health-seeking behaviour which are not available in other data sources.

The graph on the right in Figure 1.3. shows that women with higher socioeconomic status are also more likely to have access to a doctor during birth (concentration curve lies below the diagonal), while women with a lower SES are likely to have access to a nurse or a midwife[12] (concentration curve lies above the diagonal line).

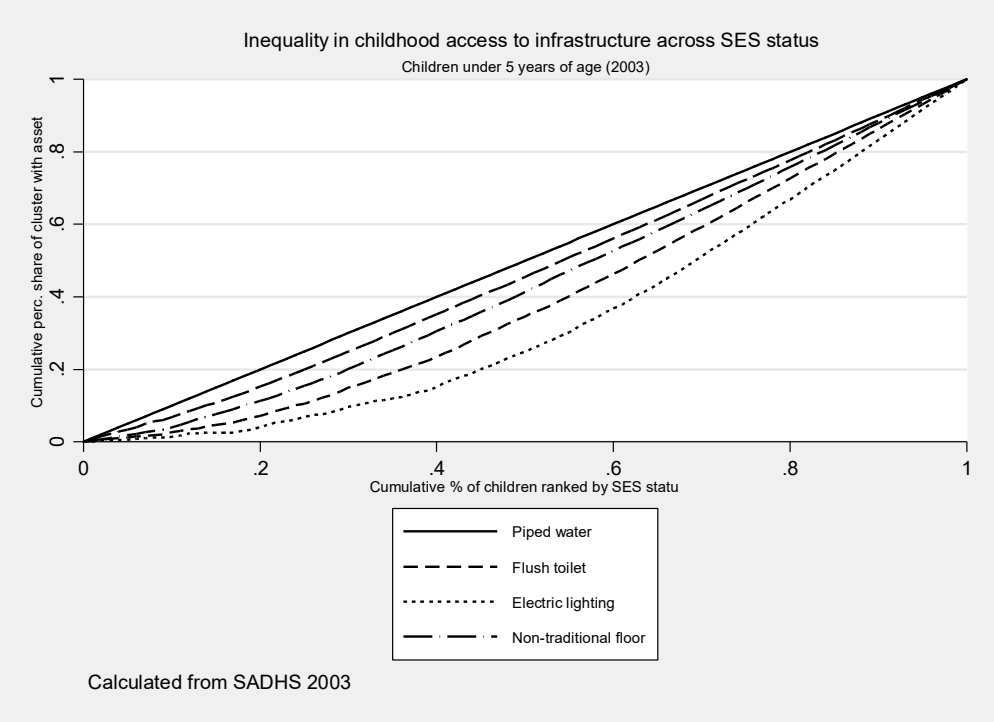
Figure 1. 3: Concentration curves: Inequality in access to care among SES groups



Another socioeconomic determinant of health is access to functioning infrastructure and clean living conditions (Lee *et al.*, 1997; Wang, 2003). In Figure 1.4, I plot the concentration curves of whether children under age five lived in households that had access to piped water, a flush toilet, electric lighting and non-traditional floors. Since the concentration curves are all below the diagonal line, it is evident that access to these services is more concentrated among the affluent.

[12] Midwives include both trained and untrained midwives.

Figure 1. 4: Concentration curve: Inequalities in the access to infrastructure.



Defining vulnerability within the Grossman model

Evaluating the health perceptions and eventual health choices of vulnerable subgroups forms the foundation of this dissertation. I will focus specifically on vulnerable and low-income individuals, with two chapters dedicated to maternal health and the health-seeking behaviour of pregnant women. In considering what drives health-seeking behaviour, it is necessary to consider and think about it within a model of the demand for health which composes the trade-offs and decisions that individuals make to reach a certain level of health. The demand for healthcare forms but a small part of the overall demand for health, which also includes day-to-day health decisions such as food and lifestyle choices.

Modelling the demand for health as an input to utility has proven difficult, given that health differs from other forms of human capital. Health is not exogenously determined, but rather, a person's level of health is to some extent determined by the resources allocated to its production (Grossman, 1972). Key to modelling this behaviour is the seminal work by Michael Grossman on developing a model for the demand for health. I briefly discuss a simplified Grossman model, followed by an interpretation of how vulnerable subgroups fit into this model.

Different from other forms of capital, health is a complex good with various functionalities. Individuals choose to invest in their health not only to (a) improve their health condition ("it feels good to be healthy" (Bhattacharya *et al.*, 2013)), but also (b) to improve their earning potential and acquire certain goods and services.

However, Grossman argues that the demand for health should be considered from (c) an investment viewpoint. Along with being a consumable, health should also be viewed as a capital good, since its value is conferred over time periods and is something that depreciates over time (with age). An individual is endowed with an initial level of health at birth (say H_0), which deteriorates (depreciates) with ageing, and health investment decisions are made accordingly to reach a desired level of health. This level of health is attained when the cost of investing in health is equal to the benefit received from that investment in health.

Grossman proposes the following simplified intertemporal utility model:

$$U = U(\varphi_0 H_o, \dots, \varphi_n H_n;\ Z_o, \dots, Z_n) \qquad (1)$$

In this simplified model, total utility is determined by consumption of health (H) and factor Z (a composite indicator of everything else non-health that determines utility), with certain trade-offs between the two. As previously mentioned, health is not only a consumable good, it is also a capital stock. Current health is a function of initial (inherited) value, H_o, the stock of health in period *i* (where each individual has *n* time periods during life) and phi, the service flow per unit of stock (Grossman, 1972). An individual's lifespan, or *n*, is endogenous to H. Healthcare-seeking behaviour and healthy lifestyle choices (amongst other health-related decisions) are filtered into the utility function via H.[13]

To show the intertemporal nature of these decisions, the utility function can be modelled as a series of individual decisions. These decisions have to be discounted to take into account that individuals value current and future costs and benefits differently. Rho, ρ[14], is the individual's time discount factor and measures the value that the individual places on future utility.

[13] Within this framework, an individual is constricted by budget and time constraints. The level of utility that individuals can achieve is a function of their earnings, but also how they choose to spend their time: this includes spending it on health-seeking activities, working or leisure activities, or time spent ill because not enough time was spent on health-seeking activities or earning enough wages to seek quality care.

[14] $\rho \in [0,1]$.

$$U = U(H_o, Z_0) + \rho U(H_1, Z_1) + \rho^2 U(H_2, Z_2) + \cdots + \rho^n U(H_n H_n) \quad (2)$$

(Bhattacharya *et al.*, 2013)

Since health is a capital stock, or something an individual can invest in and transfer across periods, it is also something that can depreciate over time and the rate of depreciation is assumed to increase with age. Therefore, an individual's investment in the health stock can be expressed as:

$$H_{i+1} - H_i = I_i - \delta_i H_i \quad (3)$$

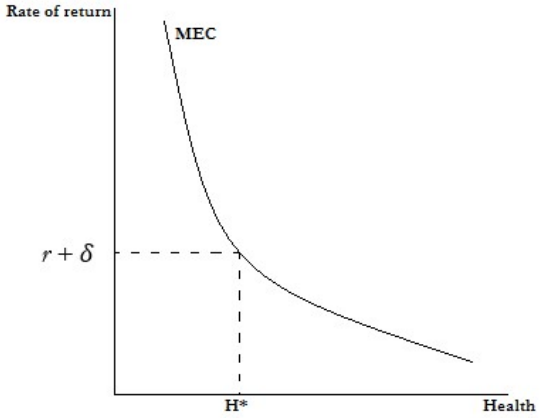
where δ_i is the depreciation rate for period *i*. According to Grossman, an individual's net investment in health stock $(H_{i+1} - H_i)$ is equal to initial gross investment in health stock (I_i) minus its depreciation. Investment in health (I_i) is expressed as follows:

$$I_i = I_i(M_i, TH_i, SES_i). \quad (4)$$

Investment in health is a function of healthcare spending (M_i), time inputs into improving health (TH_i) and socioeconomic status (SES_i). Within this framework, one can calculate an individual's optimal health stock given their rate of return and their marginal efficiency of capital (MEC) curve. This is illustrated in Figure 1.5. The MEC curve is downward sloping. This is because, at lower levels of health, an investment in health yields higher returns.[15] The cost of capital, or the cost of investment in health, is determined by both the rate of depreciation of health δ_i and the rate of return of other capital goods that an individual could have invested in, namely *r* (this is the opportunity cost of investing in health rather than other investment goods). Within this curve, individuals will invest in their health to the point where the cost of capital $(r + \delta)$ meets the MEC curve, or where the cost of investing in health is equal to the benefits they are able to receive from investing in health (the efficiency with which they produce health). The individual's level of health, H*, is determined by the amount they end up investing in health.

[15] The decreasing rate of return to health as a producer is due to the role of health as a (b) producer of productive time. An individual who is already quite healthy, and consequently productive, will benefit little from an improvement of their health. Alternatively, for an individual who is ill and has fallen into a perpetual cycle of poor health and inability to work, a small improvement in health might be all they require to reach a level of sustainable productivity which they can perpetuate to improve their health and their ability to create more productive time.

Figure 1. 5: The cost of capital and the marginal efficiency of health capital



(Source: Bhattacharya *et al.*, 2013)

Within this model proposed by Grossman, there are various factors which may affect the position of the MEC curve (the efficiency with which an individual is able to produce health) and the cost of capital. These factors may include education and consequent adherence to medical advice, genetic reasons such as deprivation in utero, and the direct role of increased income (allowing to increase health production by, for instance, buying better food or accessing better healthcare or time-inconsistent preferences) (Bhattacharya *et al.*, 2013).

The most oft-discussed of these factors is the role of poor education on health production, as put forward by Grossman. This will factor into SES in equation (4). In his model, Grossman argues that individuals with more human capital stock, specifically education, are more efficient at producing health. That is, for every set amount spent on healthcare and time invested in health, people with more human capital stock can produce a higher level of health H_i. Grossman states that in the case of improved education levels, more efficient health production is related to the ability to better process health information. In the case of wealth, one could argue that being more affluent means that you would have better access to information sources (such as computers and the internet) to do the necessary research regarding healthcare or health behaviour. The MEC curve of an individual with a lower level of education will shift to the left, meaning that at a given level of investment, they are able to produce a lower level of health (Grossman, 1972). However, behavioural economics research has provided evidence of instances where the relationship between acquiring health information and changing health behaviour are limited by other factors. For instance, pregnant women may be aware of the benefits of accessing antenatal care early, but

delay seeking care due to time-inconsistent preferences or being overwhelmed by day-to-day activities (discussed further in Chapter 3). That being said, the Grossman model remains a very influential and important model for analysing the complex decisions individuals make regarding their health.

The same is true for other vulnerable subgroups, such as individuals who were deprived of adequate resources in utero. This may be the case when their mother did not have adequate resources to consume the proper nutrients, or perhaps did not have the correct information on what to consume while pregnant. The science of epigenetics has shown that gene exposure to harsh conditions in utero will have an effect on the epigenomic dysregulation leading to poor health outcomes, and is in turn also linked to SES (Perera & Herbstman, 2011; Mcguinness *et al.*, 2012). These individuals have a lower initial health stock H_o, which will affect their ability to produce health, and consequently their MEC.

These factors which affect an individual's health production efficiency may be outside the control of the individual, and could be considered unfair predictors of health. Therefore, irrespective of how these vulnerable subgroups decide to do a trade-off between H and Z, they will always be limited by their ability to produce health (a lower MEC curve) and as such, will remain disadvantaged. Amartya Sen writes about the injustice of poor health:

> What is particularly serious as an injustice is the lack of opportunity that some may have to achieve good health because of inadequate social arrangements, as opposed to, say, a personal decision not to worry about health in particular. In this sense, an illness that is unprevented and untreated for social reasons (because of, say, poverty or the overwhelming force of a community-based epidemic), rather than out of personal choice (such as smoking or other risky behaviour by adults), has a particularly negative relevance to social justice. (Sen, 2002a).

Individuals who do not have fair opportunities to health are considered vulnerable in this dissertation. The inability to make certain health decisions puts them in a precarious position and may lead them to lead "impoverished lives", as Sen puts it (Sen, 2000). This focus on health inequalities that result as a consequence of unfair and socially unjust social, cultural and economic factors is referred to as vertical inequity. The focus on vertical inequity calls for those with greater need to be provided with greater resources, which will be the focus of this dissertation (Culyer, 2001).

Chapter 2: Poor health reporting by the rich? Using vignettes to recover the health gradient by wealth status

In Chapter 2, I address the problems and prospects of using self-reported health data to measure population health status. Accurately measuring health inequalities in South Africa is limited by the poor availability of objectively measured health data. Self-reported health data is more widely collected than clinically measured data and biomarkers, and have been linked to survival or mortality in various countries (Idler & Benyamini, 1997; Van Doorslaer & Gerdtham, 2003; Frankenberg & Jones, 2004; De Salvo *et al.*, 2006; Jylhä *et al.*, 2006; Ardington & Gasealahwe, 2014). However, self-evaluations in health are a viable alternative to comprehensive clinical evaluations in a low-resource setting (Strauss & Thomas, 1998).

The use of self-reported health measures to calculate health inequalities is impeded by the presence of reporting heterogeneity. Reporting heterogeneity occurs when an individuals' own evaluation of their health may differ from their objectively measured level of health as a result of differing experiences, health expectations and reference groups.[16] Once these differences in reporting behaviour are systematic across a subgroup, it becomes problematic to use in an analysis, especially when making cross-population comparisons. For instance, if the vulnerable subgroup systematically underestimates their ill-health when they use self-reported measures, this will translate into an underestimation of health inequalities and a miscalculation of the true problem.

In this analysis, I evaluate the use of anchoring vignettes to test and adjust for reporting heterogeneity in South African self-reported health data. An anchoring vignette is a data collection tool used to describe a fixed level of health. This acts as a benchmark against which one can compare self-reported health and gauge the level of reporting bias. Although vignettes are not often collected, they are available in the WHO Study on global AGEing and adult health collected for South Africa in 2008. One limitation of the data set is that it only samples individuals aged 50 and older. However, within the Grossman model, older individuals are less efficient at producing

[16] The typical self-reported health questions are posed in a way that people have to evaluate their health on a Likert scale from 1 to 5. Strauss and Thomas describe the problem with the measures as two-fold: firstly, the small number of discrete categories is unlikely to adequately capture the complexity of health; and secondly, the interpretation of these categories may differ if an individual is asked to rate their health without a clear reference status. It is for these reasons that the authors conclude that these measures are a good predictor of future health, but that it should be cautiously applied to other causal evaluations (Strauss & Thomas, 1998). The same is true for self-reported illness and physical ability: an individual's perception of their health will affect their reporting of their health. What is deemed a symptom by one person may not be deemed a symptom by another. These perceptions are likely to be affected by an individual's use of the health system, which in turn is affected by socioeconomic status (Strauss & Thomas, 1998).

health since their cost of capital ($r + \delta$) becomes higher with age as health depreciates at a faster rate (δ). This makes older South Africans a particularly vulnerable group to analyse. This age group in South Africa is even more vulnerable, since they grew up in a period of racial segregation prior to democratisation in 1994, which would have had a profound effect on their wealth creation and access to health services during adolescence and early adulthood.

I specifically test for the presence of reporting heterogeneity among wealth and race groups in South Africa. Once these differences in reporting behaviour have been tested for, I adjust self-reported health measures for reporting differences in order to gauge the impact and size of vulnerability on inequalities measurements in South Africa.

Chapter 3: The Thula Baba Box study: A package of interventions aimed at improving early access to antenatal care in Cape Town, South Africa. Evidence from a pilot randomised controlled trial.

In Chapter 3, I address some of the demand-side barriers facing pregnant women living in low-resource areas. I report on the results of a randomised controlled trial (RCT) I designed (along with co-authors) and implemented in the Metropolitan region of the Western Cape during 2015. The RCT consists of a demand-side package intervention aimed at improving the timing and frequency of antenatal care access. The package intervention consisted of two interventions which were jointly implemented. The first was an incentive, the Thula Baba Box (TBB), which was used to encourage pregnant women to visit ANC by providing it as a reward for early and frequent clinic attendance. The second intervention entailed supporting the women with advice, guidance and health information delivered by experienced local community health workers (CHW).

The decision to implement a package intervention is based on the literature showing that disappointing maternal and infant health outcomes may be due to multiple constraints. Joint implementation ensures the targeting of multiple impediments to optimal maternal and infant health. The chapter will therefore consider whether a package of interventions aimed to address demand-side constraints was effective in motivating pregnant women to access healthcare at facilities in a low-income, urban setting in South Africa. The chapter will also explore the impact of the intervention on health outcomes measurable at birth (maternal nutrition, depressive symptoms, birth weight and intention to exclusively breastfeed).

Both mothers and infants are considered vulnerable subgroups in South Africa amidst high rates of maternal and infant mortality. South Africa's maternal mortality ratio is far higher than that of its upper middle income country peers. These disappointing outcomes are not only attributable to low government spending, as countries that have similar levels of per capita government expenditure on health have maternal mortality ratios that are less than half of South Africa's estimate of 140 per 100, 000 live births in 2013 (World Health Organization, 2015). The same is true for infants and young children. Mortality in 2011 was 42, 30 and 14 deaths for every 1000 live births amongst children under five, infants and neonates respectively, with neonates being particularly vulnerable (Bamford, 2013).

A RCT is a powerful, experimental methodology which can be used to establish causality and identify which effects can be attributed to the programme (Banerjee & Duflo, 2009). The labour-intensive methodology has gained popularity in the last decade, but has also been met with sincere criticism regarding the generalisability of results and the impact of being observed on participants. These criticisms, along with some others, are further discussed in the concluding chapter.

Chapter 4: Two alternative approaches to urine pregnancy test distribution: A cost-effectiveness analysis

Chapter 4 is the result of one of the learnings from Chapter 3. During the recruitment of pregnant women in the RCT, it became apparent that there was a large unmet demand for urine pregnancy tests (UPTs) to establish pregnancy status in the low-resource environment. Public health facilities have to stock and provide women with free UPTs. In reality, there are often stock-outs and long-waiting times act as barriers to access. Furthermore, the tests have to be administered by a nurse and the results are often accounted in a non-confidential space. Access to urine pregnancy tests (UPTs) has been shown to decrease the gestational age at which pregnancy is detected and healthcare (antenatal care and abortion services) is sought (Jeffery *et al.*, 2000; Morroni & Moodley, 2006).

I offered sexually active women living in a low-resource area two alternative methods of accessing free UPTs. The first was door-to-door distribution of pregnancy tests to women of childbearing age by a community health worker, while the second was via a community-based mobile health-outreach site.

This chapter presents a cost-effectiveness analysis of how urine pregnancy testing at a mobile intervention site in a community setting will increase take-up of the tests, compared to door-to-door testing. The analysis followed a societal perspective, with a micro-costing approach. Effectiveness is measured by take-up of UPTs. I also descriptively explore the barriers to pregnancy testing.

Chapter 5: Conclusion

To summarise, the aim of this dissertation is to identify and assess the health status and health-seeking behaviour of vulnerable individuals in South Africa, and to provide evidence on possible solutions for improvement of their health. Vulnerability is not only defined as having low levels of income or wealth, but also as vulnerability to the social determinants of health. These are individuals and subgroups that fall within the lower end of health inequality distributions, such as groups living in low-resourced areas, having limited access to quality healthcare or being disadvantaged by the previous political system that led to entrenched racial inequalities in health. Of course, there is often overlap between individuals' income status and these social determinants. The content of all the chapters is aimed at establishing a better understanding of the demand-side of health, the factors driving health-seeking behaviour and the factors affecting health reporting.

I apply various novel quantitative techniques in this dissertation. In Chapter 2, I test for the presence of reporting differences amongst wealth and race groups in South Africa, using benchmarks known as anchoring vignettes. I use these to illustrate how health inequalities are under-captured to the disadvantage of the poor when one relies on self-reported health measures. In Chapter 3, I shift my focus to the health-seeking behaviour of pregnant women residing in a low-income area, and test the effectiveness of a package intervention on improving timing and frequency of antenatal care-seeking behaviour, using a RCT. Finally, in Chapter 4 an economic evaluation is used to provide evidence on the cost-effectiveness of two alternative approaches to the distribution of UPTs. The results from these chapters are summarised in Chapter 5.

Chapter 2

Poor health reporting by the rich? Using vignettes to recover the health gradient by wealth status

2.1 Introduction

Inequalities in health across socioeconomic subgroups is a pervasive and persistent trend globally (Van Doorslaer *et al.*, 1997), and South Africa is no exception. Studies focusing on socioeconomic health inequalities in South Africa have consistently found worse health outcomes amongst the poor relative to wealthier individuals (Zere & McIntyre, 2003; Myer, *et al.*, 2008; Ataguba *et al.*, 2011; Cockburn *et al.*, 2012; Ataguba, 2013; Ataguba & McIntyre, 2013; Ardington & Gasealahwe, 2014; Khaoya, 2015).[17] The endogenous relationship between poverty and ill health means that the widening health inequalities which lead to a decline in the health of the vulnerable poor will inevitably lead to the worsening of their socioeconomic position, resulting in a perpetual poverty cycle (Wagstaff, 2002).

Health inequalities which result as a consequence of social, cultural and economic factors are unfair or socially unjust given that the vulnerable and worse-off groups are disadvantaged by factors out of their control (Woodward & Kawachi, 2000). These health inequalities are seen as involuntary, resulting from different conditions, limitations and opportunities between subgroups. For instance, health inequalities by race groups in South Africa can partly be attributed to the segregation and land use policies put in place during apartheid (Coovadia *et al.*, 2009). Daniels, Kennedy and Kawachi make the point that fairness is an important consideration in decreasing health inequalities from a Rawlsian standpoint, if health inequalities are the result of inequalities in social determinants, such as wealth or opportunity (Daniels *et al.*, 2009). From a societal perspective, health inequalities may also put at risk the health of the entire population. In countries where health inequalities are large, and the average level of health of individuals at the lower end

[17] Having access to economic resources can play both a preventative and curative role in morbidity and mortality (Zimmer & House, 2003). One possible driver of health inequalities across SES groups are differences in education levels which lead to worse compliance or management of illness (Case *et al.*, 2002; Goldman & Smith, 2002) and lower future earnings potential (Adler & Newman, 2002). Access to income also has a health promoting effect through access to better healthcare, as well as better nutrition and living conditions (Adler & Newman, 2002).

of the distribution is poor, spill-over effects, or negative externalities of certain conditions such as tuberculosis will spread and put everyone at risk (Woodward & Kawachi, 2000).[18]

The accurate measurement of health inequalities across wealth groups is hampered by the availability of (nationally representative) objectively measured health data. These include measurements of anthropometric status, biomarkers and other information collected by a medical professional. An alternative source of health data are self-reported health data, information which is frequently collected in household surveys. Examples include self-reported incidence and history of chronic conditions, self-reported physical ability in various domains, as well the overall self-assessed health (SAH) question. The overall SAH question usually asks an individual to rate their level of health on a scale from 1 to 5, where 1 is equal to "poor" and 5 is "excellent".

Although these indicators are more readily available, individuals' own evaluation of their health may differ from their objectively measured level of health as a result of differing experiences, health expectations and reference groups (the reasons for these differences are discussed in detail in the next section). These differences in the evaluation of self-assessed health are referred to as reporting heterogeneity. If such differences in reporting behaviour are found to be systematic across a subgroup, it becomes problematic to use in an analysis, especially when cross-population comparisons are made (Lindeboom & Van Doorslaer, 2004; Hernández-Quevedo *et al.*, 2005; Etile & Milcent, 2006). For instance, if the vulnerable subgroup systematically underestimates their ill health when they use self-reported measures, this will translate into an underestimation of health inequalities and a miscalculation of the need to correct health inequalities. One methodology which can be applied to control for the presence of systematic reporting heterogeneity is the use of anchoring vignettes.

An anchoring vignette is a data collection tool used to describe a fixed level of health, and which acts as a benchmark against which we can compare self-reported health and gauge the level of self-reported bias. An anchoring vignette is usually a description of a hypothetical person or scenario, which represents a fixed health state across all individuals. Previous papers that have used the vignettes approach to establish reporting heterogeneity in self-assessed health reporting includes studies on Asia (Bago d'Uva *et al.*, 2008a; Guindon & Boyle, 2012); several countries in Europe

[18] A final argument for reducing health inequalities is that the investments that improve the health of the disadvantaged and reduce inequality are highly cost-effective, but there is little empirical evidence of this (Woodward & Kawachi, 2000).

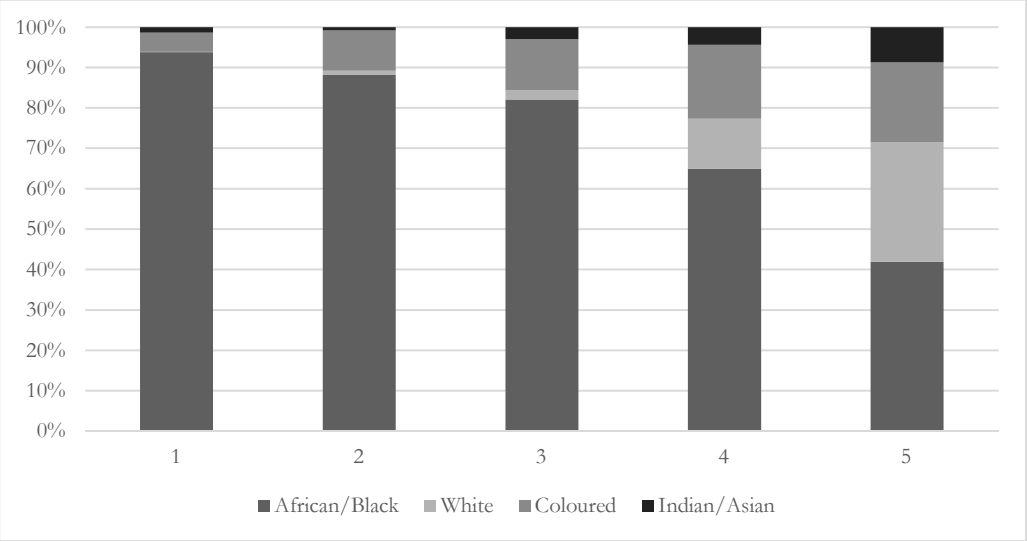
(Jürges, 2007; Bago d'Uva *et al.*, 2008b; Peracchi & Rossetti, 2012) and the USA (Dowd & Todd, 2011).[19]

A first goal of this chapter is to test whether inequalities in self-reported health by wealth status in South Africa are underestimated as a result of reporting tendencies. This is done by using ratings of so-called health anchoring vignettes to estimate hierarchical ordered probit models on data taken from SAGE, (the WHO Study on global AGEing and health) a nationally representative sample of individuals aged 50 and older in South Africa, collected in 2008 (World Health Organization (WHO), 2008).

The second objective is to investigate the presence of reporting heterogeneity amongst race groups in South Africa. South Africa has a history of economic and political segregation by racial lines, which was institutionalised during the apartheid era. During this period, the mobility of race groups other than the minority White population was severely restricted. Particularly the Black African population group was disadvantaged, with a large part of this population's movement restricted to the homelands. These were areas demarcated by the South African government, situated along the country's peripheries, with their own (severely underfunded) health departments. Their access to urban areas where better healthcare and economic opportunities were available was restricted and regulated. The apartheid policy only came to an end in 1994 when the first democratically elected government came to power (Coovadia *et al.*, 2009). This history of racial segregation led to deeply entrenched income/wealth, racial and health disparities amongst South Africans. These disparities are clearly illustrated in Figure 2.1, which shows the composition of the wealth quintiles by race group in the WHO SAGE 2008 data. The poorest group, quintile one, largely consists of Black Africans. By contrast, the White population is largely concentrated in the upper quintiles. The other two racial groups – Asian/Indian and the Coloured groups – are similarly concentrated disproportionally in the higher quintiles.

[19] To the best of my knowledge, there have been no other studies in Sub-Saharan Africa that apply anchoring vignettes to self-reported health data.

Figure 2. 1: Composition of wealth quintiles by population group, 2008



Notes: Statistics weighted with post-stratified individual weights. Graph created from own calculations from WHO SAGE 2008.

I begin this analysis by giving an overview of health inequalities in South Africa within the context of the country's history of racial segregation which had a pronounced impact on the structuring of the healthcare system (2.2). Next I discuss the effect of reporting tendencies on self-reported health, and how, if systematic, this may bias the measurement of health inequalities (2.3). In Section 2.4 I describe the methodology that I will apply to South African data to estimate and adjust for reporting tendencies. Finally, I report on the results (2.5) and discuss its impact (2.6).

2.2 Background: Health inequalities in South Africa since the political transition

Since the political transition in 1994, income and wealth inequalities have worsened and has become even more concentrated in the top income deciles (Leibbrandt *et al.*, 2011). The current inequalities in health are worsened by these comparatively high income inequalities and unequal access to basic social services (Ataguba *et al.*, 2011). In the General Household Survey (2002-2007) medical scheme coverage was estimated to be approximately 14% in South Africa, and this was heavily skewed towards the rich (Econex, 2009). The limited medical aid coverage means that poor South Africans have to rely on the public healthcare system, which is inferior in quality (Havemann & Van der Berg, 2003). Due to the poor quality and long waiting times, the less affluent often pay for private healthcare out-of-pocket, which poses a large financial strain.[20]

[20] A fifth of healthcare utilisation by individuals in the lowest consumption quintile is from private providers (Burger *et al.*, 2012).

Ataguba and McIntyre (2012) show that even though healthcare financing is broadly progressive in South Africa, the distribution of health benefits by the system is still largely pro-rich. This is due to the more affluent belonging largely to private health schemes and their contributions to these schemes translating directly into benefits solely for them. Even though public health spending has become significantly more pro-poor since 1994 (Burger *et al.*, 2012), the distribution of benefits remains inequitable (Ataguba & McIntyre, 2012) and the quality of public healthcare to which the poor have access remains inadequate (Burger *et al.* 2012). Health inequalities are further perpetuated by unequal access to services between the poor and non-poor, such as housing, piped water and modern sanitation facilities (Woolard, 2002; Armstrong *et al.*, 2008).

Ataguba *et al.* (2011) state that South Africa is subject to the inverse care law, namely that there is a mismatch between who has the largest health needs, and who has access to health services in South Africa. Even though the poor have worse health outcomes than the wealthier population, they utilise health services less. Similarly, the lower levels of health service utilisation translate into worse health outcomes among the poor. Individuals from the lower income quintiles in South Africa are not only less likely to seek care if they become sick, but are also less likely to consider themselves as ill in the first place (Havemann & Van der Berg, 2003; Burger *et al.*, 2012). Havemann and Van der Berg (2003) argue that one of the major reasons for the underestimation of ill health in South Africa is due to the lack of quality healthcare for the poor. The demand for healthcare is dependent on the price of healthcare, but also on other barriers such as limited access due to long travelling time to clinics and hospitals, and poor access to health knowledge. These barriers present themselves to individuals who are poor or who are reliant on the public healthcare system. As a result, there are still large differences in the health outcomes of the poor versus the non-poor. The same can be said for differences in health outcomes by racial divisions, with the Black African population on the losing end of the health spectrum.

A number of studies have reported racial health disparities favouring the White population in South Africa (Charasse-Pouélé & Fournier, 2006; Ardington & Gasealahwe, 2014; Lau & Ataguba, 2015), even after controlling for income. Ardington and Gasealahwe (2014), for instance, using nationally representative data for all age groups from the National Income Dynamics Study (NIDS), and after controlling for household expenditure and asset wealth, find that the White and Coloured population report significantly better overall self-assessed health than the Black African population. Similar results of the Black African and White difference in self-reported health are found in Lau and Ataguba's (2015) analysis of NIDS. The intertwined relationship between race,

wealth and health in South Africa therefore means that wealth-related reporting heterogeneity in self-reported health may also to some extent be race-related. I aim to unravel the role played by race in wealth-related health reporting heterogeneity in South Africa.

2.3 Reporting tendencies and the health gradient

Self-reported health is an opaque and compounded concept, which not only reflects an individual's true level of health, but also an individual's expectations of ideal health. These expectations are usually a function of reference groups, health knowledge and previous health conditions, factors which may vary and may be affected by socioeconomic status (SES). In the South African context, individuals' self-reporting of their health status is further complicated by the previously discussed deep social cleavages that coincide with socioeconomic status and therefore affect expectations. What may result from the impact of differing expectations is that the health gradient calculated using self-reported health measures is not an accurate depiction of actual disparities in health and SES.

Questions asking individuals to subjectively rate their overall level of health have been significantly linked to their survival or mortality in both the industrialised and emerging world (Idler & Benyamini, 1997; Van Doorslaer & Gerdtham, 2003; Frankenberg & Jones, 2004; De Salvo *et al.*, 2006; Jylhä *et al.*, 2006; Ardington & Gasealahwe, 2014). Idler and Benyamini (1997) establish that the five-category Likert-scale type question, asking respondents to rate their health on a scale from one to five, is a strong predictor of eventual mortality in several countries. Similarly, Ardington and Gasealahwe (2014) found this variable to be a significant predictor of two-year mortality in South Africa. Self-reported health variables are also highly correlated with clinically measured biomarkers that lead to mortality (Jylhä *et al.*, 2006) and is predictive of healthcare utilisation (Van Doorslaer *et al.*, 2004).

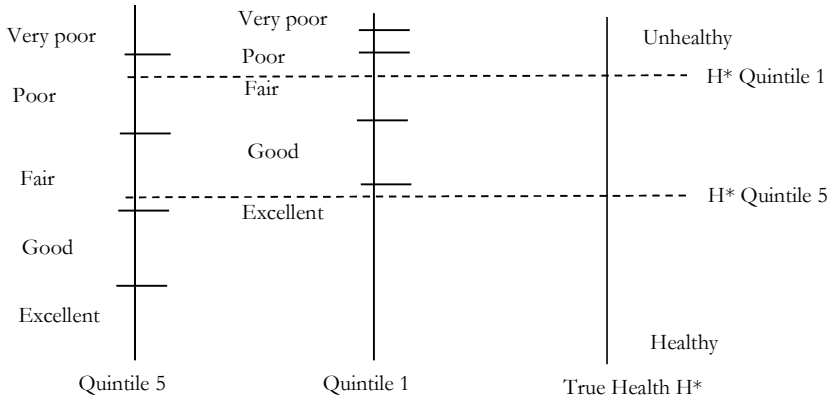
Although the relationship between self-reported health and mortality is well-established, there remains skepticism about the relationship between self-assessed health measures and morbidity. While some authors have found the SES/health gradient to hold for self-assessed health measures (Subramanian *et al.*, 2009), others have found the relationship to be weak and problematic (Lindeboom & Van Doorslaer, 2004; Hernández-Quevedo *et al.*, 2005; Etile & Milcent, 2006). Self-reported health measures are more cost-effective and less invasive to collect than objective

measures of health, but are also likely to reflect differences in reporting behaviour across different socioeconomic groups.

Take, for instance, the overall self-assessed health (SAH) question. The most common method of capturing overall SAH is categorical and ordinal. An individual is asked to classify health as either 1 "Very poor" 2 "Poor" 3 "Fair" 4 "Good" 5 "Excellent". Individuals from different subgroups could have a different interpretation of what it means to have "poor" or "excellent" health. One possible reason for different interpretations is the use of different comparison groups. Individuals tend to compare their health to their peers and surrounding subgroups (Boyce & Harris, 2011; Harris *et al.*, 2011). An individual, who is surrounded by poor health, would consider him- or herself to be relatively well-off compared to their community or peers, even though their health compares poorly to the overall population (Etile & Milcent, 2006; Bago d'Uva *et al.*, 2008a).

These differences in reporting behaviour are referred to as reporting heterogeneity. Reporting heterogeneity is present and problematic when, at a fixed level of health, a population subgroup is systematically more likely to under- or over-report their true, unobserved level of health. Bago d'Uva *et al.* (2008b) use Figure 2.2 to illustrate the impact of reporting heterogeneity on health inequality measurement. The figure illustrates the response scales, or the manner that two subgroups analyse their own health on a categorical scale (such as those used by the Likert-scale SAH variables) and how it maps onto true health status H*. The response scales are those of the poorest (quintile 1 in the middle) and the wealthiest (quintile 5 on the left) subgroups of the population. Let us assume for illustrative purposes that individuals in quintile 1 have higher thresholds at which they classify themselves as unhealthy (they are optimistic in their health evaluation). In this example, individuals in quintile 1 are always likely to report better health relative to their true level of health. For example, H*Quintile 5 and H*Quintile 1 represent the true health states of individuals in quintile 5 and quintile 1 respectively. Using their respective reporting scales, both individuals in quintile 5 and quintile 1 are likely to report their health as "fair", even though the line on the right representing true health state shows that individuals in quintile 5 have better health on average than individuals in quintile 1. In this scenario, if I trust the self-reported health scale, I would likely underestimate the health gap between those in quintile 1 and quintile 5.

Figure 2. 2: An example of different reporting styles



Source: adapted from (Bago d'Uva *et al.*, 2008b)

Case and Deaton (2005) report an example of how reporting heterogeneity can affect comparisons of self-assessed health between two countries at different levels of economic growth. They find that the level of self-assessed health in Udaipur, India, is the same as in Khayelitsha, South Africa, despite the percentage of the population being underweight (an objective measure of nutrition) in the South African sample only being a fraction of that in India. Although both regions have low levels of GDP per capita, the South African region is economically relatively better-off compared to Udaipur.[21]

Several authors have tested for reporting heterogeneity in self-assessed health measures, but most of this work has been focused on high-resource country data (Humphries & Van Doorslaer, 2000; Lindeboom & Van Doorslaer, 2004; Hernández-Quevedo *et al.*, 2005; Etile & Milcent, 2006; Lindeboom & Kerkhofs, 2009), while fewer studies have been done on developing country data (Bago d'Uva *et al.*, 2008a). A common trend in these studies is that vulnerable subgroups are found to systematically underestimate their ill health. Ren Mu explores health reporting differences

[21] Even self-assessed chronic conditions can be unreliable (Baker *et al.*, 2004). If a certain subgroup, such as a group with a lower level of education or income, does not have access to quality healthcare, chronic conditions may go undiagnosed and unreported. This is especially true for socioeconomically related health conditions that remain asymptomatic even at advanced stages, such as hypertension, diabetes, heart disease or certain cancers (Johnston *et al.*, 2009). Hypertension is a good example of a chronic condition which can go undetected unless picked up by a medical professional, since it is largely asymptomatic until a moderate or advanced stage. Johnston *et al.*, (2009) compare the incidence of self-assessed versus objectively measured hypertension across socioeconomic groups in England. They find no evidence of an income/health-gradient when observing self-assessed hypertension incidence, but a statistically significant income/health gradient when observing objectively measured hypertension.

between two provinces in China, one poor and one more affluent. She finds that individuals from the poor province systematically underestimate their ill health (Mu, 2014). Using French data, Etile and Milcent (2006) find that the poor are too optimistic about their health, as does Bago d'Uva et al. (2008a) for Indonesia, India and China. Some authors have also established that individuals with low levels of education are likely to report better health levels than their latent, true levels of health (Bago d'Uva *et al.*, 2008b; Lunde & Løken, 2011)

Researchers have cited various reasons for these discrepancies between true health status and self-assessed health status. Vulnerable subgroups are often found to systematically over-report their health (or underestimate ill health). One reason for this underestimation is due to their comparison groups as previously explained. Individuals tend to compare their health to their peers and surrounding subgroups (Boyce & Harris, 2011; Harris *et al.*, 2011), and their level of self-reported health will reflect how they view themselves compared to their peers. South Africa's history of racial segregation means that there has been a lack of bridging of comparison groups between races. Research on subjective well-being has shown that since the political transition, there have been an improvement in the integration of race-related reference groups, but that same-race reference groups are still in the majority (Von Fintel, 2015). These racially specific reference groups will affect the way individuals compare their health relative to others.

A second possibility is the asymmetry of health information to which various subgroups have access (Bonfrer *et al.*, 2014). Wealthier individuals in South Africa may have access to private healthcare which would enable them to go for regular doctors' visits and check-ups. This access will allow them to be diagnosed with chronic conditions of which they were unaware. Better access to health information could lead to greater awareness of their ill health. Better health knowledge may also affect health expectations (Bonfrer *et al.*, 2014). Sen (2002) gives an extreme example of a person growing up in a poor community where disease incidence is high and health facility access low. Such a person might view symptoms as part of a normal, healthy condition, while they could perhaps easily be prevented or remedied with appropriate treatment.

On the other hand, in their design and testing of vignettes, Grol-Prokopczyk *et al.* (2011) find evidence to suggest that familiarity and knowledge of a specific health problem, such as hypertension, leads to a more optimistic evaluation of health. Knowledge of the health problem may translate into better ability to cope with the problem, and therefore, a less fearful view of the condition.

Another possible explanation is that individuals shift their perceptions of their own ill health due to their inability to cope with the economic costs involved with being ill. This includes not being able to afford quality healthcare, and also the economic costs of taking time off from income-generating activities when ill. The idea that individuals change their perceptions of illness based on their ability to cope with the economic costs, has been put forward in a few papers. Grol-Prokopczyk *et al.* (2011) suggest that someone with a higher level of education is more confident in their ability to cope with illness or health impairment, thereby leading to a more optimistic evaluation of their health. Sauerborn *et al.* create a model of household coping strategies in dealing with the economic burden of illness. Strategies can broadly be divided into two categories, (1) ones that prevent costs from occurring and (2) strategies that aim to manage the financial costs once they do occur. Amongst the strategies to prevent costs from occurring (1) is the strategy to modify your perception of your illness, or to ignore it (Sauerborn *et al.* 1996a).[22]

As a result, individuals from the lower income and wealth quintiles in South Africa are not only less likely to seek care if they become sick, but are also less likely to consider themselves as ill in the first place (Havemann & Van der Berg, 2003; Burger *et al.*, 2012). If lower quintile individuals systematically underestimate their ill health, this will be reflected in the reporting of self-reported health questions, and health inequalities based on such measures will underestimate the health gap between poor and the non-poor.

Several authors have noted this phenomenon. Some have relied on health vignettes to directly examine reporting behaviour; others have provided more indirect evidence of reporting tendencies by comparing gradients, using more objective, observed measures. Bago d'Uva et al. (2008a) is an example of the first approach. Using vignettes data, they directly test for systematic reporting differences across various socioeconomic groups in India, Indonesia and China. In all three countries, they find that there are systematic differences in the reporting behaviour of the poor and the non-poor, and that the impact of income on health is underestimated if self-reported data is used. However, except for China effects are quite small. Nonetheless, they find that there is

22 Sauerborn *et al.* (1996b) found that the level of reported illness was lower during the rainy season in Burkina Faso. The severity of reported illness was also lower, and there was a shift towards home-based rather than hospital-based care. This lower rate of reported illness was present, despite the higher rates of fatalities for certain major objectively measured diseases (such as malaria) during the rainy season. Despite the fact that health needs are higher during the rainy season due to energy deficiencies and higher transmission of diseases, healthcare is utilised less during this period. The authors argue that the decreased household revenue and higher time costs during rainy season, compared to dry season, lead to cognitive (perception) and behavioural (decreased health-seeking behaviour) shifts in the demand for health. Litvack and Bodart (1993) found similar seasonal patterns in Cameroon.

reason for concern that reporting heterogeneity could lead to bias in measuring health disparities across income groups.

Bonfrer *et al.* (2014) provide indirect evidence of reporting heterogeneity using the second approach. They are concerned with measuring the "need for care", and demonstrate that there are reporting tendencies by comparing the measured degree of inequality (using concentration indices) in objective health measures (like stunting and underweight) and in self-reported health measures. In World Health Survey data from 18 countries in Sub-Saharan Africa (SSA) (including South Africa), they find much higher degrees of health inequality by wealth when using objective health measures, concluding that the use of subjective health measures leads to a severe underestimation of health disparities across income groups in SSA.

In what follows, I test for wealth-related reporting heterogeneity in self-assessed health measures in South Africa and examine its implications for measuring health inequalities. This is done using the vignettes approach, as in Bago d'Uva et al. (2008a). If reporting heterogeneity is present, and systematically associated with wealth status and race, then health disparity measurement across these subgroups may be biased.

2.4 Methodology: Anchoring vignettes and HOPITS

In the presence of reporting heterogeneity, analyses of inequalities in self-reported health face an identification problem: any measured inequalities in self-reported health represent a mix between associations with true health status and reporting heterogeneity (King *et al.*, 2004; Bago d'Uva *et al.*, 2008a). This identification problem can only be solved with additional data, either on "true" health status or on reporting behaviour.

One oft-used approach to test for reporting heterogeneity is to proxy for true health status, using more objective measures of health (Lindeboom & Van Doorslaer, 2004; Hernández-Quevedo *et al.*, 2005; Etile & Milcent, 2006). This method assumes that the proxy indicators capture all variation in true health status associated with the individual characteristics of interest, such that any remaining systematic variation in self-assessed health with these characteristics is attributable to health reporting behaviour (Kreider, 1999; Lindeboom & Van Doorslaer, 2004). The applicability of this method in household surveys is, however, problematic if the available proxy indicators are themselves self-reported, and so possibly also biased (Baker *et al.*, 2004). Truly

objective measures, like biomarkers, are often too expensive to collect in household surveys and therefore not available.

An alternative to using objective health measures is the anchoring vignettes approach. An anchoring vignette is a data collection tool that can be used to describe a fixed level of health, and used as a benchmark against which one can compare self-reported health and gauge the level of self-reported bias. In the WHO SAGE data set, a vignette consists of a description of the level of health of a hypothetical person. Since this description is fixed across individuals, all systematic variation in vignette ratings with respect to individual characteristics is attributed to reporting heterogeneity. Self-assessed (inequalities) can then be purged from this reporting heterogeneity (King *et al.*, 2004). The vignettes approach has been used to identify and correct for reporting heterogeneity in self-assessed health in studies on Asia (Bago d'Uva *et al.*, 2008a; Guindon & Boyle, 2012; Zhang *et al.*, 2015); several countries in Europe (Jürges, 2007; Bago d'Uva *et al.*, 2008b; Peracchi & Rossetti, 2012) and the USA (Dowd & Todd, 2011). In the remainder of this section, I describe in detail the data and methods used in this chapter.

2.4.1. Data

I use data representative of the South African elderly (50+) population, taken from the WHO's Study on global AGEing and adult health (SAGE). This is a multi-country study, recorded in 2008 and containing approximately 3400 observations for South Africa. The data were collected with the aim of exploring and comparing the health and socioeconomic characteristics of several low and middle-upper income country populations. Data collected include information on health status, chronic conditions, disability, life expectancy, health behaviour and healthcare utilisation(He *et al.*, 2012). Individuals aged 50 and older in 2008 grew up in the period of racial segregation prior to democratisation in 1994, which will have had a profound effect on their wealth creation and access to health services during adolescence and early adulthood. The effect of race and income on wealth and health is therefore particularly intertwined in South Africa.

2.4.1.1 Self-reported health and health vignettes

The SAGE questionnaire contains a series of questions asking respondents to rate their health in a range of domains on a scale from one to five. More specifically, respondents are asked to rate the difficulty they have performing in a specific domain, where 1= No difficulty, 2 = Mild difficulty 3= Moderate difficulty 4 = Severe difficulty 5 = Extreme difficulty. The domains include mobility, appearance, anxiety, pain/discomfort, cognitive abilities, interpersonal relationships,

sleeping/resting ability and vision. In the case of mobility, the respondent is asked how much difficulty the person had with moving around in the last 30 days. A similar question structure is applied to the other domains.[23] These dimensions are similar to the activities of daily living and physical mobility indices (Tomita & Burns, 2013) collected in other household surveys. Similar measures of health, such as depression or limitations in activities of daily living indices have been found to be highly correlated with mortality in South African data (Ardington & Gasealahwe, 2014).

In total, information on eight health domains was collected, with two levels of severity within each domain. For instance, for the domain of vision, individuals are asked about both their far-sightedness and nearsightedness. A detailed description of the 16 health aspects considered in this chapter, as well as their specific questions can be found in the Appendix Table A 2.1. Response rates for health domains by wealth status and race are available in the Appendix Table A 2.7. and A 2.10. For ease of reference, I refer to these as 16 health domains from here onwards.

Together with evaluating their own health in these domains, subsets of randomly chosen respondents are presented with a selected set of vignettes. The total sample is randomly divided into four groups, and each subset is given four vignette questions to answer. Randomly chosen set 1 had to evaluate vignettes for mobility, vigorous activity, depression and anxiety. Set 2 evaluate vignettes regarding relationships, conflict, body pain and body discomfort. Set 3 were asked to evaluate vignettes for energy, sleep, far-sight and nearsight. Finally, respondents in set 4 were asked to evaluate self-care, appearance, memory and learning vignettes. Table A 2.8. and A 2.11 in the appendix contain the response rates of these vignettes, aggregated by wealth status and race.

For each health domain, the respondent is asked to rate five different vignettes, each representing a different level of health and functionality. One example in the domain of mobility is: "Alan is able to walk distances of up to 200 metres without any problems but feels tired after walking one kilometre or climbing up more than one flight of stairs".[24] Respondents are then asked to rate the health of each of the vignettes in the respective domain, using the same one to five scale as is used in the self-assessment questions. Since the vignette is a health description that is kept fixed across

[23] The selection of domains was based on the World Health Survey (WHS), and was guided by validity in terms of intuitive, clinical and epidemiological concepts of health; correspondence to the conceptual framework of the International Classification of Functioning, Disability and Health; and comprehensiveness (Salomon *et al.*, 2003).
[24] The full description of all vignettes can be found on the WHO website http://www.who.int/healthinfo/sage/en/.

respondents, any systematic variation in the way that respondents rate the vignettes is indicative of reporting heterogeneity.

2.4.1.2 Socio-demographic variables

The covariates used in the analysis include gender, age, level of educational attainment, marital status, race and urban residence. Educational achievement is represented by a categorical variable: no education, less than primary school (Grade 6 or less), primary school completed (completed Grade 7), secondary school completed (Grade 9 completed), high school completed (Grade 12 or matric completed), college or university completed (3-4 years tertiary education) and post graduate degree completed. Marital status is also captured in five categories: never married (single and never married), married, cohabitating, separated/divorced and widowed. I account for four race categories as defined by Statistics South Africa: Black African, White, Coloured and Indian/Asian. Finally, wealth is accounted for by including four quintile dummies. The wealth variable is created using the household's durable assets, characteristics of their dwelling and whether they had access to basic services such as sanitation and water (He *et al.*, 2012). This is considered a better representation than income of a person's living standards when the sample consists of both retired and non-retired individuals (Grol-Prokopczyk *et al.*, 2011).

Table 2.1 shows the quintile distribution of covariate means. Females are more likely to be in the lower quintiles, while age is fairly equally distributed across wealth quintiles. Given that this is an older sample, females are overrepresented, possibly due to survival bias. The richer quintiles are significantly more likely to be married, urban and better educated. Predictably, race is very unequally distributed across quintiles: in the poorest quintile the great majority (94%) of respondents are in the Black African population group, while this proportion is only 42% in the richest quintile. Asian, Indian and White and urban respondents are more concentrated in the top wealth quintiles.[25]

[25] Response rates for the WHO SAGE data set aggregated by wealth quintile and race is provided in the appendix section A 2.8.

Table 2. 1: Sample averages of covariates by wealth quintile

				Quintile									
		Total	**(n)**	**1**	**(n)**	**2**	**(n)**	**3**	**(n)**	**4**	**(n)**	**5**	**(n)**
Female		0.56	3400	0.56	651	0.55	666	0.68	665	0.55	698	0.45	720
Age in years		61.33	3400	61.57	651	60.41	666	60.73	665	61.64	698	62.16	720
Education	Less than primary school	0.23	3400	0.41	651	0.33	666	0.21	665	0.15	698	0.05	720
	Primary school completed	0.22	3400	0.28	651	0.26	666	0.29	665	0.19	698	0.12	720
	Secondary school completed	0.23	3400	0.23	651	0.22	666	0.24	665	0.26	698	0.20	720
	High school completed	0.17	3400	0.07	651	0.14	666	0.20	665	0.23	698	0.20	720
	College or university completed	0.09	3400	0.02	651	0.04	666	0.04	665	0.09	698	0.25	720
	Post graduate degree completed	0.06	3400	0.00	651	0.02	666	0.03	665	0.08	698	0.18	720
Marital status	Never married	0.14	3400	0.21	651	0.16	666	0.15	665	0.13	698	0.07	720
	Married	0.50	3400	0.34	651	0.44	666	0.41	665	0.55	698	0.74	720
	Cohabitating	0.06	3400	0.11	651	0.10	666	0.04	665	0.03	698	0.01	720
	Separated/divorced	0.06	3400	0.07	651	0.07	666	0.10	665	0.03	698	0.02	720
	Widowed	0.24	3400	0.26	651	0.24	666	0.30	665	0.25	698	0.16	720
Race	Black African	0.74	2968	0.94	579	0.88	593	0.82	598	0.65	596	0.42	602
	White	0.09	2968	0.00	579	0.01	593	0.02	598	0.12	596	0.30	602
	Coloured	0.13	2968	0.05	579	0.10	593	0.13	598	0.18	596	0.20	602
	Asian/Indian	0.04	2968	0.01	579	0.01	593	0.03	598	0.04	596	0.09	602
Urban		0.65	3400	0.42	651	0.58	666	0.62	665	0.75	698	0.89	720

Notes: Statistics weighted with post-stratified individual weights

In the supplemental Appendix Table A 2.2, I compare the distribution of vignette ratings for the poorest and wealthiest quintile, for all health domains and for selected vignettes.[26] These tables illustrate the variation in the ratings of the vignette health across quintiles. For instance, for vignette 1 in the domain mobility, individuals in quintile 1 are more likely to report a person as having "severe" or "extreme" difficulty than individuals in quintile 5. The opposite is true for mobility vignettes 3 and 5.

2.4.2. Hierarchical Ordered Probit model – HOPIT

The hierarchical ordered probit model (HOPIT) as proposed by King *et al.* (2004) is used to establish reporting heterogeneity using the vignettes approach. The model is an extension of the ordered probit model and consists of two components, the *reporting behaviour equation* and the *health equation*, which are estimated jointly for efficiency (Bago d'Uva *et al.*, 2008a).

In the *reporting behaviour component* the vignettes are used to establish the cut-points of the ordinal self-assessed health variable as a function of individual characteristics. Only the data from the subset of individuals who answer the vignettes questions are used in this component. Each of these is modelled as a generalised ordered probit model, with heterogeneous cut-points (rather than assumed constant cut-points as in the standard ordered probit).

The *reporting behaviour component* uses vignette ratings in order to identify cut-points as functions of individual characteristics. Formally, suppose that H_{ij}^{v} represents the true latent level of health for hypothetical **v**ignette number **j** (j=1,…,5) for respondent **i**.[27] H_{ij}^{v} is assumed to be the same for all individuals, apart from random measurement error:

$$H_{ij}^{v} = \alpha_j + \varepsilon_{ij} \text{ with } \varepsilon_{ij}^{v} \sim N(0, \sigma_v^2) \quad (1)$$

where α_j is the objective and unvarying health condition of vignette number *j*. Equation (1) pertains to each health domain and each of the five vignettes (j = 1,2,3,4,5). This reflects the first identifying assumption of the vignette methodology: the *vignette equivalence* assumption requires that there are no systematic differences across individuals in their perceptions of the level of

[26] Due to the large number of vignettes (5 for each of the 16 domains), and to save on space, I present descriptive statistics just for vignettes 1, 3 and 5 in each domain.
[27] The superscript *v* denotes "vignette".

functioning described in the vignettes. Then the reported health relating to vignette **j** by respondent **i** is defined as RH_{ij}^{v}. The continuous latent (H_{ij}^{v}) health of the vignette is translated into the observed, categorical (RH_{ij}^{v}) variable in the following way:

$$RH_{ij}^{v} = m \; if \; s_i^{m-1} \leq H_{ij}^{v} \leq s_i^{m} \qquad (2)$$

and $m = 1, \ldots, 5, s_i^0 < s_i^1 < s_i^2 < s_i^3 < s_i^4 < s_i^5$, and $s_i^0 = -\infty, s_i^5 = \infty$

where s_i^m represents the individual-specific upper cut-points for category m. Finally, reporting heterogeneity is allowed in this model by defining the cut-points s_i^m as functions of the vector of individual characteristics X_i (which includes wealth, race and other socio-demographic variables, besides a constant term). Identification of reporting heterogeneity in this component derives from the vignette equivalence assumption, which enables the exclusion of individual characteristics from equation (1) above and, consequently, inclusion of them in the following:

$$s_i^m = X_i' \gamma^m \qquad (3)$$

A special case of this model is one with constant cut-points, i.e., no reporting heterogeneity. *Testing reporting homogeneity* according to one or a subset of variables included in X can therefore be done by testing significance of the respective (sets of) coefficients in the vectors γ^m, m=1,…,4 (since one of the categories becomes a reference category due to normalisation with estimation, m=4). These individual cut-points are estimated based on the differences between the respondent's interpretation of the vignette's state of health and the fixed health state represented by the vignette. Therefore, should the distances between the individual cut-points differ, this should now be an indication of the presence of reporting heterogeneity.

Equation (3) can be rewritten as:

$$AH_{ij}^{v} = m \; if \; X_i' \beta^{m-1}{}_j \leq H_{ij}^{v} \leq m \; if \; X_i' \beta^{m}{}_j$$

The second – *own health* – component of the HOPIT model is specified as a generalised ordered probit with variable cut-points identified by the vignettes in the *reporting behaviour* component. The

true own latent health level is typically modelled as a function of the same individual characteristics included in the cut-points:[28]

$$H_i^S = X_i'\beta + \varepsilon_i^s, \quad \varepsilon_i^s \sim N(0, \sigma^2) \tag{4}$$

Finally, similar to the vignette ratings, the own health ratings relate to own latent true level as:

$$SAH_i = m \; if \; s_i^{m-1} \leq H_i^s \leq s_i^m, \tag{5}$$

where the cut-points are as defined in equation (3) above. This equation corresponds to the *response consistency* assumption – individuals are assumed to use the same response scales when rating the vignettes and their own health. Under the two assumptions, the HOPIT model uses vignette ratings to identify and correct for reporting heterogeneity and returns associations between X_i and health that are purged of reporting heterogeneity, i.e., represented by the coefficients in the vector β in equation (4).

Evidence on the identifying assumptions of the vignette methodology is limited and shows mixed results. On vignette equivalence, see Bago d'Uva et al. (2011), Kristensen and Johansson (2008), Grol-Prokopczyk *et al.* (2011) and Rice *et al.* (2012); on response consistency, see Bago d'Uva et al. (2011), Datta Gupta *et al.* (2010), and Van Soest *et al.* (2011).

Identification of the HOPIT model specified by equations (1)-(5) further requires scale and location normalisations. I normalise σ_v^2 to 1 and α_1 to zero, with no loss of generalisation. The two components of the model are estimated jointly for efficiency (Bago d'Uva *et al.*, 2008a).

The own health component makes use of ratings of own health for the whole sample, while the reporting behaviour component uses data from the random subsamples of individuals who rate vignettes in the respective domain.

[28] Put another way, applications of the HOPIT model typically allow for, and so correct, any potential reporting heterogeneity according to all variables included in the own health equation (4).

2.5. Results

In this section I report on the results from applying the HOPIT model to self-reported health data among elderly South Africans and the extent to which this group might be affected by different reporting tendencies across sub-populations. Firstly, I focus on wealth-related health inequalities, which are expected to be substantial given the large economic inequalities which resulted from the apartheid regime (Özler, 2007). In the first two sections, I address the question: does reporting heterogeneity cause an underestimation of health inequalities by wealth in South Africa (Sections 2.5.1 and 2.5.2)? Since wealth inequality emanated from a regime that enforced the separation of race groups to the advantage of the White population, I aim to gain a deeper understanding of wealth-related health inequalities by exploring the role of race. To this end, I use in the following sections a more complete specification, to analyse in greater detail the health-wealth associations within race groups (Section 2.5.3), as well as health-race associations among equally wealthy individuals (Section 2.5). In the latter, I focus on the Black African versus White population groups, because of the enduring overlap between race and patterns of privilege and poverty, with the lion's share of the poor being Black African and White South Africans being predominantly affluent.

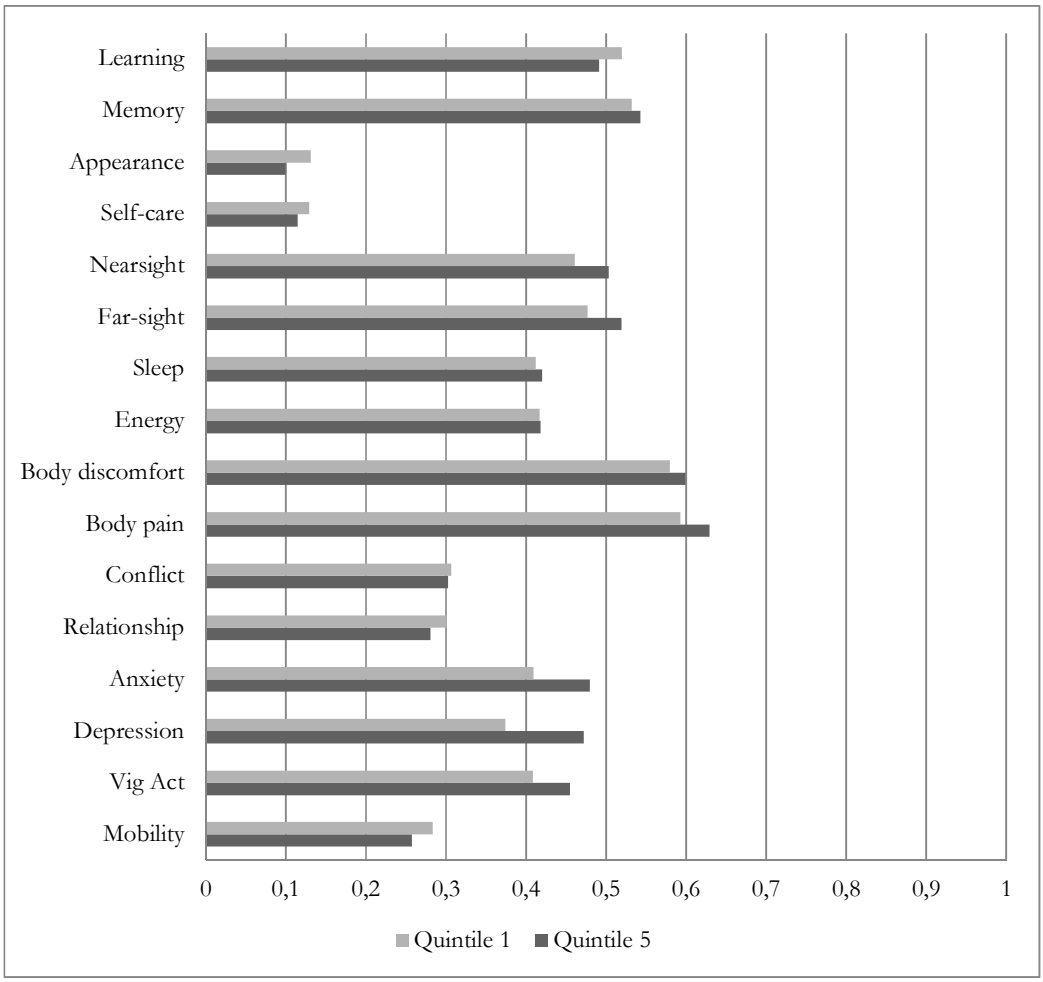
I apply both specifications of the HOPIT model to vignettes and self-reported health ratings in the 16 domains described above. I use these estimated models by domain to: (a) test for reporting heterogeneity and (b) to estimate health inequalities (un)corrected for reporting heterogeneity (more detail about all of these procedures will be given below). By comparing corrected with uncorrected health inequalities, I am able to assess the importance and the direction of any reporting bias (Tandon *et al.*, 2002; King *et al.*, 2004; Rice *et al.*, 2012).

2.5.1 Inequalities in self-reported health by wealth

I start with a naïve analysis of inequalities in self-reported health by wealth, ignoring any reporting heterogeneity. This uses a standard ordered probit model with constant cut-points, with the covariates wealth, race, age, gender, marital status, urbanisation and educational achievement. I use this model to predict the probability that an individual reports any difficulty in the respective health domain (i.e., categories 2, mild difficulty, to 5, extreme difficulty). Figure 2.3 shows average probabilities for the poorest (Q1) and wealthiest (Q5) groups of the population, for all health

domains.[29] I see very small differences between the levels of self-reported difficulties of these groups. For certain domains, such as difficulty with vigorous activity, depression, anxiety, body pain, discomfort, sight and memory, the wealthier report even *more* difficulties than the poor. Taking these self-reports at face value would lead to the overall conclusion that there is little or no health disadvantage for poor South Africans, compared to their richer counterparts. In the next subsection, I examine whether these patterns may be related to reporting biases or tendencies.

Figure 2. 3: Probability of reporting any difficulty (mild to extreme) before correcting for reporting bias



Source: WHO SAGE, 2008

2.5.2 Inequalities in health by wealth, corrected for reporting heterogeneity

I now extend the analysis of inequalities in health by wealth, by relaxing the assumption of reporting homogeneity, making use of vignettes data and the HOPIT model, for each of the 16

[29] These are the predicted probabilities from an ordered probit model, conditional on the aforementioned covariates.

domains. I keep the same covariates as in the previous section. The focus is on health inequalities and reporting heterogeneity by wealth but my specification allows for heterogeneity according to *all* covariates (equation (3) of the HOPIT model defined above). I present the results for the poorest (Q1) relative to the richest (Q5), to illustrate and highlight the differences between the two extremes in the wealth distribution in South Africa.

The reporting (or vignette) component of the HOPIT model enables a direct test of the presence of reporting heterogeneity: I test the null hypothesis that cut-points of individuals in Q5 are the same as those in Q1, conditional on the remaining covariates. Table 2.2 presents p-values of this test by health domain, as well as the results from the *reporting behaviour* of the HOPIT model, namely the evaluation of the vignettes. The table shows the position of the cut-points between the categorical options of the vignettes for individuals in Q1 relative to individuals in Q5. For instance, the positive and significant coefficient for cut-point 1 in the domain mobility can be interpreted as individuals in Q1 having a significantly higher cut-point than those in Q5 between the categories "none" and "mild" health difficulties. This is similar to the example explained in Figure 2.2, and shows that given a level of health of the vignette H_{ij}^{v}, individuals in Q1 are systematically more likely to assess the vignette as having no ("none") health problem in the domain "mobility" than individuals in Q5, indicating an optimism in their health evaluation.

I can test whether this reporting behaviour is systematic across cut-points by testing the null hypothesis that cut-points of individuals in Q5 are the same as those in Q1, conditional on the remaining covariates. This is a test of the equality of the respective coefficients in the vectors γ^{m} (m=1,…,4) in equation (3).[30]

At a 10% significance level (p-values in bold text if they are significant at a 10% significance level), I can reject the null hypothesis that the wealthiest and the poorest use the same cut-points, in 10 of the 16 health domains.

[30] In practice, since quintile 5 is the wealth reference category in my model, this corresponds to testing the significance of the coefficient of quintile 1, jointly across the four cut-points.

Table 2. 2: Tests of reporting homogeneity between wealth quintile 1 and wealth quintile 5, by health domain (p-values)

		Cut-point 1: None vs. Mild	Cut-point 2: Mild vs. Moderate	Cut-point 3: Moderate vs. Severe	Cut-point 4: Severe vs. Extreme	P=values for homogeneity
Q1 relative to Q5						
	Mobility	0.277***	0.267***	0.278***	0.0909	**0.032**
		(0.102)	(0.0987)	(0.0967)	(0.113)	
	Vigorous Activity	0.190*	0.169*	0.137	0.145	0.345
		(0.107)	(0.100)	(0.0943)	(0.0999)	
	Depression	0.288***	0.121	0.133	0.144	**0.037**
		(0.106)	(0.0976)	(0.0912)	(0.109)	
	Anxiety	0.185*	0.0916	0.146	0.0809	0.334
		(0.109)	(0.0990)	(0.0927)	(0.108)	
	Relationship	0.201*	0.111	0.317***	0.0349	**0.003**
		(0.105)	(0.101)	(0.0944)	(0.106)	
	Conflict	0.224**	0.259**	0.328***	0.129	**0.022**
		(0.109)	(0.105)	(0.0991)	(0.106)	
	Body pain	0.265**	0.0575	0.156*	0.247*	**0.016**
		(0.103)	(0.0918)	(0.0925)	(0.127)	
	Body discomfort	0.236**	0.144	0.153*	0.239*	**0.085**
		(0.103)	(0.0917)	(0.0929)	(0.126)	
	Energy	0.0566	0.0818	0.155*	0.105	0.448
		(0.101)	(0.0918)	(0.0830)	(0.114)	
	Sleep	0.0187	0.0551	0.119	0.0490	0.650
		(0.0900)	(0.0851)	(0.0829)	(0.132)	
	Far-sight	0.329***	0.196**	0.171*	0.195*	**0.003**
		(0.0916)	(0.0886)	(0.0877)	(0.104)	
	Nearsight	0.348***	0.114	0.175**	0.228**	**<0.001**
		(0.0937)	(0.0894)	(0.0869)	(0.101)	
	Self-care	0.392***	0.316***	0.0726	-0.146	**0.002**
		(0.109)	(0.102)	(0.106)	(0.120)	
	Appearance	0.420***	0.319***	-0.0234	-0.163	**<0.001**
		(0.110)	(0.103)	(0.109)	(0.119)	
	Memory	0.203**	0.110	-0.0117	0.0793	0.184
		(0.0971)	(0.0918)	(0.0942)	(0.133)	
	Learning	0.122	0.0830	0.0673	0.0724	0.788
		(0.0984)	(0.0941)	(0.0942)	(0.125)	

***p<0.01, **p<0.05, *p<0.1
Note: P-values in bold text if they are significant at a 10% significance level
Standard errors in parenthesis.
Source: WHO SAGE, 2008

Given the presence of reporting heterogeneity, self-reported data and, consequently, estimated health inequalities by wealth are likely to be biased. The *own health* component of the HOPIT model uses the cut-points identified in the *reporting behaviour component*, equation (3), and returns associations between wealth (and other covariates) and true latent health status that are purged of reporting heterogeneity, equation (4). I then use these results of the HOPIT model to estimate and compare health inequalities corrected/uncorrected for reporting heterogeneity.

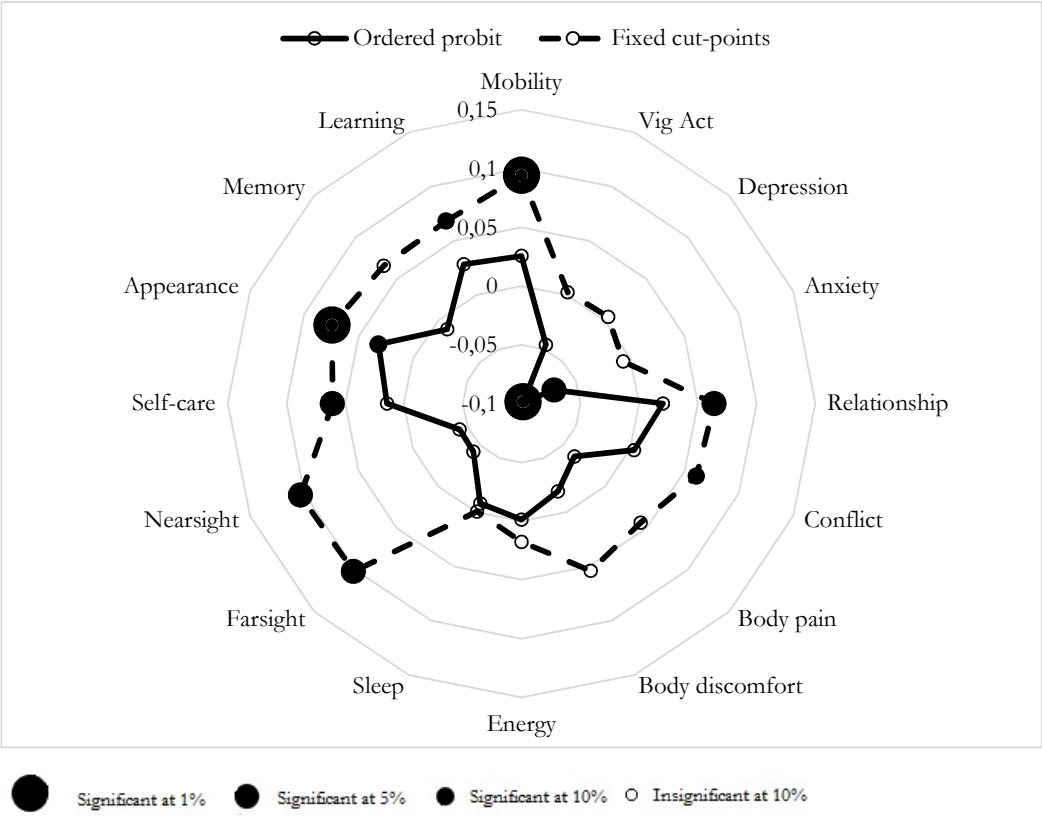
The measure of wealth-related health inequality that I present here is the average marginal effect of belonging to Q1 vs Q5 on the probability of having any difficulty (i.e., categories 2 "Mild difficulty" to 5 "Extreme difficulty"), keeping the other covariates fixed.[31] For each domain, I compute the average marginal effect on that probability: (a) using individuals' own cut-points – that is, uncorrected for reporting heterogeneity – and (b) imputing the same fixed cut-points across individuals – and so correcting for reporting heterogeneity. The fixed cut-points are those of a reference individual (an unmarried Black male; quintile 1 wealth; aged 62, the average age in the sample; who did not complete primary school; and lives in a rural area). Given the nonlinearity of these probabilities, the choice of the reference individual will have some influence on the magnitude of the marginal effects but not on the sign of the correction, nor on the significance.

To summarise the large number of estimates generated by this procedure in a concise graphical way, the results obtained are depicted in Figure 2.4 for all health domains in a sort of "radar graph" (with estimates detailed in Appendix Table A 2.3). In the radar graph, the solid black line depicts the marginal effects before correcting for reporting heterogeneity, and the dashed black line depicts the marginal effects after correcting for reporting heterogeneity. For instance, for the domain of "depression", individuals in Q1 are 10 percentage points less likely to report any difficulty than individuals in Q5, keeping other variables fixed. Applying the same cut-points for all individuals, I estimate that individuals in Q1 are, on average, approximately 0.4 percentage point more likely to have any difficulty in this domain than their Q5 counterparts. Therefore, correcting for reporting heterogeneity makes clear that the difference in the average probability of having any difficulty between poorest and wealthiest in this domain was underestimated by about ten percentage points. The graph shows that across all health domains, the health gap by wealth grows after reporting correction.

[31] I follow the usual terminology by referring to the magnitudes of the associations of health with covariates as marginal effects, even if these should not be interpreted as causal effects.

One could consider the area within the graph as the degree of illness reported, before and after correction. Before correction, the poorest are not statistically significantly more likely to report health problems in any health domain except appearance, despite probably being more likely to have them. However, in 8 of the 16 domains (mobility, relationship, conflict, far-sightedness, nearsightedness, self-care, appearance and learning), the health by wealth gap only becomes significant (at a 10% level) after controlling for systematic reporting differences. Moreover, the only instances of statistically significant reverse gaps (the rich reporting greater difficulties in the mental health domains depression and anxiety) disappears after correction. These results clearly demonstrate the risk that wealth-related health inequalities can be substantially underestimated when using uncorrected self-reported health measures.

Figure 2. 4: Average marginal effects of being in Q1 on reporting any difficulty in health relative to being in Q5



2.5.3 Inequalities in health by wealth, within race groups

In order to further unravel the complex relationships between race, wealth, health and health reporting, I now turn to a more complete specification. In this subsection, I examine the race-specific health-wealth associations, focusing on the Black African population group. Specifically,

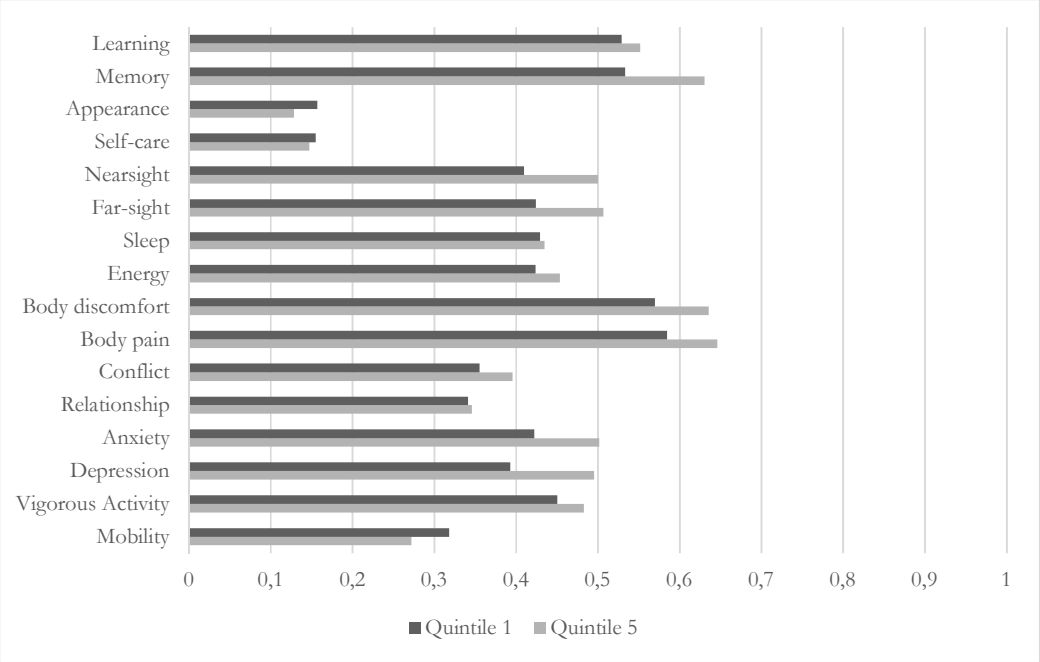
I consider the difference in reporting between the wealthiest (quintile 5) and poorest (quintile 1) individuals in the Black African population group. For this part of the analysis, wealth quintiles are established within the population group. The decision to focus solely on the Black African population group is due to the small sample size when within-population group quintiles are calculated for the other population groups.

The remaining covariates age, gender, education, marital status and degree of urbanisation, are defined as above. Again, I estimate, for each health domain: (a) a standard probit model that does not allow for reporting heterogeneity and (b) a HOPIT model including all the covariates in the own health equation and in the cut-points, and so allowing and correcting for reporting heterogeneity according to all of them.

Figure 2.5 presents average estimated probabilities of reporting any difficulty (mild to extreme) by wealth category, for the Black African population. These are the predicted probabilities calculated after regressing individual own health ratings onto the set of covariates using an ordered probit model. I find that the wealthiest (Q5) Black African population often reports *worse* health than the poorest Black African population (Q1).[32] Only in the health domains of appearance, self-care and mobility do I find that the poor report having more difficulty than the wealthiest population.

[32] These are the predicted probabilities from an ordered probit model, conditional on the aforementioned covariates.

Figure 2. 5: Average probability of reporting any difficulty (mild to extreme) before correcting for reporting bias: Black African population



Source: WHO SAGE, 2008

I now use the reporting behaviour equation (3) of the HOPIT model to formally test for reporting heterogeneity across these wealth categories in the Black African population group (results shown in Table 2.3 below). I reject the null hypothesis that Black African Q1 respondents use the same cut-points as Black African Q5 respondents, for no less than 14 of the 16 domains. It is only in the health domains relating to energy and sleep that I was unable to reject reporting homogeneity at a 10% level.

Table 2. 3: Tests of reporting homogeneity across wealth quintiles, for the Black population, by health domain (p-values)

Health domain	Black African and Q1 (vs Black African and Q5)
Mobility	**0.0042**
Vigorous Activity	**0.0064**
Depression	**0.0023**
Anxiety	**0.0014**
Relationship	**<0.001**
Conflict	**<0.001**
Body pain	**0.0570**
Body discomfort	**0.0411**
Energy	0.8705

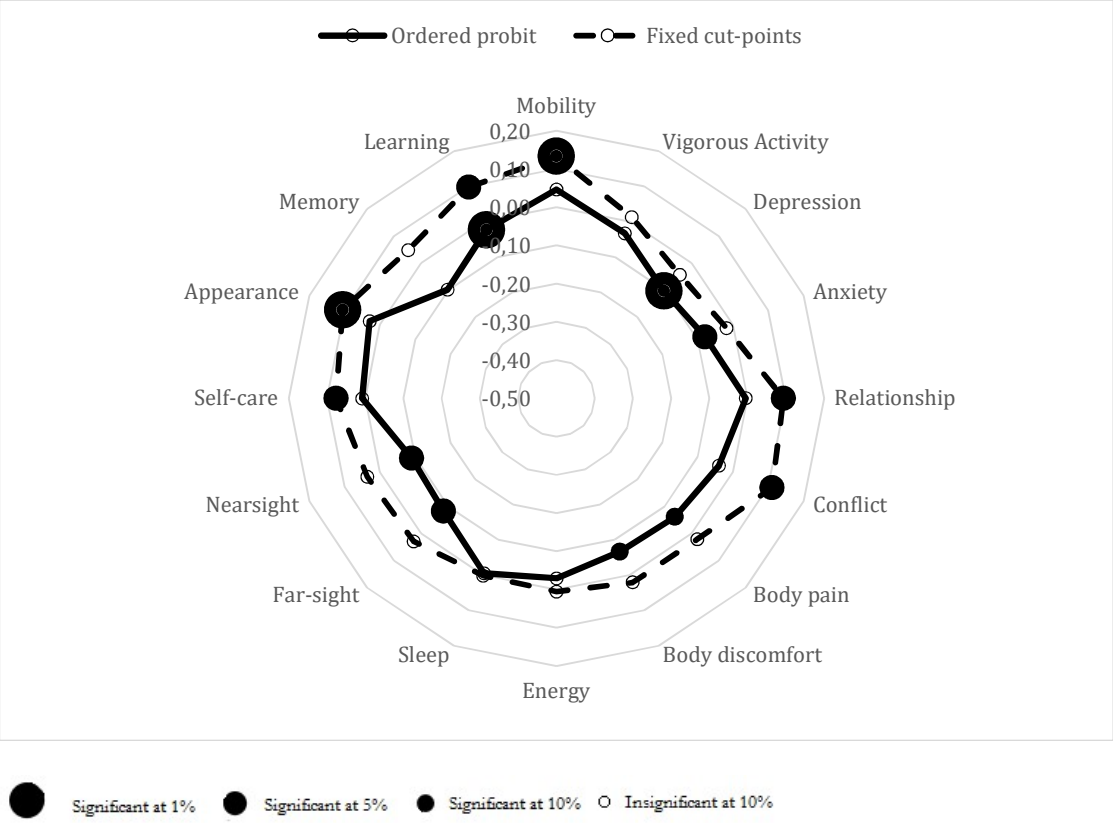
Sleep	0.7814
Far-sight	**0.0197**
Nearsight	**0.0002**
Self-care	**0.0038**
Appearance	**<0.001**
Memory	**<0.001**
Learning	**0.0028**

Note: P-values in bold text if they are significant at a 10% significance level
Source: WHO SAGE, 2008

As in the previous section, but now for the Black African population only, I use the HOPIT model to estimate health by wealth gaps purged of reporting heterogeneity and compare them to the uncorrected gaps. Again, I measure these using the average marginal effects of wealth on the probability of having any difficulty in a given health domain. Vignette-corrected probabilities are calculated using the cut-points of the reference individual (an unmarried Black African male; aged 62, the average age in the sample; who did not complete primary school; and lives in a rural area) for all individuals. The direction and size of the biases are illustrated in Figures 2.6 (comparing quintiles 1 and 5) and detailed results can be found in Appendix Table A 2.4.

Figure 2.6 shows that, across all health domains, the health by wealth gap becomes (much) larger once I control for reporting differences. That is, after controlling for reporting heterogeneity, it becomes clear that the direction of the bias was to the disadvantage of the poor: Reporting heterogeneity lead an underestimation of health disparities between the poor and the non-poor. For instance, I see that the poor Black African were 10 percentage points *less* likely than the rich Black Africans to report difficulty with memory before correction. After correction, they are 5 percentage points *more* likely to do so. The size of these shifts range from 0.7 percentage points (sleep) to 15.1 (conflict) percentage points, with an average of 8.5 percentage point shifts across domains. In certain domains, such as sleep and energy (where reporting homogeneity could not be rejected), heterogeneity correction simply leads to the removal of the health disadvantage of rich versus poor. In two health domains, namely depression and anxiety, the poor still report worse health outcomes compared to the rich. However, the size of the negative effect decreases by after applying the vignettes.

Figure 2. 6: Average marginal effects of being in Q1 on the probability of reporting any difficulty, relative to being in Q5 – Black African population



2.5.4 Inequalities in health by race, within top quintile

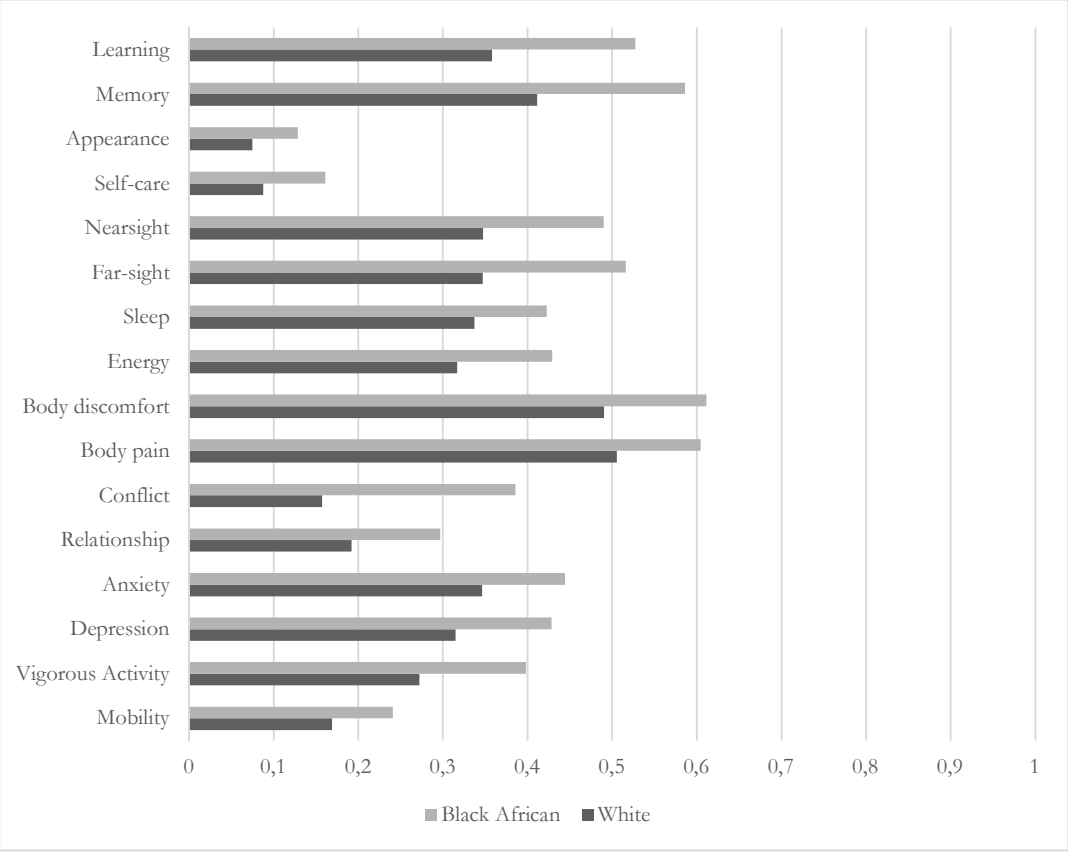
Reporting bias in the measurement of wealth-related health inequalities is evident from the first model specification (Sections 2.5.1 and 2.5.2). The second specification suggests that this trend is particularly applicable for the Black African population, with the poorest categories likely to underreport health problems relative to the richest Black Africans (Section 2.5.3). The Black African poor have worse actual health outcomes (Section 2.5.3). One question that remains is: how does the health of the historically disadvantaged Black population compare to that of the White population, in an era of decreasing economic segregation between races? I address this question by comparing health (reporting) of equally wealthy Black Africans and Whites, using the same models as in Section 2.5.3.

One major difference between the analysis in section 2.5.3 and the analysis in this section is that I use wealth quintiles for the sample as a whole in this section. In section 2.5.3, within-population group quintiles were used.

Another adjustment to this section, is that I add the continuous permanent income variable as an additional covariate to the analysis. The permanent income variable is added in order to control for the possible differences in the distribution of wealth by race group within each quintile.

As in previous sections, Figure 2.7 compares average probabilities of reporting some difficulty, estimated using a standard – homogenous reporting – ordered probit model. Across *all* domains, Black African wealthy individuals report on average worse levels of health than the White wealthy individuals. This is similar to the findings from Ardington and Gasealahwe (2014) and Lau and Ataguba (2015), who find that the Black African population have worse levels of general self-reported health than the White population. These differences are particularly large in the health domains learning and memory, and domains related to sight (far- and nearsightedness). In these domains, the affluent Black African population group report experiencing 17.4, 17.0, 16.9 and 14.2 percentage points higher levels of difficulty compared to the White population group.

Figure 2. 7: Average probability of reporting any difficulty (mild to extreme) before correcting for reporting bias for Black Africans and Whites: Q5



Source: WHO SAGE, 2008

The following results, however, suggest that this relationship between race and health amongst the rich might be biased. There is clear evidence of reporting differences, with reporting homogeneity significantly rejected in 11 of the 16 health domains (Table 2.4).

Table 2. 4: Tests of reporting homogeneity across race groups – White and quintile 5 vs Black and quintile 5 – by health domain (p-values)

Health domain	p-value	Health domain	p-value
Mobility	0.4068	Energy	**<0.001**
Vigorous Activity	0.8259	Sleep	**0.0002**
Depression	0.2280	Far-sight	**0.0254**
Anxiety	**0.0287**	Nearsight	**0.0010**
Relationship	**0.0283**	Self-care	**0.0171**
Conflict	**0.0577**	Appearance	**0.0212**
Body pain	0.3948	Memory	**<0.001**
Body discomfort	0.3749	Learning	**0.0023**

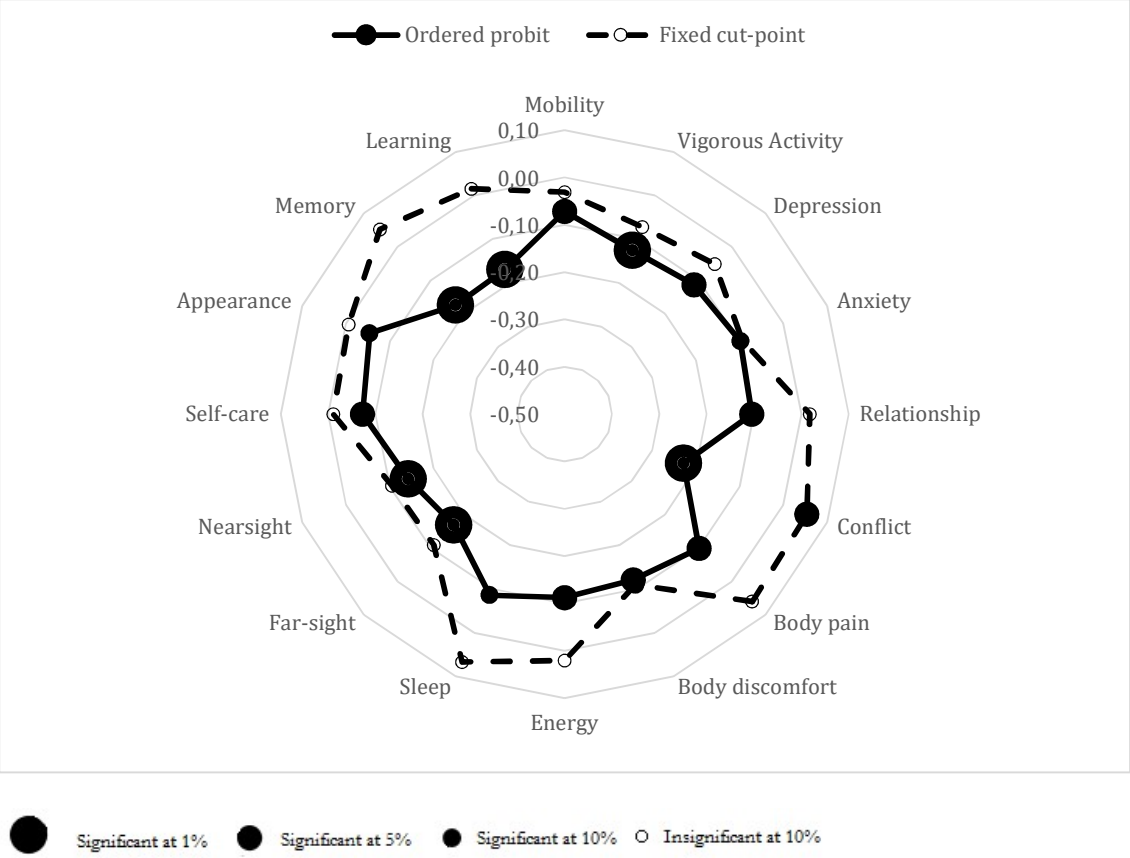
Note: P-values in bold text if they are significant at a 10% significance level. Source: WHO SAGE, 2008

Figure 2.8 shows the marginal effects of being Black and rich vs White and rich on the probability of reporting (being in) poor health: prior to controlling for reporting heterogeneity, Black African individuals are significantly more likely to report poor health than Whites.[33] Once fixed cut-points are applied, those health gaps are too extent removed or vastly shrunk. The direction of the correction is the same across all health domains: once vignettes are applied, the racial gap between the richest Black African and White population groups are minimized. The size of these shifts range from 0.5 percentage points (anxiety) to 28 percentage points (conflict), with an average of 10.3 percentage point shifts across domains.

Although the White population still shows better levels of health across most domains, the differences become much smaller and loses almost all significance.

[33] The set of marginal effects are available in the Appendix Table A 2.5.

Figure 2. 8: Average marginal effects of being White on reporting any difficulty in health, relative to being Black African: Q5



2.6 Discussion

Examination of general health differences cannot simply rely on the measurement of biomarkers and will always have to rely to a considerable extent on asking respondents to rate their health perceptions and experiences. Measurement error in the answers to such questions can lead to substantial bias if reporting tendencies are systematically associated with characteristics of interest, like wealth and race. In this research I make use of anchoring vignettes and HOPIT modelling to test and correct for such systematic reporting biases by wealth and race in a representative sample of elderly South Africans. The findings are as follows.

First, for most health domains (10 out of 16), the hypothesis of reporting homogeneity by wealth (and thus race) is rejected. Rich (Q5) South African elderly rate the same health state descriptions as worse than their poor counterparts (Q1). This leads to a severe underestimation of health gaps by wealth: observed poor-rich health disparities are small and insignificant for all domains, except two (depression and anxiety) for which it is even significantly in favour of the poor.

Secondly, after correcting for these tendencies, substantial disparities between rich (Q5) and poor (Q1) emerge, all favouring the rich and significant for half (8 of 16) of the health domains rated. But race is obviously very unequally distributed across wealth quintiles and may play some role in this. Therefore, third, and given the interrelatedness of race and wealth, I examine health disparities by wealth *within* race groups. Unfortunately, due to data limitations, my analysis is limited to the Black African population group. A similar picture emerges: also within this race group, reporting is heterogeneous and health gaps by wealth are severely underestimated when using observed, uncorrected reports. In the Black African race group, health disadvantages among the poorest (Q1) compared to the richest (Q5) always become larger and often significant after correction. Finally, I look at health disparities by race within wealth groups, which can only be done for the top quintile. Interestingly, a very different finding emerges here: before reporting correction, Black Africans report more difficulties than Whites in *every* health domain. But reporting homogeneity is also significantly rejected for most (11 out of 16) health domains: The Black African rich are much more likely to rate the same vignettes as lower health than rich Whites. Correction for these biases vastly minimises these disparities by race: Black Africans are only significantly more likely to experience more body discomfort. In other words: at similarly high wealth levels, no substantial health differences by race remain.

These findings have important implications. They suggest that inequalities in health by wealth or race can be severely under- or overestimated if reporting tendencies are not taken into account. Given the dramatic inequalities in wealth in the country, it would indeed be surprising if health were not similarly unequally distributed. But clear health inequality favouring the wealthier nonetheless only emerges after the differential health reporting between richer and poorer is accounted for. It is not clear whether anchoring vignettes are sufficient to remove all of the bias, but at least the correction is in the direction to be expected given the widely socioeconomic inequalities in "harder" health outcomes like survival and disability. I also find evidence of an overestimation of health disparities by race among the wealthiest: after correction of reporting tendencies, Black Africans are not found to be in worse health than White individuals. These results seem to suggest that amongst the more affluent population, racial differences in health have become negligible. However, I was only able to perform this analysis for the top wealth quintile, meaning that the result is only applicable at quite a high level of wealth and income.

A limiting factor of these findings is the fact that the data is only representative of South Africans aged 50 and older. Therefore, one should be careful in generalising the results from this chapter to the entire South African population. Individuals aged 50 and older grew up in a period of racial

segregation prior to democratisation in 1994, which would have had a profound effect on their wealth creation and access to health services during adolescence and early adulthood.

There are various mechanisms through which age may bias the results. Age may bias an individual's acceptance of their health condition. For instance, Tomita and Burns (2013) find that the relationship between depression and disability in the South African population aged 65 and older weakens with age. Factors which may affect this relationship is the aforementioned acceptance of depression and poor health as a result of older age (Sarkisian *et al.*, 2003), or the bias of healthcare professionals or community members for the elderly to accept the deterioration of their health (both physically and mentally).

Although this research points to the limitations of using self-assessed health measures from household survey data, valuable insights can still be drawn from self-assessed measures as they provide insights into the respondent's experience and perceptions of illness which should not be dismissed. These perceptions can often be a predictor of an individual's health-seeking behaviour and actions (Johnston *et al.*, 2009). However, drawing conclusions about national levels of inequalities in morbidities using self-assessed data can lead to the wrong conclusions (Sen, 2002b).

Does this mean that all health surveys should include health vignettes from now on? This recommendation may be premature, as there is still enough room for improvement to the anchoring vignettes methodology (when tested, its assumptions are often rejected) and not in every situation will the observed differences be as large and systematic as observed in this elderly South African population. But in populations with important socioeconomic and cultural differences (like SA), it does indeed seem wise to include the possibility to test for reporting tendencies. And they are less expensive to collect than biomarker data from blood tests or something other which, by definition, can only measure very specific aspects of (physical) health. Definitely, further research on the usefulness of vignettes is required, both on testing the underlying identifying assumptions of response consistency and vignette equivalence as on its optimal implementation (Hopkins & King 2010; Grol-Prokopczyk *et al.* 2011).

There is a large body of literature applying the vignettes methodology, and only a few research articles focused on improving the methodology. One topic for future research is the ideal number of vignettes to include in a survey questionnaire. The number of vignettes included in the WHO SAGE data set seems cumbersome and at times superfluous. The large number of vignettes translates into respondents randomly being divided into groups and only receiving a certain set of

vignettes to answer. As a result of this incomplete set, a parametric approach has to be used to estimate and correct for the reporting bias. This limits the versatility of what can be done with self-assessed health measures after correcting for reporting heterogeneity (Grol-Prokopczyk *et al.* 2011).

Another way of possibly improving vignettes design and responses is via their position in the questionnaire. Although vignettes are currently positioned after asking the self-assessment questions, there are arguments to be made for positioning them before self-assessment questions. This relates to the priming of the respondent for answering the question (Hopkins & King, 2010; Grol-Prokopczyk *et al.*, 2011).

The findings are also important from a policy perspective. Several authors have argued that the benefits of health services should be distributed within a country by healthcare need, as opposed to their ability to pay (Wagstaff & Doorslaer, 1998; McIntyre & Ataguba, 2011). This concept is referred to as social solidarity, and is one of the core building blocks of universal health coverage (Mills *et al.*, 2012). The second underlying concept of a feasible universal coverage system is that those with greater health needs should benefit most from the healthcare system.

If the poor are underreporting their ill health, their health needs will go unrealised and unmet. Since financing of the proposed National Health Insurance (NHI) is to be based on a model of cross-subsidisation from those who can afford to pay for healthcare to those who cannot afford to pay for healthcare, then an underestimation of the health needs of those who cannot afford to pay ("non-contributing individuals") will decrease the sustainability of the NHI financially. Establishing the true health needs of vulnerable subgroups is becoming increasingly important with the planning of the NHI.

These results are indicative that health inequalities measured on uncorrected self-assessed data are likely to be under-capturing the gap between poor and non-poor health outcomes. This not only includes the ordinal SAH question, but also self-assessed acute and chronic conditions, or components of the "activities of daily life" index.[34]

To conclude, reporting tendencies (possibly caused by information asymmetries, differences in

[34] Another way to see how the ill health of the poor is underreported in self-assessed health measures, is to compare it to more objectively measured indicators of health (Baker *et al.*, 2004; Johnston *et al.*, 2009; Bonfrer *et al.*, 2014). I do a short analysis of this using the SAGE data in the Appendix Section A 2.7.

comparison groups or self-censoring of health needs) bias self-assessed health measures by wealth and race groups. In this analysis I showed that vignettes can to an extent be used to correct for these reporting biases. After applying the vignettes, health gaps between the richest and poorest quintiles become larger. However, across population groups, closing the wealth gap also leads to the closing of the racial health gap. This is important since it holds the promise that the reduction in wealth inequality will contribute to a reduction in health inequality (Adler & Newman, 2002)

Appendix to Chapter 2

Table A 2. 1: Summary of health domains in WHO SAGE data

Domain	
Mobility	Overall in the last 30 days, how much difficulty did you have with moving around?
Vigorous activities	Overall in the last 30 days, how much difficulty did you have in vigorous activities ("vigorous activities" require hard physical effort and cause large increases in breathing or health rate)?
Depression	Overall in the last 30 days, how much of a problem did you have with feeling sad, low or depressed?
Anxiety	Overall in the last 30 days, how much of a problem did you have with worry or anxiety?
Relationships	Overall in the last 30 days, how much difficulty did you have with personal relationships or participation in the community?
Conflict	Overall in the last 30 days, how much difficulty did you have in dealing with conflicts and tensions with others?
Body pains	Overall in the last 30 days, how much of bodily aches or pains did you have?
Body discomfort	Overall in the last 30 days, how much bodily discomfort did you have?
Energy	Overall in the last 30 days, how much of a problem did you have due to not feeling rested and refreshed during the day (for example, feeling tired, not having energy)?
Sleep	Overall in the last 30 days, how much of a problem did you have with sleeping, such as falling asleep, waking up frequently during the night or waking up too early in the morning?
Far-sighted	In the last 30 days, how much difficulty did you have in seeing and recognising an object or a person you know across the road (from a distance of about 20 meters)?
Nearsighted	In the last 30 days, how much difficulty did you have in seeing and recognising an object at arm's length (for example, reading)?
Self-care	Overall in the last 30 days, how much difficulty did you have with self-care, such as bathing/washing or dressing yourself?
Appearance	Overall in the last 30 days, how much difficulty did you have in taking care of and maintaining your general appearance (for example, grooming, looking neat and tidy)?
Memory	Overall in the last 30 days, how much difficulty did you have with concentrating or remembering things?
Learning	Overall in the last 30 days, how much difficulty did you have in learning a new task?

Source: WHO SAGE, 2008

Table A 2. 2: Relative frequencies of ratings of vignettes 1, 3 and 5, for each health domain, and for wealth quintiles 1 (poorest) and 5 (wealthiest)

	Vignette 1		Vignette 3		Vignette 5				Vignette 1		Vignette 3		Vignette 5		
	Q1	Q5	Q1	Q5	Q1	Q5	N		Q1	Q5	Q1	Q5	Q1	Q5	N
Mobility							**866**	**Sleep**							
None	40.87	39.66	6.84	6.62	6.87	1.69		None	1.04	4.82	7.92	9.56	89.20	79.55	892
Mild	21.50	24.28	14.64	7.94	4.10	0.14		Mild	23.13	21.66	9.18	12.11	5.77	15.12	
Moderate	27.06	29.42	44.97	38.79	2.43	0.09		Moderate	26.69	28.81	34.30	26.57	1.22	3.63	
Severe	8.06	6.63	27.12	33.74	19.34	27.95		Severe	43.19	39.10	43.73	49.53	3.57	1.21	
Extreme	2.51	0.00	6.44	12.90	67.25	70.13		Extreme	5.95	5.62	4.87	2.23	0.24	0.50	
Vigorous activity								**Energy**							
None	31.88	20.58	3.89	4.35	5.25	1.69	866	None	5.91	5.13	1.31	8.07	92.95	80.27	892
Mild	30.53	28.90	7.83	7.64	0.00	0.00		Mild	5.68	10.78	6.49	8.32	2.05	15.81	
Moderate	19.02	33.85	40.03	20.98	5.19	0.09		Moderate	35.68	38.16	34.91	22.69	1.11	2.21	
Severe	16.05	16.02	36.59	46.97	17.79	25.43		Severe	45.68	36.04	50.87	50.88	3.29	1.21	
Extreme	2.51	0.65	11.67	20.06	71.77	72.78		Extreme	7.05	9.89	6.42	10.04	0.61	0.50	
Depressed								**Far-sightedness**							
None	0.47	1.26	0.63	2.39	8.19	2.36	866	None	39.05	27.72	2.81	2.24	3.06	0.98	892
Mild	7.98	15.56	7.60	1.80	0.00	0.19		Mild	29.98	36.12	6.56	8.87	0.39	2.68	
Moderate	43.62	43.54	18.87	4.63	8.79	1.89		Moderate	25.44	26.07	33.86	22.64	4.94	7.67	
Severe	43.01	37.42	52.90	60.04	40.55	39.46		Severe	5.11	5.58	45.66	53.82	26.01	38.42	
Extreme	4.93	2.21	20.00	31.13	42.47	56.11		Extreme	0.43	4.52	11.11	12.44	65.60	50.26	
Anxiety								**Nearsightedness**							
None	0.47	2.01	0.63	1.91	7.29	5.02	866	None	27.17	21.09	1.99	2.34	3.39	1.95	892
Mild	5.40	13.04	6.82	2.13	0.00	0.70		Mild	35.54	30.10	15.64	5.66	0.00	2.68	
Moderate	20.28	24.14	15.20	4.27	7.36	3.77		Moderate	25.25	36.82	32.51	27.04	3.82	8.08	
Severe	68.50	57.37	50.49	57.88	35.50	38.13		Severe	9.79	9.06	36.43	47.12	25.29	32.73	
Extreme	5.35	3.45	26.86	33.82	49.84	52.37		Extreme	2.25	2.93	13.44	17.84	67.51	54.56	
Relationships								**Self-care**							
None	35.81	24.30	11.59	3.14	93.54	87.40	822	None	29.20	20.42	28.70	34.32	1.87	0.15	820
Mild	11.16	11.23	2.21	7.48	3.85	6.16		Mild	35.01	21.61	33.59	28.99	1.64	1.91	
Moderate	36.85	34.48	22.25	14.93	0.83	3.63		Moderate	25.07	53.49	16.26	24.32	0.94	0.68	
Severe	15.49	23.39	54.88	55.95	0.91	1.73		Severe	10.65	2.88	18.79	12.37	19.91	19.37	
Extreme	0.70	6.59	9.06	18.50	0.86	1.09		Extreme	0.07	1.60	2.67	0.00	75.65	77.89	
Conflict								**Appearance**							
None	48.85	55.93	7.37	1.15	95.38	84.04	822	None	28.65	19.52	33.47	34.31	1.96	0.15	820
Mild	10.50	6.77	2.34	1.41	1.03	5.99		Mild	28.36	22.38	22.20	30.12	0.63	0.88	
Moderate	28.69	26.95	12.14	18.79	1.82	4.79		Moderate	35.94	51.28	19.14	25.88	6.01	3.53	
Severe	11.42	10.24	62.98	55.39	0.91	4.08		Severe	6.03	6.82	22.15	9.70	11.06	14.38	
Extreme	0.53	0.10	15.17	23.25	0.86	1.09		Extreme	1.01	0.00	3.04	0.00	80.34	81.06	
Body pain								**Memory**							
None	0.33	0.02	0.18	1.04	1.69	1.83	822	None	3.68	2.64	34.73	35.69	1.77	1.10	820
Mild	5.47	3.64	18.75	25.06	0.20	0.38		Mild	24.08	18.49	39.52	42.73	2.84	1.24	
Moderate	29.78	21.02	61.57	45.63	2.51	4.16		Moderate	44.14	58.12	17.72	15.81	14.16	18.27	
Severe	60.81	59.31	19.13	25.99	51.78	38.97		Severe	26.44	20.74	7.32	5.10	47.54	32.68	
Extreme	3.61	16.01	0.36	2.28	43.82	54.67		Extreme	1.66	0.00	0.70	0.67	33.69	46.72	
Body Discomfort								**Learning**							
None	0.33	0.15	0.18	0.41	1.33	1.83	822	None	5.80	3.62	36.38	36.88	1.78	0.91	820
Mild	5.76	2.50	25.95	25.56	0.20	3.73		Mild	20.24	11.78	33.07	38.50	0.42	0.30	
Moderate	27.28	21.24	53.25	53.72	2.99	2.62		Moderate	34.16	49.85	20.20	16.84	7.12	12.47	
Severe	62.64	64.30	20.25	18.37	45.26	37.64		Severe	37.83	33.88	7.16	7.78	48.80	36.61	
Extreme	3.98	11.81	0.36	1.94	50.22	54.18		Extreme	1.98	0.86	3.18	0.00	41.88	49.71	

Notes: Statistics weighted with post-stratified individual weights; Q1 and Q5 stand for wealth quintiles 1 and 5, respectively
Source: WHO SAGE, 2008

Table A 2. 3: Marginal effect of being in Q1 on reporting any health difficulty (mild to extreme) in a health domain, relative to being in Q5

Quintile 1 (versus quintile 5)				
	Ordered probit		HOPIT	
Mobility	0,026	(0,029)	0,094	(0,034)
Vigorous Act	-0,046	(0,032)	0,002	(0,036)
Depression	-0,098	(0,033)	0,004	(0,042)
Anxiety	-0,070	(0,033)	-0,006	(0,043)

Relationship	0,020	(0,03)	0,064	(0,031)
Conflict	0,004	(0,031)	0,061	(0,033)
Body pain	-0,036	(0,032)	0,043	(0,039)
Body discomfort	-0,019	(0,032)	0,054	(0,039)
Energy	-0,001	(0,033)	0,018	(0,042)
Sleep	-0,008	(0,033)	-0,001	(0,043)
Far-sight	-0,042	(0,033)	0,102	(0,047)
Nearsight	-0,043	(0,033)	0,104	(0,046)
Self-care	0,014	(0,022)	0,061	(0,024)
Appearance	0,032	(0,021)	0,075	(0,023)
Memory	-0,011	(0,032)	0,066	(0,044)
Learning	0,028	(0,032)	0,068	(0,04)

Notes: standard errors in parenthesis; Source: WHO SAGE, 2008

Table A 2. 4: Marginal effect of being in Q1 and Black African on reporting any health difficulty (mild to extreme) in a health domain, relative to being in Q5 and Black African

	Black and Q1 (versus black and Q5)			
	Ordered probit		HOPIT	
Mobility	0,05	(0,033)	0,13	(0,044)
Vigorous Act	-0,03	(0,035)	0,01	(0,041)
Depression	-0,10	(0,036)	-0,04	(0,049)
Anxiety	-0,08	(0,036)	-0,02	(0,049)
Relationship	0,00	(0,035)	0,09	(0,042)
Conflict	-0,04	(0,035)	0,11	(0,047)
Body pain	-0,06	(0,034)	0,02	(0,04)
Body discomfort	-0,07	(0,034)	0,02	(0,039)
Energy	-0,03	(0,036)	0,01	(0,045)
Sleep	-0,01	(0,036)	0,00	(0,046)
Far-sight	-0,08	(0,036)	0,03	(0,049)
Nearsight	-0,09	(0,036)	0,04	(0,049)
Self-care	0,01	(0,027)	0,08	(0,036)
Appearance	0,03	(0,026)	0,11	(0,036)
Memory	-0,10	(0,035)	0,05	(0,045)
Learning	-0,02	(0,035)	0,10	(0,043)

Notes: standard errors in parenthesis; Source: WHO SAGE, 2008

Table A 2. 5: Marginal effect of being in Q5 and White on reporting any health difficulty (mild to extreme) in a health domain, relative to being in Q5 and Black African

White and quintile 5 (versus Black and quintile 5)				
	Ordered probit		HOPIT	
Mobility	-0,07	(0,042)	-0,03	(0,049)
Vigorous Act	-0,13	(0,047)	-0,07	(0,052)
Depression	-0,11	(0,05)	-0,05	(0,071)
Anxiety	-0,10	(0,05)	-0,09	(0,069)

Relationship	-0,10	(0,044)	0,02	(0,051)
Conflict	-0,23	(0,045)	0,05	(0,049)
Body pain	-0,10	(0,05)	0,06	(0,342)
Body discomfort	-0,12	(0,05)	-0,11	(0,062)
Energy	-0,11	(0,05)	0,02	(0,067)
Sleep	-0,09	(0,05)	0,07	(0,106)
Far-sight	-0,17	(0,051)	-0,11	(0,074)
Nearsight	-0,14	(0,051)	-0,11	(0,073)
Self-care	-0,07	(0,035)	-0,01	(0,048)
Appearance	-0,05	(0,033)	-0,01	(0,045)
Memory	-0,17	(0,051)	0,05	(0,069)
Learning	-0,17	(0,051)	0,02	(0,068)

Notes: standard errors in parenthesis; Source: WHO SAGE, 2008

Section A 2.7: Objective versus subjective health in SAGE

Another way to see how the ill health of the poor is underreported in self-assessed health measures, is to compare it to more objectively measured indicators of health (Baker *et al.*, 2004; Johnston *et al.*, 2009; Bonfrer *et al.*, 2014). For instance, Johnston *et al.* (2009) compare the incidence of self-assessed versus objectively measured hypertension across socioeconomic groups in England. Hypertension is a good example of a chronic condition which can go undetected unless picked up by a medical professional, since it is largely asymptomatic until a moderate or advanced stage. They find no evidence of an income/health-gradient when observing self-assessed hypertension incidence, but a statistically significant income/health gradient when observing objectively measured hypertension.

Objective indicators of health and nutrition usually included in household survey data are the anthropometric measurements. Using the anthropometric measurements in WHO SAGE, I created a variable indicating whether an individual is underweight.[35] These anthropometric measurements are created using the respondent's measurement of height, weight and age, which are biomarkers collected by fieldworkers in the SAGE data set. In South African data, under-nutrition has been found to be a good predictor of mortality and poor levels of self-assessed health (Ardington & Gasealahwe, 2014). The percentage of the adult population who reported being underweight was relatively low at 4%, making meaningful analysis difficult. Although levels of overweight and obesity are quite high, I decided not to use these given that the relationship

[35] An individual is classified as underweight when they have a body mass index (weight in kg divided by height in meters squared) of less than 18.5.

between economic well-being and body-mass index differ by South African race groups (see Wittenberg *et al.*., 2011). The results from this section should be viewed as exploratory, and future work should rely on higher frequency health outcome measures.

Using this objective measure of health and the various self-assessed measures of health, I created concentration indices measuring the variation of health across socioeconomic status (wealth quintiles). A negative concentration index indicates that a variable is disproportionately concentrated among the poor, and a positive index indicates concentration among the rich. A negative CI for underweight would therefore indicate that under-nutrition is concentrated among the poor. The size of the negative CI is indicative of the severity of the concentration.

In Figure A 2.1 the CI for underweight (the objective measure of health) is plotted against the CIs for various subjective ability measures of health. These subjective measures include difficulty dealing with body pain, sleeping, memory, sight and anxiety. These data points are shown not only for South Africa, but other countries also included in the WHO multi-country study focusing on the adult population (these include Russia, India, Mexico and Ghana). The data points are situated above the diagonal line, which shows that CIs for the objective health measure are more concentrated amongst the poor than the CIs for the subjective health measures. In Figure A 2.2, the CI for underweight is plotted against the CIs of self-assessed chronic conditions. The data points are once again above the diagonal line. Some of the chronic conditions related to lifestyle, such as diabetes (a non-communicable disease), are more prevalent among the rich.

Figure A 2. 1: Self-reported health measures compared to underweight.

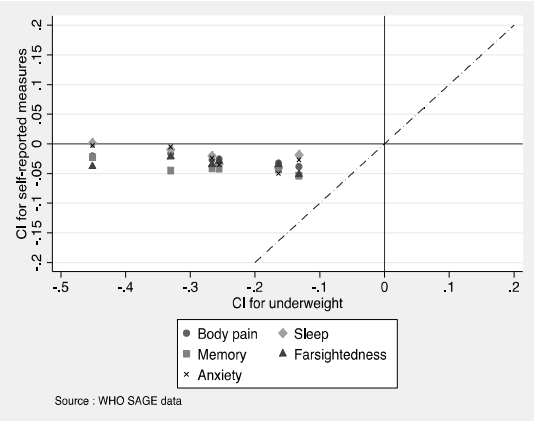
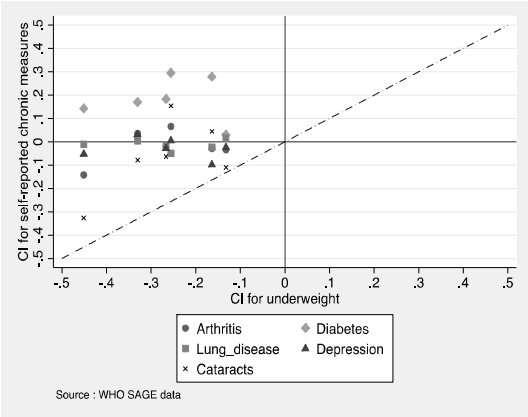


Figure A 2. 2: Self-reported health measures compared to underweight.



I find similar, albeit slightly less robust results when doing the same with hand grip strength as an indicator of objective health. Grip strength has been found to be a good predictor of disability amongst an aging population (Frederiksen *et al.*, 2002) (see Figures A 2.3 and A 2.4 below).

Figure A 2. 3: Self-reported health measures compared to grip strength

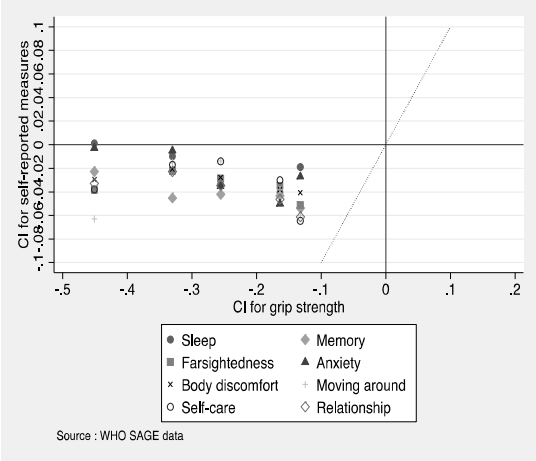
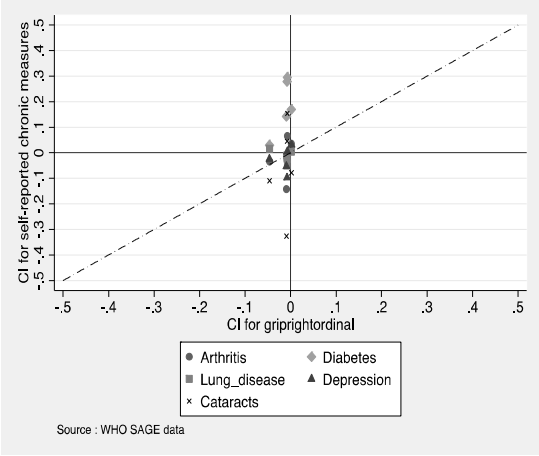


Figure A 2. 4: Self-reported health measures compared to grip strength



Section A 2.8: Response rates in the WHO SAGE data set

Section A.2.8.1: Response rates by quintile

Table A 2. 6. Response rates for SES background variables

		Quintile				
		1	2	3	4	5
Female		100%	100%	100%	100%	100%
Age in years		100%	100%	100%	100%	100%
Education	Less than primary school	98%	98%	99%	99%	99%
	Primary school completed	98%	98%	99%	99%	99%
	Secondary school completed	98%	98%	99%	99%	99%
	High school completed	98%	98%	99%	99%	99%
	College or university completed	98%	98%	99%	99%	99%
	Post graduate degree completed	98%	98%	99%	99%	99%
Marital status	Never married	97%	98%	99%	99%	99%
	Married	97%	98%	99%	99%	99%
	Cohabitating	97%	98%	99%	99%	99%
	Separated/divorced	97%	98%	99%	99%	99%
	Widowed	97%	98%	99%	99%	99%
Race	Black African	88%	87%	89%	83%	82%
	White	88%	87%	89%	83%	82%
	Coloured	88%	87%	89%	83%	82%
	Asian/Indian	88%	87%	89%	83%	82%
Urban		100%	100%	100%	100%	100%

Table A 2. 7 Response rates for health domains

	Quintile				
Health domain	1	2	3	4	5
Mobility	99%	99%	99%	97%	96%
Vigorous Activity	99%	98%	99%	96%	96%
Depression	99%	99%	99%	97%	96%
Anxiety	99%	99%	99%	97%	96%
Relationship	99%	99%	99%	97%	96%
Conflict	99%	99%	99%	97%	96%
Body pain	98%	98%	99%	97%	96%

Body discomfort	99%	98%	99%	97%	96%
Energy	99%	99%	99%	97%	96%
Sleep	99%	99%	99%	97%	96%
Far-sight	99%	98%	99%	97%	96%
Nearsight	99%	98%	99%	97%	96%
Self-care	99%	98%	99%	97%	96%
Appearance	99%	98%	99%	97%	96%
Memory	98%	98%	98%	95%	96%
Learning	98%	98%	97%	96%	96%

Table A 2. 8. Response rate for vignettes

	Quintile					
	1	2	3	4	5	Total
Vignettes set 1	100.00	96.97	97.65	96.79	96.63	97.50
Vignettes set 2	97.67	95.86	99.47	98.84	99.47	98.32
Vignettes set 3	97.38	99.48	98.87	99.46	98.54	98.74
Vignettes set 4	98.33	97.67	98.88	98.89	98.27	98.42

Section A.2.8.2: Response rates by race

Table A 2. 9. Response rates for SES background variables

		Black African	White	Coloured	Asian/Indian
Female		100%	100%	100%	100%
Age in years		100%	100%	100%	100%
Education	Less than primary school	99%	98%	99%	99%
	Primary school completed	99%	98%	99%	99%
	Secondary school completed	99%	98%	99%	99%
	High school completed	99%	98%	99%	99%
	College or university completed	99%	98%	99%	99%
	Post graduate degree completed	99%	98%	99%	99%
Marital status	Never married	98%	98%	99%	100%
	Married	98%	98%	99%	100%
	Cohabitating	98%	98%	99%	100%
	Separated/divorced	98%	98%	99%	100%
	Widowed	98%	98%	99%	100%
Quintile	1	99%	99%	100%	100%
	2	99%	99%	100%	100%
	3	99%	99%	100%	100%
	4	99%	99%	100%	100%
	5	99%	99%	100%	100%

Urban	100%	100%	100%	100%

Table A 2. 10. Response rates for health domains

Health domain	Black African	White	Coloured	Asian/Indian
Mobility	100%	99%	100%	97%
Vigorous Activity	99%	99%	100%	97%
Depression	100%	99%	100%	97%
Anxiety	100%	99%	100%	97%
Relationship	99%	99%	100%	97%
Conflict	99%	98%	100%	97%
Body pain	99%	99%	100%	97%
Body discomfort	99%	99%	100%	96%
Energy	99%	99%	100%	97%
Sleep	99%	98%	100%	97%
Far-sight	99%	99%	100%	97%
Nearsight	99%	99%	100%	97%
Self-care	99%	99%	100%	97%
Appearance	99%	99%	100%	97%
Memory	99%	98%	99%	96%
Learning	99%	98%	99%	95%

Table A 2. 11. Reporting rates by vignette sets

	Total	Black African	White	Coloured	Indian/Asian
Vignettes set 1	97.38	94.52	98.83	98.68	97.55
Vignettes set 2	98.13	98.28	98.08	97.59	98.07
Vignettes set 3	99.08	98.63	98.69	98.59	98.93
Vignettes set 4	97.80	100.00	99.38	100.00	98.46

Section A 2.9: Testing for reporting heterogeneity by gender and level of education

The tables below contain the p-values for the test for reporting heterogeneity (where the null hypothesis is reporting homogeneity) for gender (table A 2.12) and education categories (table A.13). I only find evidence of differential reporting behaviour between males and females in 2 of the 16 health domains (body pain and body discomfort). The results tend to indicate that males and females in South Africa aged 50 and older use similar reporting scales when evaluating their health. For education levels, I find little evidence of reporting heterogeneity at the lower levels of education compared to having no education. However, there is evidence that individuals who completed high school (or something equivalent) evaluate health differently in 7 of the 16 health

domains. Future research could include an analysis of this bias by education level for the South African elderly.

Table A 2. 12. Tests of reporting homogeneity between female and males, by health domain (p-values)

Health domain	Females, P=values for homogeneity
Mobility	0.3460
Vigorous Activity	0.4028
Depression	0.3624
Anxiety	0.1662
Relationship	0.8735
Conflict	0.5693
Body pain	**0.0153**
Body discomfort	**0.0257**
Energy	0.3039
Sleep	0.2780
Far-sight	0.1637
Nearsight	0.6348
Self-care	0.4683
Appearance	0.1092
Memory	0.9384
Learning	0.8987

Note: P-values in bold text if they are significant at a 10% significance level
Source: WHO SAGE, 2008

Table A 2. 13. Tests of reporting homogeneity by education level, by health domain (p-values)

Health domain	No formal education	Less than primary school	Primary school completed	Secondary school completed	High school (or equivalent) completed	College/university completed
Mobility	Ref.	0.1517	0.1975	0.3875	0.3784	0.1096
Vigorous Activity	Ref.	0.3796	0.3470	**0.0480**	0.6625	**0.0373**
Depression	Ref.	0.1237	0.4079	0.2699	0.9339	0.5482
Anxiety	Ref.	**0.0741**	0.5505	**0.0275**	0.6770	0.7999
Relationship	Ref.	**0.0415**	0.8413	0.4871	0.5255	0.2892
Conflict	Ref.	0.1540	0.3634	0.9898	**0.0133**	0.4780
Body pain	Ref.	**0.0016**	**0.0056**	0.1503	**0.0118**	0.4082
Body discomfort	Ref.	**0.0311**	**0.0047**	0.3589	**0.0027**	**0.0236**
Energy	Ref.	0.7600	0.4257	**0.0051**	**0.0090**	0.3827
Sleep	Ref.	0.2844	0.2827	**0.0691**	**0.0091**	0.3953
Far-sight	Ref.	0.1699	0.5827	**0.0063**	**0.0019**	0.0799
Nearsight	Ref.	0.6364	0.3429	**0.0109**	**0.0007**	0.1412
Self-care	Ref.	0.9815	**0.0227**	0.5470	0.9975	0.1316
Appearance	Ref.	0.6894	0.5812	0.7215	0.7168	0.2904

Memory	Ref.	0.1982	0.3656	0.0769	0.2825	**0.0345**
Learning	Ref.	0.3222	**0.0034**	**0.0098**	0.6854	0.3274

Note: P-values in bold text if they are significant at a 10% significance level
Source: WHO SAGE, 2008

Chapter 3

The Thula Baba Box study: A package of interventions aimed at improving early access to antenatal care in Cape Town, South Africa. Evidence from a pilot randomised controlled trial

3.1 Background

In this chapter, I report the results from an innovative randomised controlled trial (RCT) I implemented and tested during 2015 for the purpose of this dissertation. In this RCT, I tested a demand-side package intervention to improve timing and frequency of antenatal care (ANC) access. The package intervention consisted of two interventions which were jointly implemented. The first was an incentive, the Thula Baba Box (TBB), which was used to encourage pregnant women to visit ANC by providing it as a reward for early and frequent clinic attendance. The Thula Baba Box (TBB) is a starter kit for new mothers, containing clothing, sanitary products and toys for the infant. In the second intervention, women were supported with advice, guidance and health information delivered by experienced local community health workers (CHW).

The intervention was implemented and tested in Lwandle and Nomzamo, two low-income areas in Cape Town. This was a community-level intervention, with women recruited door-to-door and visited at their homes.[36] This chapter will therefore consider whether a package of interventions aimed to address demand-side constraints was effective in motivating pregnant women to access healthcare at facilities in a low-income, urban setting in South Africa. The chapter will also explore the impact of the intervention on health outcomes measurable at birth.

I found that women exposed to the Thula Baba Box and community health worker support were significantly more likely to utilise maternal healthcare services than their counterparts. Looking only at the subsample of women recruited into our sample on or before five months of gestation, women in the treatment group were 22.7 percentage points more likely to access care more than four times (significant at a 5% level), and were 34.5 percentage points more likely to access care on or before five months of gestation (significant at a 1 percent level). Looking at the entire sample of women, I found that women in the treatment group were likely to access care 1.3 months earlier than women in the control group (significant at 1%).

[36] Implementation and fieldwork management was done by the dissertation author.

The package intervention also led to a significant decrease in maternal depressive symptoms. Women in the treatment group score on average 1 point less on the maternal depressive score index (significant at a 5% level). Women in the treatment group also scored, on average, one point more on the infant feeding intention scale, indicating a higher intention of exclusively breastfeeding for at least six months. However, this effect was not precisely estimated.

The reduction of global maternal mortality to fewer than 70 deaths per 100 000 live births by 2030 has been identified as one of the United Nation's Sustainable Development Goals (United Nations, 2015). This reduction has also been identified as a policy priority for the national and Western Cape Departments of Health of South Africa (Western Cape Department of Health, 2014). South Africa's maternal mortality ratio is far higher than that of its upper-middle income country peers. These disappointing outcomes are not attributable to low government spending, as countries that have similar levels of per capita government expenditure on health have maternal mortality ratios (MMR) around 60 deaths per 100 000 live births, while South Africa's ratio was estimated to be 310 in 2008 (Bradshaw & Dorrington, 2012).[37] The high incidence of HIV plays a persistent role in the country's MMR. In 2008-2010, 40.5% of maternal deaths in South Africa were attributed to non-pregnancy related infections, predominantly HIV (Pattinson, 2012).

There has been a slight decline in infant and young child mortality in South Africa, but it remains unacceptably high. Mortality in 2011 was 42, 30 and 14 deaths for every 1000 live births amongst children under five, infants and neonates respectively. Approximately one in three deaths in children younger than five occur during the neonatal period (Bamford, 2013). The most important causes of death amongst neonates are complications due to pre-term birth (45%); intrapartum hypoxia (30%); infection (10%) and congenital abnormalities (7%).

Amongst South African children aged between one month and five years of age, death is usually the result of acute respiratory infection (predominantly pneumonia) (29%); diarrhoea (20.7%); septicaemia (16.2%); or tuberculosis (7.1%) and meningitis (6%) (Bamford, 2013). A large proportion of these deaths are avoidable (Pattinson, 2012).

[37] Bamford (2013) reports that 2010 was a turning point following the upward trend in maternal mortality. The 2011 interim Saving Mothers report showed a decrease in the institutional Maternity Mortality Ratio to 153 deaths per 100 000 live births, compared to 176 deaths per 100 000 live births for the period 2008 to 2010 (Bamford, 2013).

There are various government programmes and policies being implemented that promote maternal health, albeit directly or indirectly. Amongst others, there is the Nutritional Therapeutic Programme, which falls within the Integrated Nutrition Programme to combat maternal malnutrition. There is also the Infant and Young Child Feeding Policy which recommends that pregnant women should visit antenatal clinics at least four times, be provided with micronutrient supplements, promotes skin-to-skin contact between mother and infant and immediate breastfeeding within the first hour of birth (National Department of Health, 2013a).

Since maternal deaths were made notifiable in 1997, there has been a range of "Saving Mothers" reports produced by the National Committee for the Confidential Enquiry into Maternal Death (NCCEMD). They report on current determinants of maternal deaths and provide accurate figures of current maternal mortality and morbidity (Mhlanga, 2008), thus drawing attention to the issue of maternal mortality. Furthermore, the National Development Plan 2030, as formulated by the National Planning Commission, calls for the Department of Health to formulate a nutrition intervention that targets pregnant women, infants and young children specifically (National Planning Commision, 2011).

In 2012, the Strategic Plan for maternal, new-born, child and women's health and nutrition (MNCWH&N) was launched. The goal of the strategy is to identify key interventions which will affect the health and nutrition of the vulnerable groups, and to improve and strengthen these interventions. This includes scaling up these interventions at primary healthcare, community-based and district hospital level, especially in districts with poor performing socioeconomic indicators. The plan also calls for monitoring and evaluation systems to be strengthened in order to monitor the intervention outcomes (National Department of Health, 2012a).

There is little evidence that current interventions are having the desired impact. Intensification of prevention of mother-to-child HIV transmission may have resulted in an improvement in maternal and infant mortality. However, maternal mortality indicators still lag far behind that of South Africa's peers and are not within reach of global targets, suggesting that current strategies and programmes are not sufficient.

One of the demand-side factors linked to South Africa's poor maternal and infant health outcomes is late and infrequent antenatal care access (ANC) (Pattinson, 2012). Pattinson (2012) reports that in a quarter of maternal deaths, pregnant women never attended antenatal clinics or did not attend frequently enough. Early access to antenatal care is particularly vital for maternal health in South

Africa with its high HIV prevalence. In 2012, HIV prevalence amongst pregnant women in South Africa was approximately 30% (Shisana *et al*., 2012). Early initiation of antiretroviral treatment is necessary to prevent vertical transmission and to promote the health of both the mother and the infant (World Health Organization, 1999; Moodley *et al*., 2016).

The South African Department of Health suggests that pregnant women should access antenatal care before 20 weeks of gestation, as this will minimise the risk of vertical transmission of HIV. Earlier access at 14 weeks is recommended by the WHO to minimise the risk even further (Schnippel *et al*., 2015). However, according to the 2012 District Health Information System (DHIS), 59.9% of women only sought antenatal care at a gestational age of 20 weeks/five months or later (National Department of Health, 2012b). Therefore, improving access to care at an earlier gestational age is a key task facing the South African government, especially within the context of high HIV prevalence amongst pregnant women.

Contrary to what is the case in many other developing countries, frequency of antenatal care visits and institutional births are not considered high priority problems in South Africa. The frequency of antenatal care is overall high, with South African women making an average of 3.7 visits to antenatal care (National Department of Health, 2012b). South Africa also fares well in terms of birth at facilities, as approximately 91.3% of women give birth at a health facility (National Department of Health, 2012b). However, these averages fail to capture the gross inequalities (as highlighted in chapter 1), with women living in low-income households particularly vulnerable to late and infrequent care seeking behaviour.

Medical literature reports on the possible benefits of antenatal care. These are predominantly to detect, monitor and treat dangerous symptoms and conditions which may lead to morbidity or mortality of mother or infant (Liu *et al*., 2015). Although more epidemiological evidence is required to determine with certainty which antenatal interventions lead to better health outcomes, interventions aimed at monitoring and treating chronic conditions such as anaemia, infections and hypertensive diseases of pregnancy are largely found to be effective (Carroli *et al*., 2001). Research studies finding weak effects often attribute these to possible endogeneity stemming from the non-random allocation of antenatal care to more high risk cases (Conway & Deb, 2005; Conway & Kutinova, 2006). However, medical literature has predominantly focused on the role of antenatal care on infant health outcomes, rather than infant and maternal health outcomes jointly. This has

led to an underestimation of the contributing value of antenatal care to improving health outcomes (Conway & Kutinova, 2006).

Given that healthcare to pregnant women is free of charge in South Africa (Cooper *et al.*, 2004), there are factors other than direct costs barring early access to antenatal care. The limitations to available and current nationally representative health surveys mean that research on the barriers to antenatal care access in South Africa is scarce and limited to specific areas.[38] In peri-urban Pretoria, Haddad and colleagues found that early access is associated with planned and desired pregnancies. Fear of HIV testing and self-perceived HIV stigma acted as a deterrent to accessing care earlier. They also detected the presence of superstitious behaviour against accessing care early (Haddad *et al.*, 2016). Two studies, one in peri-urban Johannesburg and the other in Cape Town, found that the main contributors to late access were late identification of pregnancy status and not having time to access care (Solarin & Black, 2013; Smith, 2016).[39] Having an unplanned pregnancy is also correlated with accessing care late, pointing to the importance of access to and choice of contraception (Smith, 2016). Stein *et al.* (2015) estimate that 65% of pregnancies in the Western Cape are unplanned, and this may delay care-seeking behaviour.

I begin with an overview of the two interventions, followed by a description of how they were implemented. This includes the study design, setting, sampling methods, sample size, data collection and measurement of treatment effect and outcomes. In Section 3.3, I discuss the results from the study, starting with a description of the baseline characteristics and attrition of study participants. The results on health outcomes are divided into three broad categories, namely (3.3.2) health facility attendance and (3.3.3) health outcomes. Highlights from these results are discussed in the main text, while the majority of results are provided in the Appendix (but referred to in the main text). Finally, I conclude with a discussion of the results, their policy implications, scope for scaling up the intervention, future work and limitations of the study.

3.2. Methods

[38] During the piloting phase, I conducted focus groups with community health workers who work with pregnant women to establish the barriers to access in the sampling area. The results are reported in the Appendix Section A 3.1.

[39] Other major barriers identified in earlier studies are poor physical access to the health facility; limited knowledge of the potential health risks during pregnancy and the perception that antenatal care is unimportant; lack of adequate information by healthcare providers; and the mother's perception of the poor quality of care she will receive (Abrahams *et al.*, 2001; Myer & Harrison, 2003). There are also various supply-side limitations such as poor booking procedures, or delays caused when women are asked to return at a later date (Solarin & Black, 2013).

3.2.1 Synopsis of the package of interventions

There are multiple and overlapping risk factors contributing to maternal and infant health and mortality. For this reason, Tomlinson and co-authors propose a more horizontal approach to policy, as opposed to the current vertical approach supported by funders where single health outcomes are targeted (Tomlinson *et al.*, 2014). In order to overcome the multiple constraints, I propose a package of interventions to improve various maternal and infant health outcomes. These include the Thula Baba Box as an incentive, and information and social support provided by community health workers. What follows are descriptions of both programmes.

3.2.1.1 Intervention 1: The Thula Baba Box incentive

The Thula Baba Box (TBB) is a starter kit for new mothers, based on the idea of the Finnish baby boxes. The Finnish box was used to curb infant mortality in Finland in the 1930s and is still given to all pregnant women in Finland to this day (Kela, 2015). Research was conducted and interviews done with new mothers, healthcare workers and policy makers to adjust the box to a South African setting.

The box is valued at R440 ($27.8 on 29 February 2016) and contains baby clothing, a blanket, wash products (face cloth, hand soap, aqueous cream, baby jelly and wipes), maternity pads, condoms, a kangaroo mother care wrap, plastic balls, health information brochures[40] and nursery rhymes.[41][42] The box is clear plastic and can be used by the mother for storage or as a baby bath.

The box is used as an incentive to promote earlier and frequent antenatal care attendance, given conditional on the mother accessing antenatal care at least four times and with the first visit occurring within four weeks after her first interaction with (or recruitment by) the CHW. The content of the TBB is predominantly aimed at the infant in line with evidence indicating that

[40] Most information brochures are available in the appendix. The information brochures are relatively text-based. Although the information in the antenatal care brochures were communicated to women in the treatment group during baseline, information brochures provided at endline (this includes brochures on treating dehydration due to diarrhoea, the signs of postnatal depression and information on the importance of breastfeeding) were not communicated to respondents. Given the low level of education amongst women sampled in this study, it is therefore possible that these information brochures would have little effect on eventual health outcomes. Furthermore, baseline pamphlets were available in isiXhosa and English, while endline information brochures were only provided in English. These aspects of the study should be reconsidered if a larger RCT is attempted.

[41] Nursery rhymes were available in isiXhosa, English and Afrikaans. The CHWs would teach the rhymes to the new mothers, and encouraged them to sing to the newborns regularly. The nursery rhymes are provided in the appendix section A 3.2.

[42] For more information on how the box and its content were decided on, please see the Appendix Section A 3.2.

targeting the incentive towards the child rather than the mother or caregiver makes for a stronger incentive (Smith *et al.*, 1990). While infant health outcomes are not the primary focus of the study, it is anticipated that the box may well contribute to their health outcomes.[43] Incidentally, the use of the box as an incentive is in line with its historic role in Finland. It was awarded to pregnant women if they accessed antenatal care before 16 weeks gestation (Gissler *et al.*, 1998).

There is a substantive literature on the use of incentives to promote early antenatal care attendance in high-resource countries. McQuide *et al.* (1998) compiled a comprehensive survey of the presence of maternity benefits in Europe in the 1990s. Austria, Finland, France, Hungary and Luxembourg all offered pregnancy allowances to pregnant women, while Finland, France, Hungary and Luxembourg made receipt of the allowance conditional on early (and frequent in Luxembourg) timing of antenatal visits (McQuide *et al.*, 1998). In France, for instance, the government offers a means tested birth grant or "baby bonus" to pregnant women, payable by the 7th month of pregnancy and conditional on antenatal care attendance prior to 14 weeks' pregnancy. This falls within the *Prestation d'Accueil du Jeune Enfant* (PAJE) policy. Women who do not present in the first trimester are still eligible to receive the grant, but a lesser amount (De Costa & Wenitong, 2009).

Several of the conditional cash transfer programmes in Latin American countries such as Mexico[44] (Gertler, 2004; Barham, 2011), Brazil[45] (De Brauw *et al.*, 2012) and Honduras[46] (Eichler *et al.*, 2009; Lagarde *et al.*, 2014), and the Suraksha Yojana scheme in India[47] (Lim *et al.*, 2010) have made cash transfers conditional on antenatal care-seeking behaviour and have found evidence of success.[48]

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[43] For instance, the kangaroo mother/father care wrap promotes skin-to-skin contact and also has various psychological benefits (Bergman *et al.*, 2004).

[44] In Mexico, the implementation of the Progresa programme in 1997 led to a significant decrease in infant mortality. The health component of the programme revolved around maternal and infant health and required guardians to participate in growth monitoring (conception to age five), regular preventative health check-ups (**including antenatal care**) and attendance at health education talks focusing on health, hygiene and nutrition (Gertler, 2004; Barham, 2011). The CCT programme had a significant impact on improving child health (Gertler, 2004). The decline in infant mortality was mostly linked with the impact of the programme on deaths caused by intestinal and respiratory diseases, and nutritional deficiencies. However, there was also a decline in deaths caused by congenital anomalies, an improvement which would have resulted from improved access to antenatal care (Barham, 2011).

[45] One of the multiple conditionalities in the *Bolsa Familia,* a CCT programme implemented in Brazil, demands that pregnant women attend timely and frequent antenatal care visits to a healthcare professional (De Brauw *et al.*, 2012; Ranganathan & Lagarde, 2012).

[46] The Honduran CCT programme, PRAF (Family Allowance Programme), requires that pregnant women attend at least four appointments at an antenatal care specialist (Eichler *et al.*, 2009; Lagarde *et al.*, 2014). The programme led to an approximately 18 percentage point increase in take-up of antenatal care visits (Morris *et al.*, 2004).

[47] Also known as the "Safe Motherhood Scheme". The programme incentivised, amongst other things, births at facilities and at least three antenatal care visits (Lim *et al.*, 2010). The programme led to a significant increase in antenatal care visits (Lim *et al.*, 2010).

[48] Another CCT programme, the Jamaican PATH programme, initially required pregnant women to make regular antenatal clinic visits in order to receive a grant. However, this conditionality was eventually dropped (Levy & Ohls, 2007).

Theoretically, the rationale for incentives[49] is two-fold: it can alleviate financial barriers and correct time preference inconsistencies (Dupas, 2011; Lunze & Paasche-Orlow, 2013). In healthcare, incentives are often promoted as once-off nudges aimed at transforming social norms and individual expectations to promote long-term prudent health behaviour. It works by "triggering a virtuous circle of 'good' habits" (Ranganathan & Lagarde, 2012). Incentives can also be used as a method of rebalancing an individual's discount rate, or a "nudging" effect towards responsible and prudent behaviour and improved individual outcomes. Often it is assumed that individuals make optimal and rational choices by weighing possible costs and benefits. Recent research in behavioural economics has shown that this assumption is essentially flawed. In truth, individuals often miscalculate the true values of possible costs and benefits, especially future costs, leading to non-optimal health behavioural choices. Incentives are designed to correct such short-term distortions, "nudging" individuals towards the outcomes they desire to achieve in the long-run. However, time preference inconsistencies may not be the only factor of non-optimal health-seeking behaviour. Dupas (2011) identifies poor access to information and poor-functioning financial markets as factors that limit preventative health-seeking behaviour in a low-income setting. Non-optimal health-seeking behaviour driven by these factors may require addressing information asymmetry, a lack of liquidity or savings technology, rather than addressing time-preferences.

Incentive programmes have been used successfully in promoting preventative health behaviour for childhood immunisation (Banerjee *et al.*, 2010), promoting performance of agents in pro-social tasks aimed at development (Ashraf *et al.*, 2014a), preventing sexually-transmitted infections (De Walque *et al.*, 2012), and HIV testing (Thornton, 2008).

[49] Incentives can be divided into direct and indirect incentives, and then further be subdivided into financial (e.g., pregnancy and birth allowances, or maternity leave) and non-financial (e.g., antenatal care attendance during work hours) incentives (McQuide *et al.*, 1998). Financial incentives tend to outperform non-financial incentives when it comes to enhancing patient compliance in health behaviour (Giuffrida & Torgerson, 1997), but raises questions of intrinsic and extrinsic motivation and durability of behavioural change. Direct non-financial incentives have historically mostly been targeted towards employed pregnant women, and include attending prenatal care during work hours, having job security and having a safe working environment during your pregnancy. These benefits are considered incentives, since they create an environment where women can openly acknowledge their pregnancy and attend antenatal care without fear of repercussions (McQuide *et al.*, 1998).
Indirect incentives do not require antenatal care attendance to be eligible to receive the incentive, but rather aim to relieve the financial burden of pregnancy. Examples of financial indirect incentives are pregnancy allowances to poor women, as were given in the UK and Ireland. Various European countries also offer non-financial indirect incentives, such as housing priorities to pregnant women and transportation advantages (reserved seats in public transport, or financial assistance with travel expenditure as given in Ireland). These incentives are considered indirect since they remove barriers that make it difficult for pregnant women to attend antenatal care (McQuide *et al.*, 1998).

Given the popularity of incentives for antenatal care, it is surprising that there are only a small number of rigorous assessments of its impact. There have been a range of smaller randomised controlled trials across countries (Laken & Ager 1995;[50] Rosenthal *et al.* 2009;[51] Melnikow *et al.* 1997;[52] Dupas 2005[53]) with varying levels of success.[54] The studies found that the impact is conditional on the duration of required behavioural change (Eichler *et al.*, 2009; Lunze & Paasche-Orlow, 2013), the incentive payment or transfer structure (Sindelar, 2010), costs imposed on the user (Kremer & Miguel 2004; Tarozzi *et al.*, 2014) and the size of incentives (Thornton, 2008; Banerjee *et al.*, 2010; Dupas, 2011; De Walque *et al.*, 2012). These factors do not have parallel effects on the success of a programme, but should be considered jointly since they are interrelated. For instance, the size of an incentive will to an extent be determined by the duration of behavioural change required. A literature review and discussion of these and other factors to consider when designing an incentive programme, is provided in the Appendix Section A 3.3.

3.2.1.2 Intervention 2: Community health worker support

[50] A 1995 study done in the US offered pregnant women gift vouchers if they went to their scheduled antenatal care visits. They found that the incentives had no significant impact on visits, but admit that this failure could be related to the small size of the incentives ($5 per visit). Failure to visit was often related to poverty, with inability to pay transport fees acting as a major barrier (Laken & Ager, 1995).

[51] In Las Vegas in the United States, a small union-sponsored health plan offered pregnant women and healthcare providers $100 each if the pregnant women attended antenatal care within their first trimester and made their recommended amount of visits thereafter. Rosenthal *et al.* (2009) used billing data from 1998 to 2001 to see whether the programme had an impact on the health outcomes of the infants born from the programme. Despite data limitations (such as the quasi-experimental nature of the analysis), they found that adherence to the recommended antenatal care increased almost five-fold compared to baseline estimates. They also found moderate indications that it improved health outcomes. The authors hypothesise that the size of the incentive also played an important role on its efficiency, especially since the sample consisted predominantly of low-income women.

[52] A randomised controlled trial in California, US, looked at the effectiveness of a transport voucher and infant gift as incentives on first antenatal appointment attendance compliance. Study participants were recruited at the clinic after pregnancy confirmation. Women who were eligible to receive the travel vouchers were significantly more likely to attend their first antenatal appointment, while the baby blanket had no impact on the treatment arm's compliance. Although the women in the transport voucher arm were significantly more like to attend their first clinic visit, very few women in this treatment arm actually used their voucher. The reason for this is not explored in depth, but the authors admit the possibility of selection bias: women selected into the study are often more altruistic and participate in the study to contribute to the enhancement of knowledge to help future mothers. Upon receipt of their travel vouchers, many participants reported it was a nice gesture, but unnecessary (Melnikow *et al.*, 1997).

[53] Dupas (2005) designed and implemented a RCT in Western Kenya where free insecticide-treated nets were offered to pregnant women if they enrolled at antenatal clinics. The nets were distributed at the clinic once women enrolled. The intervention led to a 117% increase in take-up of antenatal care services. The intervention also had various positive spill-over effects, as it led to an 84% increase in take-up of HIV testing and 59% increase in follow-up visits to prenatal clinics.

[54] Incentives have also been used successfully to increase postpartum visits (Smith *et al.*, 1990; Stevens-Simon *et al.*, 1994). During a RCT study in the US, indigent adolescents between the ages of 12 and 19 were offered a baby carrier at 34 weeks of gestation if they returned to the clinic for a postpartum visit between 6 and 12 weeks of giving birth. Participants in the treatment arm (those who were offered the incentives) were 17.2 percentage points more likely to seek postpartum care before the 12-week benchmark (Stevens-Simon *et al.*, 1994). A similar programme offering adolescents a coupon for formula milk to return for postpartum care between four and six weeks after delivering found that adolescents offered the incentive were 15 percentage points more likely to return than those who were offered nothing (Smith *et al.*, 1990).

The second intervention entailed providing pregnant women with the required support and information via monthly visits by a local and trained CHW. With the help of an established and reputable CHW non-governmental organisation (NGO), Philani Health and Nutrition,[55] I recruited women with existing CHW experience from the Lwandle and Nomzamo (the sampling) communities.[56] In preparation for this study, they received further specialist training in antenatal care and nutrition from Philani Health and Nutrition. The scope of the Philani programme's impact is reported elsewhere (Le Roux *et al.*, 2013; Le Roux *et al.*, 2014; Rotheram-Borus *et al.*, 2015; Tomlinson *et al.*, 2015).[57]

The service that the CHWs provide is seen as supplemental to the standard clinical practice, and is focused on providing health information and psychosocial support. CHW visited their clients at least once a month, with visits ranging from between 30 to 90 minutes each. The content of these visits included promoting early and frequent antenatal care visits, discussing pregnancy and infant danger signs, the dangers of drinking and smoking during pregnancy, the importance of HIV and TB testing, maternal nutrition and general health, infant feeding options, the importance of bonding, and providing general emotional support. Once the CHW established a rapport with the pregnant women, they spoke about HIV status and the importance of disclosing one's HIV status, encouraging the HIV positive mothers to join Prevention of Mother to Child Transmission of HIV (PMTCT) programmes. The CHW programme is tailored to the needs of the participants,

[55] The project has been operating from Cape Town for over 30 years, and has made significant inroads in improving maternal, infant and child health. The Mentor Mother programme is built on the research and models of US (in terms of programme content) and the Brazilian (in terms of integration into government services) community health worker programmes (Le Roux *et al.*, 2015: 116). The programme is intended to be supplemental to standard clinical practice. For a more detailed description of Philani, see Le Roux *et al.*, 2015.

[56] For more details on piloting work done to design the CHW programme, please see Appendix Section A 3.4.

[57] The Philani antenatal care programme had a significant impact on WLH (women living with HIV) completing PMTCT tasks, including administering nevirapine to their infants at birth and medicating with azidothymidine (Le Roux *et al.*, 2013). Other post-birth benefits include fewer post-birth complications and higher probability of the infant's father acknowledging the infant to his family (Le Roux *et al.*, 2013). The infants of women suffering from maternal depression in the Philani programme are also less likely to suffer from a low height-for-age z-score. The findings from this study by Tomlinson et al. (2015) suggest that the psychosocial support provided by the Philani programme encourages depressed mothers to provide optimal care for their infants despite their depression.

Furthermore, the joint antenatal and postnatal programme has had significant impacts on decreasing the number of diarrhoea incidents when infants were 18 months old (Le Roux *et al.*, 2014), a significant increase in exclusive breastfeeding duration (Le Roux *et al.*, 2013, 2014), likelihood to still be exclusively feeding at six months of age (Le Roux *et al.*, 2013) and greater perceptions of social support when the infant is six months of age (Le Roux *et al.*, 2014). Infants were also less likely to be stunted at six months of age (Le Roux *et al.*, 2013). Furthermore, the programme decreased postnatal depression symptoms amongst women living in low-income areas up until three years after giving birth (Rotheram-Borus *et al.*, 2015).

and participants would receive visits focused on a specific topic if they were dealing with a particular problem. For instance, women who had a drinking problem would receive more consultations on alcohol. Information regarding the specific content of each visit for each participant was captured in order to be able to draw conclusions about what would be the minimum package of CHW visits necessary to have an impact.

The CHWs were responsible for covering a specific geographical area within Lwandle and Nomzamo, visiting each household, and identifying possible participants. Community health workers were monitored and supervised by a senior community health worker residing in a different area. The supervisor is an experienced community health worker who was recommended to the project by Philani Health and Nutrition. Given the small number of community health workers, the supervisor was able to sit in on most important contact sessions with study participants.

Philani's CHW programme, the Philani Plus (+) intervention programme was developed in response to poor access to primary healthcare facilities for pregnant women. Some of the services performed at these facilities are essential to ensure the health of both mother and infant and, as a result, the intervention programme has reallocated some of the duties performed at the primary care facilities to paraprofessional community health workers, who can perform these duties at the homes of pregnant women. Furthermore, the antenatal care services offered at public clinics are not comprehensive and lacking essential dimensions, such as maternal depression or preventative counselling (Rotheram-Borus *et al.*, 2011). The community health workers are able to supply these services and address a couple of the major health burdens amongst South Africans such as HIV, TB, malnutrition and alcohol abuse (Rotheram-Borus *et al.*, 2011).

One of the benefits of the model is that it covers a specific geographical area, rather than enrolling patients from a clinic. The CHWs visit each household, identifying possible clients. Clients receive a package of care, rather than a single service, so they are not publicly identified as HIV positive. This strategy helps to eliminate any stigma associated with receiving healthcare, given that all members of the community are subject to a visit. Furthermore, it helps to build a "supportive network and social capital" (Rotheram-Borus *et al.*, 2011). The programme is also advantageous as it lowers the burden of care seeking, as proactive case-finding means that vulnerable individuals who may not have sought care will be found and receive the necessary support and referral.

Similar programmes have been used in a high-income country context to specifically promote earlier and frequent attendance of antenatal care (Julnes *et al.*, 1994; Rogers *et al.*, 1996; Daaleman, 1997). In these programmes, similar to the Philani programme, mothers from the community were recruited and trained to provide antenatal support. The impact of these programmes on earlier antenatal care range from significantly positive (Rogers *et al.*, 1996) to only suggestive evidence (Julnes *et al.*, 1994; Daaleman, 1997). Antenatal home-visiting programmes have also been effectively used to promote adequate antenatal care usage (Issel *et al.*, 2011). There is often variation in the quality, design and sample size of these programmes. The variation in design and uncertainty in dosage of the different interventions make it difficult to draw overall conclusions about the effectiveness of community health worker interventions (Issel *et al.*, 2011).

3.2.2 The study design

The TBB and the CHW support interventions were jointly administered as a package intervention.

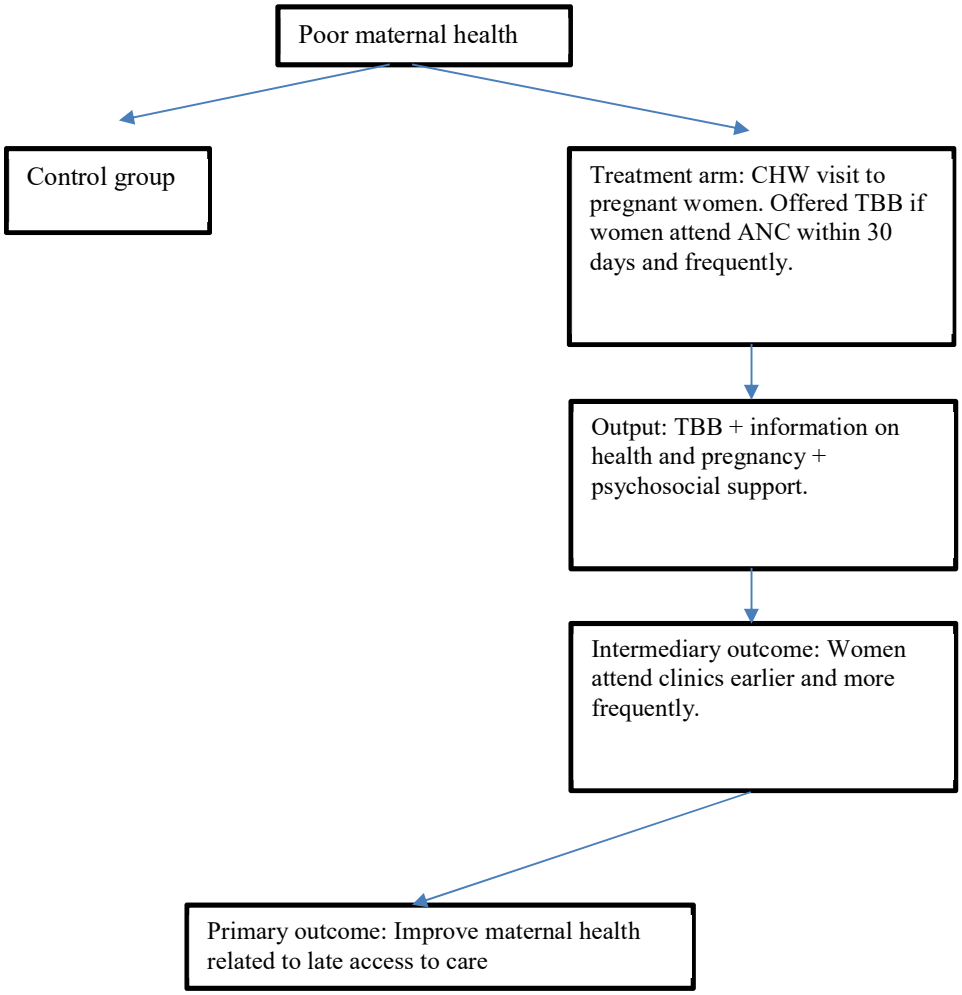
After recruitment, women were first randomised into either the intervention or the control arm using an on-site lottery. The on-site lottery was conducted by the CHW, but allocation was ultimately decided by the project manager (author of this dissertation). CHWs asked all eligible women to provide them with their cell phone number[58]. The CHW would then text the number to the project manager, who would then decide whether the pregnant woman was in the treatment or control group based on the third last digit of her number.[59] This was done in order to ensure that the CHWs did not favour any of the respondents and place them into treatment group. Once allocated, all women completed a baseline questionnaire that captured their basic profile, their socioeconomic background, their health-seeking behaviour, their understanding of pregnancy risks, their household situation and their perspectives on their pregnancy.

Women selected to receive the package intervention were told that they would receive monthly visits from the CHW and if they went to the antenatal clinic within the next 30 days and made the four necessary visits, they would receive the TBB after they had given birth. The women were also told that if they did not comply fully with these conditions, they would only receive a partial version

[58] For women who do not have a cellphone number, an identity number or house number was used.
[59] The CHWs were not informed how group selection was determined.

of the box.[60] Women in the control group were subject to standard clinical practice and received neither box nor CHW visit. This study design is illustrated in Figure 3.1.

Figure 3. 1 Graphical depiction of the study design



The primary outcome of the intervention is to improve maternal health. Maternal mortality represents an extreme outcome of childbirth. Although not regularly monitored, maternal morbidity can occur more often and has severe implications for mother and infant. Poor maternal

[60] Women in the treatment group were told at recruitment that if they did not access care within 30 days, and did not make the necessary visits to the clinic, that they would receive a smaller version of the box. This included the removal of an item with each indiscretion. Women were not told which items would be removed, but at endline the community health worker would remove selected items if the participant did not comply. These were predominantly non essentials, such as one of the toys or one of the nappies.

health outcomes also have an impact on public healthcare expenditure, since they often lead to high costs of hospitalisation due to complications or malnutrition (Conway & Kutinova, 2006).

In implementing the study, contagion between the treatment and control arm was kept to a minimum by (1) explaining to CHWs the importance of strict research and the importance of the results to the whole community if treatment and control are kept separately, (2) appointing a CHW supervisor to monitor the work of CHWs and (3) by collecting photo evidence of the handing-over of the boxes by CHWs.

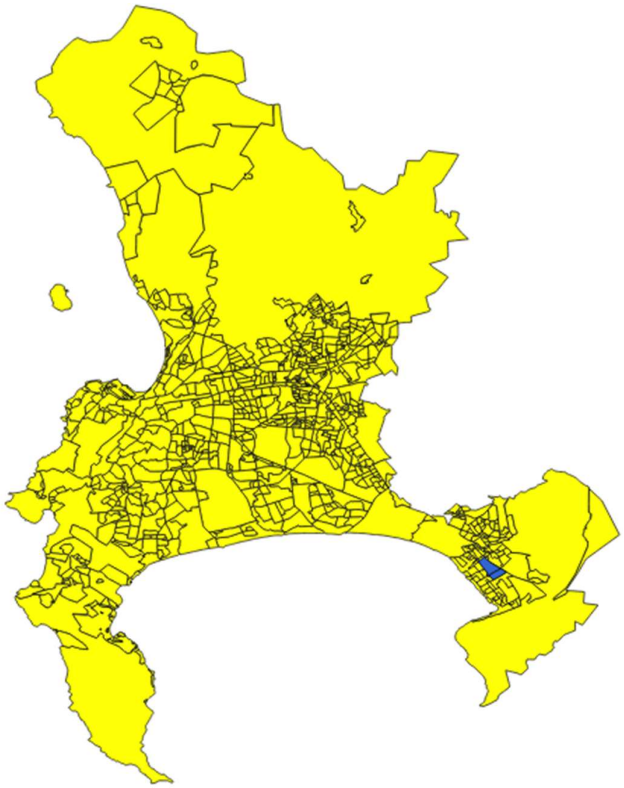
In the study, participants were only tracked up until a week after giving birth. As a result, I only tracked intermediary outcomes as proxies for improving maternal health. These intermediary outcomes are discussed in detail in Section 3.2.7.

3.2.3 The study setting

I selected Lwandle and Nomzamo for the intervention because these sites had few competing interventions and had relatively low rates of early access to antenatal care. Based on the averages of late antenatal clinic attendance (where late attendance is classified as a first booking visit after a person is 20 weeks pregnant) across clinics in health sub-districts, approximately 43% of women in the Eastern Health sub-district (where Lwandle and Nomzamo are situated) attend antenatal clinics too late (see Table 4.1 in chapter 4). This makes the Eastern Health sub-district one of the worst performing sub-districts in the Metro in terms of this indicator.

Lwandle and Nomzamo are situated in the Metro region of the Western Cape. Figure 3.2 shows a map of the Metro region of the Western Cape (yellow), with Lwandle and Nomzamo highlighted in blue. These are both low-income areas with high levels of unemployment and informal housing. They fall within the Eastern Health sub-district of the Metro region, where approximately 43% of women attend antenatal care after 20 weeks of gestation (National Department of Health, 2012b).

Figure 3. 2 Map of the Metro region in the Western Cape, South Africa



3.2.4 Sampling methods and sample size

The study targeted women who were pregnant but who had not yet been to an antenatal care facility. The CHWs went door-to-door in the sampling area, identifying and recruiting pregnant women for the study. Women who were of reproductive age and sexually active were also offered a pregnancy test, and recruited into the study if they were pregnant. The sample consists of female residents of Lwandle or Nomzamo who either knew they were pregnant and who had not yet been for antenatal care, or women who did not know they were pregnant when the CHW approached them but found out via a pregnancy test offered by the CHW. Due to ethical considerations relating to working with minors, only women aged older than 18 were recruited. The upper bound for recruitment was set at 50.

During the 36 days of recruitment, community health workers visited every house in the two communities identified, and were able to go through both communities twice. Women were screened based on their age (18-50) and their sexual activity. Gaining access to households did not

prove difficult, since the CHWs were familiar to people in the community. Since the CHWs were from the community themselves, they were able to communicate with neighbours if someone was not home when they visited and were able to identify whether there were any eligible women in those households. Often, the CHW would target these household specifically in the next couple of days or would arrange to visit them in the evening. The sample is therefore representative of the community. However, there were some safety concerns regarding some of the area. There were four women sampled who were living in an area which proved dangerous for the CHWs, as they were threatened by a local gang. The four participants were unwilling to meet with the CHWs outside of their area, and we decided that in the interest of CHW safety, to drop these women from the sample.

Due to budgetary limitations, a sample of 100 women (50 control, and 50 intervention) was obtained for this pilot study. It is therefore viewed as a pilot study for implementing a larger scale intervention. After attrition (discussed in the results section), a total sample of 72 participants remained. Power calculations reveal that with a sample size of 100 women, an estimated r-square of 0.2 and significance level of 0.1, an unconditional standard effect size of 0.5 is required to have statistical power of 80% (see figure A 3.5.1). With a final sample size of 72, this effect size needs to be 0.59 (see figure A 3.5.2).[61]

3.2.5 Data collection

Data was collected using a baseline questionnaire (conducted following recruitment into the sample), a danger signs vignette and an endline questionnaire (asked one week after birth).[62] The questionnaires contain questions on background information (e.g., race, SES status, employment), antenatal care (gestational age, pregnancy identification method, why have not visited clinic),

[61] The graphs depicting the power calculation for the required sample size to deliver statistically significant results are provided in the Appendix Section A 3.5. The initial power calculations were based on the goal of decreasing gestational age at first antenatal clinic booking. At a standard effect size of 0.15 (where standard effect size equals the effect size divided by the standard deviation of the variable of interest), an estimated r-squared of 0.2, and a significance level of 0.1, I can expect to have a statistical power of 80% at approximately 1000 observations (see Appendix Section A 3.5.3). The outcome in this calculation is the percentage of women who have their first antenatal clinic booking visit prior to 20 weeks' gestation (early booking), which is approximately 57% in the area of implementation. This sample size was not attained due to budgetary constraints.

[62] The instruments were created using the essential guide for pregnancy, childbirth, postpartum and new-born care (WHO, 2003). The WHO, UNFPA, UNICEF and the World Bank distribute this document. Other resources that were used to create the questionnaires were Philani's "mothers to be" depression questionnaire and Solarin and Black's (2013) antenatal care seeking questionnaire.

health, support system (presence of support system, knowledge of support groups) and the father's role in the infant's life (include father into infant's life, perception of role of the father).

Recruitment of participants occurred between 21 January and 13 March 2015. The final study participants gave birth during November 2015. Women in the treatment group received their Thula Baba Box after they had given birth, when the endline questionnaire was implemented.

Women received food vouchers worth R30 ($1.9 on 29 February 2016) to compensate them for the time spent completing the questionnaire.[63] The questionnaires were conducted by the study's CHWs with quality monitoring by the team supervisor and myself. Community health workers have been found to deliver high quality data and health outcome data in settings where trained fieldworkers were unavailable (Tsai *et al*., 2014).

This study was approved by the Stellenbosch University Humaniora Research Ethics Committee (HS 1020/2014). Participation was voluntary and all participants signed an informed consent form.

3.2.6 Measuring the treatment effect

The treatment effect is estimated by looking at the impact of a binary indicator equal to one if the participant was in treatment arm one and received the intervention. The binary indicator is equal to zero if the participant was in the control arm. In all regressions, I also control for treatment intensity (i.e., number of days from enrolment until giving birth).[64]

3.2.7 Measuring the outcomes

The outcomes can be divided into two broad categories, namely health facility attendance and health outcomes.

The first set of outcomes discussed are health facility attendance outcomes (Section 3.3.2). The key intermediary outcomes measured in this study is the timing of first antenatal care, but I also consider the frequency of antenatal care visits and institutional births. For frequency of visits, I

[63] Women in the treatment group also received R30 during baseline, but not at endline when they received the box, whilst women in the control group received R30 at baseline and endline for answering questionnaires.
[64] Since women were recruited at different gestational ages, there were differences in the time women spent in the study. For instance, women who were recruited when they were two months pregnant would spend seven months in the study, while women who were recruited at five months would only spend four months in the study.

use a binary indicator to indicate whether they visit the clinic at least four times. Number of visits is affected to some extent by the presence of complications. However, a minimum of four visits is recommended by the WHO. This sample is restricted to women who were recruited into the study prior to 5 months of gestation.

The timing of first ANC visit is measured using a binary indicator named "Early", equal to one if the participant went to the ANC on or before five months of gestation. Participants who never went to the antenatal clinic are considered to have gone to the clinic at nine months of gestation. This sample is restricted to women who were recruited into the study prior to 5 months of gestation. Institutional births are constructed as a binary variable indicating whether a participant did not give birth at a health facility. All health outcome measures are based on information provided in the questionnaires.

The second set of outcomes focuses on the health outcomes (Section 3.3.3) which I was able to measure shortly after participants gave birth. This includes the infant's birth weight, maternal depressive symptoms, maternal nutrition and infant feeding intention. These health outcomes, and how they were measured, are discussed in more detail in their respective subsections.

3.3 Results

I begin with a description of the baseline characteristics and validity of the randomisation process (3.3.1), followed by an analysis measuring the impact of the intervention on (3.3.2) health facility attendance and (3.3.3) health outcomes. I also briefly touch upon the current state of the outcome measure in South Africa and their risk factors where it is deemed necessary.

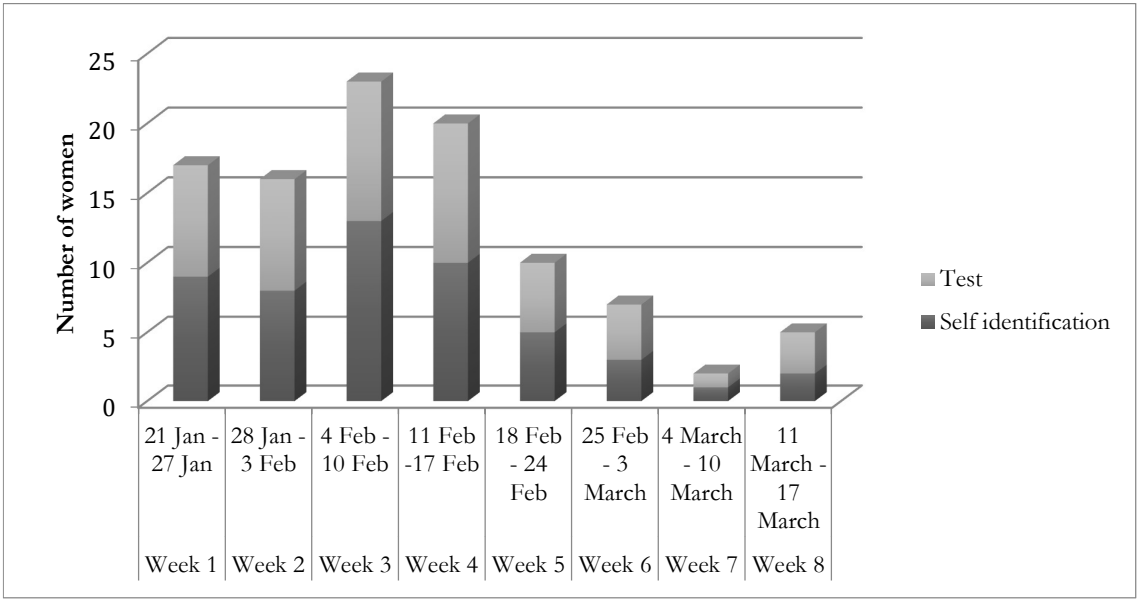
3.3.1 Baseline characteristics

A total of 100 women were recruited during baseline. Refusal to participate at this point was only 5%.[65] I found that take-up and demand for pregnancy tests were very high in the sampling area. Over a period of 36 days, 314 tests were distributed of which 54 were positive, leading to a pregnancy detection rate of 17%. Figure 3.3 shows the progression of enrolment of study

[65] High enrolment for incentive or community health worker programmes and studies are not uncommon. Other incentive programmes, such as the CCT programme PROGRESA in Mexico, also encountered high enrolment into the programme. In the PROGRESS programme, 93% of the eligible participants enrolled (Gertler, 2004). Similarly, in a study by Thornton (2008) in Malawi, 91.1% of individuals offered HIV tests accepted. Philani had similar success in recruiting and enrolling women into their programme, with a refusal rate of 2% (Le Roux *et al.*, 2013).

participants per week. In the figure, I differentiate between women recruited using a pregnancy test and the recruited women who already knew they were pregnant but had not yet accessed antenatal care (self-identification).

Figure 3. 3: Recruiting study participants: pregnancy testing versus self-identification



In Figures 3.4A and 3.4B, I compare the community health worker estimated gestational ages[66] for women recruited into the sample via pregnancy tests and those who already knew they were pregnant (labelled as "self-identified"). The figure shows that women recruited using pregnancy tests (as opposed to women who knew they were pregnant but had not yet been to a clinic) were recruited at a much younger gestational age.

[66] The CHW estimates the gestational age based on the individual's self-reported sexual activities and description of menses.

Figure 3. 4 Gestational age at recruitment

Figure 3.4A: Gestational age at recruitment (with pregnancy test)

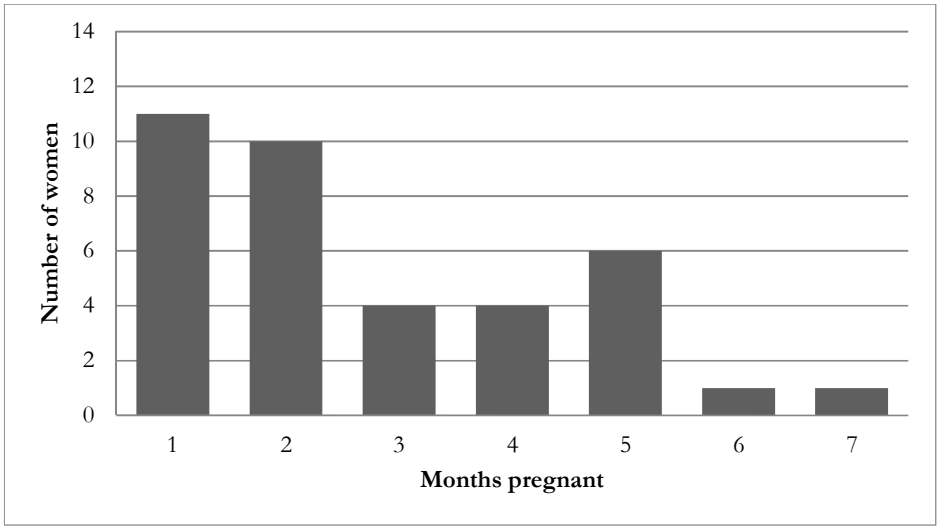
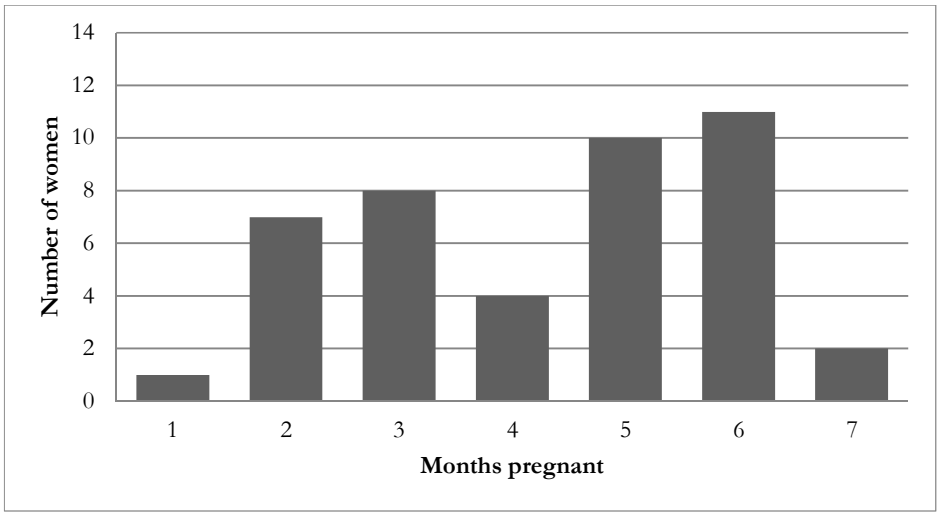


Figure 3.4B: Gestational age at recruitment (self-identified)



These women were randomised into control (50) or treatment (50). The success of the randomisation is assessed in Table 3.1. In only one of the 17 descriptive statistics (cohabitating marital status) is there a significant difference between the participants in the treatment and the control group.

Table 3. 1: Descriptive statistics on study participants aggregated by treatment status

		Full sample		**Treatment**		**Control**		**P-value**
		mean	**(n)**	**mean**	**(n)**	**mean**	**(n)**	
		(C.I.)	100	(C.I.)	50	(C.I.)	51	
	Age	27.39	100	27.14	50	27.63	51	0.695
		(26.16-28.61)		(25.56-28.72)		(25.71-29.55)		
	Unemployed	0.62	63	0.58	29	0.67	34	0.3737
		(0.53-0.72)		(0.44-0.72)		(0.53-0.80)		
Education	Choose not to answer	0.01	1	0.02	1	0	0	0.3149
		(-0.01-0.03)		(-0.02-0.06)		(0.00-0.00)		
	No Schooling	0.02	2	0	0	0.04	2	0.1604
		(-0.01-0.05)		(0.00-0.00)		(-0.02-0.09)		
	Primary (Gr 1-7)	0.15	15	0.14	7	0.16	8	0.8139
		(0.08-0.22)		(0.04-0.24)		(0.05-0.26)		
	Secondary, but no matric	0.64	65	0.62	31	0.67	34	0.6285
		(0.55-0.74)		(0.48-0.76)		(0.53-0.80)		
	Grade 12	0.18	18	0.22	11	0.14	7	0.2819
		(0.10-0.25)		(0.10-0.34)		(0.04-0.24)		
Marital status	Single	0.71	72	0.66	33	0.76	39	0.2492
		(0.62-0.80)		(0.52-0.80)		(0.64-0.89)		
	Married	0.25	25	0.26	13	0.24	12	0.7763
		(0.16-0.33)		(0.13-0.39)		(0.11-0.36)		
	Cohabit	0.04	5	0.08	4	0	1	0.0396**
		(0.00-0.08)		(0.00-0.16)		(0.00-0.00)		

Race	Black African	0.86	87	0.9	45	0.82	42	0.2707
		(0.79-0.93)		(0.81-0.99)		(0.72-0.93)		
	Coloured	0.11	11	0.06	3	0.16	8	0.1206
		(0.05-0.17)		(-0.01-0.13)		(0.05-0.26)		
	Other	0.03	3	0.04	2	0.02	1	0.3149
		(-0.00-0.06)		(-0.02-0.10)		(-0.02-0.06)		
Assets Index		1.91	100	1.88	50	1.93	51	0.7988
		(-1.7-2.1)		(1.61-2.16)		(1.63-2.23)		
Foreign		0.43	43	0.4	20	0.45	23	0.6087
		(0.33-0.52)		(0.26-0.54)		(0.31-0.59)		
Household size		3.81	100	4.04	50	3.59	51	0.33
		(3.35-4.27)		(3.30-4.78)		(3.03-4.15)		
First pregnancy		0.29	29	0.22	11	0.35	18	0.1426
		(0.20-0.38)		(0.10-0.34)		(0.22-0.49)		

*** p<0.01, ** p<0.05, * p<0.1
Note: Confidence intervals in parenthesis.

Women in the sample are on average 27 years of age, and unemployment is approximately 60%. Most women in the sample (64%) have secondary level education, but have not finished Grade 12, and a large share of women reported being unmarried. The largest subgroup of participants was Black African (86%), and most participants had poor wealth status (as measured by the asset index). Almost half of participants were foreign nationals (43%), and almost one in three participants were experiencing their first pregnancy (29%). There were on average four household members in participants' households. A full summary of all covariates included in the analysis is provided in Table A 3.6.1 in the Appendix.

During the intervention, 29 women were lost due to attrition.[67] The reasons for attrition include migration (38%), abortion due to complications (17%), the participant was living in a gang area which was unsafe for the CHW (14%), miscarriage (10%), refusal to participate further (10%), stillbirth (7%) and false pregnancy (3%). Attrition did not affect the quality of randomisation – even after taking account of attrition there were still no significant differences in the baseline characteristics of women in the treatment and the control groups. The remaining sample size available for analysis was 72 observations. To ensure that no observable characteristics predict attrition, a binary variable equal to one if the participant attrited (and zero otherwise) was regressed on a set of observable characteristics (including the binary treatment variable). The estimates are available in Table A 3.6.2 in the Appendix. The results reveal that correlations are predominantly smaller than 0.05 and all results are significantly insignificant. The only exceptions are being in the treatment group (0.12), unemployed (0.14) and Black African (0.17). However, these results are insignificant. A balance test (Table 3.2) also reveals that attrition did not relate into significant differences in the observable characteristics of participants in the treatment and control group.

[67] Although the rate of attrition is fairly high, it is not uncommon for studies in Sub-Saharan Africa which take place over a long period of time to have high rates of attrition due to migration. Baird *et al.* (2010) track a sample of school girls for a 12-month period in Malawi, and only have an attrition rate of 7% amongst treatment and 10% amongst controls. One could argue that given that the participants are still in school it makes them less likely to migrate out of the sample. Le Roux *et al.* (2013) had an attrition rate of 8% between recruitment and birth in one of their studies on Philani. Thornton (2008) had an attrition rate of 18% over a three-year period in a study done in Malawi, most of which can be attributed to migration.

Table 3. 2 Balance test: Descriptive statistics on study participants aggregated by treatment status

		Full sample		**Treatment**		**Control**		**P-value**
		mean	**(n)**	**mean**	**(n)**	**mean**	**(n)**	
		Std. dev.		Std. dev.		Std. dev.		
	Age	27.54	72	27.23	50	27.91	33	0.6255
		5.82		5.13		6.60		
	Unemployed	0.67	72	0.62	50	0.73	33	0.3225
		0.47		0.49		0.45		
Education	Choose not to answer	0.01	72	0.03	50	0.00	33	0.3613
		0.12		0.16		0.00		
	No Schooling	0.01	72	0.00	50	0.03	33	0.2801
		0.12		0.00		0.17		
	Primary (Gr 1-7)	0.18	72	0.15	50	0.21	33	0.5285
		0.39		0.37		0.42		
	Secondary. but no matric	0.63	72	0.62	50	0.64	33	0.8571
		0.49		0.49		0.49		
	Grade 12	0.17	72	0.21	50	0.12	33	0.3481
		0.38		0.41		0.33		
Marital status	Single	0.72	72	0.67	50	0.79	33	0.2588
		0.45		0.48		0.42		
	Married	0.24	72	0.26	50	0.21	33	0.6647
		0.43		0.44		0.42		
	Cohabit	0.04	72	0.08	50	0.00	33	0.1065

		0.20		0.27		0.00		
Race	Black African	0.89	72	0.90	50	0.88	33	0.8053
		0.32		0.31		0.33		
	Coloured	0.08	72	0.08	50	0.09	33	0.8335
		0.28		0.27		0.29		
	Other	0.03	72	0.03	50	0.03	33	0.3613
		0.17		0.16		0.17		
Assets Index		1.81	72	1.83	50	1.78	33	0.8261
		0.94		0.94		0.95		
Foreign		0.44	72	0.41	50	0.48	33	0.5323
		0.50		0.50		0.51		
Household size		3.69	72	3.90	50	3.45	33	0.4382
		2.40		2.72		1.95		
First pregnancy		0.26	72	0.21	50	0.33	33	0.2245
		0.44		0.41		0.48		

*** p<0.01, ** p<0.05, * p<0.1
Note: Confidence intervals in parenthesis.

A summary of the outcomes reported in this analysis is shown in Table 3.3. The outcomes can be divided into two broad categories, namely health facility attendance and health outcomes. In Table 3.3, I report the variable name, the number of observations, the mean and standard deviation, the minimum and maximum values, a short description of the variable and the desired outcome for the treatment group. Each outcome measure is discussed in more detail in their respective sections.

Table 3. 3: Summary and description of outcome variables

Variable	Obs.	Mean	Std. Dev.	Min	Max	Description
Health facility attendance						
Frequency: Four times or more	72	0.69	0.05	0	1	Binary measuring frequency: participant went to clinic at least four (WHO recommended) times
Timing: Went to the clinic before five months' gestation	71	0.68	0.06	0	1	Binary measure of timing: participant went to ANC for the first time before five months of gestation
Timing: Months went	71	4.61	2.00	.25	9	Continuous: Months pregnant when had first antenatal booking visit
Gave birth at home/on the way to the facility	72	0.10	0.04	0	1	Binary: women did not give birth in the hospital
Health outcomes						
Birth weight	71	3038.03	583.92	1100	4370	Continuous: birth weight in grams
Maternal Depressive symptoms	72	1.86	2.23	0	8	Scale from 0 to 16 measuring postnatal depressive symptoms
Maternal Nutrition: MUAC	72	29.48	4.03	22.5	45.6	Middle upper arm circumference in cm
Infant feeding intention	70	5.26	3.27	0	8	Scale from 0 to 8 measuring intention to (and intended duration) of exclusive breastfeeding

3.3.2 Outcome: Health facility attendance

Firstly, I explore the impact of the intervention on health facility attendance amongst women in the treatment group. In a first step, I apply an ordinary least squares estimator[68] to analyse the impact of the intervention on the key health facility attendance variables. Since women are recruited at different gestational ages, they receive differing intensities of the intervention and I include this as a control variable in the regression analyses.

Furthermore, I explore heterogeneity in responses within the treatment group based on behavioural economic theories, concentrating on time-inconsistent preferences and top-of-mind effects. It should be noted that this study tests the impact of a package intervention meant to address various constraints to prudent health seeking behaviour. Therefore, the intervention was not designed to address any of the underlying behavioural theories. Rather, these mechanisms were theorised and tested post-intervention. These mechanisms should be viewed as speculative in nature, and these behavioural theories should be addressed specifically in the design of a larger scale intervention.

Behavioural economics research has shown that individuals value their current experiences more than they value future experiences and call this the future present time bias or time-inconsistent preferences. This is likely to be relevant for pregnant women who need to make decisions on accessing antenatal care as they would be tempted to postpone the visit because of the much higher value placed on the current period over a later period. This makes them unwilling to invest in something like preventative healthcare since it only affects their future and not their current utility (Dupas, 2011). There is large amount of literature that shows that individuals are often surprisingly short-sighted, and have high discount rates when it comes to their future social benefits.

I test whether the intervention deals with these time-inconsistent preferences to promote investment in preventative health mechanisms by creating a commitment contract (Giné *et al.*, 2008; Dupas, 2011; Tarozzi *et al.*, 2014). A commitment contract allows an individual to commit to investment in the future, and have proven successful in increasing investments in preventative healthcare.

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[68] An ordinary least squares estimator, rather than a logit or probit estimator, is applied despite some of the outcomes being binary variables. This is done for ease of interpretation. The marginal effects (as well as the odds ratios) of a logit estimator were also calculated, and delivered estimates of a similar size and significance. Therefore, I am confident in the choice to use a OLS.

Whether a participant has time-inconsistent preferences is calculated from a set of questions answered in the endline questionnaire.[69] Participants were asked a series of questions asking them what value gifts they would accept at different points in time. Time-inconsistent preferences are measured with a binary variable labelled "Revealed time-inconsistent preference". Both these variables are also interacted with the binary treatment variable to detect a higher response for the subgroup.

The second possible channel, through which the intervention may have an effect on frequency and timing of antenatal care, is if it acts as a reminder or moral mirror for women who are overwhelmed by their day-to-day responsibilities. This is referred to as a "top-of-mind" effect, and occurs when a pregnant woman pays limited attention to accessing care since it is low down on her list of priorities. The intervention will have an impact as it serves as a reminder. Different from time-inconsistent preferences, in the case of the "top-of-mind" effect, a non-binding commitment will act as a good enough intervention as it works through focusing the attention of the participant rather than affecting self-control (Karlan *et al.*, 2016).

I measure the "top-of-mind" effect by looking at the household size, the participant's number of children, whether the pregnancy was planned, and her level of education. All these variables are also interacted with the binary treatment variables to test whether women with these characteristics might respond differently to treatment. Although I do control for level of wealth using the asset index, these proxies for "top-of-mind' effects may be confounded with poverty. Therefore, I should reiterate that these results are of a purely speculative nature, meant as a starting point for future, large-scale analysis.

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[69] The questions posed to respondents read as follows:

Q88 I'm just going to ask you a question. If a church or NGO want to give you a gift and they say they will either (1) give you R200 today or (2) R300 in one month, which one would you choose? This is not going to happen, I just want to ask you what you think.

(1) R200 today.
(2) R300 in one months' time.

Q89 What if they would give you (1) R200 in 6 months' time or (2) R300 in 7 months' time? Which one would you choose? I just want to state again, that this isn't going to happen, I just want to ask you what you think.

(1) R200 in 6 months.
(2) R300 in 7 months.

For the first question, 75% of women preferred R200 today and 25% preferred R300 in one months' time.
For the second question 54% of women preferred R200 in 6 months and R300 in 7 months.

The effect of exposure to the package intervention on utilisation of specific maternal care services are shown in Table 3.4. The table reports the coefficient estimate on the treatment variable from an ordinary least squares estimator, before and after controlling for covariates. The table shows that the interventions had a significant impact on the frequency of antenatal care sought and getting women to an antenatal clinic earlier. For this part of the analysis, I will only be looking at women recruited into out sample on or before five months of gestation, since the ability of the intervention to influence the frequency and timing of women's access to antenatal care after this period would have been significantly reduced. This reduces the sample from 72 to 61 women.

Participants who were exposed to the intervention treatment were 23.4 percentage points more likely to go to the antenatal clinic four times or more (significant at a 5% level) and 32.5 percentage points more likely of going to the antenatal clinic for the first time before five months of gestation (significant at a 5% level). The results remain significant and similar in size after controlling for confounding factors.

The intervention did not have a significant effect on the probability of delivering at a health facility.[70] The results in Row (43 of Table 3.4 show that participants in the treatment group were 0.8 percentage points more likely to give birth at home or in the car on the way to the facility. After controlling for confounding factors, the likelihood of delivering at home or on the way to the hospital becomes negative, but remains small. However, the effect is imprecisely estimated. It should be noted that only 10% of women in the sample did not give birth at a facility, making it a low frequency event.

The large and significant impact of the intervention on the timing of first ANC visit requires further investigation. As a result, I explore the impact of the intervention on months of gestation at the time of accessing ANC services in order to quantify the impact of the intervention. For this purpose, I use an ordinary least squares estimator, and regress the months of gestation at the time

[70] This is not unexpected given that this was not one of the targeted and incentivised outcomes. Women in the treatment group did receive health information from CHWs to help them prepare for delivery and to educate them on recognising the signs of labour. However, this did not translate into more facility deliveries. Other channels, such as whether a participant owned a car, was also controlled for but did not deliver conclusive results. Geographical access should also not be a problem in this study given its urban context. Haddad and co-authors find that geographical access to clinics in peri-urban Pretoria was difficult for approximately 20% of their sample, but that this had no impact on their care-seeking behaviour (Haddad *et al.*, 2016). To conclude, the barriers to giving birth at facilities are not clear from my analysis.

of accessing ANC onto the binary variable equal to one if a participant is in the treatment group. This provides me with a more quantifiably relatable measure of the impact of the intervention. The results are shown in Table 3.5.

Participants are likely to access the antenatal clinic on average 1.2 months earlier if they are in the treatment group (significant at 1% level). After controlling for confounding factors, the effect becomes slightly bigger at 1.34 months earlier, and remains statistically significant at a level of 1 percent.

Table 3. 4: The impact of the intervention on main health facility attendance outcome variables

		Coefficient estimated (unadjusted)	(SE)	**Coefficient estimate (adjusted)**	(SE)	Observations
Went to the ANC more than four times						
	Treatment	0.234**	(0.0990)	0.227**	(0.110)	61
Went to ANC before 5 months' gestation						
	Treatment	0.325***	(0.103)	0.345***	(0.120)	61
Gave birth at home/on the way to the facility						
	Treatment	0.00852	(0.0714)	-0.0347	(0.077)	72

Significance: *** p<0.01, ** p<0.05, * p<0.1
SE Standard error
+Note: Both adjusted and unadjusted coefficient estimates control for the difference in time that participants were exposed to the study.
++Note: Other confounding variables controlled for in the adjusted coefficient estimates are age, education, population group, asset wealth, being foreign, household size, first pregnancy, and found out that they were pregnant from the CHW pregnancy test.
+++Note: In result (2), where I observe the effect of the number of visits on frequency of visits, I also control for the binary treatment variable.

Table 3. 5: The impact of the intervention on months of gestation participants accessed care

	Coefficient estimated (unadjusted)	(SE)	**Coefficient estimate (adjusted)**	(SE)	Obs.
Treatment	-1.170***	(0.418)	-1.348***	(0.433)	72

Significance: *** p<0.01, ** p<0.05, * p<0.1
SE Standard error
+Note: Both adjusted and unadjusted coefficient estimates control for the difference in time that participants were exposed to the study.
++Note: Other confounding variables controlled for in the adjusted coefficient estimate are age, education, population group, asset wealth, being foreign, household size, first pregnancy, and found out that they were pregnant from the CHW pregnancy test.

3.3.2.1 Possible channels of effect

The next step is to explore the reason for this behavioural change amongst participants in the treatment group. I considered two theories, namely time-inconsistent preferences and top-of-mind effects.

Time-inconsistent preferences

The tests for the impact of the intervention on overcoming time-inconsistent preferences as the mechanism for improving the frequency and timing of antenatal care are shown in Tables 3.6 and 3.7 respectively. The proxy testing for time-inconsistent preferences is the "revealed time-inconsistent variable" (equal to one if participant revealed time-inconsistent preferences). The table shows the results from the interaction of the treatment dummy with the time-inconsistent variable, the coefficient on the time-inconsistent variable and the coefficient estimate on the treatment variable.

In Table 3.6, I show that the treatment did not affect antenatal care seeking frequency through participants with time-inconsistent preferences. Although women in the treatment group were 22.6 percentage points more likely to access care frequently than women in the control group, this estimate declined to 5 percentage points (0.226 Treatment -0.177 Treatment*Time-inconsistent preferences) for women in the treatment group with time-inconsistent preferences. The coefficient on the time-inconsistent preference variable is also positive, indicating that that women in the control group with time-inconsistent preferences were more likely to access care frequently, compared to participants in the treatment group with time-inconsistent preferences (Table 3.6, Test 1). This result is contrary to what I would expect given the literature. One possibility is that time-inconsistent preferences were poorly measured. A further concern may be the small cell sizes (described in the footnote below the table).

The same is true for the timing of antenatal care seeking behaviour (table 3.7).

Table 3. 6: The impact of the intervention on overcoming time-inconsistent preferences: frequency of care[71]

	Went to the ANC four times or more	**Coefficient estimated (unadjusted)**	**SE**	**Coefficient estimated (unadjusted)**	**SE**
Test 1	Time-inconsistent preference*Treatment			-0.177	(0.235)
	Time-inconsistent preference	0.120	(0.116)	0.221	(0.177)
	Treatment	0.224**	(0.0995)	0.226**	(0.115)

Significance: *** p<0.01, ** p<0.05, * p<0.1
SE Standard error
+Note: All estimates control for the difference in time that participants were exposed to the study.
++Note: Other confounding variables controlled for in the adjusted coefficient estimate are age, education, population group, asset wealth, being foreign, household size, first pregnancy, and found out that they were pregnant from the CHW pregnancy test.

Table 3. 7: The impact of the intervention on overcoming time-inconsistent preferences: timing of care[72]

	Went to ANC before 5 months' gestation	**Coefficient estimated (unadjusted)**	**SE**	**Coefficient estimated (unadjusted)**	**SE**
Test 1	Time-inconsistent preference*Treatment			-0.242	(0.245)
	Time-inconsistent preference	-0.0105	(0.121)	0.128	(0.185)
	Treatment	0.326***	(0.105)	0.385***	(0.120)

Significance: *** p<0.01, ** p<0.05, * p<0.1
SE Standard error
+Note: All estimates control for the difference in time that participants were exposed to the study.
++Note: Other confounding variables controlled for in the adjusted coefficient estimate are age, education, population group, asset wealth, being foreign, household size, first pregnancy, and found out that they were pregnant from the CHW pregnancy test.

Top-of-mind effect

The second possible channel, through which the intervention may have an effect on frequency and timing of ANC, is if it acted as a reminder or moral mirror for women who are overwhelmed by their day-to-day responsibilities.

The tests for whether the intervention had an impact on the frequency and timing of ANC visits via a "top-of-mind" effect is shown in Tables 3.8 and 3.9 respectively. I investigate whether the

[71] In this interaction analysis, there were 10 participants who had both time-inconsistent preferences and were in the treatment group; there were overall 16 participants who revealed time inconsistent preferences, and 31 respondents in the treatment group.
[72] In this interaction analysis, there were 10 participants who had both time-inconsistent preferences and were in the treatment group; there were overall 16 participants who revealed time inconsistent preferences, and 31 respondents in the treatment group.

intervention had different effects for those who were dealing with time-consuming responsibilities in the form of having several children or household members, for whom the pregnancy was unplanned (and may therefore engage in avoidance behaviour) or who had fewer years of schooling (and who may therefore be more vulnerable to distractions).

I find mixed evidence that the intervention had a small and positive effect on health-seeking behaviour amongst women who may have been overwhelmed by their day-to-day activities (Table 3.8). I find an increased likelihood of accessing care frequently for every extra child of 13.3 percentage points or for extra household member of 5.03 percentage points for women in the treatment group. The same cannot be said for women with unplanned pregnancies (test 3). Women in the treatment group with unplanned pregnancies were 4.85 percentage points less likely to access care four times or more than women in the treatment for whom the pregnancy was planned.

In table 3.9, I observe the effect of the treatment and interaction effects on timing of antenatal care. For participants within the treatment group, women were 10.3 percentage points more likely to access care early with every extra child (test 1). A similar, but smaller effect of 3 percentage points exists for women in the treatment group with every additional household member. However, the opposite is true for unplanned pregnancies. Women in the treatment group who experienced unplanned pregnancies were 34 percentage points less likely to access care before 5 months of gestation than women in the treatment group for whom the pregnancy was planned. Additionally, I find that women in the control group with unplanned pregnancies were more likely to access care earlier than women in the treatment group with unplanned pregnancies. Although the overall effect of unplanned pregnancies on timing of care is negative as expected, interacting it with the treatment variable delivers counterintuitive results. Therefore, having an unplanned pregnancy may not be a good proxy for women who were 'overwhelmed'.

Table 3. 8: The impact of the intervention through a "top-of-mind" effect: frequency of care

	Went to the ANC four times or more	**Coefficient estimated (unadjusted)**	**SE**	**Coefficient estimated (unadjusted)**	**SE**
Test 1	Number of children*Treatment			0.133	(0.0838)
	Number of children	-0.0278	(0.0610)	-0.117	(0.0822)
	Treatment	0.204*	(0.111)	0.032	(0.155)

Test 2	Household size*Treatment			0.0503	(0.0484)
	Household size	-0.0383	(0.0274)	-0.0708	(0.0418)
	Treatment	0.227**	(0.110)	0.0429	(0.219)
Test 3	Unplanned pregnancy*Treatment[73]			-0.0485	(0.241)
	Unplanned pregnancy	-0.208*	(0.115)	-0.182	(0.173)
	Treatment	0.182*	(0.108)	0.214	(0.194)

Significance: *** p<0.01, ** p<0.05, * p<0.1
SE Standard error
+Note: All estimates control for the difference in time that participants were exposed to the study.
++Note: Other confounding variables controlled for in the adjusted coefficient estimate are age, education, population group, asset wealth, being foreign, household size, first pregnancy, and found out that they were pregnant from the CHW pregnancy test.

Table 3. 9: Does the intervention work via a "top-of-mind" effect on timing?

	Went to ANC before 5 months' gestation	**Coefficient estimated (adjusted)**	**SE**	**Coefficient estimated (adjusted)**	**SE**
Test 1	Number of children*Treatment			0.102	(0.0896)
	Number of children	-0.0675	(0.0639)	-0.136	(0.0873)
	Treatment	0.340***	(0.118)	0.203	(0.168)
Test 2	Household size*Treatment			0.0297	(0.0559)
	Household size	-0.0251	(0.0295)	-0.0443	(0.0467)
	Treatment	0.345***	(0.120)	0.236	(0.237)
Test 3	Unplanned pregnancy*Treatment[74]			-0.341	(0.258)
	Unplanned pregnancy	-0.0909	(0.125)	0.0912	(0.185)

[73] Please note that there were 43 women in this sample for women the pregnancy was unplanned, 21 of which were in the treatment group.
[74] Please note that there were 43 women in this sample for women the pregnancy was unplanned, 21 of which were in the treatment group.

	Treatment	0.318***	(0.118)	0.543**	(0.207)

Significance: *** p<0.01, ** p<0.05, * p<0.1
SE Standard error
+Note: All estimates control for the difference in time that participants were exposed to the study.
++Note: Other confounding variables controlled for in the adjusted coefficient estimate are age, education, population group, asset wealth, being foreign, household size, first pregnancy, and found out that they were pregnant from the CHW pregnancy test.

3.3.3 Outcome: Health outcomes

Next, I give an overview of the effect of the intervention on the intermediary health outcomes measured, namely birth weight, maternal depressive symptoms, maternal nutrition and infant feeding intention. These outcomes were captured during the endline survey, a week after participants gave birth. Each health outcome is briefly discussed in their respective subsections, and a description of the variables was described earlier in Section 3.2.7. Although I only report on some of the significant and interesting results, a complete summary and discussion of the results are placed in the Appendix and referred to in the text.

3.3.3.1 Birth weight

Estimates put the incidence of low birth weight (LBW) in South Africa between 12% in 2009 (OECD, 2011) and about 15% in 2010 (Tomita *et al.*, 2015), and complications associated with being born with low birth weight or preterm is the leading cause of death amongst neonates in South Africa (Bamford, 2013). As a large contributor to infant mortality, LBW entails economic consequences for society via the burden hospital care costs associated with LBW places on the public healthcare system (Almond *et al.*, 2005; Hummer *et al.*, 2014). A recent Lancet article estimated that in 2011, 817 000 neonatal deaths and 418 000 infant deaths globally were attributable to LBW (Black *et al.*, 2013). Findings from the PROMISE exclusive breastfeeding promotion cluster randomised controlled trial found that being born with low birth weight increased the risk of being hospitalised or dying amongst infants younger than six months by almost two and a half times (Doherty *et al.*, 2014). Other studies focusing on developing countries have found this risk to be even higher (Imdad & Bhutta, 2013).

LBW also affects several other later-life infant and child outcomes which can be considered economic consequences of LBW. These include stunting (Black *et al.*, 2013; Zembe-Mkabile *et al.*, 2015), attainment of schooling (Behrman & Rosenzweig, 2004), lifetime earnings (Behrman &

Rosenzweig, 2004), but also emotional and behavioural outcomes such as attention span (Hayes & Sharif, 2009).

The incidence of LBW is predominantly the result of intrauterine growth restriction and/or preterm birth (Katz *et al.*, 2013), which can be linked to the presence of various clinical, socioeconomic and structural (such as access to care) risk factors. As such, it can be used as an indicator of prenatal development and infant health**.** A comprehensive discussion of the risk factors of LBW is included in the Appendix Section A 3.7.

In Table 3.10, the impact of being in the treatment group before and after controlling for various covariates on birth weight is estimated. The outcome variable is the continuous measure of birth weight measured in grams, and an ordinary least squares estimator is applied. In the table, I only report the results from the treatment variables, but the comprehensive set of results is reported in Table A 3.7.1 in Section A 3.7 of the Appendix. The estimates show that the treatment had no significant effect on birth weight (Column [1]). This effect does not change if I control for baseline characteristics (Columns [2]). The results in the appendix reveal (Table A 3.7.1 in Section A 3.7) that being unemployed has a robustly negative effect on birth weight (presumably through its impact on income), while being a foreign national has a robustly positive effect on birth weight.

Table 3. 10: The impact of the intervention on birth weight in grams

	OLS	OLS
Dependent variable: birth weight in grams	[1]	[2]
Treatment	-18.34	-49.73
	(141.0)	(141.8)
Number of visits from CHW		
Control for socio-demographic factors	No	Yes
Observations	71	71
R-squared	0.010	0.320

*** p<0.01, ** p<0.05, * p<0.1; Standard errors in parenthesis
+Note: the analysis was also performed using a binary outcome variable equal to one if woman's neonate weighed less than 2500 grams, and is therefore considered low birth weight. The results remained consistent.
++Note: All estimates control for the difference in time that participants were exposed to the study.
Socio-demographic factors: Age, age squared, unemployed, Black African, asset wealth, foreign national, household size, participant finished high school, married, identified using a pregnancy test.

In a second step to explore the effect of risk factors on birth weight, I interact the treatment effect with the significant and/or large risk factors to determine whether the intervention had a protective role for vulnerable subgroups. I report the results from the interaction of the treatment variable with pregnancy complication in Table 3.11. The results show that where a woman had pregnancy complications the intervention did not help to prevent low birth weight. In Column (2) it shows that having pregnancy complications will lead to a 345-gram reduction in birth weight. It appears that being in the treatment group intensifies the negative effect. Neonates born from participants who experienced pregnancy complications and were in the treatment group weighed on average 881 grams less than their counterparts in the control group (Column (4)). The effect is significant at a 1% level.

In the sample, 8 women in the control group and 10 women in the treatment reported experiencing pregnancy complications. It should be noted that complications reported are mostly having high blood pressure. The occurrence of high blood pressure is not something that the intervention would have been able to change, but is something that should have been detected had they received the necessary care. Therefore, the presence of pregnancy danger signs may not have been influenced by the intervention, but knowledge of pregnancy danger signs may have been influenced by the intervention. Furthermore, the nature of birth weight as a health outcome that is largely determined by biomedical factors may also have affected the counter-intuitive interaction

Table 3. 11: The role of the intervention on women experiencing pregnancy complications

	OLS	OLS	OLS	OLS
Dependent variable: birth weight in grams	(1)	(2)	(3)	(4)
Pregnancy complications*Treatment[75]			-745.1**	-811.0***
			(292.1)	(290.4)
Pregnancy complications	-341.0**	-345.1**	66.85	102.8
	(148.9)	(150.4)	(216.7)	(216.0)
Treatment		23.58	211.6	227.1
		(132.3)	(146.9)	(140.8)
Covariates	No	No	No	Yes

*** p<0.01, ** p<0.05, * p<0.1; Standard errors in parenthesis
+Note: covariates include age, age squared, unemployed, Black Africa, Asset index, foreign nationality, household size, first pregnancy, at least high school level of education, married and identified using a pregnancy test.
++Note: All estimates control for the difference in time that participants were exposed to the study.

[75] Please note that there were overall 18 participants who experienced pregnancy complications, of which 10 were in the treatment group.

3.3.3.2 Maternal depressive symptoms

Data on the prevalence rates of antenatal depression are sparse in South Africa, and available estimates are predominantly area-specific. Hartley *et al.* (2011), focusing on antenatal depression in two Cape Town low-income, peri-urban settlements, find an antenatal depression rate of 39%. Also focusing on urban Cape Town, Baron and co-authors find this rate to be slightly lower at around 19% (Baron *et al.*, 2015), and the rate is found to be between 20% and 24% in another area in the Western Cape (Brittain *et al.*, 2015; Stein *et al.*, 2015). Prevalence often differs by area sampled, but remains high with at least one in five women who have recently given birth suffering from depression. This is similar to antenatal depression rates found in urban Kwazulu-Natal (38.5%), and postnatal depression in urban Johannesburg (16.4%) (Ramchandani *et al.*, 2009; Manikkam & Burns, 2012).

In South Africa, antenatal depression has often been linked to women who were abused or not supported by their partners, teenage pregnancies or very low levels of household income. Other risk factors of antenatal and postnatal depression are discussed in detail in Appendix Section A 3.8.

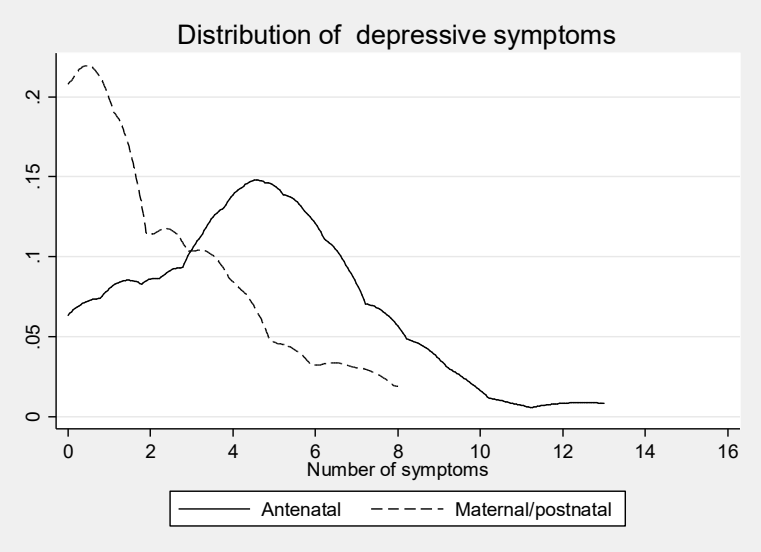
Antenatal and postnatal depression has repercussions for the health outcomes and health-related behaviour of mother and infant. For instance, it can lead to poor bonding between mother and infant (Rossen *et al.*, 2016), adverse foetal growth (Brittain *et al.*, 2015) and may affect various other biomarkers of the infant (Gentile, 2015). In South Africa, maternal depression (prior and during pregnancy) has been linked to the incidence of low birth weight (Tomita *et al.*, 2015).

In this study, antenatal and maternal (postnatal) depressive symptoms are measured using the scale developed by Mark Tomlinson and implemented by Philani to monitor the presence of depression in their communities. The scale is an adaption of the Edinburgh Postnatal Depression Scale, a screening tool for depressive symptoms. Philani and Tomlinson adapted the scale for their study setting. The scale is based on women revealing depressive symptoms, rather than actual clinical diagnosis and the scale is therefore referred to as measuring depressive symptoms rather than depression. Antenatal depressive symptoms were captured during the baseline questionnaire when women were pregnant, while maternal (or postnatal) depressive symptoms were captured during the endline survey, a week after women had given birth.

The maternal depressive symptom scale ranges from null to 16, with a higher value indicating the presence of more depressive symptoms. The distribution of maternal depressive symptoms across the entire sample is shown in Figure 3.5. At baseline, most women in the sample showed the presence of 3 to 6 depressive symptoms on average. This distribution shifted to the left when I

monitored the presence of depressive symptoms after birth: the figure shows that the presence of maternal/postnatal depressive symptoms amongst women in the sample was relatively low, with no-one scoring more than eight on the scale.

Figure 3. 5: The distribution of depressive symptoms at the antenatal versus postnatal period



In Table 3.12, the impact of the intervention on maternal depressive symptoms (collected at endline) is measured using an ordinary least squared estimator. In this section, I only report the results from the impact of the binary treatment variable. The estimates for the remaining risk factors are reported in the Appendix Table A 3.8.1 in Section A 3.8 of the Appendix.

Table 3. 12: The impact of the intervention on maternal depressive symptoms

	OLS	OLS	OLS
	[1]	[2]	[3]
Treatment	-1.164**	-1.077**	-1.051**
	(0.504)	(0.497)	(0.518)
Control for "Planned pregnancy" and antenatal depression		Yes	Yes
Control for socio-demographic factors		No	Yes
Observations	72	72	72
R-squared	0.117	0.183	0.360

*** p<0.01, ** p<0.05, * p<0.1; Standard errors in parenthesis
Socio-demographic factors: age, age squared, unemployed, Black African, Asset index, foreign nationality, household size, first pregnancy, at least high school level of education, married and identified using a pregnancy test.

++Note: All estimates control for the difference in time that participants were exposed to the study.

In estimate [1] the continuous maternal depressive symptom score is regressed onto the binary treatment variable. Women in the treatment group were likely to have a significantly lower maternal depressive score. On average, women receiving the intervention scored 1-point lower on the maternal depressive symptoms score. The effect remains significant and similar in size after controlling for possible confounding factors, ([2] and [3]).

Risk factors of maternal depressive symptoms in the sample include the number of antenatal depressive symptoms detected and having an unplanned pregnancy. I find a positive relationship between maternal depressive symptoms and wealth status: the richer an individual, the more likely they are to show symptoms of maternal depression (Appendix Table 3.8.1). This relationship is unexpected, given the literature on maternal depression, but may not reveal much, given that the level of wealth in the sample is already low.[76]

3.3.3.3 Maternal nutrition[77]

Maternal malnutrition (undernutrition or obesity), can have severe consequences on the health of both mother and infant. Research articles focusing on maternal malnutrition and its determinants are few due to the limited data available on the subject (Nannan *et al.*, 2007).[78] Countries like South Africa experiencing economic and consequently nutritional transitions are also characterised by the presence of dual burden households, where parents or adults are overweight and children are undernourished (Jehn & Brewis, 2009). This makes designing a policy response to target malnutrition difficult, as different policy responses are usually prescribed to under- versus over-nutrition.

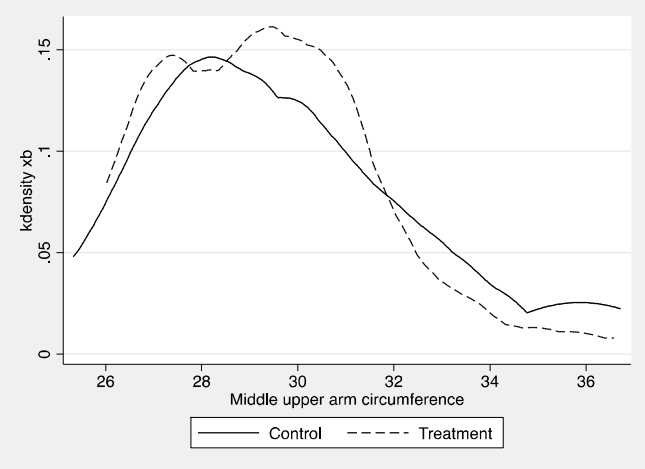
Various methods are used to measure maternal malnutrition, including body mass index of women of childbearing age (Nannan *et al.*, 2007), weight circumference (Sattar *et al.*, 2001), BMI adjusted for gestational age (Davies *et al.*, 2012) and mid-upper arm circumference or MUAC (National Department of Health, 2007b; Grundlingh *et al.*, 2013). There is little consensus on which method is the most reliable (Ververs *et al.*, 2013). In this study, I measure malnutrition using middle-upper arm circumference (MUAC). MUAC is a less costly way to measure maternal malnutrition,

[76] This unexpected positive relationship between maternal depression and wealth is robust to various specifications, including the bivariate relationship between these two variables of interest.
[77] Maternal nutrition in this study is used to describe maternal stature. Maternal micronutrient deficiencies are also described as maternal malnutrition, but were not captured in this analysis.
[78] The health outcomes and possible risk factors contributing to maternal malnutrition are discussed in the Appendix Section 3.9.

especially in a low-resource setting, and is frequently used in South Africa (Rollins *et al.*, 2007).

Figure 3.6 shows the distribution of MUAC in centimetres (adjusted for MUAC at baseline) for both the control and treatment arms. Women in the treatment arm had slightly more women in the healthy normal range of MUAC ranging between 29 and 32. Women in the control group are marginally more likely to have distributions at the tails of the distribution, at the upper and lower values of MUAC.

Figure 3. 6: Distribution of MUAC across treatment and control arms



Regression analysis of the impact of the intervention on participants' MUAC was performed, but no significant results were found. The results are reported in Table 3.13. The bivariate relationship between the binary treatment variable and MUAC in centimetres is reported in Column [1]. The results show a small, positive and insignificant relationship between receiving the intervention and MUAC. The relationship does not change when controlling for other risk and confounding factors (Columns [2] - [3]]), but remains statistically insignificant. After controlling for confounding factors, women in the treatment group are likely to have a MUAC of approximately 0.4 cm higher than women in the control group. This effect is of such a small size that it could possibly be attributed to measurement error during data collection.

Table 3. 13: The impact of the intervention on the MUAC of participants

Outcome: MUAC in cm	OLS	OLS	OLS
	[1]	[2]	[3]
Treatment	0.465	0.320	0.276
	(0.801)	(0.828)	(0.873)
Control for socio-demographic variables	No	Yes	Yes

Control for health and lifestyle factors	No	No	Yes
Observations	72	72	72
R-squared	0.388	0.543	0.619

*** p<0.01, ** p<0.05, * p<0.1; Standard errors in parenthesis
+Note: Since I am interested in the change in MUAC, all estimates control for the participant's MUAC at baseline.
++Note: All estimates control for the difference in time that participants were exposed to the study.
Health and lifestyle factors: Diagnosed with diabetes, stroke, TB, number of children and antenatal depressive symptoms.
Socio-demographic factors: age, age squared, unemployed, Black African, Asset index, foreign nationality, household size, first pregnancy, at least high school level of education, married and identified using a pregnancy test.

The full set of results from this regression analysis and the various correlates of MUAC is given and discussed in the Appendix Section A 3.9. Given the lack of research done on the risk factors to maternal malnutrition in South Africa, the results from the analysis may prove fruitful as a contribution to the public health literature.

Given that both low and high values of middle upper arm circumference are problematic from a health perspective, I also perform regression analyses looking at the impact of the treatment variable on the participant's probability of being obese and underweight is performed and discussed in the Appendix Section A 3.9. The intervention did not have any impact on either outcomes.

3.3.3.4 Infant feeding intention

Exclusive breastfeeding is often promoted as a source of feeding provision in resource-poor countries, as it has several health benefits (Kramer & Kakuma, 2012).[79] In a low-resource setting, where exclusive formula feeding is not always affordable, exclusive breastfeeding is recommended for six months, regardless of HIV status. Formula feeding in a low-resource environment can often pose a dangerous risk to neonatal mortality due to exposure to poor hygiene and sanitation conditions (Meyer *et al.*, 2007). Breastfeeding is considered one of the most cost-effective strategies for child survival, decreasing the incidence of risk factors contributing to neonatal mortality.

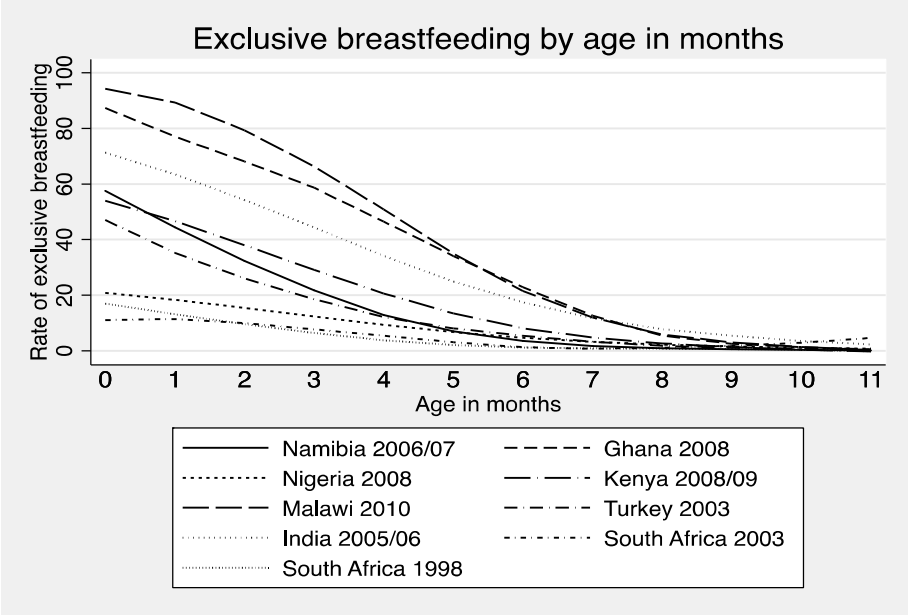
Breastfeeding initiation rates are reportedly high in South Africa, while breastfeeding duration and exclusivity fairs poorly compared to international standards (Meyer *et al.*, 2007). According to the SADHS 2003, 81% of women who gave birth between 1998 and 2003 had breastfed their infants for any amount of time (National Department of Health, 2007a). Of those who had breastfed, only 61% had started breastfeeding within an hour of birth. Although breastfeeding is occasionally introduced alongside formula feeding, exclusive breastfeeding rates (where the infant is given only

[79] See Appendix Section A 3.10 for a summary of the benefits of exclusive breastfeeding.

breastmilk, and nothing else) in South Africa are extremely low. By 2003, the exclusive breastfeeding rate of children younger than 6 months was only 8.3% (National Department of Health, 2007a). This is well below the reported average exclusive breastfeeding rate of 33% and 39%[80] for low- and middle-income countries in 1995 and 2010 respectively (Cai *et al.*, 2012).

In Figure 3.7 I report the rate of exclusive breastfeeding at different infant ages for various resource constrained countries. The figure is constructed from estimates collected from demographic and health survey (DHS) reports. The figure shows the poor performance in exclusive breastfeeding in South Africa relative to other countries in the DHSs.

Figure 3. 7: Exclusive breastfeeding rates across countries reported in the DHS



Source: various DHS reports

Meyer *et al.* attribute low exclusive breastfeeding rates in South Africa to unethical promotion of feeding formula by large producers of breast milk substitutes, rapid urbanisation which have led to the adoption of westernised diets and the mixed messaging on breastfeeding for HIV positive mothers[81] (Doherty *et al.*, 2006; Meyer *et al.*, 2007). These mixed messages have translated into severe uncertainty amongst women about what is the best option (Doherty *et al.*, 2006). Other risk factors or barriers to exclusive breastfeeding identified in the literature is urbanisation (Trussell *et*

[80] These estimates are based on the average across 66 low- and middle-income countries. The estimates exclude China.
[81] Please see Appendix Section A 3.10 for a discussion of the role of the HIV epidemic on exclusive breastfeeding rates in South Africa.

al., 1992), employment, low maternal education, births by either adolescent or older mothers, presence of maternal or infant morbidities, poor access to refrigeration facilities or constant supply of electricity and a lack of social support (Balogun *et al.*, 2015). Low income levels also pose a threat to exclusive feeding[82] as well as the perception that breast milk is not adequate nutrition for the infant.

Cultural influence and beliefs have also acted as barriers to exclusive breastfeeding, especially when enforced by family and community members (Balogun *et al.*, 2015). Using qualitative methods, Doherty *et al.* (2006) find that women's initial decision to exclusively breastfeed can often be overridden by the decision of a family member such as a mother or grandmother. Financial dependence on family members exacerbates this pressure (Doherty *et al.*, 2006). Studies have also found a relationship between antenatal care attendance and exclusive breastfeeding rates (Balogun *et al.*, 2015).[83] Community health worker programmes have been used successfully to promote exclusive breastfeeding.[84]

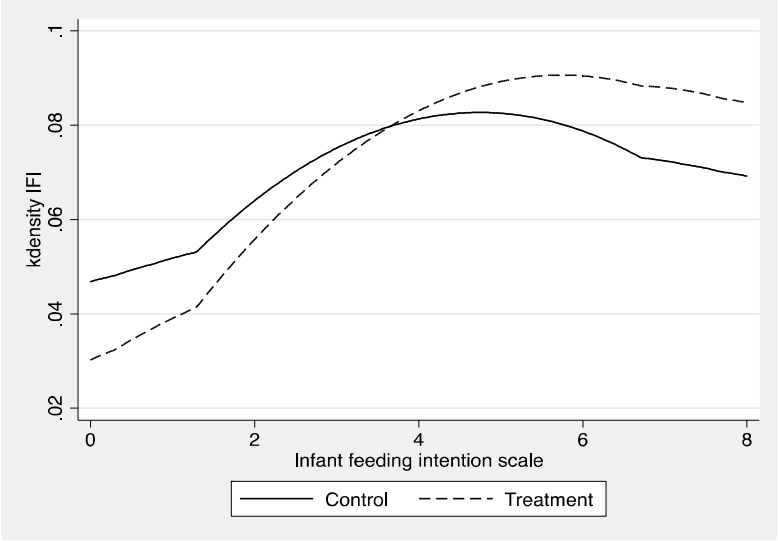
The limited budget of the study meant that I could not follow up with participants after six months to find out whether they were breastfeeding. I use infant feeding intention (measured a week after giving birth) as an intermediary measure of exclusive breastfeeding, measured using an adapted version of the infant feeding intention (IFI) scale. The scale is developed to measure the intended duration and exclusivity of breastfeeding (Nommsen-Rivers & Dewey, 2009), and measures to what degree participants agree with statements about breastfeeding. These measurements are added to create a range from 0 (No intention to breastfed at all) to 8 (Very strong intention to breastfeed exclusively for six months).[85, 86]

In Figure 3.8, I depict the distribution of the IFI for both control and treatment arms. The proportion of women with medium to high IFI scores ($4<x<8$) is higher amongst women in the

[82] Women who decide to exclusively formula feed may have had to resort to mixed feeding if they are unable to afford formula milk during the first six months of life (Doherty *et al.*, 2006).
[83] Santo *et al.* (2007) find that exclusive breastfeeding is higher amongst women who access care six times or more (Santo *et al.*, 2007). Okafor *et al.* (2014) find that attending formal antenatal care and delivering in an institutional facility are both positively correlated with exclusive breastfeeding up until six months (Okafor *et al.*, 2014). These studies do not attempt to answer whether this is due to the impact of clinic interventions on breastfeeding, or whether women who self-select into attending antenatal clinics more frequently are also those who would self-select into exclusive breastfeeding.
[84] Please see Appendix Section A 3.10 for a description of CHW programmes and other peer support programmes that have been successful in increasing rates of exclusive breastfeeding.
[85] The original scale ranges from 0 to 16. However, while piloting the scale with CHWs, they indicated that it would be too difficult for participants to interpret. As a result, the scale was simplified.
[86] The adapted scale is provided in Appendix Section A 3.10.

treatment compared to control group. The opposite is true for medium to low IFI scores (0-4).

Figure 3. 8: Distribution of IFI scores by treatment group



In Table 3.14, I explore the impact of being part of the intervention on infant feeding intention. The dependent variable in these regressions is the continuous infant feeding intention value. Therefore, I apply an ordinary least squares. I only report on the results of the treatment variables and statistically significant risk factors. The remainder of the results are available in Table A 3.10.2 in Appendix Section A 3.10. Women in the treatment group on average score one point higher than women in the control group on the IFI scale [1]. The effect is not precisely estimated, possibly due to the small sample size. The size of the effect remains the same after controlling for variation in socioeconomic status and other demographic factors [2].

In Table 3.14, I also control for the relationship between various socioeconomic and cultural factors and the IFI scale. According to the estimates, age and intention to exclusively breastfeed are negatively and significantly correlated. For every extra year of age, participants are likely to score lower on the IFI scale (Column [2]).

Another significant risk factors for exclusive breastfeeding is not owning a refrigerator (Column [2]). This corresponds with the literature that finds that women who fear contamination by not having access to constant refrigeration facilities, opt not to breastfeed. The effect could also be capturing the result of poor socioeconomic conditions on the likelihood to breastfeed. However, the effect remains after controlling for other SES variables like education and unemployment status, indicating that this may not be the case.

Facilitators of exclusive breastfeeding are being unemployed, being a foreign national, experiencing your first pregnancy and having at least high school education (see Table A 3.10.2 in Appendix Section A 3.10). These effects are all large in size in the bivariate analysis, but imprecisely estimated.

Table 3. 14: The impact of the intervention on infant feeding intention

Dependent: infant feeding intention scale	OLS	OLS
	[1]	[2]
Treatment	1.035	1.159
	(0.762)	(0.797)
Age		-0.161**
		(0.0756)
Own a refrigerator		-1.594*
		(0.890)
Control for socio-demographic factors	No	Yes
Observations	72	72
R-squared	0.032	0.063

*** p<0.01, ** p<0.05, * p<0.1; Standard errors in parenthesis
+Note: All estimates control for the difference in time that participants were exposed to the study.
Socio-demographic factors: unemployed, Black African, foreign nationality, household size, first pregnancy, at least high school level of education, married and identified using a pregnancy test.

By interacting the statistically significant risk factors with the treatment variable, I was able to estimate the possible impact of the intervention on the IFI of vulnerable subgroups. These results (reported and discussed in *Table A 3.10.3 and A 3.10.4* in the Appendix) show that the intervention plays a protective role in increasing IFI for participants in the treatment group compared to participants exposed to the risk factors in the control group. Most notably, participants in the treatment group who do not own a refrigerator score on average 2.9 points higher on the IFI scale than those in the control group who do not own a refrigerator. The effect is significant at a 10% level. Although the treatment does not statistically significantly contribute to IFI of all treatment group participants, it has an impact on those who are in vulnerable subgroups (those who do not own a refrigerator).

3.4 Discussion and conclusion

Health facility attendance

The package intervention was successful in improving the frequency and timing of antenatal care visits. Specifically, the intervention led to an increase in the probability that a woman would make at least four antenatal care visits and significantly increased their timing of a first antenatal care visit by a month.

Health outcomes

The intervention did not play a role in improving birth weight. One of the main risk factors for low birth weight was women who experienced pregnancy complications. The intervention had no effect on improving the birth weight of this subgroup, and women in the treatment group experienced an even larger negative effect on the birth weight of their infants if they also experienced pregnancy complications. This points to the large impact of biomedical factors (discussed in the Appendix) in contributing to low birth weight, which falls beyond the scope of this intervention.

The intervention did have a significant effect on decreasing maternal depressive symptoms amongst its recipients. Other risk factors associated with maternal depressive symptoms are antenatal depressive symptoms and lack of social support. There are also indications that having an unplanned pregnancy increases the risk of having maternal depressive symptoms. Decreasing unplanned pregnancies should be a policy priority, urging government to ensure that contraception is available and easily accessible. It is also increasingly important to provide contraception choice which is matched to an individual's preferences and lifestyle in order to ensure that contraception is used effectively and to prevent possible contraception failure.

The lack of effects of the treatment on nutritional status of participants could be the result of the relatively good nutritional status of women in the sampling population. The largest governmental nutrition intervention to combat maternal malnutrition is the Nutritional Therapeutic Programme which falls within the Integrated Nutrition Programme (INP) (Grundlingh *et al.*, 2013). This entails that all pregnant women visiting antenatal clinics are provided with nutritional supplements (National Department of Health, 2007b). This includes routine iron supplementation, which is essential, given the high rates of anaemia amongst pregnant women in South Africa (Meyer *et al.*,

2007). The programme also provides for the care of underweight pregnant women at clinics (Grundlingh *et al.*, 2013). Grundlingh *et al.* report that in Cape Town the nutritional supplement programme is well targeted, but the food supplementation programme was not successfully implemented (Grundlingh *et al.*, 2013)

Women are also secondary beneficiaries of the Infant and Young Child Feeding Policy. According to the policy, pregnant or lactating women who have suffered as a result of any emergency should be provided adequate food (National Department of Health, 2013a). The "Roadmap for Nutrition in South Africa 2013 – 2017", developed by the Department of Health in 2012 is another policy initiated to decrease malnutrition amongst South Africans. In the policy, the importance of sufficient intrauterine nutrition and nutrition for children up until two years of age is emphasised. Key interventions to target the nutritional status of these groups are stipulated in the report (Hendricks *et al.*, 2006).

Although the treatment has a positive (albeit insignificant) impact on the IFI scale of participants in the treatment group, it has a significant and positive impact on women who do not own a fridge (one of the risk factors for poor breastfeeding rates). The effect of CHWs on the infant feeding intention will not necessarily translate into exclusive breastfeeding for six months. Doherty *et al.* finds that although health workers have the strongest influence on initial feeding decisions, this power diminishes as women are faced with various challenges over time (Doherty *et al.*, 2006).

I also measure the likelihood of breastfeeding in the first hour after giving birth aggregated by treatment arm. There was no significant difference in the likelihood of women to initiate breastfeeding in the first hour after birth between women in the control and treatment groups. This lack of significant difference could possibly point to the important role of health staff at the facilities in ensuring that breastfeeding is initiated shortly after birth and possibly the lack of autonomy of women in this decision. Alternatively, the intervention was perhaps not effective in delivering the message of early initiation of breastfeeding. One major limitation of the analysis is that I do not control for HIV in the decision to exclusively breastfeed.

It is possible that the intervention had a positive effect on the health outcomes of infants due to the content of the incentive. The soap and recipe for a home remedy for diarrhoea may decrease the incidence of diarrhoea and dehydration caused by diarrhoea (Shahid *et al.*, 1996; Curtis & Cairncross, 2003). The kangaroo mother/father care wrap promotes skin-to-skin contact and also has various psychological benefits (Bergman *et al.*, 2004). Fathers were also explicitly encouraged

to use the wrap in order to promote bonding between infant and father. This skin-to-skin contact (also known as Kangaroo Mother Care) between infant and mother/caretaker of a low birth weight infant immediately after delivery is a valid, feasible alternative to incubators in poor low-income settings (Bergman *et al.*, 2004). These effects were not measured due to budgetary limitations.

Future work: aspects to consider when scaling up the intervention and eventual policy implications

Prior to allowing deviations in the neoclassical model of decision-making, economists' policy recommendation regarding health behaviour was limited to decreasing the effects of negative externalities or provision of health information. However, the current understanding of behaviour has allowed economists to broaden their scope of policy recommendations (Sindelar, 2010).

Currently, policy designed to promote preventative health behaviour broadly take on the form of either a "stick" or "carrot" approach (Dupas, 2011). The "stick" approach entails mandates which will legally require individuals to behave according to this mandate, and a punishment is imposed if this is not done. These are often problematic in low-resource countries where the supply-side is severely lacking or law enforcement possibly corrupt (Dupas, 2011).

The alternative is a "carrot" approach to changing health behaviour, as is proposed by this intervention. A "carrot" approach may entail using subsidies or incentives to promote healthy behaviour (Sindelar, 2010; Dupas, 2011). This approach allows for more flexibility and freedom for individuals to respond to these policies, as individuals can choose not to respond and this will not alter their current state (Sindelar, 2010). If poor antenatal care attendance is driven by a poor access (availability, affordability and acceptability) to public sector clinics, a subsidy to access private antenatal care facilities can help to improve attendance. The subsidy would allow women to experiment with antenatal care at a lowered cost, and increase their knowledge of the effectiveness of antenatal care services.

Based on the literature showing that disappointing maternal and infant health outcomes may be due to multiple constraints, I proposed both the incentive and community health worker programme, thereby targeting multiple impediments to optimal maternal and infant health. Although part of the intervention entails a "carrot" approach to improving preventative health behaviour (namely, the TBB as an incentive), the barriers to accessing care and optimising health

outcomes in a low-resource setting are more intricate than purely considering prices and benefits and calls for a more nuanced approach to policy. In addressing the complexities of the demand for health amongst pregnant women, I also addressed poor health knowledge and lack of social support as barriers to early care-seeking behaviour.

Community health worker programmes are often viewed as feasible programmes which could be integrated into South African primary healthcare, and is an increasingly important extension of the operational capacity within the public health system. The Department of Health is supportive of the concept of integrating CHWs into the current healthcare structure, and are in the process of drafting a framework stipulating their potential role and working conditions (Pillay & Barron, 2011; Le Roux et al., 2015; Rotheram-Borus *et al.*, 2015). It is difficult to draw any conclusions about the feasibility of a community health worker programme from this current intervention, since I have combined the CHW programme with an incentive. Furthermore, no cost-effectiveness analysis has been performed for the package intervention.

Although there is widespread evidence of the effectiveness of CHW programmes, there is less evidence available for the success of incentive programmes. Incentive programmes, such as those in European countries and the CCT programmes in Latin America, have been successful in other contexts, but there is little evidence of the effect of similar programmes in Sub-Saharan Africa (SSA). This makes it difficult to conclude whether a large-scale incentive programme will be effective in South Africa, and further work is required to test the impact of an incentive programme (not a package intervention) in other settings and with a larger group of participants.

One example of a successful incentive programme in SSA is a randomised controlled trial in a district of Malawi aimed at improving school enrolment and the sexual behaviour of adolescent women. Women in the treatment group were offered a financial incentive in the form of a cash transfer and school fees if they remained in or returned (if they had previously dropped out) to school (Baird *et al.*, 2010). The RCT increased re-enrolment by dropouts by approximately 44 percentage points, and decreased the dropout rates by women already enrolled in school by 3.9 percentage points (or 35%). The programme further led to a significant decrease in the marriage rates, probability of childbearing, sexual activity and number of sexual partners amongst dropouts (Baird *et al.*, 2010).

Although it is difficult to conclude from the design of the Thula Baba Box study (since I cannot distinguish between the TBB and the CHW effects), the results provide initial evidence of the possible impact of an incentive programme in a low-resource setting in South Africa. Results from the study can be applied to women living in an urban, low-income setting in South Africa. The study is implemented in the Eastern Health sub-district in the Metro-region of the Western Cape. The Metro as a district compares relatively poorly against the other districts of the Western Cape in terms of timing of antenatal visits.

A programme designed to affect behaviour should take into account both the "monetary and psychological" (Kane *et al.*, 2004) costs faced by individuals needing preventative care. Although the monetary costs faced by women in my sample may be replicable to other low-income, urban settings in South Africa, the psychological costs and cultural barriers may differ. These should be considered when considering a scale-up of the intervention discussed in this chapter to other settings.

Another aspect to consider when exploring the feasibility of scaling up the intervention is the socioeconomic position of the recipient. Community health worker programmes are common practice in developing countries. However, as previously mentioned, incentive programmes have been successful in high-resource settings, but there are various factors which may affect how eligible recipients respond in low-resource settings.

Incentives in preventative health interventions will have a different impact in a low-resource compared to a high-resource context. Eichler *et al.* (2009) point out that there are two reasons for this differing impact, namely (1) the difference in out-of-pocket expenditure between the two contexts and (2) that the illnesses that are more prevalent in low-resource countries, such as HIV and TB, require a form of behavioural change to reduce incidence. The larger amount spent on out-of-pocket expenses in low-resource countries are indicative of the large expenses incurred due to health expenditures, meaning that incentives are likely to have higher take-up and impact.

In this way, incentives targeted at poorer populations can help to alleviate part of the health inequities (Giuffrida & Torgerson, 1997). Lunze and Paasche-Orlow (2013) argue that the opposite might happen, and that incentives may exacerbate existing health inequalities amongst higher and lower SES groups. Although incentives may alleviate financial costs, it might not be enough to crowd out opportunity costs of accessing preventative care, leaving the lower SES groups in a worse position than before. An incentive size which does not lead to coercive behaviour is one

which not only covers the direct financial cost, but also the opportunity cost of accessing preventative healthcare (Lunze & Paasche-Orlow, 2013).

The effectiveness of a policy to improve preventative health-seeking behaviour will depend on the constraints to preventative healthcare. It is important to note that the constraints facing women in high-resource settings are not the same as in a low-resource setting. Health behaviour is something which can be more easily adjusted amongst higher socioeconomic groups. They are able to eat more healthily, join a gym or access private healthcare. Amongst lower socioeconomic groups, adjustments are more difficult to achieve. Incentives can also contribute to alleviating the affordability (financial access) barriers to better preventative behaviour (Lunze & Paasche-Orlow, 2013), but may not help to overcome the acceptability and availability access barriers.

In the early 1990s, Blondel and Saurel-Cubizolles (1991) did a cross-sectional analysis of an urban sample of women in France who had just given birth. They set out to establish whether there were significant differences between women who received the pregnancy grant and those who did not. Given that at this point, all women in France were eligible to receive the pregnancy allowance, women who did not receive the benefits were women who did not meet the grant's conditions. These were women who did not seek antenatal care early or frequently enough.

They report that women who did not receive the grant were predominantly disadvantaged women: they were likely to be single, unemployed and/ or from foreign countries. Their reasons for not meeting the grant's conditions were often related to their disadvantaged state: they could not afford the regular visits, or they had trouble establishing their pregnancy status. Denial and anxiety to face medical staff were barriers to early access for single mothers.

Similarly, Lim *et al.* (2010: 2018) found that enrolment in a CCT programme to promote maternal health in India was not consistently the highest amongst the poorest and least educated women. They speculate that this could either be due to low levels of literacy which make communication of the programme difficult, or poor physical access to the points where cash transfers have to be made. Finally, they also consider that there may be cultural barriers to the conditions set by the CCT, such as giving birth at a health facility.

In their study to promote frequent antenatal care visits, Laken and Ager (1995) also found that the inability to afford transport costs proved to be a bigger barrier to access than lack of motivation, making the incentives ineffective. Without taking into account supply- and demand-side barriers

which impede access, these incentives proved redundant in targeting the disadvantaged population.

These findings highlight the importance of understanding the root causes of late antenatal care initiation in order to design a successful policy.

Other concerns and factors which may influence effectiveness is the presence of stigma and female bargaining power in low-resource settings. There is a fear that incentive programmes, such as the conditional cash transfer programmes in Latin American countries, may lead to stigmatisation as it identifies recipients as being poor and possibly as irresponsible. Lunze and Paasche-Orlow (2013) suggest treating incentives as rewards rather than charity in order to overcome this barrier.

The autonomy of women in the household may also affect the effectiveness of an intervention. A woman's household bargaining power may affect her ability to respond to an intervention. A RCT in Zambia which removed supply-side constraints to accessing contraception found that women who were offered easy access to contraception in front of their partners were significantly less likely to access the contraception than women who were offered contraception in the absence of their partners (Ashraf *et al.*, 2014b).

Sindelar (2010) writes about the issues economists should take into account when designing large-scale incentive programmes for public policy, such as fairness and sustainability. The Thula Baba Box programme as it currently stands punishes good behaviour; i.e., women who have already accessed antenatal clinics at recruitment are not eligible to join the programme and receive the box. When scaling up this programme, cost-effectiveness analysis should be based on providing the box to all women who access antenatal clinics early. Dupas (2005) overcomes this obstacle by distributing the incentive to all women who access early, at the clinic level. Women who are not in the research programme, since they have already behaved prudently, will receive the incentive during their second or third (as opposed to their first visit) to the antenatal clinics.

Besides fairness, another factor to consider is the sustainability of the programme. This includes concerns regarding the cost and cost-effectiveness of the proposed intervention, and whether continued external funding is required to keep the programme and its effects successful. In order to be able to say anything meaningful about the sustainability of the programme, an economic evaluation of the intervention programme needs to be performed. Secondly, one should consider

whether the programme should be available to all participants (such as 2005 Dupas experiment) or should solely target high risk women who may be prone to poor health outcomes and health seeking behaviour. This would require more information on the characteristics of women for who the intervention was effective, and conversely, for those to whom it was ineffective or even disadvantages (Rychetnik *et al.*, 2002). Although I have attempted to establish some of these characteristics in this analysis, these results are marred and limited by the small sample size.

Another point to consider is supply-side limitations when scaling up a study of this size. It would be pointless to increase antenatal care attendance if women receive poor quality care or are shown away from the clinic. One way to overcome this is through the use of supply-side or provider incentives. A limitation to my study is that it does not control for the quality of care received at the facilities. As a result, it may be that this increased care-seeking behaviour does not even translate into improved long-term health outcomes. The Latin American CCT programmes were met with an improvement in the supply-side of health services. Supply-side quantity and quality barriers, once utilisation increased, were taken into account, and provisions such as mobile clinic and foot doctors were made.

If the supply-side is functioning poorly in the implementation setting, one should consider whether making receipt of a transfer conditional is necessary or appropriate. Unconditional transfers can sometimes be just as effective. If we assume that what is limiting access to antenatal care is credit constraints, then an in-kind transfer which will alleviate part of the costs associated with birthing and raising a child will be enough to motivate early and frequent antenatal care access. The child support grant, an unconditional cash transfer in South Africa, was successful in improving child nutritional status in South Africa (Aguero *et al.*, 2007; Coetzee, 2013). The child support grant, along with other unconditional social assistance grants in South Africa have led to a substantial decline in poverty (Van Der Berg *et al.*, 2008; Van Der Berg *et al.*, 2010). In various CCT programmes in Latin America, conditionalities were unnecessary for improving health outcomes (Gaarder *et al.*, 2010). The monitoring of conditionalities are also necessary but expensive (Gaarder *et al.*, 2010), and this will complicate expanding the programme to the entire country.

Study limitations and future research

To conclude, there is scope for a scaling up of the Thula Baba Box intervention, but a larger RCT is recommended in order to confidently draw conclusions about the effectiveness of the

programme. One major limitation of the study is the inability to distinguish between the effects of the CHW programme and the incentive. A future design should distinguish between the two in order to establish the causal effects. A larger sample size is also required to detect statistically significant effects, such as the sample size suggested in the power calculations.

One could consider having different box designs, depending on the needs of the mother and infant. A neonate of low birth weight should receive a form of thermal care. Provision should also be made for mothers who are not able to breastfeed and will resort to unhealthy alternatives if not provided with formula milk powder. Mothers in rural compared to urban areas also have different needs due to a decreased geographical access to health facilities.

Furthermore, in a future research study, one could also consider variations in the CHW programme design to increase cost-effectiveness. If the CHW programme is too expensive on a larger scale, feasible alternatives that can be considered are women's groups, which have also been used as a successful mechanism to provide psychosocial support and promote antenatal care-seeking behaviour (Manandhar *et al.*, 2004). Alternatively, content of the CHW visits could be aimed at targeting the specific outcomes. In the results, sessions that were focused on a specific topic (for example family planning) lead to better knowledge of those topics (contraception knowledge).

A limitation of the study is the possible effect of contagion on outcomes. Since randomisation was done at an individual level, there was no control over participants in treatment and control groups discussing the intervention with one another. A cluster RCT would also be more effective than the individual level RCT in order to contain contagion effects of the intervention on women in the control group.

Another limitation of the study is the fact that it was implemented and managed by myself. This, combined with the small scale of the study meant that the programme may have been applied more intensely than is sustainable and manageable in a real-world context. These effects may dissipate as the programme is scaled up.

I was also limited in the sample of respondents I was allowed to recruit and questions I was allowed ask. Information on HIV was not collected. In the South African context of HIV prevalence, this can have a substantial impact on the choice to exclusively breastfeed and there are various other

impediments to their decision compared to someone who is HIV negative (Doherty *et al.*, 2006). I was unable to recruit women younger than 18. Adolescents are a particularly vulnerable subgroup and may face different barriers to accessing care than older women (Abrahams *et al.*, 2001).

A final future avenue for the current study design is to make it easier to use the money spent on remedial healthcare on preventative healthcare, given a household's budget constraint. The only way to do this is to alleviate the remedial health burden expenditure (Dupas, 2011). One way of doing this is by distributing self-diagnostic tests, such as pregnancy tests. By doing this, women will be able to access antenatal clinics earlier, which will increase the probability that pregnancy danger signs are detected. Household expenditure on remedial healthcare can in this way be curbed by decreasing the occurrence of morbidities. The distribution of pregnancy tests is discussed in the next chapter.

Appendix to Chapter 3

A 3.1: Barriers to antenatal care access

Two focus groups were done with 12 community health workers currently providing support to pregnant women in areas in the Metro, Western Cape. The work was done jointly with a fellow PhD student, Anja Smith. The focus group discussions (FGDs) were used to gain insight into the health-seeking behaviour of pregnant women. A second goal of the FGDs was to get feedback from health workers as to what they believe the content of the Thula Baba Box should be.

The following key trends were identified during the FGDs as reasons why pregnant women seek antenatal care at a late stage of their pregnancy.

Trend 1: HIV stigma

1. **Fear of finding out HIV status**

   Women do not receive adequate pre-test counselling and are afraid of knowing their HIV status.

   Quote: *"Yes, women are scared of HIV testing."*

2. **Fear of being identified as HIV positive by the community**

Women who know that they are HIV positive fear having their status revealed at public health facilities where members of their community will also be visiting. As a result, women visit clinics far from their communities, and travel becomes an access barrier.

Quote: *"…everybody will see me"*

Trend 2: Mental health (depression) and alcoholism

1. ***A*ntenatal depression:** Factors that often lead to pregnancy-related depression are adolescent pregnancies and being HIV positive. In these instances, priorities shift and women do not consider going to the antenatal clinics an immediate concern.

   Quote: *"She did not go to antenatal clinic because they are fighting … depression. She doesn't have support."*

2. **Alcohol abuse** shifts perceptions of what is important:

   Quote: *"Most of the mothers are alcoholic. They don't care about their health. It is difficult to explain. Sometimes if you visit you do not find her. She is found at the shebeen all the time."*

Trend 3: Quality of services

1. **Nurse attitudes:** There is a perception amongst pregnant women that they will be yelled at by the nurses at public health facilities, which often deters them from seeking care.

   Quotes: *"…and they are scared, they say the nurses shout at them."*

   It seems to be common knowledge which clinics have rude or nice staff and women will make the effort to go to the nicer clinics.

   Quote: *"[They say] 'Let me choose where I want to go.'"*

2. **Duration of the first booking visit.** The first visit to the clinics takes an entire day, as women have to wait for their results. Women often delay in seeking antenatal care, as they simply do not have time to take a day off work.

Trend 4: Knowledge and information

1. **Uncertainty about pregnancy status:** Many women are uncertain about their pregnancy status due to their irregular menstrual cycles.

   Quote: *"Others they don't care about their bodies. They jump the period month but she can't follow why she is jumping her periods."*

2. **Women do not receive proper counselling and information at the clinics.** Pregnant women who attend antenatal clinics aren't necessarily informed about the importance of regular antenatal visits.

   Quote: "*They're just not fully aware.*"

The results from the focus group surveys were presented at the University of Cape Town's Medical Humanities conference in August, 2014.

A 3.2: Deciding on the content on the Thula Baba Box

The content of the Thula Baba Box was decided on after various pre-piloting initiatives. This includes 40 short interviews with women who had infants younger than one year old, two focus group discussions with community health workers currently providing antenatal care in Khayelitsha and 11 one-on-one discussions with women in hospitals a week after they had given birth.[87] I also had various discussions with experts. These include:

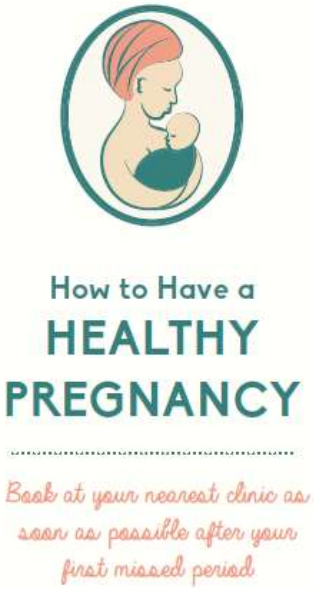
- Edna Arends who is the deputy director at the Maternal Provincial Health Facility-based Programme at the Western Cape Department of Health (WCDoH).
- Sonia Botha who is the deputy director at the Child Health Provincial Facility-based Programme at the WCDoH.
- Hilary Goeiman who is the deputy director at the Nutrition Provincial Facility-based Programme at the WCDoH.
- I had several discussions with Dr Miemie du Preez, a paediatrician at Tygerberg Hospital.
- Dr Cathy Cluver, an obstetrician at Tygerberg Hospital.

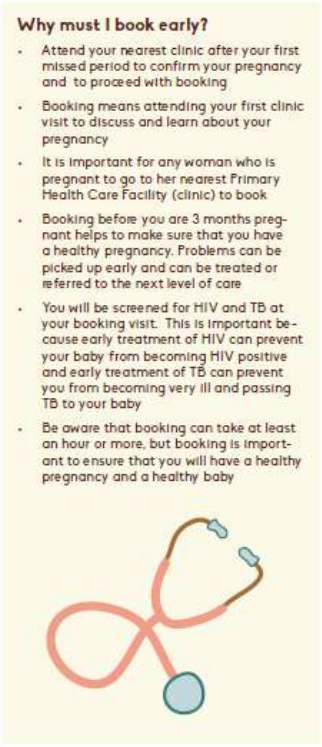
[87] Interviews were done with 11 women who had given birth in the last seven days at the Macassar MOU in the Eastern health sub-district. The interviews were done in order to assess what products new mothers felt were particularly useful, and what products they struggled to afford. Most women reported that their most draining expense were non-reusable nappies. All women interviewed revealed that they use predominantly Johnsons & Johnsons products. Results from these interviews are available on request.

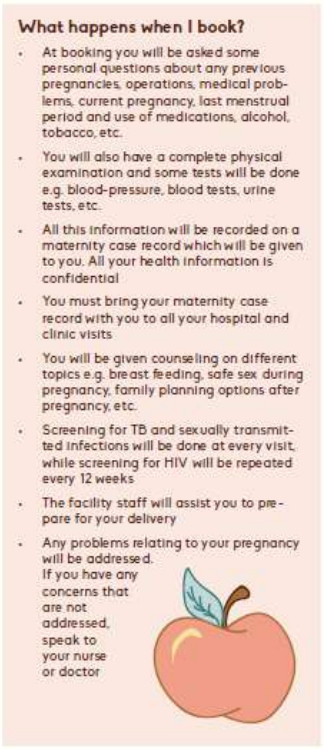
- Sister Jasmin Michaels at Tygerberg antenatal clinic.
- Dr Keith Cloete, chief director of the Metro District Health Services.
- I also had a meeting and a workshop with other members of the WCDoH, including Dr Tracey Naledi (director of health programmes in the Western Cape), Dr Frederick Marais (from the Health Impact Assessment directorate) and Dr Elmarie Malek (chair of the Provincial Forum for Improving Maternal Infant and Child (MICH) Wellness at the WCDoH. Dr Malek is also a paediatrician at Tygerberg Hospital.
- Dr Lawrence Bitalo, head of health services in the Metro Northern sub-district.

Information brochures

Information brochures were put together by the author of the dissertation, and graphic design was done alongside graphic design agency. Provided here are the antenatal care brochures (available in both English and isiXhosa) and the pregnancy journey map.







How can I keep myself and my baby healthy?

- Have a balanced diet with plenty of vegetables and fruit (5 pieces a day)
- Do moderate exercise daily, such as walking
- Avoid alcohol, tobacco and drugs as these will damage your baby's brain and organs
- You should drink 6 to 8 glasses of water daily
- If you are feeling depressed or worried about the pregnancy, if you feel sad or if you are nervous most of the time, ask for assistance from a health worker
- Use a condom every time you have sex, even if having sex with your regular partner. Condoms protect you and your baby from infections, including HIV infection

Male condom

Female condom

How to prepare for your delivery

- You have to arrange your own transport in advance to take you to the maternity unit. If you have an emergency, an ambulance can be called at 10177
- Identify a partner/companion to support you during labour
- Remember to bring all your current medication to the clinic/hospital with you for your delivery
- Personal things to take with you to the clinic/hospital: facecloth, toothbrush, toothpaste, soap and sanitary towels
- Things to take with you to the clinic/hospital for your baby: Baby clothes, nappies/kimbies, baby blankets
- You and your baby will be kept in the maternity ward for a minimum of 6 hours and if both the baby and yourself are fine you will be discharged to go home
- Remember to go to your clinic for your first check-up for you and baby within 3 – 6 days of giving birth

How will I know when labour starts?

- Regular pains in your abdomen (contractions) that become longer and stronger with time
- Sometimes a gush of fluid or leakage from the vagina (water breaks)
- When you see a "show" (bloody, thick mucous) passing out of the vagina
- A backache similar to the one some women get when they have their monthly period. The backache may be more severe

What should I look out for while pregnant?

When experiencing any of the following signs, go to your clinic immediately to be checked:

- Severe headaches/blurred vision
- Seizures/fits
- Pain in your abdomen/stomach/belly
- Water or blood draining from the vagina
- If the baby moves less than usual or not at all

Congratulations on your pregnancy!

We are very excited to take this wonderful jouney with you.

This will be your pregnancy journey guide. Keep it safe with your maternity case record. You will receive your case record when you visit the clinic for the first time.

This pregnancy guide contains information and health tips on taking care of your own health and the health of your new baby. Your mentor mother will discuss these with you during your visits. With this pregnancy guide, your mentor mother will also be able to see when you went for antenatal clinic visits.

Why is antenatal care so important?

It is very important that you visit your closest clinic or doctor as soon as you suspect that you may be pregnant. The clinic can help you to pick up problems early and ensure the health of you and your baby. It is important to go to the clinic while you are pregnant – even if you feel well and even if you had a healthy baby the previous time.

What do you need to take with to your first antenatal clinic booking visit?

If you are a first time visitor to a health facility you will be asked to

- Fill out a form and a folder will be opened for you
- Your identity document (ID)
- Any medication you are taking
- Clinic or hospital card if previously registered at the facility

Remember to check what day of the week your nearest clinic is open for first booking visits.

What can you expect from your first visit?

Your first booking visit at the antenatal clinic is essential to establish how healthy you and your baby are. The nurse will do many tests to assess your health. Since this first visit is very important, it usually takes longer. Remember to take something with to keep you busy while you are waiting!

You can expect the following to happen at your first antenatal clinic booking:

- A Physical examination: the nurse will record your weight and height, measure your blood pressure, feel your breasts (for any lumps) and uterus (to see how far along your baby is). There might be a vaginal examination if you've never had one before.
- Tests: you will have to provide some of your urine so that the clinic can test your glucose levels and to see if there are any infections. They will also ask to perform an HIV test. If you are HIV positive, the counselor can help you to stay healthy and to stop the virus from going to your baby.
- Plan: at the clinic, they will help you to plan your future visits to healthcare facilities.
- Supplements: Everybody will receive pregnancy supplements that you need to drink during your pregnancy. This will help to keep you and your baby healthy.

REMEMBER TO GET YOUR MATERNITY CASE RECORD

When should I go for my follow-up visits?

When and where you have to go for your follow-up visits will depend on how far pregnant you are at your first booking visit. The follow-up visits will not take as long as your first booking visit, and is necessary to see that you and your baby are doing well!

The ideal will be that you go to the clinic/doctor 4 times before you give birth, but this will differ from mother to mother. Tell your mentor mother about your planned visits so that she can help remind you when to visit the clinic.

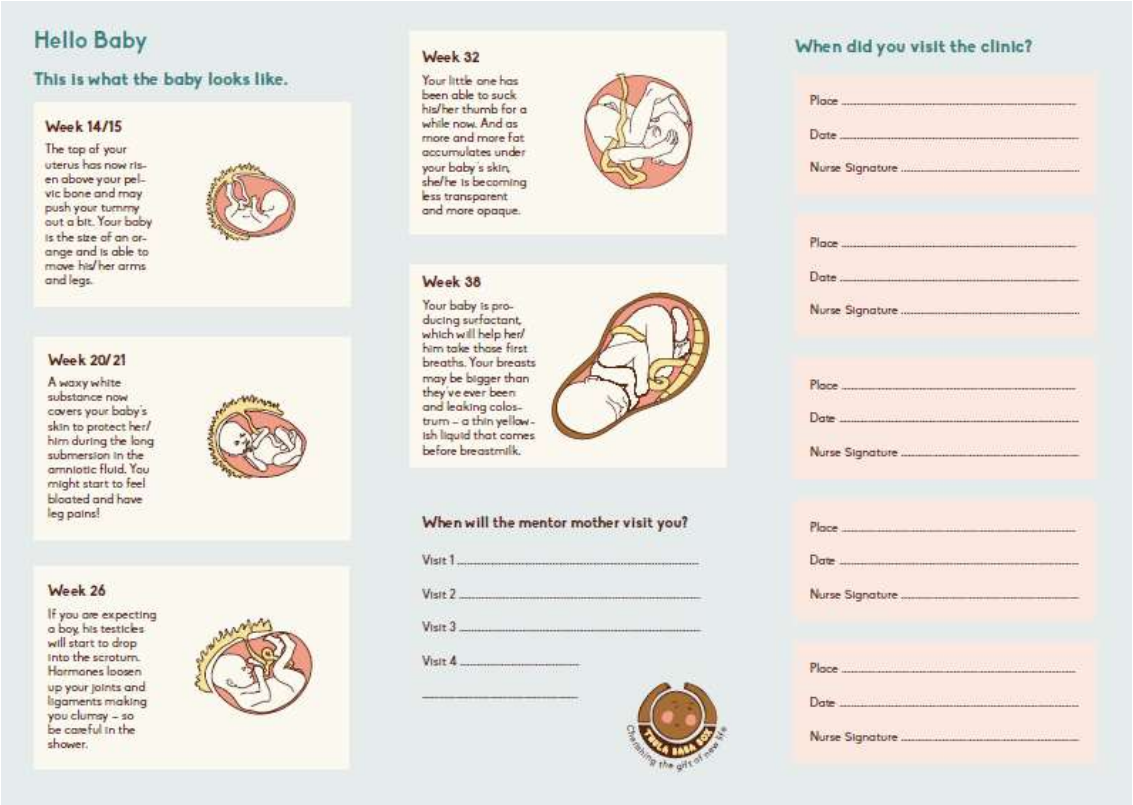
REMEMBER TO ALWAYS TAKE YOUR MATERNITY CASE RECORD WITH YOU TO THE CLINIC

Pregnancy checklist:

- Remember to plan your transport to the hospital/MOU.
- Rember to have a bag ready for when you go to the hospital/MOU

What should you take with to the hospital?

- Remember to take all your necessary documents.
- For yourself: sanitary pads, roll of toilet paper, night gown, panties, something to eat and drink.
- For the baby: try to take something with that the baby can wear and something that can keep the baby warm (a small blanket).

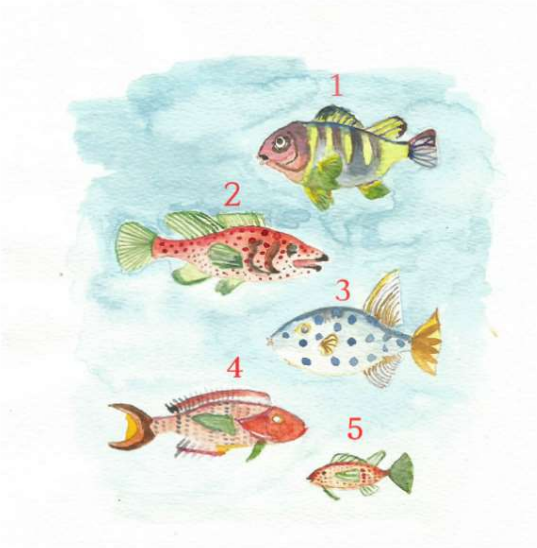


Nursery rhymes

Nursery rhymes were provided by Dr Miemie du Preez, and illustrated by the dissertation author.

Undlebende

Ndlebende ufelwe
ngunyoko okanye
uyihlo
le nto unesililo
esibuhlungu
kangaka?
Oko ndikuva
ukhala usithi:
"oko-ndafelwa-ngumama-
notata-nde-ingxowa-
zasemaXhoseni-zithwalisa-
mna-ndedwa"



1, 2, 3, 4, 5

One, two, three, four, five,
once I caught a fish alive.
Six, seven, eight, nine, ten,
then I let it go again.

Why did you let it go?
Because it bit my finger so.
Which finger did it bite?
This little finger on the right.

Wippie en Snippie

Wippie en Snippie loer uit 'n gaatjie,
Wip is 'n muisie en Snip is sy maatjie.

Wippie en Snippie
daar kom die groot kat.
Woeps spring die twee muisies weer
terug in die gat.

Umvundlana othile

Unvundlana othile
wangena entsimini
waqakatha
waqakatha
wadibana nembotyi
wayitya kwasemini
wanyantsula
wanyantsula
wagoduka ehluthi

A 3.3: Factors to consider when developing an incentive programme

There is large amount of literature that shows that individuals are often surprisingly short-sighted, and have high discount rates when it comes to their future social benefits. They are often unwilling to make small but immediate sacrifices in order to obtain large benefits in the future. This is important in explaining sub-optimal health-seeking behaviour. Although incentives have been proven to be effective, the specifics and content of the incentive will determine whether or not the recipient's discount rate for future health can be altered.

A 3.3.1 The size of the incentive and the duration of required behavioural change

Various factors should be considered when estimating the size of an incentive, including the duration of required behavioural change, the personal benefits to the recipient, and the socioeconomic position of the recipient. The size of the incentive is important when considering the duration of the programme (Lunze & Paasche-Orlow, 2013). Time-limited intervention (such as expecting pregnant women to behave prudently for nine months) have been found to be more effective than interventions that require longer-term behavioural change (such as smoking cessation) (Eichler *et al.*, 2009).

In scenarios where little is required from the respondent and the opportunity cost of time lost is trivial, a small incentive can alter behaviour significantly. Small incentives can have disproportionately large impacts on take-up of health behaviour (Dupas, 2011). During a RCT study in Udaipur, India, childhood immunisation rates were significantly increased by offering parents raw lentils and a metal plate as an incentive. Since the commitment was not long-term, the small incentive proved immensely efficient (Banerjee *et al.*, 2010). These small incentives increase current utility and allow an individual to invest in health behaviour which has long-term benefits.

Larger incentives are often necessary when longer-term behavioural change is required from the recipient. In the case of the TBB, where women have to be committed to the programme for a couple of months, a larger incentive is necessary. In a 12-month study in Tanzania, study participants were offered different size cash grants to incentivise safe sex practices. The study found a significant reduction in the occurrence of sexually transmitted infections (a result of safe sex practices) amongst participants who were eligible to receive $20 quarterly payments, while there were no significant effects for those who were eligible to receive $10 quarterly payments (De Walque *et al.*, 2012).

The elasticity of behaviour to the size of the incentive often differs according to the types and extent of behavioural change required. Thornton (2008) finds that incentivised behaviour to collect HIV test results are highly elastic: an individual receiving monetary incentives to learn their HIV results was twice as likely as an individual receiving no monetary incentives to learn their HIV results. Even individuals who only received a 10^{th} of their daily wage were highly more likely to attend.

When deciding on the incentive size, the economic position of the recipient should also be considered. An incentive size which does not lead to coercive behaviour is one which not only covers the direct financial cost, but also the opportunity cost of accessing preventative healthcare (Lunze & Paasche-Orlow, 2013).

Apart from incentive size, another factor to consider is payment structure, i.e., should payments be made immediately or over a long period of time (Sindelar, 2010). Due to hyperbolic discounting, recipients of an immediate cash transfer may not spend their transfer in a way that will lead to an optimal health outcome (which may only become evident in a couple of months' time) and may

rather choose to satisfy immediate need (Dupas, 2005). This is especially true for women who are pregnant and have to wait nine months before delivering their child. Their discount rates may change significantly over this period.

A 3.3.2 Cost-sharing

Imposing even small costs on the user may also affect take-up of preventative health behaviour. In a RCT in Kenya aimed at increasing take-up of deworming technology, the introduction of a small fee drastically decreased treatment rates (Kremer & Miguel, 2004). Similarly, take-up and use of insecticide treated bed nets (a strategy to prevent malaria) during a RCT in India, was higher amongst those users who received the nets for free, as opposed to those who could receive microloans to purchase the nets (Tarozzi *et al.*, 2014). The private benefits of preventative health behaviour are not always clear to the user, and are often deemed unnecessary. An individual with a limited budget would be less inclined to spend money on an intervention if they do not personally deem it necessary.

A 3.3.3 Cash or in-kind transfer

Another aspect to consider is whether to use cash or in-kind transfer when creating incentive programmes. Considering the context of recipients is crucial here. In a few studies, cash incentives have been found to be more effective compared to peer counselling (Tulsky *et al.*, 2000), entry into a prize draw (Drummond *et al.*, 2014) or in-kind transfers such as diaper vouchers (Dykema *et al.*, 2012).[88] Although cash can be more effective in motivating behavioural change and has shown to increase human capital (Duflo, 2000), they may also have unintended consequences. Using the 1993 PSLSD (Project for Statistics on Living Standards and Development) data, Case and Deaton found that pension transfers to women in South Africa are less likely to be spent on alcohol and tobacco than pension transfers to males (Case & Deaton, 1998). Using the same data, Duflo finds that pension income transfers can improve the nutritional status of children, but only if the recipient of the pension is a woman (Duflo, 2000). Dupas (2005:24) refers to this as the heterogeneous preferences of household members. In using an in-kind transfer, such as the Thula Baba box, I can be sure that the transfer is to the benefit of the mother and infant.

[88] The studies listed here are all randomised controlled trials with at least 100 observations. These are just a few examples to illustrate the efficiency of cash incentives. In order to conclusively say that one is more efficient than the other, a systematic review needs to be performed on the difference in efficiency of monetary versus non-monetary incentives.

However, a field experiment in Zambia where hairdressers were trained and incentivised to sell female condoms to clients, found that non-financial incentives in the form of public acknowledgement proved a much stronger incentive than cash. The authors attribute this to the pro-social motivation of the hairdressers (Ashraf *et al.*, 2014a).

Non-cash incentives are preferred to cash incentives when the non-cash incentive has positive externalities, and as such, the social benefits outweigh the private benefits of the incentive. This is often the case when the incentive itself has an impact on health outcomes (Dupas, 2005).
However, individuals who receive a gift as an incentive may also be inclined to sell the incentive should its market value exceed the recipient's valuation of its benefit. This could be problematic if the incentive itself is designed to have a health impact (Dupas 2005). Cash has the added benefit of alleviating credit constraints to access care.

A 3.3.4 Ethical considerations on the use of incentives in preventative healthcare

The introduction of incentives to influence healthcare brings with it a range of ethical concerns, one of which is that it may lead to perverse outcomes. The Australian baby bonus, a sequence of payments to new families after the birth or adoption of a child, was scaled down and repackaged in 2013 within the family benefits scheme in order to save costs. However, there was speculation that this decrease in benefits would lead to women forcing earlier births in order to be eligible for the older, larger baby bonus (Klapdor, 2014). Based on Australian data, authors Guest and Parr showed that a policy shift could lead to a shift in timing and amount of births, but that this was of a very small magnitude (Guest & Parr, 2010). A few researchers have also speculated that the South African child support grant – an unconditional cash grant provided to caregivers of children – may incentivise women to have children. However, careful analysis suggests that the effect is small (Makiwane *et al.*, 2006; Van Der Berg *et al.*, 2010).

Incentive programmes should only create extrinsic motivation when there is no initial intrinsic motivation. A major concern is that an incentive programme will decrease the intrinsic motivation of recipients who have high intrinsic motivation. Therefore, it is advised that the intrinsic motivation of recipients be assessed and analysed before the programme is designed (Eichler & Levine, 2009).

This may only be necessary in interventions that require long-term or permanent behavioural changes from individuals, such as smoking cessation. Curry *et al.* (1991) find that in the case of a self-help smoking cessation programme in the United States, an intervention which improves intrinsic motivation leads to higher rates of smoking cessation and lower rates of relapse. It is a much more efficient strategy than providing individuals with extrinsic, financial incentives in improving duration of smoking cessation. In their study, they find that extrinsic incentives even ameliorate the effect of improved intrinsic motivation. In the case of the study, where short-term behavioural change is required, I argue that creating extrinsic motivation is sufficient to optimise the targeted health outcomes.

Researchers have argued that making an individual pay for health services will induce better adherence, since one is making that individual invest in their health (Family Health International (2005),[89] as cited in Dupas 2005). However, one could argue that individuals who are willing to invest in their own health already require the intrinsic motivation to improve their health and are not the groups of individuals who should be targeted to improve behavioural health outcomes.

Another factor to consider regarding the ethics of the programmes is whether or not it is **fair.** One negative spill-over from performance-based payment programmes is that individuals in a community who have behaved in a risk-averse manner or optimised their health will be inadvertently punished by not receiving a gift/incentive. There are methods to deal with issues concerning fairness. In a RCT designed by Dupas (2005), antenatal clinic attendance was rewarded using insecticide-treated nets. The incentives were used to motivate pregnant women who had not yet been to the clinic to access care. Women who had already visited the clinic at the time the study was implemented also received a net at their follow-up visits. In that way, distribution of the nets was fair and women who acted prudently were not punished.

Another concern is that reliance on an incentive **removes any personal responsibility** that an individual may have to access preventative healthcare, in which case removal of the incentive will lead to a complete reversal of effects. The idea of incentives offends Immanuel Kant's fundamental principal of morality, which states that "rational will must be regarded as autonomous" (Johnson, 2010). In the context of health and incentives, an individual should strive towards healthy

[89] Family Health International (2005). *The Tanzania AIDS Project: Building Capacity, Saving Lives. The AIDSCAP Response, 1993-1997*. Chapter 3: Selling Protection: Condom Social Marketing. http://www.FHI.org/en/HIVAIDS/pub/Archive/aidscapreports/tanzaids/chap3.htm

behaviour due to an intrinsic duty and desire to maintain their health, rather than an extrinsic incentive (Lunze & Paasche-Orlow, 2013).

A final concern is that incentives **coerce** individuals into behaving in a way in which they do not want to. Lunze and Paasche-Orlow (2013) argue that this may not be true if you consider that incentives decrease costs and make prevention cost-neutral, and recipients may have more autonomy in accessing healthcare than before when they were cost-constraint. On the other hand, an incentive that is disproportionately large to the required behavioural change may conceivably function as a bribe.

These factors were to some extent considered in the design of this programme: the incentive is of a large enough size to motivate behavioural change over a few months and to justify the costs which the programme imposes on the participant; and I used a gift rather than a cash transfer since this is aligned with the messaging of the intervention on the importance of investment in young children. I consider the programme's goal as nudging women into behaving responsibly.

A 3.4: The Community Health Worker Programme

The community health worker model is based on the Philani Mentor Mother model, a programme currently being implemented by Philani Health and Nutrition (an NGO in Khayelitsha) in other areas of the Metro. Most pregnant women in the sample treatment group will receive a monthly visit from the CHW. Women who are malnourished or have other complications will be visited more regularly by the CHW. Amongst other things, the CHW will provide pregnant women with antenatal care advice and information, psychosocial support, and nutrition advice (alcohol, smoking, food intake and breastfeeding advice).

In order to ensure an efficient community health worker programme, I had several discussions with experts and researchers who have extensive experience with these types of programmes.

- I had several discussions with Dr Ingrid le Roux and Kwanie Mbewu from Philani Mentor Mothers, who have successfully implemented community health worker programmes in other areas in the Metro.

- Prof Mark Tomlinson, a Professor at the Psychology Department at Stellenbosch University. Professor Tomlinson has implemented several randomised control trials and pilot studies involving community-based home visits.
- Dr Lungiswa Nkonki, a health economist based at Tygerberg. Dr Nkonki is considered an expert in community health worker programmes and programmes promoting breastfeeding.
- Karen Bufé, a facilitator at Masikhule, an NGO based in Somerset West who focuses on early childhood development programmes.
- Roger Allingham, GM at Masincedane, an NGO in the Eastern Health sub-district who runs community health worker programmes focusing on chronic care.

Interviews for the community health workers took place in October, 2014. A member of Philani assisted with the interviews, and eventually ten women were identified as potential CHWs. All the women that were interviewed are living in the sampling area. This makes it easier and more affordable for them to travel to participants. Since they are familiar with the area, they are also aware which areas are unsafe and should be avoided. These ten women attended training at Philani Health and Nutrition in Khayelitsha for four weeks during November 2014. Two of the ten women dropped out during the first week of training. One had found alternative employment, and the other left after an argument with one of the course lecturers.

I employed six of the eight remaining women trained. These six received instrument training and house-to-house training from 15 to 20 January, and started implementing the roll-out on the 21st of January, 2015.

After roll-out (which ended on the 13th of March), only three CHWs remained employed by the project in order to do follow-up visits with the pregnant women in the treatment group.

After consulting with Philani and Mark Tomlinson, it became clear that a CHW supervisor was essential in order to ensure the success of the programme. As a result, a supervisor was employed on the 23rd of February to assist and supervise the CHW currently operating in the field. The supervisor is an experienced community health worker who was recommended to the project by Philani Health and Nutrition. All CHWs returned to their previous employers after completion of the project.

A 3.5: Power calculations

Figure A 3.5. 1. Power calculation for baseline sample

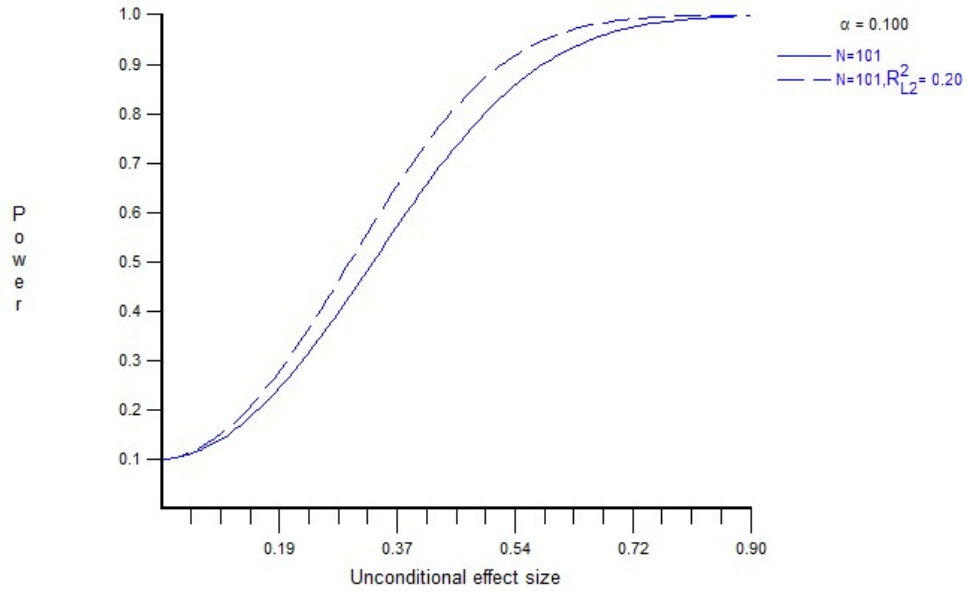


Figure A 3.5. 2. Power calculation for final sample (after attrition)

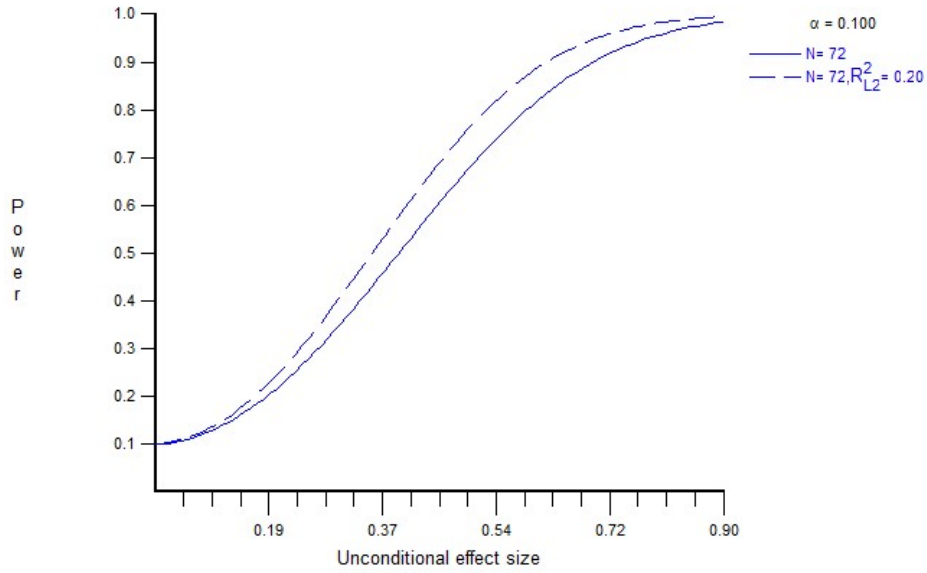
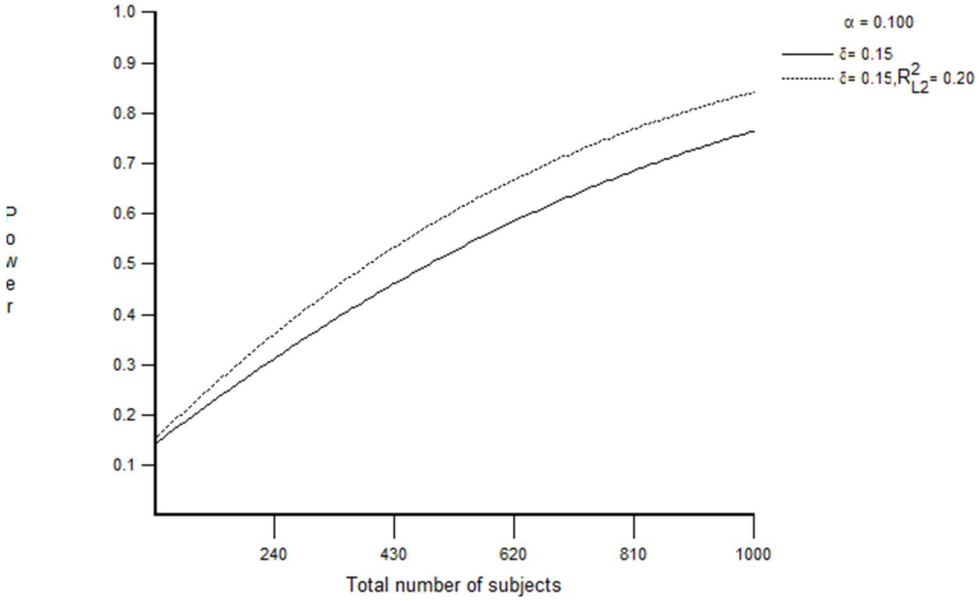


Figure A 3.5. 3. Power calculations for the desired sample



A 3.6 Summary of covariates included in the analysis

Table A.3.6.1 Summary of covariates included in analyses

Variable	Obs.	Mean	Std. Dev.	Min	Max	Description	Instrument used to capture information
Time inconsistent preferences	72	0.22	0.05	0	1	Variable equal to one if participant revealed time inconsistent preferences. This is established using a set of questions. Q88 I'm just going to ask you a question. If a church or NGO want to give you a gift and they say they will either (1) give you R200 today or (2) R300 in one month, which one would you choose? This is not going to happen, I just want to ask you what you think. (1) R200 today. (2) R300 in one months' time. Q89 What if they would give you (1) R200 in 6 months' time or (2) R300 in 7 months' time? Which one would you choose? I just want to state again, that this isn't going to happen, I just want to ask you what you think. (1) R200 in 6 months. (2) R300 in 7 months. For the first question, 75% of women preferred R200 today and 25% preferred R300 in one months time. For the second question 54% of women preferred R200 in 6 months and R300 in 7 months. An individual considered to have time inconsistent preferences if they picked (1) in Q88, and (2) in Q89.	Endline
Antenatal depressive symptoms	72	4.403	2.853	0	13	Scale from 0 to 16 measuring antenatal depressive symptoms	Baseline

MUAC at baseline	68	31.2	5.311	22.5	47.3	Middle upper arm circumference at recruitment	Baseline
Number of children	72	1.319	1.254	0	5	Number of children women has (excluding study pregnancy)	Baseline
Social support scale	72	8.625	1.946	4	12	Scale from 0 to 12, measuring the extent and reliability of participant's support network.	Endline
Pregnancy complications	71	0.254	0.438	0	1	Binary: participant experienced complications during pregnancy	Endline
Birth complications	68	0.206	0.407	0	1	Binary: participant experienced complications during birth	Endline
Consumed alcohol during pregnancy	70	0.157	0.367	0	1	Binary: participant self-reported consuming any alcohol during pregnancy	Endline
Smoked during pregnancy	70	.0571	0.234	0	1	Binary: participant self-reported smoking during pregnancy.	Endline
High blood pressure	72	0.139	0.348	0	1	Binary: participant has high blood pressure	Baseline
Diabetes	72	0.014	0.118	0	1	Binary: participant has diabetes	Baseline
Stroke	72	0.014	0.118	0	1	Binary: participant has experienced a stroke	Baseline
Tuberculosis	72	0.069	0.256	0	1	Binary: participant has ever been diagnosed with TB	Baseline
Fruit & vegetables	72	5.556	3.952	0	14	Weekly consumption of fruit and vegetables	Baseline
Red meat	72	1.576	2.644	0	14	Weekly consumption of red meat	Baseline

Fish	72	2.201	3.043	0	14	Weekly consumption of fish	Baseline
Planned pregnancy	72	0.25	0.436	0	1	Binary: Pregnancy was planned	Baseline
Unplanned and wanted pregnancy	72	0.556	0.500	0	1	Binary: Pregnancy was unplanned, but participant is happy	Baseline
Unplanned and unwanted pregnancy	72	0.194	0.399	0	1	Binary: Pregnancy was unplanned, and participant is unhappy	Baseline
Lives with older female	66	0.106	0.310	0	1	Binary: An older female figure, such as a mother, grandmother or mother-in-law resides in the same household	Endline
Live-in father	72	0.570	0.499	0	1	Binary: Father of the neonate resides in the household	Endline
No refrigerator	72	0.306	0.464	0	1	Binary: Participant does not own a refrigerator	Baseline
Want more children	72	0.222	0.419	0	1	Binary: Participant wants more children in the future	Endline
Used contraception before pregnancy	72	0.056	0.231	0	1	Binary: Participant used contraception before falling pregnant	Endline
Momconnect	72	0.069	0.256	0	1	Binary: Participant was connected to Momconnect	Endline
Danger signs knowledge at baseline	72	5.583	1.480	0	7	Scale from 0 to 8 measuring whether the participant will respond correctly to the occurrence of danger signs, measured at recruitment	Baseline
Labour signs knowledge at baseline	72	1.917	0.622	1	3	Number of labour signs the participant could list at recruitment	Baseline

Table A.3.6. 2 Correlates of attrition

VARIABLES	OLS Attrite	OLS Attrite	OLS Attrite	OLS Attrite	OLS Attrite	OLS Attrite	OLS Attrite	OLS Attrite	OLS Attrite	OLS Attrite	OLS Attrite
Treatment	-0.120										
	(0.0899)										
Age		-0.00265									
		(0.00731)									
Unemployed			-0.143								
			(0.0923)								
Black African				-0.173							
				(0.130)							
Assets					0.0698						
					(0.0448)						
Foreign national						-0.0424					
						(0.0915)					
Household size							0.0168				
							(0.0195)				
First pregnancy								0.0913			
								(0.0995)			
Married									0.0533		
									(0.105)		
Finished high school										0.0650	
										(0.118)	
Identified with a pregnancy test											0.0512
											(0.0906)
Constant	0.340***	0.353*	0.368***	0.429***	0.279***	0.298***	0.216**	0.254***	0.267***	0.268***	0.204
	(0.0636)	(0.205)	(0.0727)	(0.120)	(0.0448)	(0.0600)	(0.0871)	(0.0536)	(0.0523)	(0.0500)	(0.142)

Observations	100	100	100	100	100	100	100	100	100	100	100
R-squared	0.018	0.001	0.024	0.018	0.025	0.002	0.008	0.009	0.003	0.003	0.003

A 3.7 Birth weight

As discussed in the main text, the incidence of low birth weight (LBW) is predominantly the result of intrauterine growth restriction and/or preterm birth (Katz *et al.*, 2013), which can be linked to the presence of various clinical, socioeconomic and structural (such as access to care) risk factors. The risk factors associated with LBW, amongst others, are poor maternal nutrition (Rollins *et al.*, 2007; Black *et al.*, 2013; Feresu *et al.*, 2015), maternal anaemia (Black *et al.*, 2013; Feresu *et al.*, 2015), multiple childbirths (Tomita *et al.*, 2015) and maternal depression (Tomita *et al.*, 2015). Poor socioeconomic status, including low level of education and wealth, are also considered risk factors for LBW (Khatun & Rahman, 2008). Furthermore, medical factors such as obstetrical complications (Feresu *et al.*, 2015) and the presence of infections, such as HIV (Rollins *et al.*, 2007; Feresu *et al.*, 2015; Moodley *et al.*, 2016) also negatively affect birth weight, as do social factors such as exposure to intimate partner violence (Stein *et al.*, 2015).

Late and infrequent access to care also have a detrimental effect on birth weight (Khatun & Rahman, 2008; Abu-Ghanem *et al.*, 2012; Feresu *et al.*, 2015; Moodley *et al.*, 2016), although one would expect structural factors to be operating through various channels. For instance, women who are HIV positive but do not access care and, as such, do not receive any anti-retroviral treatment, are likely to experience adverse health outcomes such as LBW of their infant. Other structural factors, such as social support from family members (especially partners and grandmothers) have a protective effect on birth weight (Cunningham *et al.*, 2010).

The assessment of risk factors and outcomes of LBW stems predominantly from public health and medical literature, based on cross-sectional data and therefore does not explore the role of endowment heterogeneity in the occurrence of LBW (Behrman & Rosenzweig, 2004; Almond *et al.*, 2005). Genetic and/or family background may also play a contributing factor in intrauterine growth, and is also likely to play a role in future life achievements. The detrimental medical effect of low birth weight may be overestimated, and the importance of improving unfavourable family environment underestimated (Behrman & Rosenzweig, 2004). The paucity of available panel data capturing both familial and medical factors, and which allows for the necessary econometric techniques to be applied to establish this endogenous relationship, means that the true outcomes of LBW is often unknown.

In Table A 3.7.1, the impact of being in the treatment group and various other risk factors and covariates on birth weight is estimated. The outcome variable is the continuous measure of birth weight, and an ordinary least squares estimator is applied. The estimates show that the treatment had no significant effect on birth weight (Column [1]). This effect does not change when I control for a set of covariates (Column [2]).

Table A 3.7. 1: The impact of the intervention and other risk factors on birth weight

	OLS [1]	OLS [2]
Treatment	-18.34	-49.73
	(141.0)	(141.8)
Age		-47.64
		(98.96)
Age squared		0.924
		(1.683)
Unemployed		-289.7*
		(145.9)
Black African		160.6
		(211.3)
Assets		26.06
		(90.82)
Foreign national		318.3**
		(147.6)
Household size		-47.38
		(35.37)
First pregnancy		151.4
		(187.1)
At least high school education		165.4
		(181.7)
Married		194.4
		(171.1)
Identified using pregnancy test		-274.0*
		(141.2)
Constant	2,920***	3,796**
	(194.0)	-1,551
Observations	71	71
R-squared	0.010	0.320

*** p<0.01, ** p<0.05, * p<0.1; Standard errors in parenthesis
+Note: the analysis was also performed using a binary outcome variable equal to one if woman's baby weighed less than 2500 grams, and is therefore considered low birth weight. The results remained consistent.
++Note: All estimates control for the difference in time that participants were exposed to the study.

A 3.8: Maternal depressive symptoms

The scope of research focusing on the determinants and prevalence of antenatal and postnatal depression and anxiety[90] is currently limited (Akiki *et al.*, 2016). Using the framework drawn from the work of Akiki *et al.* (2016), the possible determinants can broadly be grouped into socioeconomic/demographic factors (such education or income), prior pregnancy or medical conditions (such as previous miscarriages), psychological stress (such as having an unplanned pregnancy or a lack of support) and other risks which occur during pregnancy (such as smoking) (Akiki *et al.*, 2016). Wittkowski *et al.* suggest that sociocultural factors, such as a feeling of cultural dissonance, also play an important role in the Sub-Saharan African countries (Wittkowski *et al.*, 2014).

Previous international studies have found the prominent correlates of antenatal anxiety to be unplanned and unwanted pregnancies (Brittain *et al.*, 2015; Akiki *et al.*, 2016; Biaggi *et al.*, 2016), a history of domestic abuse (Brittain *et al.*, 2015; Biaggi *et al.*, 2016), occurrence of adverse events (Brittain *et al.*, 2015; Biaggi *et al.*, 2016), low self-esteem of the mother (Akiki *et al.*, 2016; Biaggi *et al.*, 2016), history of mental illness (Biaggi *et al.*, 2016) and poor social support, especially from one's partner (Wittkowski *et al.*, 2014; Akiki *et al.*, 2016; Biaggi *et al.*, 2016; Cheng *et al.*, 2016).[91] Socio-demographic factors such as low levels of income, education and single marital status are also correlated with antenatal depression and anxiety (Brittain *et al.*, 2015; Biaggi *et al.*, 2016). Postnatal or postpartum depression in turn is largely influenced by antenatal depression and having a history of mental health disorders (Chojenta *et al.*, 2016; Kita *et al.*, 2016).

An added stressor in the South African context is the high rate of HIV, especially amongst pregnant women. South African women often only find out about their HIV status during their antenatal care visits. Stigma and uncertainties associated with HIV contributes significantly to antenatal and postnatal anxiety and depression (Mall *et al.*, 2013; Scorgie *et al.*, 2015; Davies *et al.*, 2016). A further stressor which came as a significant risk factor of postnatal depression in South Africa is fear of violence, often brought on by witnessing a violent crime or being in danger of being killed (Ramchandani *et al.*, 2009; Wittkowski *et al.*, 2014). Intimate partner violence is also a contributing stressor in South Africa (Stein *et al.*, 2015).

In Table A 3.8.1, the impact of the intervention on maternal depressive symptom score is measured

[90] Antenatal depression and anxiety are highly comorbid, and are considered to have the same determinants (Biaggi *et al.*, 2016). Therefore, I use it interchangeably.
[91] These results were obtained during a search of "antenatal anxiety" and "prenatal anxiety" on Pubmed.

using an ordinary least squared estimator. In the regression analysis, I also report on the other correlates of depressive symptoms. The results of the treatment variable on maternal depressive symptoms are discussed in the main text (Table 3.12). The risk factor analysis is reported in Table A 3.8.1.

A factor significantly associated with maternal depressive symptoms are: the presence of antenatal depression (Column [2]). Although having an unplanned pregnancy (Column [3]) is positively correlated with maternal depressive symptoms, the relationship is not significant in this analysis.

Of the socio-demographic factors, age, wealth and unemployment are the only significant correlates. There is a nonlinear relationship between age and maternal depressive symptoms ([4]). Up until 30 years of age, the older you become, the more likely you are to be depressed when you give birth. After 30, this relationship becomes negative. The effects are robust ([6]). The relationship between maternal depressive symptoms and asset wealth is also positive. The richer an individual, the more likely they are to show symptoms of maternal depression. Both these relationships are unexpected, given the literature on maternal depression.

Table A 3.8. 1: The impact of the intervention on and other risk factors of maternal depressive symptoms

	OLS	OLS	OLS	OLS	OLS	OLS
	[1]	[2]	[3]	[4]	[5]	[6]
Treatment	-1.164**				-1.077**	-1.051**
	(0.504)				(0.497)	(0.518)
Antenatal Depression		0.182**			0.188**	0.211**
		(0.0909)			(0.0876)	(0.0957)
Planned			Reference		Reference	Reference
Unplanned and wanted			0.456		0.262	0.155
			(0.635)		(0.605)	(0.673)
Unplanned and unwanted			0.984		0.643	0.276
			(0.797)		(0.763)	(0.874)
Age				1.028***		1.013***
				(0.373)		(0.373)
Age squared				-0.0166**		-0.0164**
				(0.00633)		(0.00635)
Unemployed						1.065*
						(0.544)
Black African						0.797
						(0.800)
Assets						0.632*
						(0.354)
Foreign national						0.505
						(0.575)
Household size						-0.0598
						(0.129)
First pregnancy						0.512
						(0.719)
At least high school education						-0.384
						(0.694)
Married						-0.508
						(0.702)
Identified using pregnancy test						-0.343
						(0.542)
Constant	3.685***	1.086**	1.444***	-6.608	2.541***	-14.32**
	(0.683)	(0.476)	(0.527)	(5.007)	(0.957)	(5.894)
Observations	72	72	72	72	72	72
R-squared	0.117	0.054	0.022	0.042	0.183	0.360

*** p<0.01, ** p<0.05, * p<0.1; Standard errors in parenthesis
+Note: All estimates that contain the treatment variable control for the difference in time that participants were exposed to the study

A 3.9: Maternal nutrition

The risk factors of maternal undernutrition identified in public health literature include lower household income (Davies *et al.*, 2012) or socioeconomic status, infection, smoking, inadequate energy intake, short pregnancy intervals and pregnancy induced hypertension (Imdad & Bhutta, 2013). Maternal undernutrition can have severe consequences on the health of both mother and infant. Malnutrition amongst pregnant women is considered to be a major risk factor for intra-uterine growth retardation and an increased probability of low birth weight, increasing the risk of mortality amongst infants and children up to five years of age (Nannan *et al.*, 2007; Rollins *et al.*, 2007). A systematic review of the impact of undernutrition on infant health globally found that maternal undernutrition increased the risk of preterm birth by 29% and the risk of the infant being born with low birth weight by 64%. The effect on preterm birth is especially pronounced in low-resource settings (Han *et al.*, 2011). Maternal undernutrition has also been linked to increased risk of maternal mortality (Christian *et al.*, 2008).

Maternal obesity and overweight also presents negative outcomes for mother and infant. Obesity amongst pregnant mother is associated with an increased probability of gestational diabetes mellitus (Torloni *et al.*, 2009; Denison *et al.*, 2010), and an increased risk of stillbirth (Denison *et al.*, 2010). Pre-eclampsia and obstetric haemorrhaging is more prevalent amongst obese compared to normal weight pregnant women (Black *et al.*, 2013).

Research articles focusing on maternal malnutrition and its determinants are few due to the limited data available on the subject (Nannan *et al.*, 2007), and various methods are used to measure maternal malnutrition. Nannan *et al.* (2007), instead of measuring malnutrition amongst pregnant women, measure the incidence of malnutrition amongst women of two childbearing age groups. Women between the age of 15 and 29 (age group 1) or 30 and 49 (age group 2), with a body mass index (kg/m^2) of less than 20 are considered malnourished. Using the 1998 Demographics and Health Survey, they find 18.7% and 6.6% rates of undernutrition in these age groups respectively (Nannan *et al.*, 2007).

I measure malnutrition using middle upper arm circumference (MUAC). To allow for maximum variation of the dependent variable, I use the continuous version of middle upper arm circumference and apply the ordinary least squares estimator. The results are shown in Table 3.7.1. The bivariate relationship between the treatment arm and MUAC is reported in Column [1] and discussed in the main text.

Next, I control for the bivariate relationship between several risk factors and MUAC. These are a history of diagnosed chronic conditions and infection [2] and antenatal depression [3]. I also look at the relationship between possible socio-demographic factors and MUAC before [4] and after controlling for risk factors ([5]-[6]).

The only risk factors that came out as significantly correlated with a higher MUAC is being previously diagnosed with high blood pressure [2] (not surprising given the relationship between high blood pressure and being overweight (Sattar *et al.*, 2001)). In Column [5] I control for this risk factor along with the socio-demographic factors, and in Column [6] I control for the remaining health and lifestyle risk factors too. The effect of having high blood pressure reduces slightly in size and loses significance in Columns [5] and [6]. None of the socio-demographic factors are significantly correlated with MUAC. Being married or Black African are positively correlated with MUAC, and unemployed negatively correlated with MUAC, but the effects are not robustly significant.

Table A 3.9. 1: The impact of the intervention on maternal nutrition

	OLS	OLS	OLS	OLS	OLS	OLS
Dependent: MUAC in cm	[1]	[2]	[3]	[4]	[5]	[6]
Treatment	0.465			0.320	0.207	0.276
	(0.801)			(0.828)	(0.845)	(0.873)
High blood pressure		1.866*			1.219	1.003
		(1.102)			(1.342)	(1.373)
Diabetes		1.468				-2.124
		(3.211)				(3.791)
Stroke		-4.981				-5.038
		(3.217)				(3.699)
TB		-1.937				-2.386
		(1.478)				(1.615)
Baseline MUAC		0.455***	0.459***	0.466***	0.409***	0.387***
		(0.0749)	(0.0746)	(0.0753)	(0.0782)	(0.0824)
Number of children					0.166	0.428
					(0.466)	(0.534)
Antenatal Depression			-0.117			-0.111
			(0.137)			(0.160)
Age				-0.250	-0.163	-0.113
				(0.572)	(0.585)	(0.581)
Age squared				0.00611	0.00402	0.00320
				(0.00973)	(0.0101)	(0.0100)
Unemployed				-1.248	-1.336	-1.036
				(0.837)	(0.850)	(0.864)

Black African				1.466	1.321	1.735
				(1.233)	(1.276)	(1.331)
Assets				-0.587	-0.548	-0.428
				(0.522)	(0.529)	(0.580)
Foreign national				0.112	-0.0546	0.0851
				(0.842)	(0.885)	(0.914)
Household size				-0.0445	-0.105	-0.133
				(0.201)	(0.216)	(0.218)
First pregnancy				-0.678	-0.364	-0.182
				(1.071)	(1.253)	(1.317)
At least high school education				0.0471	0.193	-0.0685
				(1.050)	(1.072)	(1.085)
Married				1.873*	1.767*	1.265
				(0.939)	(0.972)	(1.014)
Identified using pregnancy test				-0.888	-0.666	-1.133
				(0.803)	(0.844)	(0.888)
Constant	13.72***	15.25***	15.28***	18.85**	18.38**	17.48*
	(2.555)	(2.328)	(2.388)	(8.961)	(9.064)	(9.042)
Observations	72	72	72	72	72	72
R-squared	0.388	0.434	0.378	0.537	0.544	0.586

*** p<0.01, ** p<0.05, * p<0.1; Standard errors in parenthesis
+Note: Since I am interested in the change in MUAC, all estimates control for the participant's MUAC at baseline.
++Note: All estimates that contain the treatment variable control for the difference that participants were exposed to the study.

Given the distribution of MUAC (as shown in Figure 3.6 in the main text) where there is grouping of MUAC at the tails for women in the control group, I test for the robustness of the results by changing the dependent variable into a binary indicator of obesity or being underweight. A woman is classified as underweight if she has a MUAC of 23 cm or less. This cut-off is based on the Médecines Sans Frontiers systematic review of MUAC cut-offs used globally, and is considered a cut-off below which women are at increased risk of delivering low birth weight infants (Ververs *et al.*, 2013). The WHO cut-off of 33 cm or more is used to classify a woman as obese.

For parsimony, I only report the results from specifications [5] to [6] of Table A 3.9.1, and only for the coefficients that were significant and/or large in the previous regression analysis. The results are reported in Table A 3.9.2.

The relationship between the treatment variable and nutritional status remains small and insignificant despite the change in specification. Surprisingly, high blood pressure (HBP) is positively correlated with being both obese (Columns [8] and [9]) and being underweight (Columns [5] and [6]), but the effect is small. Having a history of TB infection or a stroke decreases the probability of being underweight and obese, while being diabetic increases the probability of being underweight and decreases the probability of being obese. All these relationships (except for the negative relationship between TB infection and being underweight, and the positive relationship between HBP and obesity) are the opposite of what is reported in the medical literature, and indicative that the reported relationships in the previous table were probably spurious. These irregular correlations could point to the poor state of capturing self-reported chronic conditions in lower-resource settings, as discussed in Chapter 2. Alternatively, the odd relationship could be driven by the small number of women declared underweight and obese in this sample.

Being Black African or married decreases the probability of being underweight, but increases the probability of being overweight. These effects are all imprecisely estimated.

Table A 3.9. 2: The impact of the intervention on MUAC, underweight and obesity

	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
	MUAC	MUAC	MUAC	Underweight	Underweight	Underweight	Obese	Obese	Obese
Treatment	Treatment	0.320	0.276	0.213	0.0224	0.0231	0.0217	0.0245	0.0464
		(0.828)	(0.873)	(0.838)	(0.0534)	(0.0586)	(0.0545)	(0.102)	(0.108)
High blood pressure	High blood pressure		1.003	1.181		0.0178	0.00778		-0.00844
			(1.373)	(1.327)		(0.0921)	(0.0862)		(0.170)
Diabetes	Diabetes			-2.124			0.154		
				(3.791)			(0.254)		
Stroke	Stroke			-5.038			-0.0306		
				(3.699)			(0.248)		
TB	TB			-2.386			-0.0974		
				(1.615)			(0.108)		
Baseline MUAC	Baseline MUAC	0.409***	0.403***	0.392***	-0.00710	-0.00623	-0.00722	0.0324***	0.0330***
		(0.0782)	(0.0833)	(0.0807)	(0.00505)	(0.00558)	(0.00525)	(0.00967)	(0.0103)
Unemployed	Unemployed	-1.248	-1.036	-1.323	0.0504	0.0506	0.0499	0.0306	0.0723
		(0.837)	(0.864)	(0.843)	(0.0540)	(0.0579)	(0.0548)	(0.104)	(0.107)
Black African	Black African	1.466	1.735	1.264	-0.0822	-0.0928	-0.0835	0.183	0.250
		(1.233)	(1.331)	(1.256)	(0.0795)	(0.0892)	(0.0816)	(0.152)	(0.164)
Married	Married	1.873*	1.265	1.843*	-0.0226	-0.0462	-0.0227	0.0690	0.0275
		(0.939)	(1.014)	(0.941)	(0.0606)	(0.0680)	(0.0612)	(0.116)	(0.125)
Control for other socio-demographic variables	yes	yes	yes	yes	yes	yes	yes	yes	yes
Control for health and lifestyle factors	no	no	yes	no	no	yes	no	no	yes

*** p<0.01, ** p<0.05, * p<0.1; Standard errors in parenthesis

+Note: Since I am interested in the change in MUAC, all estimates control for the participant's MUAC at baseline.

++Note: All estimates that contain the treatment variable control for the difference in time that participants were exposed to the study.

Other socio-demographic factors include age, age squared, Asset index, foreign nationality, household size, first pregnancy, at least high school level of education, and identified using a pregnancy test.
Other health and lifestyle factors included and not shown are number of children and antenatal depression.

A 3.10: Infant feeding intention

Breastfeeding reduces exposure to contaminated food and water sources, thereby decreasing the probability of infants dying of diarrhoea. Early initiation of breastfeeding and subsequent exclusive breastfeeding is linked to decreased neonatal mortality (Edmond, 2006; Doherty *et al.*, 2014), reduced incidence of infectious diseases such as acute respiratory infection (Arifeen *et al.*, 2001; Jones *et al.*, 2003), decreased hospitalisation in the first three to six months of life (Kindra *et al.*, 2012; Doherty *et al.*, 2014) and reduced neonatal sepsis (Jones *et al.*, 2003).

Breastfeeding also hold benefits for maternal health. The lactational amenorrhea method can act as a form of postpartum contraception which can increase spacing between births (Sober & Schreiber, 2009), and can also help to prevent postpartum anaemia due to the release of oxytocin during uterus contractions when breastfeeding (Stein & Kuhn, 2009). It also decreases risk of maternal haemorrhaging (if breastfeeding is initiated within the first hour of birth) (Jones *et al.*, 2003).

In a low-resource setting, where exclusive formula feeding is not always affordable, exclusive breastfeeding is recommended for six months, regardless of HIV status. Formula feeding in a low-resource environment can often pose a dangerous risk to neonatal mortality due to exposure to poor hygiene and sanitation conditions (Meyer *et al.*, 2007). Breastfeeding is considered one of the most cost-effective strategies for child survival, decreasing the incidence of risk factors contributing to neonatal mortality.

The HIV epidemic created an uncertainty on the necessary policy stance on breastfeeding. The risk of transmitting the HIV virus from mother to infant is significantly higher amongst women who breastfeed if they are not on ARV treatments. This has posed a dilemma for breastfeeding promotion, and led to various mixed messaging on breastfeeding at the start of the century. However, if women who are HIV positive are initiated onto a highly active ARV therapy, and if infants are provided with postpartum ARV prophylaxis, the risk of HIV transmission from mother to infant during breastfeeding is minimised (Coutsoudis *et al.*, 2010). Studies have shown that with the necessary treatment, the risk of transmission is even lower when women exclusively breastfeed

compared to mixed feed (Coutsoudis *et al.*, 2001; Iliff *et al.*, 2005). In 2006, the WHO issued guidelines recommending exclusive breastfeeding amongst all women regardless of HIV status, if formula feeding in that setting is not acceptable, feasible, affordable, sustainable and safe. It is the responsibility of each country to assess whether exclusive breastfeeding is viable within this framework (World Health Organization, 2010).

The South African Department of Health's current stance on exclusive breastfeeding was established in the Tshwane Declaration for the Support of Breastfeeding in South Africa, which was announced in August 2011 (Editorial Office, 2011). The MNCWH&N strategy further promotes this declaration. The strategy calls for the promoting of early and exclusive breastfeeding for six months, regardless of the HIV status of the mother (National Department of Health, 2012a). This is in line with the recommendations by the WHO (Kramer & Kakuma, 2012).

Community health worker programmes that have improved exclusive breastfeeding rates

Community health worker programmes have been successfully used to promote exclusive breastfeeding. In Kwazulu-Natal, South Africa, a programme was initiated where pregnant women living with HIV attended approximately eight antenatal and postnatal peer meetings led by a trained Peer Mentor. A range of topics were discussed at these meetings, including feeding options, condom use and partner testing. The programme had a significant impact on the infant's weight-for-age, the probability of being exclusively fed (and specifically exclusively breastfed) and in decreasing the symptoms of maternal depression (Rotheram-Borus *et al.*, 2014).

In a study in the United Kingdom, seven local mothers were trained to provide personal peer counselling and postnatal support to pregnant women. These women provided four peer counselling sessions to local pregnant women, two during the antenatal period and two during the postnatal period. The programme had a significant impact on breastfeeding initiation, but not duration (McInnes *et al.*, 2000). Peer counselling by trained local mothers has also been used to promote exclusive feeding and the duration of exclusive breastfeeding in Bangladesh (Haider *et al.*, 2000), and various Sub-Saharan African countries (Tylleskär *et al.*, 2011). The success of the interventions is often contingent on the content and frequency of these visits. Interventions where nursing staff (Pugh & Milligan, 1998; Kramer *et al.*, 2001), midwives or physicians (Kramer *et al.*, 2001) are specifically trained to promote exclusive breastfeeding duration are rarely ineffective, but would not be feasible in a human resource-constrained country such as South Africa. In South

Africa, community health worker support programmes have proven successful in improving exclusive breastfeeding, even in HIV prevalent areas (Bland *et al.*, 2008).[92]

The infant feeding intention scale and possible risk factors

I measure infant feeding intention using an adapted version of the infant feeding intention scale. In Table A 3.10. 1, the adapted version of the statements on breastfeeding is presented with their allocated scores.

Table A 3.10. 1: The adapted infant feeding intention scale

	Very much agree	Unsure	Very much disagree
1. I am planning to only formula feed my baby (I will not breastfeed at all)	0	1	2
2. I am planning to at least give breastfeeding a try.	2	1	0
3. When my baby is 1 month old, I will be breastfeeding without using any formula or other milk.	2	1	0
4. When my baby is 3 months old, I will be breastfeeding without using any formula or other milk.	2	1	0
5. When my baby is 6 months old, I will be breastfeeding without using any formula or other milk.	2	1	0

[92] Interventions which could be implemented to increase initial breastfeeding rates and prolong exclusive breastfeeding are structured education programs (including breastfeeding topics in antenatal classes); education programmes with support (one-on-one consultations with new mothers); and peer support or counselling programs (pairing volunteers with breastfeeding experience with new mothers) (Centre for Community Child Health 2006).

Breastfeeding education classes have proven to be one of the most successful interventions to increase initiation and duration of breastfeeding. These education sessions differ in type and impact. In Australia, antenatal practical group sessions teaching mothers how to position and attach babies on the breast led to more women opting to breastfeed (Duffy *et al.*, 1997). Similar results were found in the USA (Brent *et al.*, 1995). Amongst low-income African-American mothers in the USA, women who received either one-on-one sessions with nurses or attended group information sessions on the fallacies, problematic aspects and benefits of breastfeeding were significantly more likely to breastfeed than women with no extra education programmes (Kistin *et al.*, 1990). In Ireland, a three-minute discussion by a medical student to mothers in the late stages of their pregnancy proved to be a very cost-effective way to increase initial breastfeeding rates (Loh *et al.*, 1997).

Maternal fatigue is listed as one of the reasons why mothers often do not opt to breastfeed. An intervention where 2-hour postnatal visits by nurses were flexible, and included helping mothers with "non-nursing" tasks, such as doing the dishes or the laundry, increased the average breastfeeding duration (Pugh & Milligan, 1998). Other education-based interventions which have increased rates on and the duration of exclusive breastfeeding include postpartum visits by community-based peer councillors three days after delivery (Aksu *et al.*, 2011) or on a routine basis until the mother is no longer breastfeeding (Haider *et al.*, 2000) and antenatal and postnatal promotion of breastfeeding by healthcare workers (Kramer *et al.*, 2001).

So far, the sole use of **written material** promoting breastfeeding in high income countries has proven unsuccessful. For better results, written material should be combined with individualized support (Curro *et al.*, 1997). The distribution of gift packs containing formula samples is negatively correlated with exclusive breastfeeding (Bergevin *et al.*, 1983; Snell *et al.*, 1992; Howard *et al.*, 2000). The effect of supplying manual breast pumps to new mothers is inconsistent across studies. A 1994 study in the United States covering 1600 found that providing breast pumps did increase the duration of exclusive breastfeeding amongst subgroups, but not significantly (Bliss *et al.*, 1997).

In Table A 3.10.2, I explore the relationship between being part of the intervention and other risk factors on infant feeding intention. The dependent variable in these regressions is the continuous infant feeding intention value. The results are discussed in the main text.

By interacting the risk factors with the treatment variable, I can estimate the possible impact of the intervention for vulnerable subgroups. In Tables A 3.10.3 and A 3.10.4 below, I report the results of these interactions with the risk factors age and not owning a refrigerator. Column [4] contains the results of these interactions, controlling for possible confounding factors. From Table A 3.10.3, it is clear that age is negatively and significantly correlated with the IFI scale. For women in the treatment group, the effect of age is even more negative (but statistically insignificant) compared to those in the control group.

The intervention has a positive and significant role in increasing the IFI scale of participants in the treatment group who do not own a refrigerator, compared to participants in the control group who do not own a refrigerator (Table A 3.10.4). The results are discussed in the main text.

Women who do not possess a refrigerator are likely to score 1.6 points less on the IFI scale than participants who possess a refrigerator (Column [2] in Table A 3.10.4). However, women in the treatment group who do not possess a refrigerator are likely to score up to 2.9 points higher on the IFI scale than their counterparts in the control group (Column [4])

Table A 3.10. 2: Possible risk factors of infant feeding intention

	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Dependent: IFI scale	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]
Treatment	1.035										1.159
	(0.762)										(0.797)
Age		-0.20***									-0.161**
		(0.0616)									(0.0756)
Unemployed			0.740								0.805
			(0.806)								(0.825)
Black African				-0.734							-0.757
				(1.214)							(1.199)
Does not own a refrigerator					-1.588*						-1.594*
					(0.808)						(0.890)
Foreign national						0.669					0.373
						(0.765)					(0.813)
Household size							0.0313				-0.0594
							(0.161)				(0.169)
First pregnancy								1.293			0.320
								(0.854)			(1.021)
At least high school education									1.058		0.296
									(1.018)		(1.050)
Married										-0.0647	-0.349
										(0.900)	(0.944)
Identified using pregnancy test											0.197
											(0.793)
Constant	4.105***	10.87***	4.792***	5.937***	5.770***	4.988***	5.169***	4.943***	5.108***	5.300***	8.742***

	(1.033)	(1.733)	(0.658)	(1.144)	(0.447)	(0.510)	(0.706)	(0.439)	(0.416)	(0.437)	(3.092)
Observations	72	72	72	72	72	72	72	72	72	72	72
R-squared	0.032	0.134	0.012	0.005	0.052	0.011	0.001	0.032	0.015	0.000	0.230

*** p<0.01, ** p<0.05, * p<0.1; Standard errors in parenthesis
+Note: All estimates containing the treatment variables control for the difference in time that participants were exposed to the study.

Table A 3.10. 3: Interacting age and treatment

Dependent: IFI scale	[1]	[2]	[3]	[4]
Age*Treatment			-0.0540	-0.0791
			(0.126)	(0.137)
Age	-0.203***	-0.201***	-0.179**	-0.130
	(0.0616)	(0.0616)	(0.0811)	(0.0924)
Treatment		0.905	2.393	3.379
		(0.715)	(3.544)	(3.815)
Covariates	No	No	No	Yes

Table A 3.10. 4: Interacting not owning a refrigerator with treatment

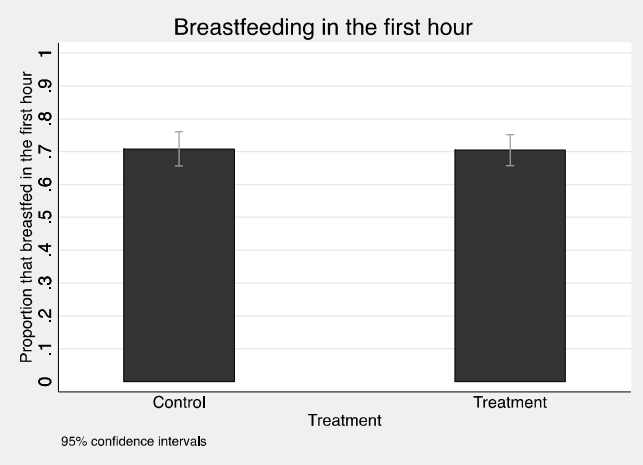
Dependent: IFI scale	[1]	[2]	[3]	[4]
No Refrigerator*Treatment[93]			3.349**	2.920*
			(1.611)	(1.735)
No Refrigerator	-1.588*	-1.635**	-3.559***	-3.227**
	(0.808)	(0.808)	(1.216)	(1.308)
Treatment		1.128	0.114	0.229
		(0.747)	(0.877)	(0.982)
Covariates	No	No	No	Yes

*** p<0.01, ** p<0.05, * p<0.1; Standard errors in parenthesis
+Note: covariates include unemployed, Black African, foreign nationality, household size, first pregnancy, at least high school level of education, married and identified using a pregnancy test.
++Note: All estimates containing the treatment variables control for the difference in time that participants were exposed to the study.

[93] Please note that there are 22 women in the sample who report not owning a fridge, 13 of who are in the treatment group.

I also collected data on whether participants breastfed within the first hour after giving birth. There are various health benefits of initiating breastfeeding within the first hour, such as decreasing the risk of maternal haemorrhaging (Jones *et al.*, 2003). In Figure A 3.10.1, I depict the likelihood of breastfeeding in the first hour after giving birth aggregated by treatment arm, and find no significant difference. This lack of a significant difference could point to the important role of health staff at the facilities in how fast breastfeeding is initiated and possibly the lack of autonomy of women in this decision. Alternatively, there could have been poor messaging from the intervention on the importance of immediate breastfeeding.

Figure A 3.10. 1: Breastfeeding in the first hour after giving birth



+Note: The estimates control for days in the study, and other covariates, including age, age squared, owning a refrigerator, unemployed, Black African, foreign nationality, household size, first pregnancy, at least high school level of education, married and identified using a pregnancy test.

A 3.11: Impact of the intervention, aggregated by pregnancy detection method

Women recruited into the study using the CHW urine pregnancy tests identified their pregnancies at a much earlier gestational age than women who self-identified their pregnancies. An analysis by sub-group is necessary to determine whether the package intervention, or the package intervention along with the urine pregnancy test is required to change health seeking behaviour. This subgroup analysis is provided in table A 3.11.1. These are the estimates from an OLS analysis, looking at the impact of the binary treatment variable on the months of gestation (continuous measure) that women accessed care. This subgroup analysis was not performed for the other health facility attendance outcome measures, since these samples were too small. The table reveals that treatment had a large and significant effect on the health-seeking behaviour of participants who self-identified pregnancy. After controlling for covariates, participants in the treatment group were

likely to access care 2 months earlier than participants in the control group (significant at a 1% level). The effect is much smaller and insignificant for women who used the UPT. This sub-group analysis suggests that the package intervention, rather than the UPT, was driving prudent health-seeking behaviour.

Table A.3.11. 1 Months of gestation at first booking visit, by testing method

	Self-identified		Identified with urine pregnancy test	
Treatment	-1.942***	-2.107***	-0.415	-0.125
	(0.569)	(0.714)	(0.591)	(0.649)
Control for socio-demographic variables	No	Yes	No	Yes
Observations	37	37	34	34
R-squared	0.300	0.328	0.290	0.466

Chapter 4

Two alternative approaches to urine pregnancy test distribution: a cost-effectiveness analysis

4.1 Introduction and research question

South Africa has a comparatively high maternal and infant mortality ratio, given its level of economic development and high levels of public health expenditure. One of the many factors contributing to these ratios is the fact that pregnant women in South Africa seek antenatal care for the first time at a very late stage of their pregnancy (Pattinson, 2012). Researchers have attributed part of the late antenatal health-seeking behaviour to difficulty in early pregnancy detection (Solarin & Black 2013; Myer & Harrison 2003; Smith, 2016). Access to urine pregnancy tests (UPTs) has been shown to significantly decrease the gestational age at which pregnancy is detected and antenatal care is sought (Jeffery *et al.*, 2000; Morroni & Moodley, 2006).

In South Africa, public clinics have to stock and provide women with free UPTs. In reality, the clinics often do not have UPTs in stock and since public antenatal clinics are regularly under-capacitated and waiting times are very long, women are often unwilling to wait at a clinic all day to access a test.

In this chapter I discuss the results from a study that measures the cost-effectiveness of two alternatives approaches to UPT distribution. The first approach is distribution at a mobile health outreach site. The second approach is door-to-door distribution of pregnancy tests by community health workers trained in antenatal care. I find that distributing UPT using the door-to-door approach is more cost-effective relative to the mobile outreach facility.

The analysis will follow a societal perspective, with a micro-costing approach. Effectiveness will be measured as take-up of the tests and number of pregnancies detected. The aim of the study is to provide evidence to policymakers about the cost-effectiveness of two alternative UPT distribution approaches.

I shall begin with an overview of the South Africa's maternal health situation, discussing it within the broader context of the poor focus on sexual and reproductive health in South Africa. In this

section I shall also provide the rationale for distributing UPTs more broadly, focusing on the link between earlier pregnancy detection and maternal health via its impact on the timely access to contraception, antenatal care and abortion services. In Section 4.3, I give a description of the two approaches, followed by the methodology applied to calculate cost-effectiveness in Section 4.4. This will be followed by the results, including the total costs (4.5), the total effectiveness (4.6), cost-effectiveness (4.7) and a sensitivity analysis (4.8). I shall conclude with a listing of the study limitations (4.9), and a discussion of my findings (4.10).

4.2. Background

4.2.1 South Africa's high maternal mortality ratio and historically poor focus on sexual reproductive health

South Africa's high maternal mortality ratio, given its level of economic development and high public healthcare expenditure, was comprehensively discussed in the previous chapter.[94] Late identification of pregnancy status poses an extensive threat to maternal health and may directly and indirectly contribute to maternal deaths. Late pregnancy identification has repercussions for the timing of antenatal care and termination of pregnancy (ToP) services, which in turn is linked to a high incidence of unplanned and often unwanted pregnancies and poor access to contraception (Smith, 2016).

South Africa currently has a number of the most progressive policies and initiatives in women's sexual and reproductive health, aimed at closing the gap in health inequalities amongst women and improving the overall level of health of the population. The inequalities are the result of various health and land policies implemented by the pre-1994 apartheid government. Examples of progressive policies include the 1996 Choice on the Termination of Pregnancy Act, the Contraception policy within a reproductive health framework of 2001, free access to primary-level care for children under age six and pregnant and lactating women and the establishment of a directorate focusing on Mother, Child and Women's health, to name a few (Fonn *et al.*, 1998; Cooper *et al.*, 2004).

[94] Pattinson and his team audit the maternal and infant deaths that occur in a large sample of South African hospitals and find that 40% of maternal deaths in 2010 can be classified as avoidable (Pattinson, 2012). The leading causes of these avoidable deaths are non-pregnancy related infections, obstetric haemorrhaging and hypertension. Together these represent two thirds of all avoidable deaths (Pattinson, 2012).

Despite these innovative policies and their contribution towards change, there still remain obstacles to their successful implementation. A combination of limited human and financial resources in the public sector has often resulted in poor implementation, management and monitoring of these policies (Fonn *et al.*, 1998; Cooper *et al.*, 2004).

One of the areas where policy implementation can be improved and contribute to the improvement of maternal mortality is in the availability and choice of contraception, which have been linked to maternal mortality (Ahmed *et al.*, 2012). Improved access to contraception, especially amongst adolescents, decreases maternal deaths by decreasing exposure to the hazards of giving birth or having abortions. Access to contraceptive services is also likely to have an effect on maternal morbidity and mortality, as it empowers women to plan and space births (Ahmed *et al.*, 2012). Improving access for women who are HIV positive is key to preventing maternal deaths, as these women are particularly vulnerable during the process of childbirth (The inter-agency task team for prevention and treatment of HIV infection in pregnant women, mothers, and their children, 2011).

Access to contraception in South Africa is fairly high compared to other Sub-Saharan African countries. In 2003, the Demographics and Health Survey reported that 65% of South African women aged between 15-49 were using a form of modern contraception, with 83% of women accessing contraceptives at public health facilities (National Department of Health, 2007a). Contraception choice remains poor, with injectable being the most oft-used method distributed. In the absence of a recent demographics and health survey, small qualitative and quantitative studies have been implemented and have shown various challenges still at play for contraception choice and availability in South Africa. These include inadequate provision of information on contraception, lack of privacy, unaccommodating clinic opening times and stigmatisation of use of contraception by adolescents (Cooper *et al.*, 2004; Orner *et al.*, 2008; Dickson-Tetteh *et al.*, 2011).

In lieu of access to contraception, unwanted and unplanned pregnancies often occur. In the event of these unintended pregnancies, women often seek to terminate their pregnancies. There are various reasons why women are not able to access safe and legal ToP services. Firstly, access to legal ToP services is often hampered by the poor availability of services and the stigma attached to abortion, leading women to seek illegal and unsafe ToP practices. There remains a strong stigma around ToP in South Africa (Jewkes *et al.*, 2005), and only a portion of the clinics dedicated to performing ToPs provide the service, due to conscientious objection by providers or lack of

training of health staff (Ramkissoon *et al.*, 2010; Harries *et al.*, 2014; Harries *et al.*, 2015). These barriers are especially pronounced in rural parts of South Africa (Harrison *et al.*, 2000; Mhlanga, 2003). In the year 2000, three years after the 1996 Act was implemented, only 32 percent of designated health facilities were actually performing ToPs (Hodes, 2013). There were also reports of abortion patients being treated poorly and denied pain medication (Hodes, 2013).

Secondly, late identification of unintended and unwanted pregnancies also means that women are often too late to legally access abortion services in their first trimester. Given that second trimester abortions are only allowed under severe medical and economic circumstances, women presenting for second trimester abortions are often shown away, leading to unwanted pregnancies or women seeking out illegal and often unsafe abortion practices (Harries *et al.*, 2015). Unsafe abortions contribute to 13% of maternal deaths (Haddad *et al.*, 2016).

Even if they are able to access a second trimester abortion legally, they still face the various health hazards and financial barriers[95] of getting an abortion at such a late stage. Almost a third of abortions in South Africa are estimated to occur during the second trimester, much higher than the global average of 10% reported in other countries where abortion is also legalised and data is available (Lince-Deroche *et al.*, 2015; Morroni & Moodley, 2006). According to the 1996 ToP Act, only a medical doctor is allowed to perform a second trimester abortion, while a ToP trained midwife and registered nurse are allowed to perform a first trimester abortion (Harries *et al.*, 2014). This further limits the availability of care when women seek second trimester ToP services.

Another contributor to maternal and infant mortality and morbidity is the late access to antenatal care, which was discussed in detail in the previous chapter. Early access to antenatal care (ANC) is vital for maternal health, particularly in South Africa with its high HIV prevalence. Pregnant women who are HIV positive have to initiate antiretroviral therapy during their first trimester in order to minimise the possibility of transmitting HIV from mother to baby. In the 2012, 59.9% of women only sought antenatal care at a gestational age of 20 weeks/five months or later (National

[95] Second trimester abortion services also impose significant direct and indirect costs on women who seek these services, and usually require multiple visits to the health facility (Lince-Deroche *et al.*, 2015). In a survey on women seeking abortion services in their second trimester, approximately half of the study participants reported seeking financial assistance to pay for abortion-related expenses, indicative of one of the direct financial barriers to accessing this service (Lince-Deroche *et al.*, 2015).

Department of Health, 2012b).[96] Pattinson (2012) reports that in almost a quarter of maternal deaths, the mothers never attended antenatal clinics, or did not attend frequently enough.

South Africa's high maternal and infant morbidity and mortality stem partly from its segregated history. Prior to the political transition in 1994, restrictive policies in South Africa dictated who had access to which health resources and services (Coovadia *et al.*, 2009). Black African women and children suffered most under these policies, especially those whose movements were restricted to the rural homelands where health resources were few.[97]

The reign of the apartheid government was characterised by population policies designed to curb the growth of the Black African population group. Policy allowed for the widespread provision of contraception, but there were differences in the type of contraception available to different race groups: long-lasting injectable contraception was promoted amongst Black African women, while White women were encouraged to use the oral contraceptive pill (of which the use and potency as a form of contraceptive could be halted almost immediately). By the end of apartheid, there was a stark imbalance between the large amount of contraception distribution points available compared to other sexual and reproductive health services, such as ToP or antenatal care facilities.

Strong religious ideology meant that policy dictating access to ToP was very restrictive (Hodes, 2013). In 1975, the Abortion and Sterilisation Act was implemented, curbing legal abortions to severe medical cases (Hodes, 2013). Although the apartheid government took a strong stance on banning abortion, very little was done to prevent illegal and often dangerous abortions amongst the Black African population, leading to a large surge in the number of illegal abortions being performed in the 1970s and 1980s[98] (Hodes, 2013). Unsuccessful illegal abortions had severe consequences for maternal health such as tetanus and septic abortions leading to high levels of morbidity and often mortality. Women seeking post-abortion care at public health facilities also placed a large strain on the public health system (Hodes, 2013).

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[96] According to the Demographic and Health Survey of 2003, approximately 30% of pregnant women in South Africa attended antenatal care clinics during their first trimester (National Department of Health, 2007a). This compares poorly to early access in other developing countries, and shows a declining trend when compared to 1998 levels.

[97] During the 1996 parliamentary consideration of legalising abortion, the Medical Research Council reported that 84% of the 45 000 women who sought care after undergoing incomplete backstreet abortions were Black African. The 1975 policy dictating who had access to legal abortion services was structured in such a way that only women who were relatively affluent, and living in urban, well-resourced areas were able to access these services. Due to restrictive movement policies, these women were predominantly White (Sidley, 1996; Mhlanga, 2003). When the apartheid regime ended in 1994, the new government was burdened with the large inequalities in maternal, infant and child health outcomes between Black African and White women (Chopra *et al.*, 2009).

[98] The estimated rate of illegal abortions during this period was between 200,000 and 300,000 per year (Hodes, 2013).

4.2.2 Rationale for earlier pregnancy detection

4.2.2.1 Earlier access to antenatal care

It is unclear why such a large proportion of pregnant women enter the system at such a late gestational age, but recent research in inner-city Johannesburg by Solarin and Black (2013) found that women who attended antenatal clinics too late said that they did not know they were pregnant (20%), they did not have time to attend the clinic (20%), they chose to go to a GP (17%), they did not know that they had to go earlier (7.5%) or that they did not feel that it was necessary to go earlier (3.8%). Myer and Harrison (2003) also found for rural South Africa that a large percentage of women access antenatal care late due to establishing pregnancy at a late gestational age.

In her analysis of a sample of women who had given birth in four health facilities in the Metro, Western Cape, Smith (2016) found that approximately 50% of women who sought antenatal care after their first trimester, did so because they were uncertain of their pregnancy status.

Despite the limitation of data sources available, these studies all suggest that uncertainty of pregnancy status seems to delay take-up of antenatal services, especially when menses are historically irregular (Harries *et al.*, 2007; Andersen *et al.*, 2013). Pregnancy detection can also be delayed when women experience contraception failure without their knowledge, and irregular menses is not attributed to a possible pregnancy (Harries *et al.*, 2015). Failure to link pregnancy symptoms, such as nausea, with the possibility of being pregnant can also lead to a delay in establishing pregnancy status (Harries *et al.*, 2007).

4.2.2.2 Time to consider termination of pregnancy

Similar to studies conducted in South Africa to determine the reasons for late antenatal care seeking behaviour, studies conducted for second trimester or unsafe ToP practices in South Africa are mostly small and limited to a specific geographic area.

A survey conducted by Morroni and Moodley (2006) found that women presenting for second trimester abortions in the Western Cape, compared to first trimester abortions, were significantly more likely to be isiXhosa-speaking (as opposed to Afrikaans- and English-speaking), and were more likely to wait longer between suspecting pregnancy and confirming pregnancy. There were

also information barriers stopping women from accessing abortion services during their first trimester, such as mistakenly believing that they had to wait three months before presenting for care and less aware of the time restrictions on the timing of abortion services. Most importantly, they were likely to recognise pregnancy at a later stage of gestation than first trimester abortions and were also significantly less likely to purchase a UPT from a pharmacy during their pregnancy (Morroni & Moodley, 2006).

An exploratory study conducted by Jewkes *et al.* (2005) in Gauteng found that the major contributors linked to women seeking illegal abortion practices include non-familiarity with the law on ToP, and where to access legal ToP services, fear of rude staff, fear of being discovered and being too late in the pregnancy to access ToP services.

4.2.2.3 Uncertainty of pregnancy status and delayed contraception initiation

In order to initiate individuals on hormonal contraception, an accurate assessment of the individual's pregnancy status has to be performed by the healthcare provider (Klein *et al.*, 2015). When there is uncertainty about the pregnancy status of someone seeking contraception, this could lead to unnecessary delay of initiating family planning and result in unwanted and unplanned pregnancies (Whiteman *et al.*, 2015).

A proposed method to alleviate some of the overburdened clinics of the care burden of contraception distribution is to transfer some of these services to community health workers. Having CHWs provide oral and injectable contraception at a household level (as opposed to the clinic) has been successfully tested in several Sub-Saharan countries, can be delivered at a level of high quality and is able to reach a high proportion of new users (Stanback *et al.*, 2010; Prata *et al.*, 2011; Hoke *et al.*, 2012). This has helped to alleviate some of the barriers to access and choice of contraception. However, before initiating contraception, it has to be confirmed that an individual is not already pregnant. Therefore, several of these studies have equipped CHWs with urine pregnancy tests in order to confirm pregnancy status (Nettleman *et al.*, 2009; Andersen *et al.*, 2013).

A RCT in Madagascar tested the impact of providing women with UPTs on their contraceptive behaviour by equipping CHW who usually provided family planning and contraceptive services, with UPTs. Women in the control group had to rely on six-point questionnaire (which was usually the standard practice) to establish pregnancy status. These questionnaires were often dismissed by

CHWs, and created various missed opportunities for providing women with contraception. In the study, CHWs who were equipped with UPTs provided a significantly larger number of injectable contraceptives to their clients (SHOPS project, 2015).

4.2.3 Early pregnancy detection by providing urine pregnancy tests (UPTs)

A possible method to overcome the barrier of late pregnancy detection is to provide women with easily accessible urine pregnancy tests. I propose that it can be used as a successful tool to link women to reproductive and health services. Very little research has been conducted on the provision of UPTs. Since public antenatal clinics are often under-capacitated and waiting times are very long, women who are sexually active and merely suspect that they are pregnant are unwilling to wait in a clinic all day to get tested. There are widespread reports of women being refused tests at public health facilities, or being required to present positive pregnancy test results once they present for antenatal or abortion services (Lince-Deroche *et al.*, 2015). In a survey of women presenting for second trimester abortion services in the Western Cape, 25% of the sample reported paying for a pregnancy test (Lince-Deroche *et al.*, 2015).

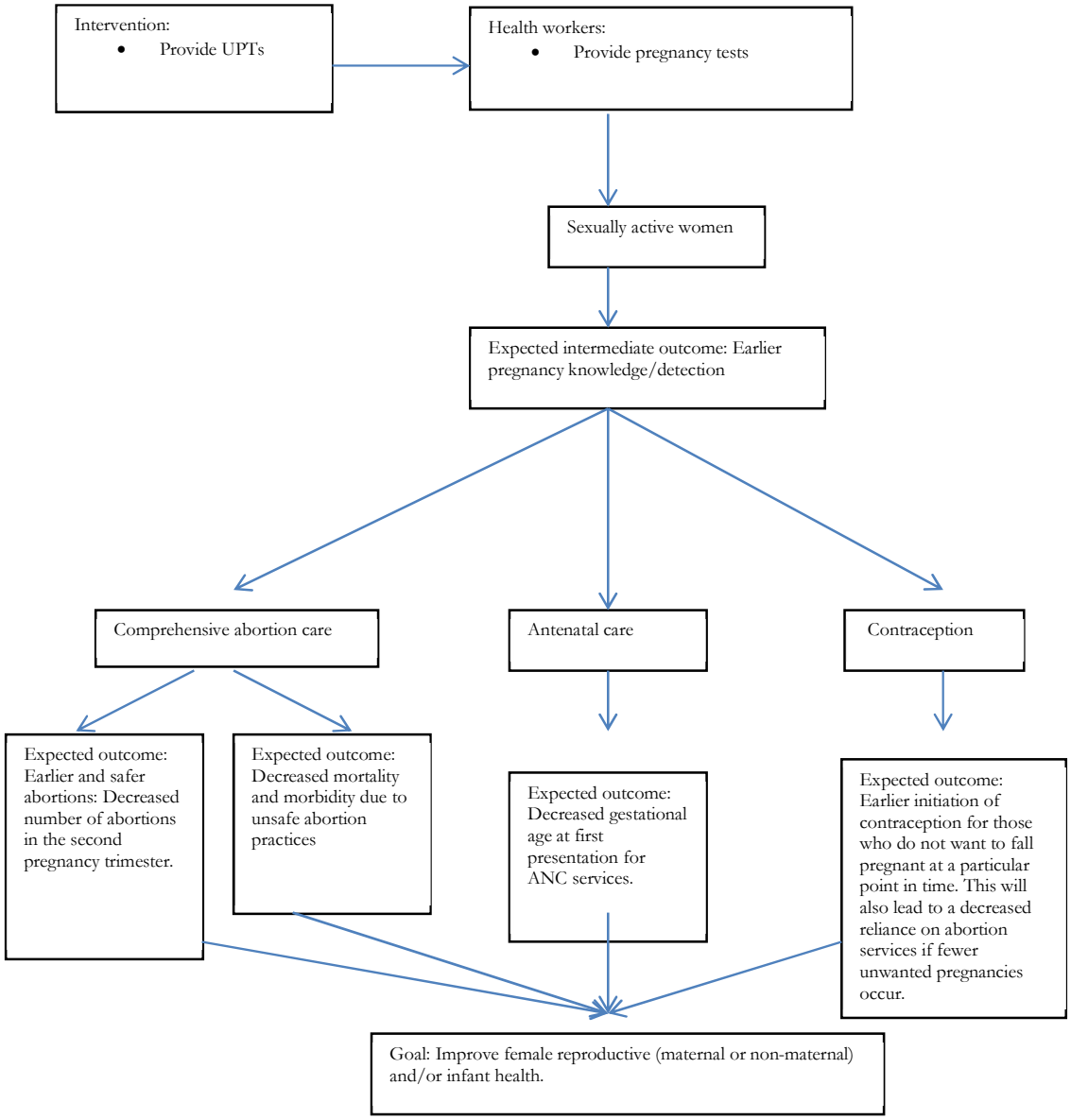
Studies have found significant links between UPT use and earlier first antenatal clinic visits in South Africa (Jeffery *et al.*, 2000; Morroni & Moodley, 2006). Morroni and Moodley (2006), using routine data from Cape Town, found that having access to UPTs decreased gestational age at first ANC booking by 3.6 weeks. Jeffery *et al.* (2000) set up pregnancy confirmation clinics adjacent to antenatal clinics at three sites in Pretoria. The average gestational age at presentation was 12 weeks and four days. This was a significant reduction from previous figures the authors calculated during a health-seeking behavioural study in the same areas. It also falls below the WHO recommendation of first presentation before 14 weeks.

Access to UPTs has also decreased the mean gestational age at presentation in foreign country settings. In Israel, urine pregnancy tests were made available to soldiers at military primary healthcare facilities, as opposed to only secondary facilities where they were usually available. The primary care facilities were more accessible to the soldiers, since they had to travel out of their military compound to access any secondary services. Mean gestational age at pregnancy confirmation was 41.07 days (+/- 6 weeks) compared to 48.42 days at the secondary facilities (+/- 7 weeks). Easier access to UPTs significantly decreased gestational age at pregnancy confirmation (Hochman *et al.*, 2012).

There have also been studies showing the willingness of women to utilize UPTs. In a pilot study done in Nepal, female community health volunteers were recruited and trained to provide pregnancy tests and the appropriate counselling to women at a home-based level. In the study, take-up was high and it led to numerous referrals to antenatal care and abortion services (Andersen *et al.*, 2013). In the USA, a study on women who were at risk of having unwanted pregnancies found that providing women with short counselling, health education and at-home pregnancy testing kits significantly increased the likelihood that they would use the UPTs (Nettleman *et al.*, 2009).

A model illustrating the impact of a pregnancy testing intervention on the reproductive health of women is shown in Figure 4.1 below. The model is adapted from an article by Anderson *et al.* (2013). Access to UPTs can lead to earlier pregnancy detection which in turn can lead to (a) more comprehensive abortion services (lower incidence of abortions in the second trimester; increased possibility of abortion of unwanted pregnancies; decreased mortality and morbidity due to unsafe abortions), (b) more comprehensive antenatal care (women present for ANC at an earlier gestational age), and (c) initiate contraception sooner since this is often impeded by lack of certainty of pregnancy status. These intermediary outcomes will affect women's reproductive health positively.

Figure 4. 1: The impact of pregnancy testing on the reproductive health of women



In this study, I propose two alternative mechanisms for providing women with improved access to urine pregnancy tests, namely a mobile health outreach facility and door-to-door testing. Although these approaches have rarely been used or tested for the distribution of UPTs, there have been experiments with getting such essential and easily administered services to the community, using alternative approaches. For instance, door-to-door distribution and mobile health outreach facilities are common practice in the provision of HIV counselling and testing

services.[99] These approaches have proven to be successful in reaching vulnerable subgroups (Van Schaik *et al.*, 2010; Van Rooyen *et al.*, 2013).

The goal of this chapter is to provide evidence for policy makers on alternative mechanisms which can be implemented in order to alleviate part of the client burden at public health facilities.

The Drummond checklist on economic evaluations was used as a benchmark for this cost-effectiveness analysis (Drummond & Jefferson, 1996; Drummond *et al.*, 2005).[100]

4.3 Two different approaches to distribution

In this chapter, I compare the costs and effectiveness of two approaches to UPT distribution, namely using a mobile outreach site (Approach 1) and door-to-door distribution (Approach 2). It is important to note that the research question of this chapter only came about after observing the effectiveness of take-up of the pregnancy tests and the high pregnancy detection rate in the larger study, discussed in the previous chapter, where door-to-door UPT distribution was used as a recruitment strategy. After observing this, Approach 1 was initiated in order to create a valid comparison group. Therefore, all comparisons of pregnancy test distribution modalities of Approach 1 to Approach 2 compare the results from the ancillary study (Approach 1) to results collected ex-post the larger study (Approach 2).

Approach 1: Testing at a mobile outreach site

After consulting with the local municipality in Lwandle, a mobile outreach health facility was set up next to the municipal office. The mobile facility consisted of a branded tent and roller banner promoting family planning and offering pregnancy tests. Although recruitment and consulting

[99] In Sub-Saharan Africa, various approaches have been adopted in an attempt to improve access to HIV counselling and testing (HCT) services (Tabana *et al.*, 2015). Although this service is available at public health facilities, there are various impediments to accessing care. This has led to innovative programmes to provide HCT services at other access points, such as mobile testing facilities and door-to-door provision of the service, with varying levels of success. Mobile HCT services have proven to be an effective strategy in reaching groups who did not test at clinics, like men or younger age groups (Van Rooyen *et al.* 2013; Van Schaik *et al.* 2010). Meehan *et al.* attribute this to opportunistic testing made possible due to the alternative points of access, which make testing possible at a relatively low personal cost (Meehan *et al.*, 2015). Take-up of door-to-door HCT services was also highly successful due to the convenience and confidentiality it offered users (Angotti *et al.*, 2009).

[100] The Drummond checklist is provided in the Appendix Section A 4.5 for reference.

occurred at the tent, pregnancy testing occurred in the municipality. Promotion of the programme was also done in the community by handing out flyers door-to-door.[101]

The facility was up and running from 09:00 to 13:00 for 12 days. The tent was manned by two community health workers seconded from the larger RCT discussed in the previous chapter.

The testing site and municipality were situated next to one of the major roads in the community, and right next to the Lwandle taxi rank. Since the mobile intervention site was in the community, and pregnancy testing occurred in a public space, there was a trade-off for the women to seek care at the mobile intervention site compared to the public health clinic: the tents were highly visible, which could amplify concerns around stigma, but on the other hand it was very convenient.

Approach 2: Door-to-door distribution by a CHW

The second approach to UPT distribution was door-to-door distribution by appropriately trained community health workers (CHW). Ten CHWs were recruited and trained in antenatal care. Of these ten, six were hired to do recruitment into the study for 36 days. Three of these six were employed for the entire year to work on the remainder of the study (i.e., visit women in the treatment arm of the intervention described in the previous chapter). These CHWs then proceeded to go door-to-door in the intervention area, offering pregnancy tests to sexually active women between the ages of 18 and 50. They were supervised by a community health worker supervisor.

This intervention arm was part of the larger study discussed in the previous chapter, aimed at motivating pregnant women to attend antenatal care earlier and frequently during their pregnancy. Women identified as pregnant during the testing received regular community health worker visits after doing the tests.

During these 36 days of testing, the CHWs also had other research duties related to the larger RCT, such as collecting data for the baseline survey. In considering the cost-effectiveness of this testing strategy, I only consider the costs incurred by the six CHWs and supervisor during the 36

101 In preparation for the mobile outreach facility, I also piloted a similar testing approach in neighbouring Macassar. The intervention proved less successful in Macassar, but the lack of success can be attributed to various factors. This includes the fact that there was no allocated staff to perform the testing: testing was performed by a nurse from the assisting NGO, who had a variety of other duties. Furthermore, the NGO assisting with the pregnancy testing was also performing HIV testing. This could have acted as a deterrent due to the stigma attached to HIV. The testing was also performed using a commode (rather than a flush toilet), and conversations with some of the women revealed that they found this factor unattractive.

days which were related to the testing. Calculation of these percentages is discussed in the Appendix (Section A 3.2).

4.4 Methodology

4.4.1 Sampling area

Both approaches were tested in Lwandle and Nomzamo, two low-income neighbourhoods in the Eastern Health sub-district (part of the Western Cape metro). Based on the averages of late antenatal clinic attendance (where late attendance is classified as a first booking visit after a person is 20 weeks pregnant) across clinics in health sub-districts, approximately 43% of women in the Eastern Health sub-district attend antenatal clinics too late (see Table 4.1). This makes the Eastern Health sub-district one of the worst performing sub-districts in the Metro in terms of this indicator.

Table 4. 1: Percentage late first antenatal clinic visits in the Metro, Western Cape

District	Sub district	Percentage late attendance
Metro	Cape Town Southern Health sub-district	48.63
Metro	Khayelitsha Health Sub-District	47.18
Metro	Cape Town Western Health Sub-District	44.47
Metro	Cape Town Eastern Health Sub-District	43.17
Metro	Mitchells Plain Health Sub-District	41.18
Metro	Tygerberg Health Sub-District	38.41
Metro	Cape Town Northern Health Sub-District	34.89
Metro	Klipfontein Health Sub-District	32.31

Source: created from District Health Barometer

In Table 4.2, I compare the socioeconomic and demographic characteristics of the users of Approach 1 and Approach 2. Since Approach 2 was part of the recruitment strategy for the larger RCT, I only collected limited information on women who participated in this approach. This makes comparison of socio-demographic characteristics between women in the two groups difficult. I have collected sufficient information on women in Approach 2 who were pregnant as these women were recruited into the larger study. As a result, I compare the limited background characteristics on all women who were tested, followed by a more complete comparison of those who were pregnant.

Looking at the confidence intervals, there are few statistical differences between the two groups. Women accessing both groups are in their mid to late twenties, and unemployment ranges between 50 and 68%, depending on who is sampled. This corresponds with estimates from the census 2011 in this area. Women using the mobile services come from slightly larger households. The difference is significant when I compare all women who were tested. Women using Approach 2 have significantly lower levels of education: they are significantly more likely to only have primary or no schooling compared to women using Approach 1. Most women are single, and the sample is predominantly Black African.

Interesting to note is also that almost a quarter of women accessing mobile services reported using contraception whilst seeking to be tested, pointing to possible contraception failure. The percentage is slightly higher when looking at women who are pregnant. Unfortunately, this statistic is only available for women using the mobile facility.[102]

[102] Although I did collect information on contraception use by pregnant women in Approach 2, this was only collected during the endline survey when several women had already attrited. However, I do know that amongst women in the sample who were recruited using the pregnancy test, were pregnant and did not attrite, contraception use was incredibly low. Of this entire sample, only one woman reported using contraception before falling pregnant.

Table 4. 2: Socioeconomic and demographic characteristics of users: Approach 1 versus Approach 2

		Approach 1: Mobile		Approach 2: D2D		P-value	P-value
		Tested	Pregnant	Tested	Pregnant	Tested Approach 1 vs. Tested Approach 2	Pregnant Approach 1 vs. Pregnant Approach 2
	Age	26.12	25.79	27.55	28.00	0.0951*	0.2829
		(24.46-27.78)	(21.86-29.72)	(26.85-28.25)	(25.92-30.08)		
	Unemployed	0.68	0.50		0.60		
		(0.56-0.79)	(0.20-0.80)		(0.46-0.74)		
	Women in household	2.48	2.38	1.94	2.02	0.0017***	0.3966
		(2.12-2.85)	(1.38-3.39)	(1.80-2.08)	(1.66-2.38)		
Education	No schooling	0.01	0.00		0.19		0.0821*
		(-0.01-0.04)	(0.00-0.00)		(0.07-0.30)		
	Primary (Gr 1-7)	0.04	0.07		0.65		0.0001***
		(-0.01-0.09)	(-0.08-0.23)		(0.51-0.79)		
	Secondary (Gr 8-12) but did not finish	0.60	0.79		0.17		0.0000***
		(0.48-0.72)	(0.54-1.03)		(0.06-0.28)		
	I finished matric/Grade 12	0.32	0.07		0.00		0.0636*
		(0.21-0.44)	(-0.08-0.23)		(0.00-0.00)		
	Diploma/degree after high school	0.01	0.07		0.00		0.0636*
		(-0.01-0.04)	(-0.08-0.23)		(0.00-0.00)		0.6833
Relationship	Single	0.79	0.57		0.64		
		(0.70-0.89)	(0.27-0.87)		(0.50-0.78)		0.3190
	Married	0.21	0.43		0.28		
		(0.11-0.30)	(0.13-0.73)		(0.15-0.41)		0.2767
	Cohabit				0.08		
					(0.00-0.16)		
Population group	Black	0.94	0.93		0.88		0.5992
		(0.88-1.00)	(0.77-1.08)		(0.79-0.97)		
	Coloured	0.04	0.00		0.08		0.2767
		(-0.01-0.10)	(0.00-0.00)		(0.00-0.16)		
	Mixed race	0.01	0.07		0.04		0.6417

		(-0.01-0.04)	(-0.08-0.23)		(-0.02-0.10)		
Contraception use		0.24	0.29		Not collected		
		(0.13-0.34)	(0.02-0.56)				
Observations		68	14	314	50		

*Confidence intervals in parenthesis.

*** p<0.01, ** p<0.05, * p<0.1; Standard errors in parenthesis

This study was approved by the Stellenbosch University Humaniora Research Ethics Committee (HS 1020/2014). Participation was voluntary and all participants signed an informed consent form.

4.4.2 Conceptualising effectiveness

The first thing to consider when conceptualising a measure of effectiveness is the intention of the proposed intervention. The desired outcome of this study is for pregnant women to access antenatal and abortion services at an earlier gestational age, or for non-pregnant women to access contraception earlier. One limitation of this study is that only intermediate outcomes, namely the uptake of urine pregnancy tests and the number of pregnancies identified, are collected in this study. The link between the intermediate outcomes and the final outcomes cannot be demonstrated in this small sample study, but are plausible based on earlier evidence – as shown in Figure 4.1.

A major limitation to an intermediate outcome measure is the uncertainty of a woman's decision to access health services after she finds out her pregnancy status. That is, given a set of supply-side and demand-side barriers, will women continue to seek care once they find out that they are pregnant? One way of overcoming this limitation would be to observe what factors are driving the uptake of UPTs in both interventions. By observing what is driving preventative health-seeking behaviour during "diagnosis" (i.e., seeking a urine pregnancy test), one can make assumptions about a woman's discount rates and draw conclusions about how they will react to future preventative health-seeking behaviour (seeking early antenatal or abortion services).

Drawing conclusions regarding the preventative health-seeking behaviour should be assessed within the context of costs and benefits imposed upon women in the respective testing approaches. Across both interventions, the benefits are similar: knowing your pregnancy status and making your decisions accordingly. However, there are differences in the costs imposed on women in the two interventions. Women who sought UPTs at the mobile facility had various costs imposed on them, but still chose to access testing. These costs include the travel cost of reaching the mobile facility (albeit opportunity cost of time spent walking), the opportunity costs of taking time off from work to get tested,[103] and social anxiety experienced from being seen and identified by other members of your community for being sexually active. However, since the testing was

[103] The results from Table 4.2 show that women using Approach 1 are more likely to be employed.

done close to the taxi rank, the impact of travelling costs may have been over-estimated since the testing station provided women with an opportune moment to test rather than a service they sought. These costs are discussed further in the results section. The door-to-door intervention, on the other hand, impose very few costs on its users: there are no direct costs for acquiring the test (since they are free) and opportunity cost of time lost is limited to the time spend doing the test, since there are no direct travelling costs as with the mobile facilities.

I also calculate the cost-effectiveness based on the number of pregnancies detected as a robustness check. Both take-up of testing and pregnancies detected are converted to weekly value in order to adjust for the different implementation times. The results from both approaches are based on non-random observational studies.

4.4.3 Measuring cost-effectiveness

The aim of the chapter is to do a cost-effectiveness analysis (CEA) of mobile pregnancy testing facilities compared to door-to-door UPT distribution. The analysis qualifies as a CEA since the two interventions have the same outcomes, but different costs. The outcomes are also measured in natural units, making CEA an appropriate tool.

It is possible to run a separate Cost Utility Analysis to identify the added benefit of easy accessible pregnancy testing facilities on a woman's quality of life, but this is not attempted in this chapter, since the necessary data to calculate quality adjusted life years was not collected.

Cost-effectiveness of the intervention will be established by calculating the average costs per outcome measure and by comparing the incremental cost-efficiency ratio (ICER) of the two approaches. The analysis will follow a societal perspective, with a micro-costing approach. The societal perspective implies that I take into account costs to both the provider and the user. The main approach is the micro-costing or ingredient approach. Micro-costing is possible in this analysis, as there is detailed data on the actual use of resources and the value of productivity lost. It allows for a more detailed analysis of the costs per test, as it allows for an analysis of both the demand-side and supply-side costs. This makes the micro-costing approach the most suitable option when using the societal perspective.[104]

[104] The micro-costing approach and societal perspective allows for the researcher to include patient-related costs in the costing analysis. If patient-related costs are excluded, this could undermine the feasibility and sustainability of the

4.5 Total costs of the programme

In Table 4.4, I report the total economic costs of Approach 1 and Approach 2. The detailed costs of the two approaches are reported and discussed in the Appendix (Sections A 4.1 and A 4.2). Total costs were broadly grouped into either capital or recurrent costs.[105]

Economic costs, as opposed to financial costs, take the discount rate into account when considering the depreciation of assets. Economic costs also take into account the opportunity costs and productivity losses incurred by users. It is therefore intended to represent the opportunity value of resources (Drummond *et al.*, 2005). Total economic costs are equal to the sum of the total economic capital and recurrent costs, annuitised[106] and adjusted for CPI.

Capital costs are annuitised using the annuity factor. The annuity factor is based on the discount rate and expected life years of the item.[107] A discount rate of 8% is chosen for this analysis. The discount rate is equal to the interest rate of 10-year government bonds in South Africa in 2015. The rate has also been applied to other economic evaluations in South African health studies (Nkonki *et al.*, 2014). The following annuity factors, drawn from Drummond *et al.* (2005), are used:

Table 4. 3: Annuity factors by assumed life years

Assumed life years	Annuity factor
20 years	9.8181
10 years	6.71
5 years	3.9927
2 years	1.7833
1 year	0.9259

Annuitised economic costs are calculated by dividing the cost of the capital item by the annuity factor.

project. For instance, will the intervention work if you cannot motivate women to take time off from work to participate in testing at one of the sites? An underestimate of these costs means that the project can be classified as cost-efficient, when actually it is not. Therefore, using micro-costing can give the researcher a better representation of allocative efficiency.

[105] Capital costs are costs incurred during the start-up of the programme, which are non-recurrent and have a future resell value. Recurrent costs are operational in nature, and costs which are continuously incurred throughout the programme.

[106] The annuity factors for each item are determined by the chosen discount rate and the assumed life years of the capital asset.

[107] For capital items, life years had to be assumed. The assumed life years, and the reasoning behind the assumed life years, are discussed in the Appendix under Sections A 4.1 and A 4.2.

$$\frac{Cost\ of\ capital\ item}{Annuity\ factor}$$

After annuitisation, costs are adapted for inflation using the consumer price index (CPI), with 2012 as the base year (the base year used by Statistics South Africa).

The total costs of Approach 1 and Approach 2 are shown in Table 4.4, separated into capital and recurrent costs. Costs are converted to a Dollar value using the relevant Dollar-Rand exchange rate.[108] Approach 1 (the outreach mobile clinic) is more than four times less expensive than the door-to-door approach (approach 2).

Table 4. 4: Total economic costs of Approach 1 and Approach 2

	Rand	Dollar
	Economic	Economic
Approach 1: Outreach clinic		
Total capital costs	2601,2	317,0
Total recurrent costs	6823,3	831,5
TOTAL COSTS	9424,5	1148,5
Approach 2: D2D		
Total capital costs	16655,1	2029,6
Total recurrent costs	24279,5	2958,8
TOTAL COSTS	40934,6	4988,4

Since Approach 2 was implemented for 36 days, and Approach 1 for 12 days, costs were converted to weekly costs to make them more comparable. This change to weekly costs is depicted in Figure 4.2, and the weekly costs presented in Table 4.5. Differences in the total costs between the two programmes become substantially smaller when I control for the differences in the implemented time periods.

[108] $1 = R8, 206. This is the average exchange rate of 2012.

Figure 4. 2: Total cost of Approach 1 versus Approach 2

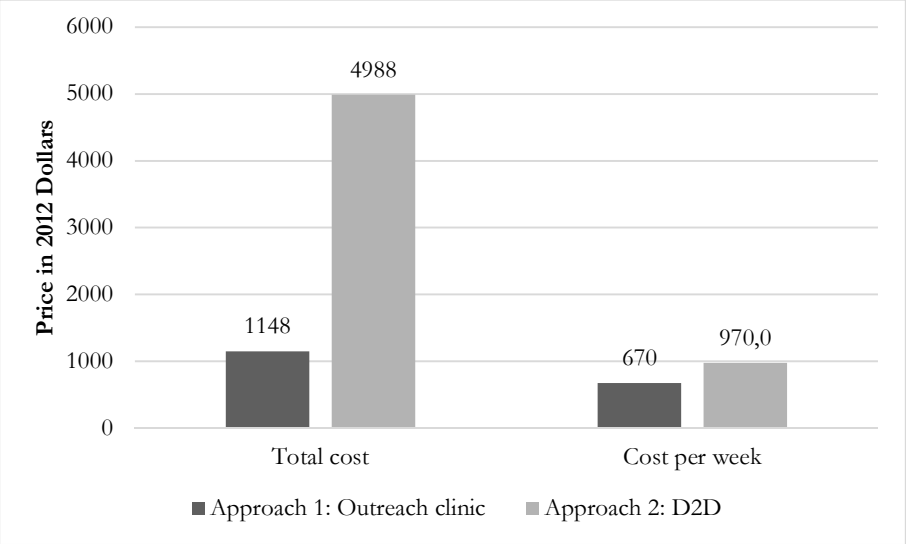
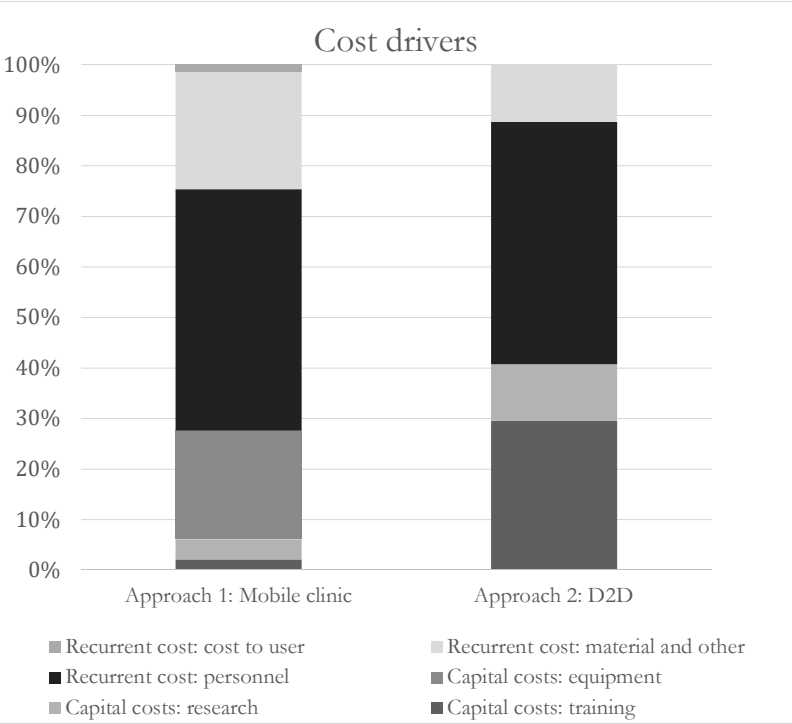


Table 4. 5: Total economic costs of Approach 1 and Approach 2 per week

	Rand	Dollar
	Economic	Economic
Approach 1: Outreach clinic		
Total capital costs	1517,4	184,9
Total recurrent costs	3980,3	485,0
TOTAL COSTS	5497,7	670,0
Approach 2: D2D		
Total capital costs	3238,5	394,6
Total recurrent costs	4721,0	575,3
TOTAL COSTS	7959,5	970,0

The cost drivers of each intervention are depicted in Figure 4.3. Costs are driven primarily by recurrent costs, with personnel costs making up almost 50% of both Approach 1 and Approach 2. Capital costs make up 41% of the total cost of running Approach 2, compared to only 27% for Approach 1. Training constitutes a large portion of the capital costs of Approach 2.

Figure 4. 3: Cost drivers in Approach 1 and Approach 2



4.6 Effectiveness

4.6.1 Overall effectiveness: total take-up of tests and number of pregnancies detected

The overall effectiveness of Approaches 1 and 2 are shown in Figure 4.4 and Table 4.6. Over a period of 36 days, 314 tests were distributed to women using the door-to-door approach. Of these 314 who were tested, 54 women were unknowingly pregnant. At the mobile health outreach facility, a total of 68 women were tested over a period of 12 days, of which 14 were unknowingly pregnant. From these raw numbers, the door-to-door approach appears to be much more effective.

Figure 4. 4: Overall effectiveness of Approach 1 versus Approach 2

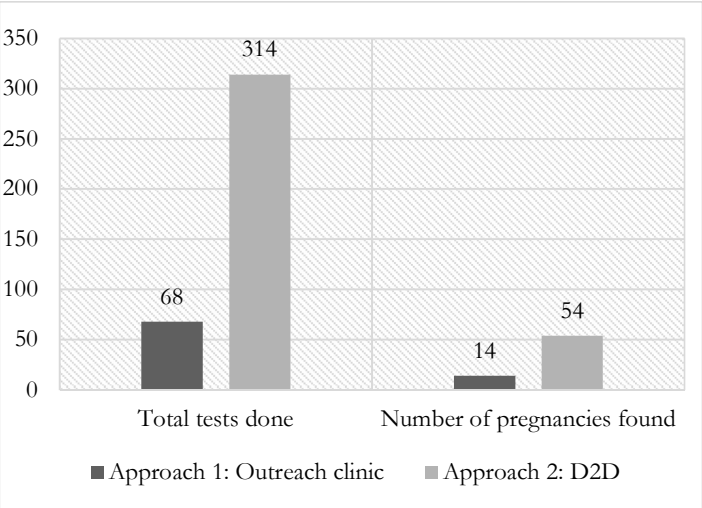
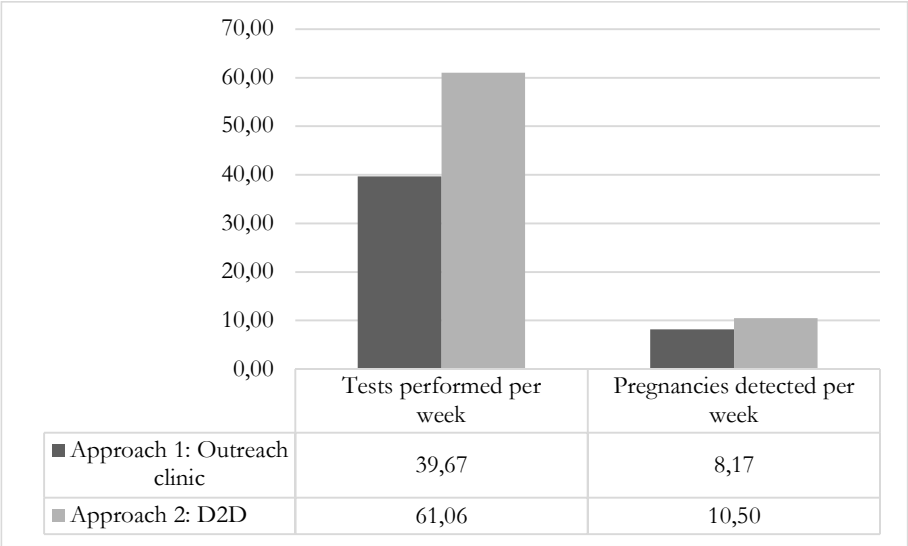


Table 4. 6: Overall effectiveness of Approach 1 versus Approach 2

	Approach 1	Approach 2
Total tests done	68	314
Number of pregnancies found	14	54
Percentage of tests that are positive	21%	17%
No. days tests performed	12	36

Once again, to control for the differences in testing periods, I converted these outcome measures to weekly measures of effectiveness. The results are reported in Figure 4.5. Although door-to-door remains a more effective measure, the difference in effectiveness between the two approaches is now much smaller. I did not apply discounting rates to the measures of effectiveness, since these health benefits do not accrue in the future.

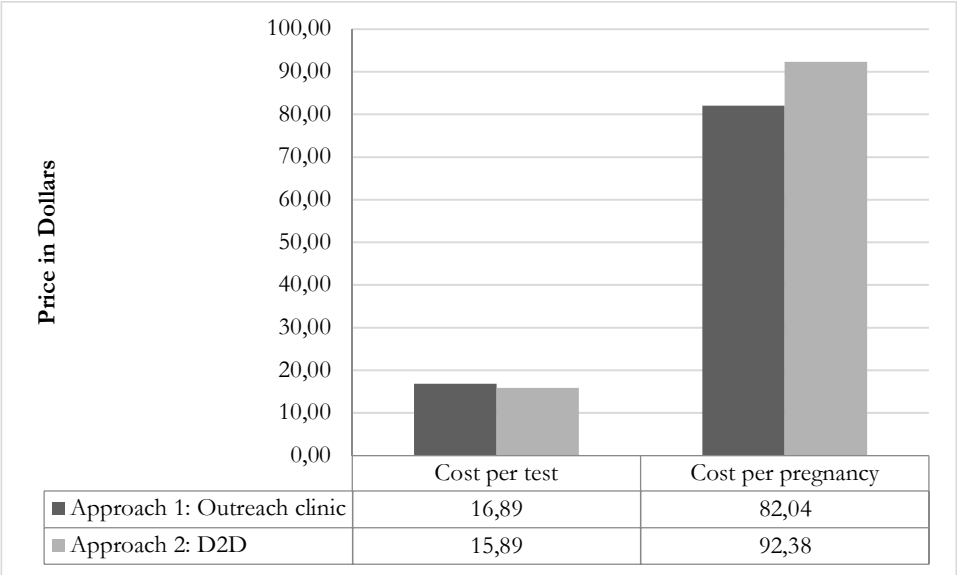
Figure 4. 5: Effectiveness per week: Approach 1 versus Approach 2



4.7 Cost-effectiveness

Average cost-effectiveness of the two interventions is calculated by dividing total weekly costs by weekly outcome measures. These results are reported in Figure 4.6. The cost on average for distributing tests using Approach 1 is $16,89, and $15,89 for Approach 2. The cost per pregnancy identified in Approach 1 is $82,04 and $92,38 dollar in Approach 2. The average costs reveal that Approach 2 is more affordable when I focus on take-up of testing, while Approach 1 is more affordable when the outcome measure is number of pregnancies detected.

Figure 4. 6: Measuring cost effectiveness: Approach 1 versus Approach 2



Reporting the average costs per intervention is solely a cost-analysis, and does not provide information on the comparability of the two programmes. In order to provide evidence of the comparative advantage of one intervention relative to the other, the incremental cost-effectiveness ratio (ICER) needs to be calculated. The ICER is calculated as the incremental cost of one intervention compared to the other against the incremental benefit of one intervention compared to the other. The formula is as follows:

$$\frac{Cost\ Approach\ 2 - Cost\ Approach\ 1}{Effects\ Approach\ 2 - Effect\ Approach\ 1}$$

The ICERs are reported in Table 4.7 below:

Table 4. 7: The incremental cost-effectiveness ratio

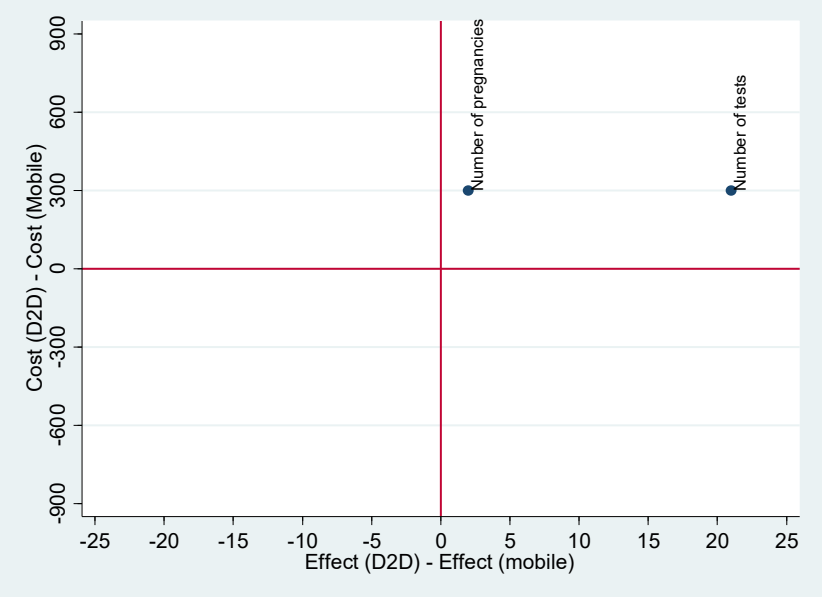
	Cost per week		**Effectiveness per week**		**Cost (D2D) - Cost (Mobile)**	**Effect (D2D) - Effect (mobile)**	**ICER**
	Approach 1	Approach 2	Approach 1	Approach 2			
Number of tests	670	970	39,7	61,1	300	21	14,0

Number of pregnancies	670	970	8,2	10,5	300	2	128,6

The incremental cost-effectiveness ratio (Table 4.7) shows that even though Approach 2 is more cost-effective, it is still not the dominant strategy and delivers a positive ICER. Although Approach 2 is more effective, it is also costlier. These results are easier to explain within the cost-effectiveness plane. The plane depicts the difference in costs on the y-axis and difference in effects on the x-axis. An ICER that falls within Quadrant Two can be interpreted as Approach 2 being highly cost-effective compared to Approach 1: Approach 2 is more efficient and less costly than Approach 1. An ICER that falls within Quadrant Four means that Approach 1 is highly cost-effective: Approach 1 is more effective and less costly than Approach 2.

Both my measures of cost-effectiveness fall within Quadrant One (Figure 4.7). Using the first measure of effectiveness (the number of tests performed), Approach 2 is more expensive, but also more effective. This is also true for the second measure of effectiveness, the number of pregnancies identified. Approach 2 yields greater benefits, but is also more expensive. However, the marginal expense is less than the marginal benefit, making it the most cost-effective.

Figure 4. 7: The cost-effectiveness plane



The cost-effectiveness ratios need to be assessed within a budget or threshold to establish whether they are affordable. While several countries and institutions have clearly established thresholds, this is not the case for South Africa. For instance, in the USA, a threshold of $50 000 per QALY for cost-effectiveness has been frequently applied (Eichler *et al.*, 2004). A widely used threshold is the WHO's recommendation of using a country's GDP per capita as a threshold. An intervention is considered cost-effective if the ICER is less than three times the GDP per capita, and highly cost-effective if it is less than once the GDP per capita (Tan-Torres Edejer *et al.*, 2003). Considering that the South African GDP per capita was around $6500 in 2014 (The World Bank, 2014b), this intervention falls well within the cost-effectiveness threshold.

However, these thresholds have proven to be problematic, especially when used as a guide by policymakers. It ignores allocative efficiency and trade-offs. The threshold is also arbitrarily chosen, and considered to be too lenient, allowing for too many interventions to be classified as cost-effective. This approach also assumes a linear relationship between the amount that an intervention costs, the GDP per capita and the amount that a country is willing to spend on an intervention (Marseille *et al.*, 2015). While this threshold has been applied to analyses in Sub-Saharan Africa, and South Africa specifically (Chisholm & Saxena, 2012; Chola *et al.*, 2015a; Chola *et al.*, 2015b), they have all done so with caution.

4.8 Sensitivity analysis

One-way sensitivity analyses were undertaken to test the impact of the variation of uncertain parameters on the cost-effectiveness of the interventions. This includes varying the discount rates to 3% (Figure 4.8 and Table 4.8) and 6% (Figure 4.9 and Table 4.9), and excluding research costs from the costing data (Figure 4.10 and Table 4.10). The effects remain robust to these variations.[109]

[109] Full costs are available in the Appendix Section A 4.3.

Figure 4. 8: The cost-effectiveness plane: 3% discount rate

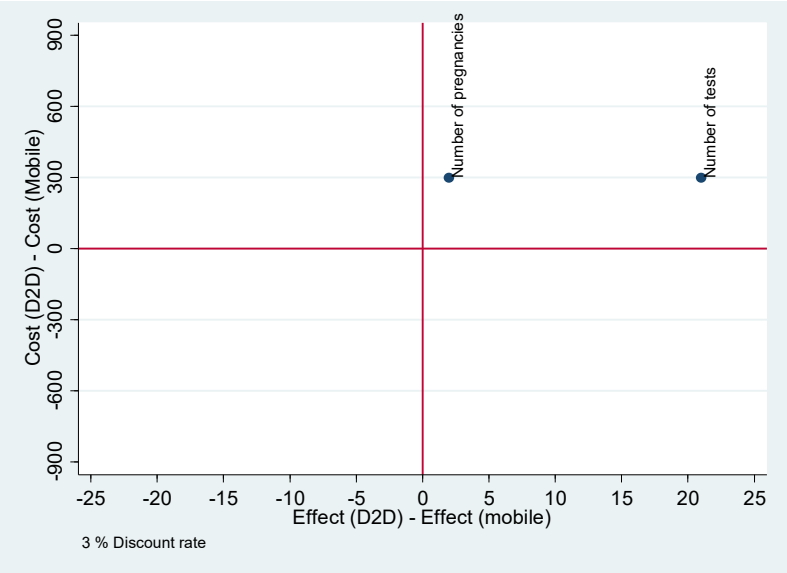


Table 4. 8: The incremental cost-effectiveness ratio at 3% discount rate

	Cost per week		**Effectiveness per week**		**Cost (D2D) - Cost (Mobile)**	**Effect (D2D) - Effect (mobile)**	**ICER**
	Approach 1	Approach 2	Approach 1	Approach 2			
Number of tests	633	931	39,7	61,1	298	21	13,9
Number of pregnancies	633	931	8,2	10,5	298	2	127,8

Figure 4. 9: The cost-effectiveness plane: 6% discount rates

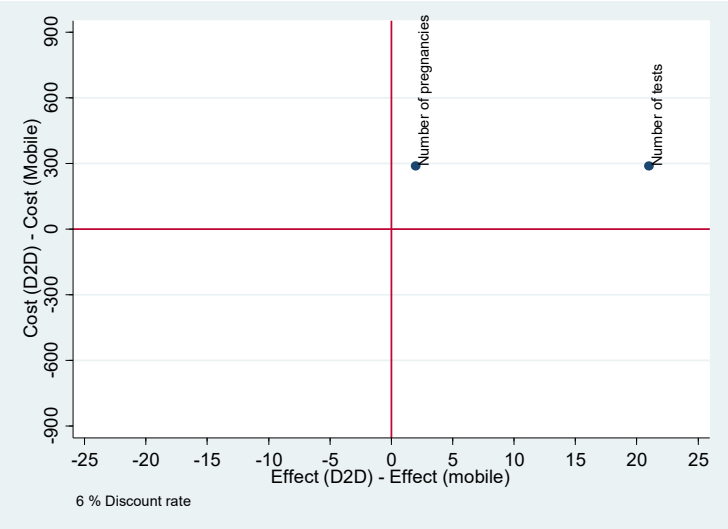


Table 4. 9: The incremental cost-effectiveness ratio at 6% discount rate

	Cost per week		**Effectiveness per week**		**Cost (D2D) - Cost (Mobile)**	**Effect (D2D) - Effect (mobile)**	**ICER**
	Approach 1	Approach 2	Approach 1	Approach 2			
Number of tests	665	954	39,7	61,1	289	21	13,5
Number of pregnancies	665	954	8,2	10,5	289	2	124,0

Figure 4. 10: The cost-effectiveness plane (no research costs)

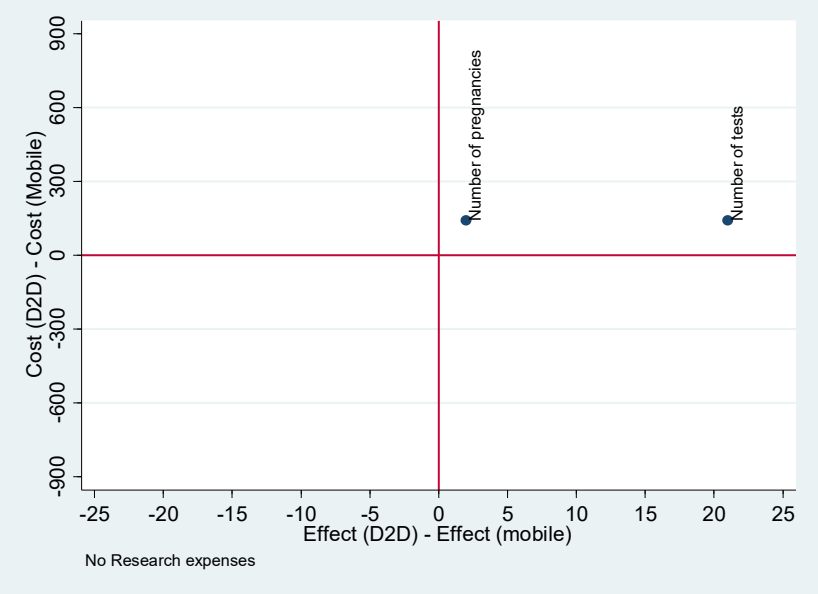


Table 4. 10: The incremental cost-effectiveness ratio: no research costs

	Cost per week		**Effectiveness per week**		**Cost (D2D) - Cost (Mobile)**	**Effect (D2D) - Effect (mobile)**	**ICER**
	Approach 1	Approach 2	Approach 1	Approach 2			
Number of tests	604	746	39,7	61,1	141	21	6,6
Number of pregnancies	604	746	8,2	10,5	141	2	60,5

4.9 Limitations

There are several limitations to keep in mind when considering the results from this economic evaluation. The first is the choice of approaches being considered. In this analysis I compare two alternative approaches which can be used by policy makers to distribute pregnancy tests in a more efficient manner compared to distributing it at public health clinic. Although the analysis shows that the door-to-door approach is more cost-effective than a mobile testing facility, I cannot conclude that it is more cost-effective than distributing it at a public health facility. The infrastructure in place at public health facilities means that the incremental costs of improving

access at clinics may be minimal. Therefore, pushing for better access at the clinics themselves may prove to be the best strategy. However, this conclusion cannot be drawn from this analysis. Drummond writes that the wrong choice of comparison group takes away from the external validity and application to population health (Drummond *et al.*, 2005). Limited access to clinic-level data made this comparative analysis difficult. The analysis can still be useful for organisations, such as NGOs, who are considering alternative strategies of test distribution.

A second concern which may affect the external validity of my analysis is the inclusion and use of protocol-driven costs and outcomes. The use of outcomes and costs related to research can bias my findings, since these are not the costs of a proper infrastructure for long-term implementation of the two approaches of testing.

Thirdly, in my analysis I assume perfect divisibility of programmes and constant returns to scale. This may also threaten the external validity of my cost-effectiveness measures (Drummond *et al.*, 2005). As discussed in Section 4, the use of an intermediate outcome (take-up of tests) is also problematic, since it does not reflect the final health-seeking behaviour of users. This makes it difficult to know whether I am measuring the real impact.

4.10 Discussion and conclusion

The initial results show that door-to-door distribution of UPTs is a more cost-effective approach to UPT distribution than a mobile health outreach site. Small costs associated with the mobile outreach site (such as the opportunity cost of other people seeing one access a test) could be acting as a barrier to access and possibly explain the low numbers of take-up of UPTs at this site.

One major concern is that the intermediate measure does not give me an indication of the actual health impact of the intervention. Take-up of UPTs does not necessarily reflect eventual health-seeking behaviour. It is impossible to conclude from my data whether women sought antenatal care or abortion services earlier since they found out earlier that they were pregnant. However, one could argue that I am also measuring the value of having the option of accessing an individual's choice of care: early pregnancy status establishment means that individuals have the choice of accessing either contraception, early abortion or antenatal care.

As established in the previous chapter, part of delayed antenatal care-seeking behaviour is the result of inconsistent time preferences. That is, late care-seeking behaviour may result due to

distorted discount rates when weighing up the current costs of accessing antenatal care compared to the future benefit of antenatal care to her and her infant.

This issue points to the importance of understanding what is driving the timing of a woman's decision to take the pregnancy test, and understanding the difference in characteristics of women accessing the two services. For women who are provided with a test during one of the interventions, yet have inconsistent time preferences, this may not change their eventual care-seeking behaviour. One could argue that these women should not be targeted by these interventions, since it is unlikely to change their health outcomes and would be a waste of resources.

The costs imposed on women in both groups differ. There are quite a few costs imposed on the women in the mobile outreach site: in order to access care, they have to travel to the testing site, they possibly have to take time off from work to visit the site and they have to risk being seen by members of their community and identified as sexually active. Compared to them, women who access testing via door-to-door visits only incur small personal costs. They probably have to forgo their leisure time and there are also the emotional costs of being tested. They could possibly also incur social or reputational costs when CHWs are seen entering their home, but I made no attempt at quantifying this possible stigma.

Women utilising the mobile facility are willing to seek preventative care and incur the aforementioned costs due to the future health benefits of being tested. The same generalisation cannot necessarily be made for women who access testing in the door-to-door approach, since there are almost no costs imposed upon these women to get tested.

Although the mobile health clinic was less successful in terms of take-up, it managed to attract a higher proportion of pregnant women. While only 17% of women who accessed the door-to-door service were pregnant, 21% of women who accessed the mobile facility were pregnant (see Figure 4.11). While this marginal difference could be down to coincidence, it can also be explained partially by the type of clientele drawn to both services. Before women were tested, I asked them how likely did they think it was that they were pregnant, on a scale from 1 to 5, where 1 is not very likely and 5 is very likely. The results are shown in Figure 4.12. Women who accessed care at the mobile site were most likely to choose Categories 3 and 4, while women using the door-to-door service were more likely to choose 2 and 3. Women accessing the mobile facility thought the

possibility that they were pregnant was much higher. Women using the door-to-door approach were more likely to choose the lower category, so they were more inclined to think that they were not pregnant, but they saw the fact that someone was knocking on their door as a good opportunity to test anyway.

Figure 4. 11: Percentage of women who were pregnant in Approach 1 compared to Approach 2

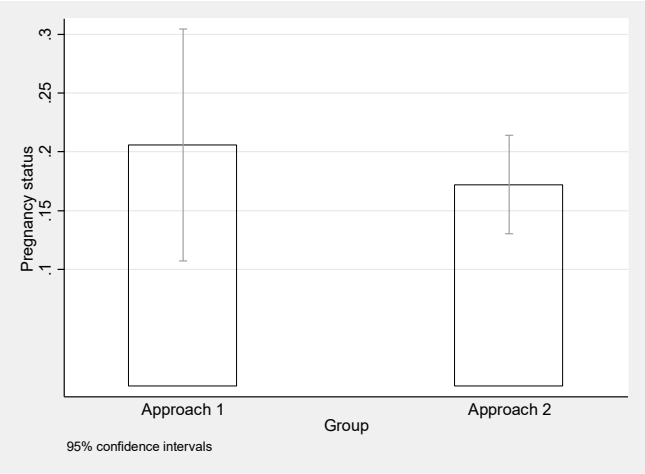
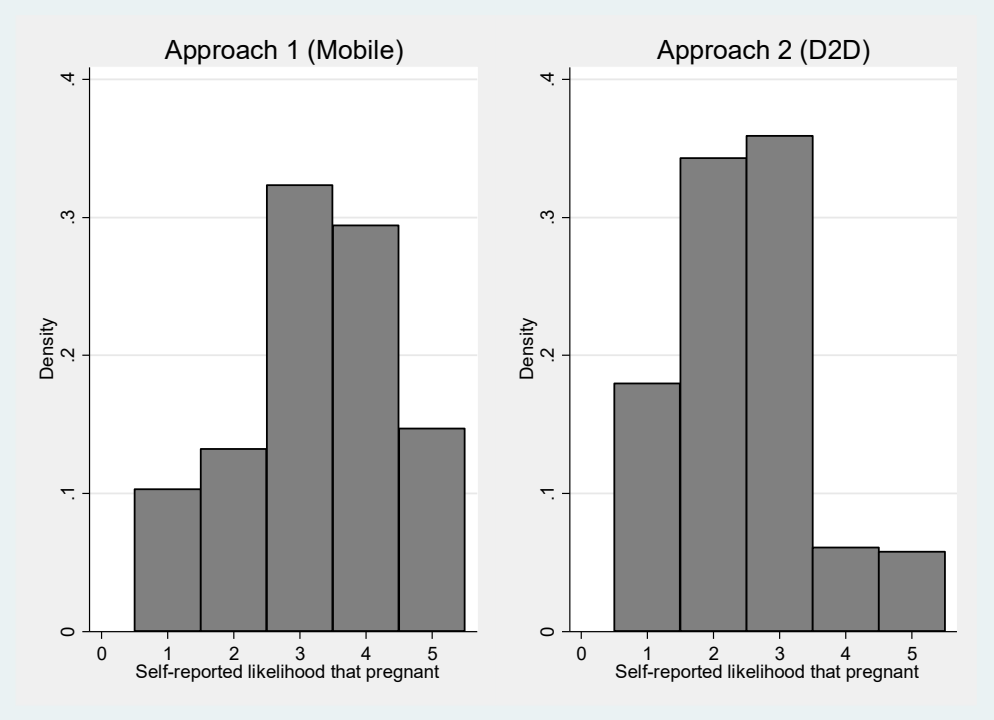


Figure 4. 12: Distribution of pregnancy likelihood score: Approach 1 versus Approach 2



Using an ordinary least squares estimator[110] I regress the likelihood of being pregnant (a binary variable equal to one if she is pregnant) onto group status [1], the expected likelihood of pregnancy variable [2], age [3] and number of women in the household [4] (Table 4.11). Column [1] shows that the women in Approach 2 were 3.3 percentage points less likely to be pregnant than women in Approach 1. The effect becomes positive when I control for expected pregnancy likelihood, age and number of women in the household (Columns [2] to [5]). That is, after controlling for these confounding factors, the pregnancy detection rate is actually higher amongst women using Approach 2. However, the difference remains imprecisely estimated.

In Column [2], I also control for the expected likelihood of pregnancy. Women who chose "Not likely" were significantly more likely to be pregnant than women who chose "Not very likely". They were also more likely to be pregnant than women who opted for the middle category "Unsure". Women who chose "Likely" were 29 percentage points more likely to be pregnant than women who thought that it was very unlikely that they were pregnant. Women who thought it was "Very likely" that they were pregnant were almost 76 percentage points more likely to be pregnant than those who thought it was very unlikely. The effect of age [3] and number of women in the household [4] on pregnancy status is small and insignificant.

The results points to the predictive value of expected pregnancy status on actual pregnancy status. Expected pregnancy status explains almost 25% of the variation in pregnancy status (R-squared). I interact the group status with expected likelihood in Column [5], showing the results for the interaction with the two extreme expectation categories, namely "Not very likely" and "Very likely". Women using Approach 2 who said that they were very likely to be pregnant, were less likely to actually be pregnant than women in Approach 1 [5]. Women using Approach 2 who said that they did not expect to be pregnant (choosing "Not very likely"), were also less likely to be pregnant than women using Approach 1 who reported this expectation, but the difference is. Although these effects are small and imprecisely estimated, it is indicative that women using Approach 1 were better equipped to guess their pregnancy status when they expected to be pregnant, but the opposite holds true when they did not expect to be pregnant.

[110] A logit estimator with marginal effects was also applied, but delivered almost the exact same results. I opted to present the results from the ordinary least squares estimator since this provided me with an R-squared which proved insightful. The results for the logit are provided in the Appendix Section A 4.4.

Table 4. 11: Correlates of pregnancy status

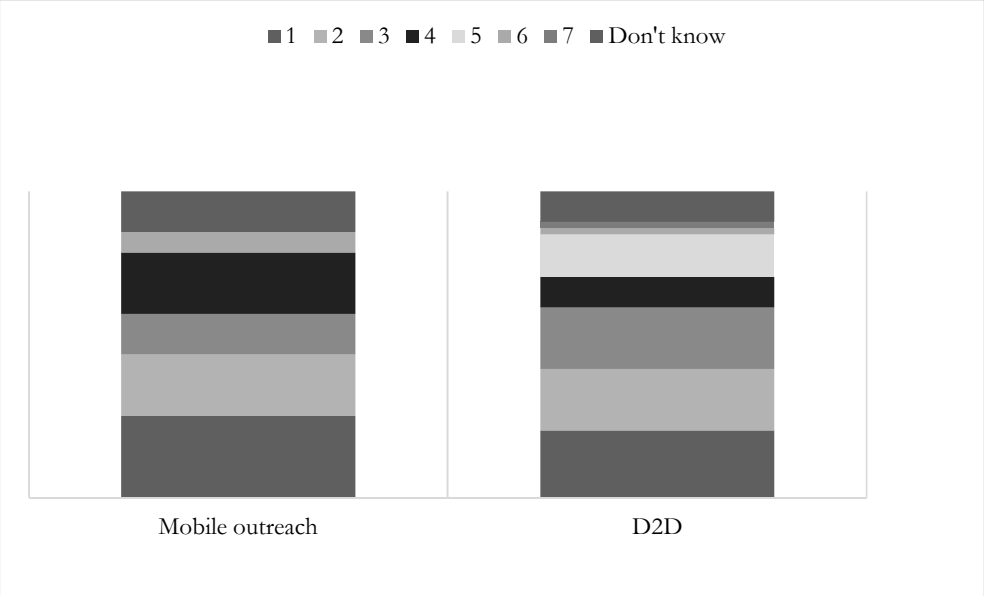
Dependent: Binary = 1 if pregnant		[1]	[2]	[3]	[4]	[5]
		OLS	OLS	OLS	OLS	OLS
Group	Approach 1	Reference	Reference	Reference	Reference	Reference
	Approach 2	-0.0339	0.0790	0.0745	0.0800*	0.104*
		(0.0513)	(0.0481)	(0.0480)	(0.0481)	(0.0560)
Expected likelihood	Not very likely	Reference	Reference	Reference	Reference	Reference
	Not likely		0.105**	0.105**	0.0959*	0.0495
			(0.0528)	(0.0524)	(0.0523)	(0.139)
	Unsure		0.0536	0.0475	0.0401	-0.00425
			(0.0516)	(0.0513)	(0.0513)	(0.137)
	Likely		0.292***	0.291***	0.268***	0.231*
			(0.0714)	(0.0709)	(0.0708)	(0.139)
	Very likely		0.758***	0.757***	0.756***	0.815***
			(0.0775)	(0.0770)	(0.0762)	(0.163)
Age				0.000917	0.00129	0.00140
				(0.00271)	(0.00274)	(0.00275)
No. of women in household					0.00562	0.00504
					(0.0138)	(0.0138)
Approach 2*[Not very likely]						-0.0824
						(0.144)
Approach 2*[Very likely]						-0.128
						(0.142)
Constant		0.206***	-0.0226	-0.0441	-0.0684	-0.0480
		(0.0465)	(0.0603)	(0.0933)	(0.103)	(0.147)
Observations		382	380	379	372	372
R-squared		0.001	0.238	0.244	0.253	0.254

*** p<0.01, ** p<0.05, * p<0.1; Standard errors in parenthesis

A next step is to look at the gestational age of women in both groups when they went for a pregnancy test. This is the gestational age as estimated by the community health worker.[111] If women using Approach 1 are more conservative in their health-seeking behaviour, I would expect them to access care at an earlier gestational age. However, the results (Figure 4.13) show that the differences in gestational age between the two groups are small, with women using Approach 1 going slightly earlier than women using Approach 2.

[111] The CHW estimates the gestational age based on the individual's self-reported sexual activities and description of menses.

Figure 4. 13: Gestational age at recruitment/testing: Approach 1 versus Approach 2



Participants were also asked why they did not access UPTs at the health facility or purchase it from a shop. The various reasons listed by the two groups are shown in Figures 4.14 and 4.15. Women who access via Approach 1 are more likely to be discouraged by supply-side factors (long waiting times at the facility and rude staff). Women who access care via Approach 2 are more likely to list demand-side factors (they do not have time to access care, or buying it at the shop is too expensive).

Figure 4. 14: Reasons for not accessing UPTs at the health facility or a shop, Approach 1

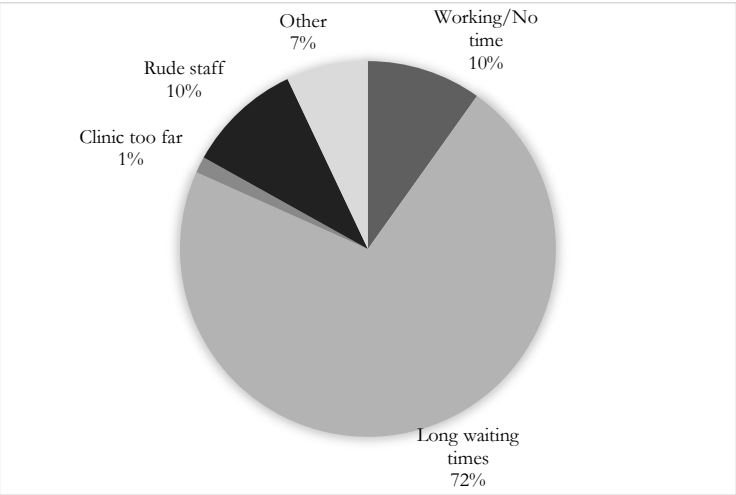
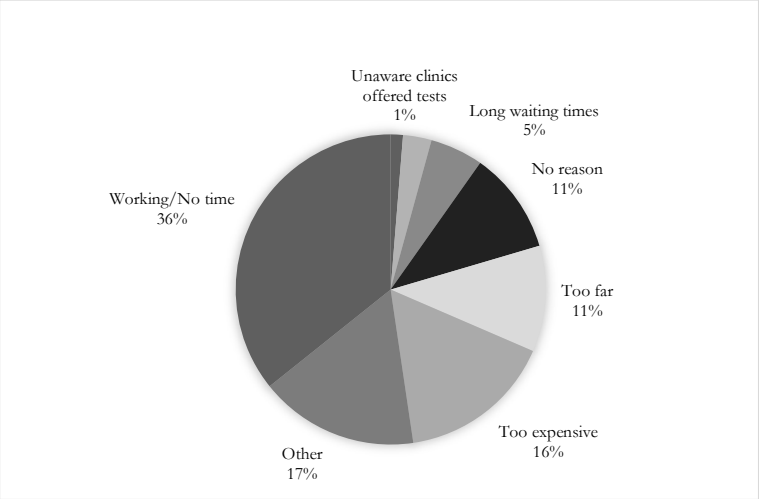


Figure 4. 15: Reasons for not accessing UPTs at the health facility or a shop, Approach 2



To conclude, throughout the analysis, women using Approach 2 come out as more vulnerable than women in Approach 1. Not only do they have lower levels of education, they are also more likely to be unemployed and more likely to be 30 years or older. They are less likely to assume that they are pregnant and are likely to access care at a slightly older gestational age. Finally, they are also more likely to be deterred from testing at public health facilities by demand-side factors. This means that removing supply-side barriers to care, such as long waiting times, will not necessarily encourage them to access care earlier. Using the door-to-door distribution approach has also proven to be more cost-effective in terms of take-up of testing and identification of pregnancies. All these estimates point to the fact that door-to-door testing would be the most successful strategy, since it targets the vulnerable and is more cost-effective.

Recommendations for a scale-up of this study would be to (a) more clearly establish what is driving take-up of testing, (b) follow up on women's future health-seeking behaviour and choices following pregnancy detection and, (c) compare these results regarding costs and effectiveness of distributing tests at public health facilities. The results from this study should be analysed against the QALYs (quality adjusted life years) gained from earlier antenatal care attendance, using a cost-utility analysis. Calculating QALYs was not possible in this analysis, since the necessary data was not collected.

The findings also emphasise the need for an updated Demographics and Health Survey to improve policy makers' understanding of the root causes of health inequalities and limitation to access. While late access to antenatal and abortion services is linked to delay in pregnancy confirmation,

these delays could often merely be symptoms of more deep-rooted causes and individual-specific preferences. Delays in seeking abortion care could be related to personal reasons, such as the uncertainty on whether to have an abortion, which may lead to a long waiting time before initiating the procedure. This could be spurred on by emotional distress, or even uncertainty about her future financial situation (Harries *et al.*, 2007).

Appendix to Chapter 4

Section A 4.1

Table A 4. 1: The total costs of the mobile facility

								Annual cost		Adjusted for CPI (base year 2012)	
Cost category		**Cost**	**Unit**	**Allocation %**	**Amount**	**Life years**	**Year**	**Financial costs**	**Economic costs**	**Financial costs**	**Economic costs**
Capital											
Computer		12999	unit	1%	1	5	2014	35,61	44,60	35,61	40,65
Intervention design		180000	unit	1%	1	10	2014	246,58	367,47	246,58	334,98
Branded tent		14900	unit	100%	1	10	2014	1490,00	2220,57	1490,00	2024,22
Recruitment of CHW		10000	unit	0,5%	1	1	2014	0	49,32	0,00	44,96
Training (20 days)		55019	unit	0,5%	1	2	2014	125,61	141	125,61	128,42
Travel costs for training		1200	per trainee	0,5%	10	2	2014	27,40	31	27,40	28,01
Total capital costs								**1925**	**2854**	**1925**	**2601**
Recurrent											
Personnel											
	Project manager	15000	month	0,075	0,5		3025	563	563	563	506,07
	Community health workers	85	day	100,0%	12		2015	1020	1020	1020	917,68
	Community health worker supervisor	225	day	100,0%	12		2015	2700	2700	2700	2429,15
	Community health worker supervisor travel and communication	60	day	100,0%	12		2015	720	720	720	647,77
Pregnancy testing material											
	Pregnancy tests	8,8	unit	100,0%	68		2015	598	598	598	538,37
	Cleaning and testing material	745,77	unit	100,0%	1		2015	746	746	745,77	670,96
Promotional material	Flyers	0,25	Unit	100,0%	1000		2015	250	250	250,00	224,92
	Rolla Banners	800	Unit	100,0%	1		2015	800	800	800,00	719,75

Cost for women tested											
	Cost of getting to the facility	40	total	100%	1		2015	40	40	40	35,99
	Time spent getting to the facility	66,83	total	100%	1		2015	0	66,83	0	60,13
	Opportunity cost: Time spent doing test	32,75	total	100%	1		2015	0	33	0,00	32,75
Instrument printing costs		0,65	instrument	100%	68		2015	44,20	44,20	44,20	39,77
Total recurrent costs								**7481**	**7580**	**7481**	**6823**
TOTAL COSTS								9406	10434	9406	9425

The following content was included and will be briefly discussed below. Inclusion of each line item in its respective category is justified.

- **Computer –** The computer is categorized as a capital cost, as it was incurred during the start-up of the project, and has a future resale value. The computer is considered to have a life-span of five years. The amount of time the computer was used for planning and implementation of this project is five days. The allocated percentage is 1% (=5/365 days).

- **Intervention design –** Costs incurred in designing the intervention occurs during the start-up of the project, and is therefore considered a capital cost. The intervention design is assumed to have a 10-year lifespan. Although it is possible to make small changes to the intervention design on a regular basis, the initial design of the project is unlikely to change. Evidence of inefficiencies in the intervention design will become apparent during roll-out, but tweaking of the intervention design will be considered a recurrent cost. The allocative percentage is the same as the amount of time spent using the computer. I chose 10 years, as this is generally the time frame in which research and eventual policy on the research topic will change so drastically so that the entire project is likely to change and a new intervention will have to be designed.

- **Branded tent –** The branded tent was required for the purpose of implementing the mobile outreach facility. Since it was a cost incurred during the start-up of the project, and is an asset with a future resale value, it is considered a capital cost. The tent was used 100% for this project.

- **Recruitment of CHW –** The initial recruitment of community health workers is a start-up cost, and therefore a capital cost. Given the turnover rate, the lifespan of the recruitment is considered to be one year. Turnover amongst community health workers is high in South Africa (Nkonki *et al.*, 2010).

- **Training (20 days) –** The first training session is considered a capital cost. This is because it is a start-up cost, but also because the training adds value to the education of the CHW. This is something that she can use in the future to earn a salary, therefore it is considered to have a future resale value. The lifespan of the training is assumed to be two years. This is based on an assumption of the quality of the training due to its short duration.

- **Travel costs during training –** These were the taxi fees for transporting the trainees to and from training. This was a once-off payment incurred during the start of the programme. Therefore, it is included in the capital costs of the programme. The lifespan of travel costs is the same as that of the training, since the two are inherently bounded.

- **Time allocated to recruitment, training and travel costs of CHWs –** Since these costs were incurred as part of the larger study (discussed in the previous chapter), only a percentage of the costs spent on these expenses are included in this cost analysis. The calculation of the proportion of time allocated to these activities is reported in the table below. Since only the CHWs (not the CHW supervisor) were trained, the time allocation of training refers only to the CHW working at the mobile site.

Total days worked by CHWs	219	
Total days tests performed	12	
CHW daily rate	85	
CHW supervisor daily rate	225	
CHW supervisor travel expense	60	
Total cost of CHW and supervisor to do testing	4440	
Percentage of time allocated to testing by CHW	0,5%	*(Total days tested/total days worked)/Number of women trained

Recurring costs

- **Personnel cost: Project manager –** The cost of the project manager equals the monthly rate of the PhD student who did the project management, multiplied by the proportion of the year (allocation %) spent doing project management. Since this is an operational cost, it is a recurrent cost incurred. The project manager spent three hours a week at the implementation site. Assuming that she works 40 hours per week, this means that 0.075 of her time is allocated to the project. Since this project was implemented for 12 days, visits were made in two of the four weeks of the month (amount = 2/4=0.5).

- **Personnel cost: Community Health worker –** This is an operational cost, and is therefore a recurring cost. She worked from 09:00 to 13:00 for 12 days, at a rate of R85 per day. 100% of her time was allocated to testing.

- **Personnel cost: Community Health worker supervisor –** This is an operational cost, and is therefore a recurring cost. She worked from 09:00 to 13:00 for 12 days, at a rate of R225 per day. 100% of her time was allocated to testing.

- **Pregnancy testing material –** Pregnancy testing material is considered a recurrent and operational cost. Material used included the pregnancy tests, but also various cleaning materials and disposable cups for urine collection, latex gloves for the CHWs and various disinfectants. Since a micro-costing approach is used, the amount of the pregnancy tests used is equal to the

number of tests distributed (68). The cleaning and testing material cost is the total amount spent on these products for this study.

- **Promotional material –** I argue that promotional material is a recurrent cost, since it is operational in nature, required for social mobilisation and will have to be continuously incurred, as the project is implemented over a longer period of time.

- **Costs for women tested –** Given that I take a societal perspective and micro-costing approach to the cost evaluation, costs incurred to the users of the project (the mothers) also have to be taken into account. Costs to the user can be divided into direct costs incurred by the user to get to the testing site (collected in the survey), indirect cost of time spent getting to the testing site (collected in the survey) and the opportunity cost of time spent doing testing.

- **Cost of getting to the facility:** The cost reported here is the summation of all costs reported by participants of the mobile outreach facility. Very few women reported paying anything to get to the mobile testing site; therefore, the total cost is only R40.

Travel cost	Number	%
Nothing	66	97.06
< R20	2	2.94

- **Time spent getting to the facility:** While few women reported that they incurred costs to get to the site, a few women reported they spent time to get to the facility. These figures are shown in the table below. 44 women reported that it took them less than 30 minutes to get to the facility, 18 reported that it took them more than 30 and less than 60 minutes and six women reported travelling more than 60 minutes.

Time travelled	Number	%
< 30 minutes	44	64.71
>30; <60 minutes	18	26.47
>60 minutes	6	8.82

Time spent getting to the facility is considered to be productive time lost which could have been spent earning an income. This opportunity cost is estimated by calculating the potential monthly

wage of every individual based on their demographic characteristics in a nationally representative South African data set (NIDS). This potential monthly wage is converted to an hourly wage and multiplied by the amount of time the user spent travelling to the clinic. For women who reported being unemployed, this opportunity cost is set equal to null. The cost reported in Table A 4. 1 is the summation of all these opportunity costs.

- **Opportunity cost due to time spent doing the testing –** The second set of indirect costs incurred by users of the service is the opportunity cost due to time spent doing the test at the facility. The cost of productivity lost is calculated as before, with the cost equal to null for unemployed users.

- **Instrument printing costs –** Printing costs are operational, and therefore recurrent. The instruments used for the testing were tracking sheets where basic information was collected.

Section A 4.2

Table A 4. 2: The total costs of the door-to-door testing

								Annual cost		Adjusted for CPI (base year 2012)	
Cost category		**Cost**	**Unit**	**Allocation %**	**Amount**	**Life years**	**Year**	**Financial costs**	**Economic costs**	**Financial costs**	**Economic costs**
Capital											
Computer		12999	unit	17%	1	5	2014	433,30	542,62	433,30	494,64
Intervention design		180000	unit	17%	1	10	2014	3000,00	4470,94	3000,00	4075,61
Recruitment of CHW		10000	unit	24%	1	1	2014	0	2621,72	0,00	2389,90
Training (20 days)		55019	unit	24%	1	2	2014	6677,80	7489	6677,80	6827,03
Travel costs for training		1200	per trainee	24%	10	1	2014	2912,94	3146	2912,94	2867,88
Total capital costs								**13024**	**18271**	**13024**	**16655**
Recurrent											
Personnel											
	Project manager	15000	month	20%	1,8		2015	5400	5400	5400,00	4858,30
	Community health workers	1700	month	86%	10,8		2015	15785	15785	15784,50	14201,08
	Community health worker supervisor	4500	month	6%	1,8		2015	510	510	509,85	458,70
	Community health worker supervisor travel and communication	1200	month	6%	1,8		2015	136	136	135,96	122,32
CHW material											
	Outfit	465	per CHW	24%	7		2015	790	790	790,14	710,87
	Bags	97,99	per CHW	24%	3		2015	71	71	71,36	64,20
Antenatal care information brochure		1,51	unit	24%	2000		2014	733	733	733,09	668,27

Opportunity cost for women tested		0	visit	100%	314		2015	0	0	0,00	0,00
Instrument printing costs		0,65	instrument	100%	60		2015	39	39	39,00	35,09
Pregnancy testing material											
	Pregnancy tests	6,57	unit	100%	314		2015	2063	2063	2062,98	1856,03
	Hygiene and maintenance material	160,55	unit	100%	1		2015	161	161	160,55	144,44
Office rental		750	month	86%	2		2015	1290	1290	1289,58	1160,22
Total recurrent costs								**26977**	**26977**	**26977**	**24280**
TOTAL COSTS								40001	45248	40001	40935

- **Computer –** The computer is categorised as a capital cost, as it was incurred during the start-up of the project, and has a future resale value. The computer is considered to have a lifespan of five years. The amount of time the computer was used for planning and implementation of this project is two months. The allocated percentage is 17% (=2 months/12 months). This is the amount of time the computer was used to do research and design the study.

- **Intervention design –** Costs incurred in designing the intervention occurs during the start-up of the project, and is therefore considered a capital cost. The intervention design is assumed to have a 10-year lifespan. Although it is possible to make small changes to the intervention design on a regular basis, the initial design of the project is unlikely to change. Evidence of inefficiencies in the intervention design will become apparent during roll-out, but tweaking of the intervention design will be considered a recurrent cost. The allocative percentage is the same as the amount of time spent using the computer. I chose 10 years, as this is generally the time frame in which research and eventual policy on the research topic will change so drastically so that the entire project is likely to change and a new intervention will have to be designed. It is estimated that 17% of the intervention design was specific to the pregnancy testing. The remaining portion of the intervention design can be allocated to the larger RCT design.

- **Recruitment of CHW, training and travel costs –** Justification of the inclusion of these costs as capital costs is explained in the description of the mobile outreach health facility costs. Since these costs were incurred as part of the larger study, only a portion of costs are allocated to the costing analysis of door-to-door testing. The calculation of the allocated percentage is shown in the table below. 24% of the training (recruitment, training and travelling) can finally be allocated to this testing approach.

Item			**Calculation**
(1)	Number of days CHWs employed	219	
(2)	Days tests performed	36	
(3)	Hours worked per day	5	
(4)	Time it takes to do one survey (hours)	1,5	
(5)	Time spent on survey by supervisor (hours)	1,67	
(6)	No. of CHWs	6	
(7)	No. of surveys done	100	
(8)	Average surveys done per day (based on no. of surveys done)	2,81	(7)/ (2)
(9)	Hours worked during recruitment	1080	(2) *(3) *(6)
(10)	Hours spent doing surveys	151,5	(4) *(7)
(11)	Hours spent testing	928,5	(9) -(10)
(12)	Total hours worked by CHW	3825	((1) *(3) *3) + ((2) *(3) *3)
(13)	Percentage of time done testing	24%	(11)/ (12)

Recurring costs

- **Personnel cost: Project manager –** The cost of the project manager equals the annual rate of the PhD student who did the project management, multiplied by the proportion of the year (allocation %) spent doing project management. Since this is an operational cost, it is a recurrent cost incurred. The project manager spent approximately 20% per month project managing

pregnancy testing and sourcing products for implementation. Since a work month is 20 days long, and since implementation was 36 days, the amount of months spent working is 1.8 (36/20).

- **Personnel cost: Community Health worker –** This is an operational cost, and is therefore a recurring cost. The community health workers were employed for R1700 per month. 86% of the month was used for pregnancy testing (calculation below). Since a work month is 20 days long, implementation was 36 days long and there were six women working, the total amount of months worked in sum by CHWs was 10.8 (36/20*6).

Item			Calculation
(1)	Number of days worked per month by CHW	20	
(2)	Days tests performed	36	
(3)	Hours worked per day	5	
(4)	Time it takes to do one survey (hours)	1,5	
(5)	No. of CHWs	6	
(6)	No. of surveys done	100	
(7)	Hours worked by CHWs	1080	(2) *(3) *(5)
(8)	Hours spent doing surveys	151,5	(4) *(6)
(9)	Hours done testing over 36 days	928,5	(7) -(8)
(10)	Hours done testing per month	515,83	((1) *(3) *3) + ((2) *(3) *(6))
(11)	Percentage of time done testing	86%	(10)/ ((1) *(3) *(5))

- **Personnel cost: Community Health worker supervisor salary and travel cost –**These are operational costs, and are therefore classified as a recurring cost. Only 6% of the supervisor time was spent doing the testing (calculation below). She was more involved with monitoring all the surveys being implemented. Since a work month is 20 days long, and since implementation was 36 days, the amount of months spent working is 1.8 (36/20).

Item			Calculation
(1)	Number of days worked per month by supervisor	20	
(2)	Days tests performed	36	
(3)	Hours worked per day	5	
(4)	Time it takes to do one survey (hours)	1,5	
(5)	Time spent on survey by supervisor (hours)	1,67	
(6)	No. of CHWs	6	
(7)	No. of surveys done	100	
(8)	Hours worked by CHW supervisor	180	(2) *(3)
(9)	Hours spent doing surveys by CHW supervisor	168,67	(5) *(7)
(10)	Hours done testing over 36 days	11,33	(8) -(9)
(11)	Hours done testing per month	6,29	(10)/ (2) *(1)
(12)	Portion of month spent on testing by CHW supervisor	6%	(11)/ ((1) *(5))

- **CHW material –** All CHW material (outfit and bag) are recurring costs, as they are considered as supplies and are operational in nature. These were also acquired for the larger project. Similar to recruitment and training costs, only 24% of these costs are allocated to testing.

- **Antenatal care information brochure –** These were information brochures distributed to women in the community reminding them of the importance of finding out early whether they were pregnant and to live a healthy lifestyle. These were promotional and intended to mobilise the community. These were part of the larger study, and only 24% was allocated to the testing.

- **Opportunity cost for women –** As previously discussed, in this study, the costs to the mother are minimal, and entail productivity lost due to time spent with CHW rather than working (opportunity costs). The user costs to the mother are relatively low, as the mothers are visited by the CHWs at home. There are thus no transport costs involved for the mother. The only other real cost to the mothers is possible emotional costs due to possible stigmatisation by the community. It is possible that home visits by CHW could signal to the community that the woman

is HIV positive, as home-based care is often associated with HIV treatment. However, it will be difficult to measure this "inconvenience factor", and this will affect take-up (my measure of effectiveness). Unfortunately, employment information was not collected for all women tested using the door-to-door strategy. However, since women were at home when I tested them, I assume that they were not losing productive time and that these were leisure hours lost. The opportunity costs are assumed to be null.

- **Instrument printing costs –** Printing costs are operational, and therefore recurrent. The instruments used for the testing were tracking sheets where basic information was collected.

- **Pregnancy testing material –** Pregnancy testing material is considered a recurrent and operational cost. Material used included the pregnancy tests, but also various cleaning materials and disposable cups for urine collection, latex gloves for the CHWs and various disinfectants. Since a micro-costing approach is used, the amount for pregnancy tests used is equal to the number of tests distributed (314). The cleaning and testing material cost is the total amount spent on these products for this study.

- **Office rental –** For the purpose of the roll-out of the study, I rented an office space for two months where CHWs could meet and keep equipment if necessary. The office was used 86% of the time for pregnancy testing for a period of 36 days.

Section A 4.3

Table A 4. 3: Sensitivity analysis

Approach 1		Economic costs			Approach 2		Economic costs		
		Discount rate					**Discount rate**		
		8 %	3%	6%			8 %	3%	6%
Capital					**Capital**				
Computer		40,65	35,44	38,53	Computer		494,6356	431,236	468,8376
Intervention design		334,98	263,50	305,39	Intervention design		4075,605	3205,94	3715,617
Branded tent		2024,22	1592,28	1845,42	Recruitment of CHW		2389,9	2279,131	2345,568
Recruitment of CHW		44,96	42,87	44,12	Training (20 days)		6827,035	6362,504	6640,477
Training (20 days)		128,42	119,68	242,75	Travel costs for training		2867,88	2734,958	2814,681
Travel costs for training		28,01	26,10	52,95					
Total capital costs		**2601,24**	**2079,89**	**2529,17**	**Total capital costs**		**16655,06**	**15013,77**	**15985,18**
Recurrent					**Recurrent**				
Personnel					Personnel				
	Project manager	506,07	506,07	506,07		Project manager	4858,3	4858,3	4858,3
	Community health workers	917,68	917,68	917,68		Community health workers	14201,08	14201,08	14201,08
	Community health worker supervisor	2429,15	2429,15	2429,15		Community health worker supervisor	458,7045	458,7045	458,7045
	Community health worker supervisor travel and communication	647,77	647,77	647,77		Community health worker supervisor travel and communication	122,3212	122,3212	122,3212
Pregnancy testing material					CHW material				
	Pregnancy tests	538,37	538,37	538,37		Outfit	710,873	710,873	710,873
	Cleaning and testing material	670,96	670,96	670,96		Bags	64,20133	64,20133	64,20133
Promotional material	Flyers	224,92	224,92	224,92	Antenatal care information brochure		668,2682	668,2682	668,2682

	Rolla Banners	719,75	719,75	719,75	Opportunity cost for women tested		0	0	0
Cost for women tested					Instrument printing costs		35,08772	35,08772	35,08772
	Cost of getting to the facility	35,99	35,99	35,99	Pregnancy testing material				
	Time spent getting to the facility	60,13	60,13	60,13		Pregnancy tests	1856,032	1856,032	1856,032
	Opportunity cost: Time spent doing test	32,75	32,75	32,75		Hygiene and maintenance material	144,4444	144,4444	144,4444
Instrument printing costs		39,77	39,77	39,77	Office rental		1160,219	1160,219	1160,219
Total recurrent costs		**6823,30**	**6823,30**	**6823,30**	**Total recurrent costs**		**24279,53**	**24279,53**	**24279,53**
TOTAL COSTS		**9424,54**	**8903,19**	**9352,48**	**TOTAL COSTS**		**40934,59**	**39293,3**	**40264,71**

Section A 4.4:

Table A 4. 4: Marginal effects of a logit estimator: correlates of pregnancy status

Dependent: Binary = 1 if pregnant		[1]	[2]	[3]	[4]
		Marginal effects, Logit	Marginal effects, Logit	Marginal effects, Logit	Marginal effects, Logit
Group	Approach 1	Reference	Reference	Reference	Reference
	Approach 2	-0.0339	0.0719*	0.0679*	0.0730*
		(0.0535)	(0.0393)	(0.0393)	(0.0382)
Expected likelihood	Not very likely	Reference	Reference	Reference	Reference
	Not likely		0.100**	0.100**	0.0910**
			(0.0410)	(0.0409)	(0.0408)
	Unsure		0.0493	0.0433	0.0362
			(0.0355)	(0.0350)	(0.0352)
	Likely		0.309***	0.307***	0.283***
			(0.0892)	(0.0891)	(0.0891)
	Very likely		0.766***	0.765***	0.768***
			(0.0785)	(0.0788)	(0.0787)
Age				0.000993	0.00142
				(0.00288)	(0.00291)
Number of women in household					0.00649
					(0.0140)
Observations					
		382	380	379	372

*** p<0.01, ** p<0.05, * p<0.1; Standard errors in parenthesis

Section A 4.5: Drummond checklist (Drummond & Jefferson, 1996; Drummond *et al.*, 2005)

Item	Yes	No	Not clear	Not appropriate
Study design				
(1) The research question is stated	☐	☐	☐	
(2) The economic importance of the research question is stated	☐	☐	☐	
(3) The viewpoint(s) of the analysis are clearly stated and justified	☐	☐	☐	
(4) The rationale for choosing the alternative programmes or interventions compared is stated	☐	☐	☐	
(5) The alternatives being compared are clearly described	☐	☐	☐	
(6) The form of economic evaluation used is stated	☐	☐	☐	
(7) The choice of form of economic evaluation is justified in relation to the questions addressed	☐	☐	☐	
Data collection				
(8) The source(s) of effectiveness estimates used are stated	☐	☐	☐	
(9) Details of the design and results of effectiveness study are given (if based on a single study)	☐	☐	☐	☐
(10) Details of the method of synthesis or meta-analysis of estimates are given (if based on an overview of a number of effectiveness studies)	☐	☐	☐	☐
(11) The primary outcome measure(s) for the economic evaluation are clearly stated	☐	☐	☐	
(12) Methods to value health states and other benefits are stated	☐	☐	☐	☐
(13) Details of the subjects from whom valuations were obtained are given	☐	☐	☐	☐
(14) Productivity changes (if included) are reported separately	☐	☐	☐	☐
(15) The relevance of productivity changes to the study question is discussed	☐	☐	☐	☐
(6) Quantities of resources are reported separately from their unit costs	☐	☐	☐	
(17) Methods for the estimation of quantities and unit costs are described	☐	☐	☐	
(18) Currency and price data are recorded	☐	☐	☐	
(19) Details of currency of price adjustments for inflation or currency conversion are given	☐	☐	☐	
(20) Details of any model used are given	☐	☐	☐	☐
(21) The choice of model used and the key parameters on which it is based are justified	☐	☐	☐	☐
Analysis and interpretation of results				
(22) Time horizon of costs and benefits is stated	☐	☐	☐	
(23) The discount rate(s) is stated	☐	☐	☐	☐
(24) The choice of rate(s) is justified	☐	☐	☐	☐
(25) An explanation is given if costs or benefits are not discounted	☐	☐	☐	☐
(26) Details of statistical tests and confidence intervals are given for stochastic data	☐	☐	☐	☐
(27) The approach to sensitivity analysis is given	☐	☐	☐	☐
(28) The choice of variables for sensitivity analysis is justified	☐	☐	☐	☐
(29) The ranges over which the variables are varied are stated	☐	☐	☐	☐
(30) Relevant alternatives are compared	☐	☐	☐	
(31) Incremental analysis is reported	☐	☐	☐	☐
(32) Major outcomes are presented in a dissaggregated as well as aggregated form	☐	☐	☐	
(33) The answer to the study question is given	☐	☐	☐	
(34) Conclusions follow from the data reported	☐	☐	☐	
(35) Conclusions are accompanied by the appropriate caveats	☐	☐	☐	

Chapter 5

Conclusion

In this dissertation, I explored the impact of health perceptions and the eventual health choices of vulnerable South African individuals, as contributors to poor health outcomes and health inequalities in South Africa. The focus in all chapters has been on the demand-side of health, and the factors driving the health decisions of individuals. I have also provided evidence on interventions that can be used to improve their health outcomes. Vulnerable individuals assessed in this dissertation include the income and wealth poor and, in particular, women living in low-resource areas with limited access to sexual and reproductive health services. In my analysis of the topic, I have also applied novel quantitative and experimental methods.

In Chapter 2, I calculated the impact of systematically different health perceptions across subgroups on individuals' reporting behaviour, and on the measurement of health inequalities. The analysis was performed using anchoring vignettes, and estimated using a HOPIT model as proposed by King *et al.* (2004). The findings from this chapter are important, as they have implications for the accuracy with which one measures health inequalities when household surveys are used.

In Chapter 3, I implemented and measured the impact of a package intervention on the timing and frequency of antenatal care sought among pregnant women living in a low-resource area in urban South Africa. These outcomes fall within the United Nation's Sustainable Development Goals and local South African policy to improve maternal health outcomes. In measuring the impact of the intervention, I also analysed the mechanisms through which the intervention could have influenced behaviour by testing for possible heterogeneous preferences. Heterogeneity in preferences for antenatal care is measured by looking at differences in individual discount rates (inconsistent time preferences) and prioritisation (top-of-mind effect). A randomised controlled trial methodology was used in this chapter.

In Chapter 4, I implemented and measured the cost-effectiveness (an economic evaluation) of two alternative approaches to providing women access to urine pregnancy tests. Effectiveness and health behaviour was measured by looking at differences in take-up of the UPTs in the two approaches.

I will summarise the findings, consequences, limitations and implications and prospects for future research of the respective chapters, below.

Chapter 2*:* Poor health reporting by the rich? Using vignettes to recover the health gradient by wealth status

Studies using household data to measure health outcomes and health needs often rely on self-reported information rather than objectively measured health data in their analyses. Subjective ratings of health have been significantly linked to survival and mortality in both the industrialized and developing world, and specifically South Africa. While the relationship between self-reported health and mortality is well-established, self-reported health is prone to differences in reporting behaviour across different socioeconomic groups. This reporting bias means that health disparities measured using self-reported health outcomes could possibly be biased. While some authors have found the SES/health gradient to hold for self-reported health measures, others have found the relationship to be weak and problematic.

These differences in the evaluation of self-assessed health are referred to as *reporting heterogeneity*. If reporting heterogeneity is found to be systematic across a subgroup, it becomes problematic to use it for cross-population comparisons. Differences in reporting behaviour is likely to occur when individuals have differing experiences, health expectations and reference groups.

I tested and adjusted for the presence of reporting heterogeneity using health as reported by anchoring vignettes to estimate HOPIT models on data taken from the first wave of SAGE, the WHO Study on global AGEing and adult health. An anchoring vignette is a data collection tool used to describe a fixed level of health that acts as a benchmark against which one can compare self-reported health and gauge the level of bias. The WHO SAGE data set contains anchoring vignettes on 16 health domains including variations of mobility, appearance, anxiety, pain/discomfort, cognitive abilities, interpersonal relationships, sleeping/resting ability and vision.

Reporting heterogeneity may severely bias measures of the socioeconomic gradient in health. A first goal of this chapter was to test whether inequalities in self-reported health by wealth status in South Africa were underestimated as a result of reporting tendencies. I found that in 10 of the 16 health domains tested, reporting heterogeneity was present, meaning that the poorest and richest wealth quintiles use (statistically) significantly different reporting scales when evaluating their

health. I also found that this health reporting is to the disadvantage of the poor, meaning that reporting bias leads to an underestimation of health disparities between the poorest and richest wealth quintiles. The size of this underestimation ranges between one and 15 percentage points

I also investigated the presence of wealth reporting heterogeneity within and across race groups in South Africa. The racial subgroup analysis was performed due to the overlap in the composition of race and wealth quintiles, with the poorest wealth quintile consisting largely of Black Africans and the richest quintile consisting largely of the White population. Health inequalities which result as a consequence of social, cultural and economic factors are unfair or socially unjust given that the vulnerable and worse-off groups are involuntarily disadvantaged (Woodward & Kawachi, 2000). Health inequalities by racial divisions in South Africa can partially be attributed to the segregation and land use policies put in place during apartheid. Within the Black African population group, I detected the presence of reporting heterogeneity between the poorest (Q1) and the richest quintile (Q5) in 14 and 11 of the 16 domains, respectively. Across all health domains, the reporting bias was to the disadvantage of the poor. Due to data limitations, I was only able to test for the presence of within-group heterogeneity for the Black African population.

I analysed the level of reporting heterogeneity across race groups by calculating reporting differences between Black African and White populations in the most affluent quintile (Q5). Before correction, Black Africans reported more difficulties than Whites in *every* health domain. However, reporting homogeneity was also significantly rejected for most (11 out of 16) health domains. After correcting for reporting heterogeneity there were almost no statistically significant differences in the health of the Black African and White populations. Correction for these biases erases virtually all of these health disparities by race.

My findings have important implications. Firstly, they suggest that using self-reported health data to calculate health disparities by SES in South Africa will be inaccurate due to the presence of reporting heterogeneity by wealth and race. This reporting behaviour translates into an underestimation of the health of the poorest and most vulnerable subgroups relative to the affluent, and consequently an underestimation of the change required to alleviate these disparities. This research is important in South Africa given the shortage of widely available objectively measured health data, and the frequent reliance on self-reported health data.

A second important finding is the possibility that closing the wealth gap also leads to the closing of the racial health gap. This holds the promise that the reduction in wealth inequality will

contribute to a reduction in health inequality, although various limitations to the analysis means that this is a cautionary finding. The major limitation to this chapter is that it only applies to the South African population aged 50 and older, and findings can only be generalised to this age cohort. In South Africa, the composition and socioeconomic status of the older cohort looks different from younger age groups. The older cohort grew up during apartheid. This would have had a profound effect on their wealth creation and access to health services during adolescence and early adulthood, thereby affecting their reporting behaviour differently than the rest of the population.

The subjective nature of self-reported health status also provides a unique opportunity to draw inferences about health perceptions. Since differences in reporting behaviour are likely to result due to differing experiences, health expectations and reference groups, the results indicate that reporting behaviour is driven by heterogeneous perceptions of health by the poor relative to the rich. This illustrates the disadvantaged position of the poor in terms of access to quality healthcare, information and the relative level of health of their reference groups. People usually compare their health to their peers and surrounding subgroups (Harris *et al.*, 2011; Boyce & Harris, 2008). A person, who is surrounded by poor health, would consider himself or herself to be relatively well-off compared to their community or peers, even though their health may compare poorly to the overall level of health of the population. Self-reported health data gives one insight into an individual's experience and perceptions of illness which should not be dismissed. These perceptions can often be a predictor of an individual's health-seeking behaviour and actions.

A future avenue for research in this topic would be to experiment with the optimal design and positioning of vignettes. Although vignettes are gaining popularity as a data collection tool, it remains a novel approach. Future research should also entail strategies to establish the specific channels through which reporting heterogeneity is affecting reporting behaviour. If reporting differences are the result of health information asymmetry or differences in reference groups, then a demand-side intervention aimed at increasing access to health knowledge could equalize health perspectives. Finally, it would be useful to translate the results from this chapter (the presence and size of reporting bias) to self-reported health measures in other household surveys that do not collect vignettes, allowing us to control and adjust for reporting heterogeneity in a wider selection of data sets.

Chapter 3: The Thula Baba Box study: A package of interventions aimed at improving early access to antenatal care in Cape Town, South Africa. Evidence from a pilot randomised controlled trial.

The main aim of Chapter 3 was to test the impact of a package intervention consisting of an incentive and community health worker programme on improving the timing and frequency of antenatal care visits amongst pregnant women. The data collected during the evaluation also allowed me to test for the impact of the intervention on other key health outcomes measurable at birth, namely infant birth weight, maternal nutrition and depressive symptoms and infant feeding intention (the intention to exclusively breastfeed for six months).

The goal was to assess whether providing health information, psychosocial support and a nudge in the form of an incentive was able to affect the health-seeking behaviour of a vulnerable subgroup of women residing in a low-resource area in the Western Cape.

I tested for the impact of the intervention using a randomised controlled trial, which is an experimental methodology in which the intervention is only provided to a subset of randomly chosen individuals. I found that women who received the intervention were 18.5 percentage points more likely to access antenatal care four times or more, compared to women in the control group. They also accessed care 1.34 months earlier than women in the control group. The effects were statistically significant.

I also tested whether the impact of the intervention operated through specific channels. This enabled me to draw inferences about the perceived importance and necessity of antenatal care. Care-seeking behaviour is a function of both the demand- and supply-side. While timing and frequency of access to care is to a large extent determined by the affordability, geographical accessibility and acceptability of that care (McIntyre, Thiede & Birch, 2009), factors such as the individual's perception of the importance of care or her perception on the acceptability of care will also affect her care-seeking behaviour. Therefore, I explored the heterogeneity in responses across the treatment group based on behavioural economic theories, concentrating on time-inconsistent preferences and top-of-mind effects. This evidence should be viewed as speculative in nature.

In evaluating the impact of the intervention on health outcomes, I found that the intervention had a significant impact on improving the maternal depressive symptoms and infant feeding intention of women in the treatment group.

Although randomised controlled trials provide an opportunity to establish causal impacts, the research methodology also has various limitations which may influence the robustness of results. One of the concerns regarding experimental research includes environmental dependence. This includes concerns about the generalisability of the results and the role of implementer effects (Banerjee & Duflo, 2009). Another concern is the effect of randomisation and being in a research study on behaviour and reporting. Randomisation itself may also have a detrimental effect as individuals in the control group may act perversely as a reaction to not being selected into a treatment arm. These may all affect the external validity of the intervention.

Banerjee and Duflo (2009) warn of the heterogeneity of treatment effects, especially when taking the mean treatment effect as an indicator of the effectiveness of a programme on all members of society. The effectiveness of the programme may differ for various subgroups. I try to take this into account by observing the effect of the treatment on specific subgroups. However, as Banerjee and Duflo rightly point out, these subgroups are decided on ex post and therefore I run the risk of *"specification searching*". The subgroups in my analysis are determined partially by public health literature on risk correlates, but are also somewhat determined by risk factors and groups identified in the data. Hopefully, these results can help in future research to *ex ante* determine vulnerable subgroups.

Future research should entail scaling up the intervention to a larger research area, and to increase the sample size. Whether the results found in this pilot RCT will translate into effects when scaled-up will depend on several factors. One factor to consider is whether the barriers to access in a larger sample is similar to the barriers faced by the participants in the pilot. Understanding the context and vulnerability of the sample population is key to successful implementation and project design. For instance, providing women with travel vouchers to access care in urban Cape Town would not necessarily nudge women to access care earlier, since clinic care is in walking distance for most women. Other factors, such as inability to identify their pregnancy or not comprehending the importance of early care are considered to be more important drivers of poor access.

Another issue related to scaling up the programme is the possibility of equilibrium effects (Banerjee & Duflo, 2009). When scaled up nationwide, an increase in early attendance may lead to crowding at the clinic level, which in turn will lead to a decline in the quality of care received due to the limited supply of nurses at public health facilities.

In their article describing the role of experimental approaches to research in development economics, Banerjee and Duflo (2009) point to the important role of the researcher in implementation. In implementing randomised experiments and interventions, it is often the practice for implementation to be operated by an independent party (such as a local NGO) and the data analysed by the researchers. Continuous involvement between the implementer and researcher encourages a process of ongoing learning and fostering of mutual interests. In the case of the Thula Baba Box project, the implementation was done by myself, the researcher. This made it possible to constantly monitor progress and ensure that the quality of research was not compromised. Engaging with the implementation process also lead to a better understanding of the processes necessary to scale up an intervention.

A final possibility for future research would be to use the estimates from the analysis to build a complementary structural model to externally validate the results from my study (Banerjee & Duflo, 2009).

Chapter 4: Two alternative approaches to urine pregnancy test distribution: a cost-effectiveness analysis

In Chapter 4, I tested the cost-effectiveness of two approaches to providing women easier access to UPTs. This is important for the sexual and reproductive health of women, given that use of UPTs have been linked to accessing antenatal care or abortion services at an earlier gestational age. Access to UPTs are also essential for the provision of contraception. Access refers to making the testing process more acceptable, affordable and geographically available compared to getting tested at a public healthcare facility. While affordability and geographical availability is not usually a problem at primary care facilities in urban areas, since care is free of cost and clinics are in close proximity to communities, there are widespread reports of poor staff attitudes, long waiting times and the rejection of request for UPTs, which act as supply-side barriers to women getting tested. There are also various self-reported demand-side barriers that mar access, such as the inability to take time off from work to access UPTs at clinics.

I implemented and tested two alternative approaches to UPT distribution, namely distribution at a mobile health outreach facility (Approach 1) and door-to-door test distribution (Approach 2). I find that door-to-door distribution is a more cost-effective approach than distribution at a mobile health facility, predominantly due to the large take-up of tests using Approach 2. Women using Approach 2 are also less likely to assume that they are pregnant and are likely to access care at a slightly older gestational age. Finally, they are also more likely to be deterred from testing at public health facilities by demand-side factors.

Discrepancies in take-up of UPTs can partially be explained by individual heterogeneous preferences for healthcare, and the way that individuals cope with the uncertainty of finding out they are pregnant. The design of the interventions does not allow me to distinguish which factors are specifically driving testing or non-testing: is it fear of finding out you are pregnant (psychological costs), the costs associated with testing (travel cost) or the inconvenience of going somewhere to get tested? Future research should entail collecting this information, and information on the discount rates of participants. Future research should also link testing to eventual health-seeking behaviour (timing of access to antenatal, ToP or family planning services).

Final comments

In s*ummary,* the main contribution of this dissertation was to provide evidence on how heterogeneity in individual preferences may lead to differences in health reporting behaviour and health-seeking behaviour, often to the disadvantage of the vulnerable. I also provided evidence and information on interventions that address the limitations to health-seeking behaviour and can improve the health outcomes of these vulnerable individuals. These findings are crucial to overcome the inequalities in health outcomes of South Africans.

While economists and policy makers often assume preferences are stable across individuals and time, Feldstein proposes that in order to translate government spending into improved health outcomes, this heterogeneity should be central to the discussion. There will always be a human element to the way individuals respond to policy, and once we acknowledge and attempt to quantify these differences in demand-side responses, we can move toward improving the health of all members of society. However, there will always remain a level of heterogeneity in individual preferences that we cannot explain. I conclude with a paragraph from Feldstein's 1995

presentation at the American Economic Association annual meeting. Although speaking about the US as a nation, he eloquently describes the challenge facing all countries to improve the health of their populations, and which is still applicable today:

> **"As I look back over the past three decades, I realize that the most fundamental challenge to any health-care system is to make the pattern of care responsive to individual preferences without imposing excessive financial burdens on individuals or denying necessary care because of an inability to pay. The task for future research on the economics of health and health care is therefore to increase the information that can help us as a nation to meet that challenge."**
>
> (Feldstein, 1995)

References

Abrahams, N., Jewkes, R. & Mvo, Z. 2001. Health care-seeking practices of pregnant women and the role of the midwife in Cape town, South Africa. *Journal of Midwifery and Women's Health*.

46(4):240–247.

Abu-Ghanem, S., Sheiner, E., Sherf, M., Wiznitzer, A., Sergienko, R. & Shoham-Vardi, I. 2012. Lack of prenatal care in a traditional community: Trends and perinatal outcomes. *Archives of Gynecology and Obstetrics*. 285(5):1237–1242.

Adler, N.E. & Newman, K. 2002. Socioeconomic disparities in health: Pathways and policies. *Health Affairs*. 21(2):60–76.

Aguero, J.M., Carter, M.R. & Woolard, I. 2007. *The Impact of Unconditional Cash Transfers on Nutrition: The South African Child Support Grant*. [Online], Available: http://iap.tchpc.tcd.ie:8085/dspace17/handle/10611/1781.

Ahmed, S., Li, Q., Liu, L. & Tsui, A.O. 2012. Maternal deaths averted by contraceptive use: An analysis of 172 countries. *The Lancet*. 380(9837):111–125.

Akiki, S., Avison, W.R., Speechley, K.N. & Campbell, M.K. 2016. Determinants of maternal antenatal state-anxiety in mid-pregnancy: Role of maternal feelings about the pregnancy. *Journal of Affective Disorders*. 196:260–267.

Aksu, H., Kucuk, M. & Duzgun, G. 2011. The effect of postnatal breastfeeding education/support offered at home 3 days after delivery on breastfeeding duration and knowledge: A randomized trial. *Journal of Maternal Fetal Neonatal Medicine*. 24(2):354-361.

Almond, D., Chay, K.Y. & Lee., D.S. 2005. The costs of low birth weight. *Quarterly Journal of Economics*. (August):1031–1083.

Andersen, K., Singh, A., Shrestha, M.K., Shah, M., Pearson, E. & Hessinia, L. 2013. Early pregnancy detection by female community health volunteers in Nepal facilitated referral for appropriate reproductive health services. *Global Health: Science and Practice*. 1(3):372–381.

Angotti, N., Bula, A., Gaydosh, L., Kimchi, E.Z., Thornton, R.L. & Yeatman, S.E. 2009. Increasing the acceptability of HIV counseling and testing with three C's: Convenience, confidentiality and credibility. *Social Science and Medicine*. 68(12):2263–2270.

Ardington, C. & Gasealahwe, B. 2014. Mortality in South Africa: Socio-economic profile and association with self-reported health. *Development Southern Africa*. 31(1):127–145.

Arifeen, S., Black, R.E., Antelman, G., Baqui, A., Caulfield, L. & Becker, S. 2001. Exclusive breastfeeding reduces acute respiratory infection and diarrhea deaths among infants in Dhaka

slums. *Pediatrics*. 108(4): E67.

Armstrong, P., Lekezwa, B. & Siebrits, K. 2008. Poverty in South Africa: A profile based on recent household surveys. *Stellenbosch Economic Working Paper*. 1–26.

Armstrong, P. & Burger, C. 2009. Poverty, Inequality and the Role of Social Grants: An Analysis using Decomposition Techniques. *Stellenbosch Economic Working Papers*, 87.

Ashraf, N., Bandiera, O. & Jack, B.K. 2014a. No margin, no mission? A field experiment on incentives for public service delivery. *Journal of Public Economics*. 120:1–17.

Ashraf, N., Field, E. & Lee, J. 2014b. Household bargaining and excess fertility: An experimental study in Zambia. *American Economic Review*. 104(7):2210–2237.

Ataguba, J.E.-O. 2013. Inequalities in multimorbidity in South Africa. *International Journal for Equity in Health*. 12(1):64.

Ataguba, J.E., Akazili, J. & McIntyre, D. 2011. Socioeconomic-related health inequality in South Africa: Evidence from General Household Surveys. *International Journal for Equity in Health*. 10(1):48.

Ataguba, J.E. & McIntyre, D. 2012. Paying for and receiving benefits from health services in South Africa: Is the health system equitable? *Health Policy and Planning*. 27(SUPPL.1).

Ataguba, J.E.-O. & McIntyre, D. 2013. Who benefits from health services in South Africa? *Health Economics, Policy, and Law*. 8(1):21–46.

Bago d'Uva, T., Van Doorslaer, E., Lindeboom, M. & O'Donnell, O. 2008a. Does Reporting Heterogeneity Bias the Measurement of Health Disparities? *Health Economics*. 17:351–375.

Bago d'Uva, T., O'Donnell, O. & Van Doorslaer, E. 2008b. Differential health reporting by education level and its impact on the measurement of health inequalities among older Europeans. *International Journal of Epidemiology*. 37(6):1375–1383.

Bago d'Uva, T., Lindeboom, M., O'Donnell, O., & van Doorslaer, E. 2011. Slipping Anchor?: Testing the Vignettes Approach to Identification and Correction of Reporting Heterogeneity. *Journal of Human Resources*, *46*, 875–906.

Baird, S., Chirwa, E. & Mcintosh, C. 2010. The short-term impacts of a schooling conditional cash transfer program on the sexual behavior of young women. *Health Economics*. 19 (Sept.) Suppl.:55–68.

Baker, M., Stabile, M. & Deri, C. 2004. What Do Self-Reported, Objective, Measures of Health Measure? *The Journal of Human Resources*. 39(4):1067–1093.

Balogun, O.O., Dagvadorj, A., Anigo, K.M., Ota, E. & Sasaki, S. 2015. Factors influencing breastfeeding exclusivity during the first 6 months of life in developing countries: A quantitative and qualitative systematic review. *Maternal & child nutrition*. 11(4):433–451.

Bamford, L. 2013. Maternal, Newborn and Child Health. In A. Padarath, R. English (eds.). *South African Health Review 2012/13*:49–66. Durban: Health Systems Trust.

Banerjee, A.V. & Duflo, E. 2009. The Experimental Approach to Development Economics. *Annu. Rev. Econ.* 1(1):151–178.

Banerjee, A.V., Duflo, E., Glennerster, R. & Kothari, D. 2010. Improving immunisation coverage in rural India: Clustered randomised controlled evaluation of immunisation campaigns with and without incentives. *British Medical Journal*. 340(May17).

Barham, T. 2011. A healthier start: The effect of conditional cash transfers on neonatal and infant mortality in rural Mexico. *Journal of Development Economics*. 94(1):74–85.

Baron, E., Field, S., Kafaar, Z. & Honikman, S. 2015. Patterns of use of a maternal mental health service in a low-resource antenatal setting in South Africa. *Health and Social Care in the Community*. 23(5):502–512.

Behrman, J.R. & Rosenzweig, M.R. 2004. Returns to birthweight. *Review of Economics and Statistics*. 2:586–601.

Bergevin, Y., Dougherty, C. & Kramer, M.S. 1983. Do infant formula samples shorten the duration of breast-feeding? *The Lancet*. 21 (May):1148–1151.

Bergman, N.J., Linley, L.L. & Fawcus, S.R. 2004. Randomized controlled trial of skin-to-skin contact from birth versus conventional incubator for physiological stabilization in 1200- to 2199-gram newborns. *Acta pædiatrica*. 93(6):779–785.

Bhattacharya, J., Hyde, T. & Tu, P. 2013. *Health Economics*. Basingstoke (United Kingdom): Palgrave Macmillan.

Biaggi, A., Conroy, S., Pawlby, S. & Pariante, C.M. 2016. Identifying the women at risk of antenatal anxiety and depression: A systematic review. *Journal of Affective Disorders*. 191:62–77.

Black, R.E., Victora, C.G., Walker, S.P., Bhutta, Z.A., Christian, P., De Onis, M., Ezzati, M.,

Grantham-Mcgregor, S., *et al.* 2013. Maternal and child undernutrition and overweight in low-income and middle-income countries. *The Lancet*. 382(9890):427–451.

Bland, R.M., Little, K.E., Coovadia, H.M., Coutsoudis, A., Rollins, N.C. & Newell, M.L. 2008. Intervention to promote exclusive breast-feeding for the first 6 months of life in a high HIV prevalence area. *Aids*. 22: 883–891.

Bliss, M.C., Wilkie, J., Acredolo, C., Berman, S. & Tebb, K.P. 1997. The effect of discharge pack formula and breast pumps on breastfeeding duration and choice of infant feeding methods. *Birth*. 24(2):90–97.

Blondel, B., & Saurel-Cubizolles, M. J. 1991. An indicator of adverse pregnancy outcome in France: not receiving maternity benefits. *J Epidemiol Community Health*, *45*(3), 211–215.

Bonfrer, I., Van de Poel, E., Grimm, M. & Van Doorslaer, E. 2014. Does the distribution of healthcare utilization match needs in Africa? *Health Policy and Planning*. 29(7):921–937.

Boyce, G. & Harris, G. 2011. A closer look at racial differences in the reporting of self-assessed health status and related concepts in South Africa. *Health SA Gesondheid*. 16(1).

Bradford, D., Courtemanche, C., Heutel, G., McAlvanah, P. & Ruhm, C. 2014. *Time Preferences and Consumer Behavior*. (20320). [Online], Available: http://www.nber.org/papers/w20320.

Bradshaw, D. & Dorrington, R.E. 2012. Maternal mortality ratio – trends in the vital registration data. *South African Journal of Obstetrics and Gynaecology*. 18(2):38–42.

Brent, N.B., Redd, B., Dworetz, A., D'Amico, F. & Greenberg, J.J. 1995. Breastfeeding in a low-income population. Program to increase incidence and duration. *Archives of Pediatrics and Adolescent Medicine*. 149(7):798–803.

Brittain, K., Myer, L., Koen, N., Koopowitz, S., Donald, K.A., Barnett, W., Zar, H.J. & Stein, D.J. 2015. Risk factors for antenatal depression and associations with infant birth outcomes: Results from a South African birth cohort study. *Paediatric and Perinatal Epidemiology*. 29(6):504–514.

Burger, R., Bredenkamp, C., Grobler, C. & Van der Berg, S. 2012. Have public health spending and access in South Africa become more equitable since the end of apartheid? *Development Southern Africa*. 29(5):681–703.

Cai, X., Wardlaw, T. & Brown, D.W. 2012. Global trends in exclusive breastfeeding. *International*

Breastfeeding Journal. 7(1):12.

Carroli, G., Rooney, C. & Villar, J. 2001. How effective is antenatal care in preventing maternal mortality and serious morbidity? An overview of the evidence. *Paediatric and Perinatal Epidemiology*. 15:1–42.

Case, A. & Deaton, A. 1998. Large cash transfers to the elderly in South Africa. *Economic Journal*. 108(450):1330–1361.

Case, A. & Deaton, A. 2005. Health and wealth among the poor: India and South Africa compared. *The American Economic Review*. 95(2):229–233.

Case, A., Lubotsky, D. & Paxson, C. 2002. Economic status and health in childhood: The origin of the gradient. *American Economic Review*. 92(5):1308–1334.

Charasse-Pouélé, C. & Fournier, M. 2006. Health disparities between racial groups in South Africa: A decomposition analysis. *Social Science & Medicine (1982)*. 62(11):2897–2914.

Centre for Community Child Health. 2006. *Breastfeeding promotion: Practice resource*.The Royal Children's Hospital: Melbourne.

Cheng, E.R., Rifas-Shiman, S.L., Perkins, M.E., Rich-Edwards, J.W., Gillman, M.W., Wright, R. & Taveras, E.M. 2016. The Influence of Antenatal Partner Support on Pregnancy Outcomes. *Journal of Women's Health*. 00(00):jwh.2015.5462.

Chisholm, D. & Saxena, S. 2012. Cost effectiveness of strategies to combat neuropsychiatric conditions in sub-Saharan Africa and South East Asia: Mathematical modelling study. *British Medical Journal (Clinical research ed.)*. 344(March):e609.

Chojenta, C.L., Lucke, J.C., Forder, P.M. & Loxton, D.J. 2016. Maternal Health Factors as Risks for Postnatal Depression: A Prospective Longitudinal Study. *PloS One*. 11(1):e0147246.

Chola, L., McGee, S., Tugendhaft, A., Buchmann, E. & Hofman, K. 2015a. Scaling up family planning to reduce maternal and child mortality: The potential costs and benefits of modern contraceptive use in South Africa. *PLoS One*. 10(6):e0130077.

Chola, L., Fadnes, L.T., Engebretsen, I.M.S., Nkonki, L., Nankabirwa, V., Sommerfelt, H., Tumwine, J.K., Tylleskär, T., *et al.* 2015b. Cost-Effectiveness of Peer Counselling for the Promotion of Exclusive Breastfeeding in Uganda. *PLoS One*. 10(11).

Chopra, M., Daviaud, E., Pattinson, R., Fonn, S. & Lawn, J.E. 2009. Saving the lives of South

Africa's mothers, babies, and children: Can the health system deliver? *The Lancet*. 374(9692):835–846.

Chopra, M., Lawn, J.E., Sanders, D., Barron, P., Karim, S.S.A., Bradshaw, D., Jewkes, R. & Karim, Q.A. 2009. Achieving the health Millennium Development Goals for South Africa: Challenges and priorities. *The Lancet*. 374(9694):1023–1031.

Christian, P., Katz, J., Wu, L., Kimbrough-Pradhan, E., Khatry, S.K., LeClerq, S.C. & West., K.P. 2008. Risk factos for pregnancy-related mortality: A prospective study in rural Nepal. *Public health*. 122(2):161–172.

Cockburn, N., Steven, D., Lecuona, K., Joubert, F., Rogers, G., Cook, C. & Polack, S. 2012. Prevalence, causes and socio-economic determinants of vision loss in Cape Town, South Africa. *PLoS One*. 7(2).

Coetzee, M. 2013. Finding the benefits: Estimating the impact of the South African child support grant. *South African Journal of Economics*. 81(3):427–450.

Conway, K.S. & Deb, P. 2005. Is prenatal care really ineffective? Or, is the "devil" in the distribution? *Journal of Health Economics*. 24(3):489–513.

Conway, K.S. & Kutinova, A. 2006. Maternal health: Does prenatal care make a difference? *Health Economics*. 15(5):461–488.

Cooper, D., Morroni, C., Orner, P., Moodley, J., Harries, J., Cullingworth, L. & Hoffman, M. 2004. Ten Years of Democracy in South Africa: Documenting Transformation in Reproductive Health Policy and Status. *Reproductive Health Matters*. 12(24):70–85.

Coovadia, H., Jewkes, R., Barron, P., Sanders, D. & McIntyre, D. 2009. The health and health system of South Africa: Historical roots of current public health challenges. *The Lancet*. 374(9692):817–834.

Coutsoudis, A., Kwaan, L. & Thomson, M. 2010. Prevention of vertical transmission of HIV-1 in resource-limited settings. *Expert Review of Anti-infective Therapy*. 8(10):1163–1176.

Coutsoudis, A., Pillay, K., Kuhn, L., Spooner, E., Tsai, W.Y. & Coovadia, H.M. 2001. Method of feeding and transmission of HIV-1 from mothers to children by 15 months of age: Prospective cohort study from Durban, South Africa. *AIDS (London, England)*. 15(3):379–387.

Cunningham, S.A., Elo, I.T., Herbst, K. & Hosegood, V. 2010. Prenatal development in rural

South Africa: Relationship between birth weight and access to fathers and grandparents. *Population studies*. 64(3):229–246.

Curro, V., Lanni, R., Scipione, F., Grimaldi, V. & Mastroiacovo, P. 1997. Randomised controlled trial assessing the effectiveness of a booklet on the duration of breast feeding. *Arch Dis Child*. 76(6):500–504.

Curry, S.J., Wagner, E.H. & Grothaus, L.C. 1991. Evaluation of intrinsic and extrinsic motivation interventions with a self-help smoking cessation program. *Journal of Consulting and Clinical Psychology*. 59(2):318–324.

Curtis, V. & Cairncross, S. 2003. Effect of washing hands with soap on diarrhoea risk in the community: A systematic review. *Lancet Infectious diseases*. 3(5):275–281.

Curtis, V., Kanki, B., Cousens, S., Diallo, I., Kpozehouen, A., Sangaré, M. & Nikiema, M. 2001. Evidence of behaviour change following a hygiene promotion programme in Burkina Faso. *Bulletin of the World Health Organization*. 79(6):518–527.

Daaleman, T. 1997. The effect of a paraprofessional home visiting program on utilization of prenatal care. *Kansas Medicine*. 98(2):6–9.

Daniels, N., Kennedy, B.P., Kawachi, I. & Kennedy, P. 2009. Why Justice is Good for Our Health: The Social Determinants of Health Inequalities. *Daedalus*. 128(4):215–251.

Datta Gupta, N., Kristensen, N., & Pozzoli, D. 2010. External validation of the use of vignettes in cross-country health studies. *Economic Modelling*, *27*(4), 854–865.

Davies, H.R., Visser, J., Tomlinson, M., Rotheram-Borus, M.J., Le Roux, I. & Gissane, C. 2012. An investigation into the influence of socioeconomic variables on gestational body mass index in pregnant women living in a peri-urban settlement, South Africa. *Maternal and Child Health Journal*. 16(8):1732–1741.

Davies, T., Schneider, M., Nyatsanza, M. & Lund, C. 2016. "The sun has set even though it is morning": Experiences and explanations of perinatal depression in an urban township, Cape Town. *Transcultural Psychiatry*. 53(3) (June):286–312.

Day, C., Gray, A. & Budgell, E. 2011. Health and Related Indicators 11. *South African Health Review*. 120–247.

De Brauw, A., Gilligan, D.O., Hoddinott, J., Moreira, V. & Roy, S. 2012. The impact of Bolsa

Familia on child, maternal, and household welfare. *IFPRI. Washington, DC.* (Jan).

De Costa, C. M., & Wenitong, M. 2009. Could the Baby Bonus be a bonus for babies? *The Medical journal of Australia*, *190*(5), 242–243.

De Salvo, K.B., Bloser, N., Reynolds, K., He, J. & Muntner, P. 2006. Mortality prediction with a single general self-rated health question. *Journal of General Internal Medicine*. 21(3):267–275.

De Walque, D., Dow, W.H., Nathan, R., Abdul, R., Abilahi, F., Gong, E., Isdahl, Z., Jamison, J., *et al*. 2012. Incentivising safe sex: A randomised trial of conditional cash transfers for HIV and sexually transmitted infection prevention in rural Tanzania. *British Medical Journal Open*. 2(1):e000747.

Deaton, A. 2003. Health, Inequality, and Economic Development. *Journal of Economic Literature*. 41(1):113–158.

Denison, F.C., Roberts, K.A., Barr, S.M. & Norman, J.E. 2010. Obesity, pregnancy, inflammation, and vascular function. *Reproduction*. 140(3):373–385.

Dickson-Tetteh, K., Pettifor, A. & Moleko, W. 2011. Working with public sector clinics to provide adolescent-friendly services in South Africa. *Reproductive Health Matters Reproductive Health Matters*. 9(17):160–169.

Doherty, T., Chopra, M., Nkonki, L., Jackson, D. & Greiner, T. 2006. Effect of the HIV epidemic on infant feeding in South Africa: "When they see me coming with the tins they laugh at me". *Bulletin of the World Health Organization*. 84(04):90–96.

Doherty, T., Jackson, D., Swanevelder, S., Lombard, C., Engebretsen, I.M.S., Tylleskär, T., Goga, A., Ekström, E.C. & Sanders, D. 2014. Severe events in the first 6 months of life in a cohort of HIV-unexposed infants from South Africa: effects of low birthweight and breastfeeding status. *Tropical medicine & international health: TM & IH*. 19(10):1162–1169.

Dowd, J.B. & Todd, M. 2011. Does self-reported health bias the measurement of health inequalities in US adults? Evidence using anchoring vignettes from the Health and Retirement Study. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*. 66(4):478–489.

Drummond, M.F. & Jefferson, T.O. 1996. Guidelines for authors and peer reviewers of economic submissions to the BMJ. *British Medical Journal*. 313(7052):275–283.

Drummond, F.J., O'Leary, E., O'Neill, C., Burns, R. & Sharp, L. 2014. "Bird in the hand" cash was more effective than prize draws in increasing physician questionnaire response. *Journal of*

Clinical Epidemiology. 67(2):228–231.

Drummond, M.F., Sculpher, M.J., Torrance, G.W., O'Brien, B.J. & Stoddart, G.L. 2005. *Methods for Economic Evaluation of Health Care Programmes*. Third Edited ed. Oxford University Press.

Duffy, E.P., Percival, P. & Kershaw, E. 1997. Positive effects of an antenatal group teaching session on postnatal nipple pain, nipple trauma and breastfeeding rates. *Midwifery*. 13(4):189–196.

Duflo, E. 2000. Child Health and Household Resources in South Africa: Evidence from the Old Age Pension Program. *AEA Papers and Proceedings*. (1993):393–398.

Dupas, P. 2005. The Impact of Conditional In-Kind Subsidies on Preventive Health Behaviors: Evidence from Western Kenya. Working paper. Paris: EHESS-PSE.

Dupas, P. 2011. Health Behavior in Developing Countries. *Annual Review of Economics*. 3(1):425–449.

Dupas, P. & Miguel, E. 2016. Impacts and Determinants of Health Levels in Low-Income Countries. Forthcoming in the Handbook of Field Experiments. [Online], Available: http://web.stanford.edu/~pdupas/Health_DupasMiguel_Handbook.pdf [2016, October02].

Dykema, J., Stevenson, J., Kniss, C., Kvale, K., González, K. & Cautley, E. 2012. Use of monetary and nonmonetary incentives to increase response rates among African Americans in the Wisconsin Pregnancy Risk Assessment monitoring system. *Maternal and Child Health Journal*. 16(4):785–791.

Econex. 2009. *What does the demand for healthcare look like in SA?* NHI Note 3 (October).

Editorial Office. 2011. The Tshwane declaration of support for breastfeeding in South Africa. *The South African Journal of Clinical Nutrition*. 24(4):214.

Edmond, K.M. 2006. Delayed Breastfeeding Initiation Increases Risk of Neonatal Mortality. *Pediatrics*. 117(3).

Eichler, H., Kong, S.X., Gerth, W.C., Mavros, P. & Jönsson, B. 2004. Use of Cost-Effectiveness Analysis in Health-Care Resource Allocation Decision-Making: How Are Cost-Effectiveness Thresholds Expected to Emerge? *Value in Health*. 7(5):518–528.

Eichler, R., Levine, R. & The Performance-Based Incentives Working Group. 2009. *Performance incentives for global health: Potential and pitfalls*. Washington DC: CGD Books.

Etile, F. & Milcent, C. 2006. Income-related reporting heterogeneity in self-assessed health:

Evidence from France. *Health economics*. 15(9):965–981.

Fatti, G., Shaikh, N., Eley, B., Jackson, D. & Grimwood, A. 2014. Adolescent and young pregnant women at increased risk of mother-to-child transmission of HIV and poorer maternal and infant health outcomes: A cohort study at public facilities in the Nelson Mandela Bay metropolitan district, Eastern Cape, South Africa. *South African Medical Journal*. 104(12):874–880.

Feresu, S.A., Harlow, S.D. & Woelk, G.B. 2015. Risk factors for low birthweight in Zimbabwean women: A secondary data analysis. *PLoS One*. 10(6).

Feldstein, M. 1995. The economics of health and health care: What have we learned? What have I learned? *American Economic Review*. 85(2).

Fleming, P.J., Gilbert, R., Azaz, Y., Berry, P.J., Rudd, P.T., Stewart, A. & Hall, E. 1990. Interaction between bedding and sleeping position in the sudden infant death syndrome: A population based case-control study. *British Medical Journal (Clinical research ed.)*. 301(July):85–89.

Fonn, S., Xaba, M., Tint, K.S., Conco, D. & Varkey, S. 1998. Reproductive Health Services in South Africa: From Rhetoric to Implementation. *Reproductive Health Matters*. 6(11):22–32.

Frankenberg, E. & Jones, N.R. 2004. Self-Rated Health and Mortality: Does the Relationship Extend to a Low Income Setting? *Journal of Health and Social Behavior*. 45(4):441–452.

Frederiksen, H., Gaist, D., Petersen, H.C., Hjelmborg, J., McGue, M., Vaupel, J.W. & Christensen, K. 2002. Hand grip strength: A phenotype suitable for identifying genetic variants affecting mid- and late-life physical functioning. *Genetic Epidemiology*. 23(2):110–122.

Gaarder, M.M., Glassman, A. & Todd, J.E. 2010. Conditional cash transfers and health: Unpacking the causal chain. *Journal of Development Effectiveness*. 2(1):6–50.

Galiani, S., Gertler, P. & Orsola-Vidal, A. 2012. Promoting Handwashing Behavior in Peru and Community Level Interventions. Policy Research Working Paper 6257. The World Bank Sustainable Development Network Water and Sanitation Program.

Gentile, S. 2015. Untreated depression during pregnancy: Short- and long-term effects in offspring. A systematic review. *Neuroscience*. Sep 4.

Gertler, P. 2004. Do conditional cash transferts improve child health: Evidence from PROGRESA's control randomized experiment. *American Economic Review*. 94(2):336–341.

Giné, X., Karlan, D. & Zinman, J. 2008. Put Your Money Where Your Butt Is: A Commitment

Savings Account for Smoking Cessation. *Mimeograph*.

Gissler, M., Geraedts, M., Hemminki, E., & Buekens, P. 1998. Insufficient prenatal care in Finland and Baden-Wurttemberg: Characteristics of women and infant outcome. *The European Journal of Public Health*. 8(3):227–231.

Giuffrida, A. & Torgerson, D.J. 1997. Should we pay the patient? Review of financial incentives to enhance patient compliance. *British Medical Journal (Clinical research ed.)*. 315(7110):703–707.

Goldman, D.P. & Smith, J.P. 2002. Can patient self-management help explain the SES health gradient? *Proceedings of the National Academy of Sciences of the United States of America*. 99(16):10929–10934.

Grol-Prokopczyk, H., Freese, J. & Hauser, R.M. 2011. Using anchoring vignettes to assess group differences in general self-rated health. *Journal of Health and Social Behavior*. 52(2):246–261.

Grossman, M. 1972. On the concept of health capital and the demand for health. *Journal of Political economy*. 80(2):223–255.

Grundlingh, H., Herselman, M. & Iversen, P.O. 2013. An assessment of the implementation of the national therapeutic programme for pregnant women within the City of Cape Town district. *South African Medical Journal*. 103(8):549–551.

Guest, R. & Parr, N. 2010. The Effects of Family Benefits on Childbearing Decisions: A Household Optimising Approach Applied to Australia. *Economic Record*. 86(275):609–619.

Guindon, G.E. & Boyle, M.H. 2012. Using anchoring vignettes to assess the comparability of self-rated feelings of sadness, lowness or depression in France and Vietnam. *International Journal of Methods in Psychiatric Research*. 21(1):29–40.

Gurman, T.A., Rubin, S.E. & Roess, A.A. 2010. Effectiveness of mHealth behavior change communication interventions in developing countries: a systematic review of the literature. *Journal of Health Communication*. 17(Supplement 1):82–104.

Haddad, D.N., Makin, J.D., Pattinson, R.C. & Forsyth, B.W. 2016. Barriers to early prenatal care in South Africa. *International Journal of Gynaecology and Obstetrics*. 132(1):64–67.

Haider, R., Ashworth, A., Kabir, I. & Huttly, S.R. 2000. Effect of community-based peer counsellors on exclusive breastfeeding practices in Dhaka, Bangladesh: A randomised controlled trial. *The Lancet*. 356, (9) (SPEC. ISSUE 1):1643–1647.

Hamad, R., Fernald, L.C. & Karlan, D.S. 2011. Health education for microcredit clients in Peru: A randomized controlled trial. *BMC Public Health*. 11(1):51.

Han, Z., Mulla, S., Beyene, J., Liao, G. & McDonald, S.D. 2011. Maternal underweight and the risk of preterm birth and low birth weight: A systematic review and meta-analyses. *International Journal of Epidemiology*. 40(1):65–101.

Harries, J., Cooper, D., Strebel, A. & Colvin, C.J. 2014. Conscientious objection and its impact on abortion service provision in South Africa: A qualitative study. *Reproductive health*. 11(1):16.

Harries, J., Gerdts, C., Momberg, M. & Greene Foster, D. 2015. An exploratory study of what happens to women who are denied abortions in Cape Town, South Africa. *Reproductive health*. 12:21.

Harries, J., Orner, P., Gabriel, M. & Mitchell, E. 2007. Delays in seeking an abortion until the second trimester: A qualitative study in South Africa. *Reproductive Health*. 4:7.

Harris, B., Goudge, J., Ataguba, J.E., McIntyre, D., Nxumalo, N., Jikwana, S. & Chersich, M. 2011. Inequities in access to health care in South Africa. *Journal of Public Health Policy*. 32 Suppl 1(S1):S102–S123.

Harrison, A., Montgomery, E.T., Lurie, M. & Wilkinson, D. 2000. Barriers to implementing South Africa's Termination of Pregnancy Act in rural KwaZulu/Natal. *Health Policy Plan*. 15(4):424–431.

Hartley, M., Tomlinson, M., Greco, E., Comulada, W.S., Stewart, J., Le Roux, I., Mbewu, N. & Rotheram-Borus, M.J. 2011. Depressed mood in pregnancy: Prevalence and correlates in two Cape Town peri-urban settlements. *Reproductive health*. 8(1):9.

Havemann, R. & Van der Berg, S. 2003. The demand for health care in South Africa. *Journal for Studies in Economics and Econometrics*. 27(3):1–27.

Hayes, B. & Sharif, F. 2009. Behavioural and emotional outcome of very low birth weight infants –Literature review. *The Journal of Maternal-Fetal and Neonatal Medicine*. 22(October): 849–856.

He, W., Muenchrath, M.N. & Kowal, P.R. 2012. *Shades of Gray: A Cross-Country Study of Health and Well-Being of the Older Populations in SAGE Countries, 2007 – 2010 International Population Reports*. Washington DC.

Hendricks, M., Bourne, L. & Eley, B. 2006. Child Nutrition. In P. Ijumba & A. Padarath (eds.).

South African Health Review. Durban: Health Systems Trust. 203–220.

Hernández-Quevedo, C., Rice, N. & Jones, A.M. 2005. Reporting bias and heterogeneity in self-assessed health. Evidence from the British Household Panel Survey. HEDG Working Paper 05/04. (June).

Hochman, E., Elami-Suzin, M., Soferman, H.G., Galil, T., Hershkovitz, Y., Tzur, D., Derazne, E. & Elad, H. 2012. Early pregnancy confirmation – the role of urine pregnancy test in military primary care clinics. *Military medicine*. 177(8):947–951.

Hodes, R. 2013. The Medical History of Abortion in South Africa, c. 1970–2000. *Journal of Southern African Studies*. 39(3):527–542.

Hoke, T.H., Wheeler, S.B., Lynd, K., Green, M.S., Razafindravony, B.H., Rasamihajamanana, E. & Blumenthal, P.D. 2012. Community-based provision of injectable contraceptives in Madagascar: "Task shifting" to expand access to injectable contraceptives. *Health Policy and Planning*. 27(1):52–59.

Hopkins, D.J. & King, G. 2010. Improving anchoring vignettes designing surveys to correct interpersonal incomparability. *Public Opinion Quarterly*. 74(2):201–222.

Howard, C., Howard, F., Lawrence, R., Andresen, E., DeBlieck, E. & Weitzman, M. 2000. Office prenatal formula advertising and its effect on breast-feeding patterns. *Obstetrics & Gynecology*. 95(2):296–303.

Hummer, M., Lehner, T. & Pruckner, G. 2014. Low birth weight and health expenditures from birth to late adolescence. *European Journal of Health Economics*. 15:229–242.

Humphries, K.H. & Van Doorslaer, E. 2000. Income-related health inequality in Canada. *Social Science and Medicine*. 50(5):663–671.

Idler, E.L. & Benyamini, Y. 1997. Self-Rated Health and Mortality: A Review of Twenty-Seven Community Studies. *Journal of Health and Social Behavior*. 38(1):21–37.

Iliff, P.J., Piwoz, E.G., Tavengwa, N. V, Zunguza, C.D., Marinda, E.T., Nathoo, K.J., Moulton, L.H., Ward, B.J. & Humphrey, J.H. 2005. Early exclusive breastfeeding reduces the risk of postnatal HIV-1 transmission and increases HIV-free survival. *AIDS (London, England)*. 19(7): 699–708.

Imdad, A. & Bhutta, Z.A. 2013. Nutritional management of the low birth weight/preterm infant

in community settings: A perspective from the developing world. *Journal of Pediatrics*. 162(3 SUPPL.): S107–S114.

Issel, L.M., Forrestal, S.G., Slaughter, J., Wiencrot, A. & Handler, A. 2011. A Review of Prenatal Home-Visiting Effectiveness for Improving Birth Outcomes. *Journal of Obstetric, Gynecologic, and Neonatal Nursing*. 40(2):157–165.

James, S., Rall, N. & Strümpher, J. 2014. Perceptions of pregnant teenagers with regard to the antenatal care clinic environment. *Curationis*. 35(1):1–19.

Jamison, J., Karlan, D. & Raffler, P. 2013. Mixed method evaluation of a passive mHealth sexual information texting service in Uganda. *National Bureau of Economic Research*. No. w19107.

Jeffery, B.S., Tsuari, M., Pistorius, L.R., Makin, J. & Pattinson, R.C. 2000. The impact of a pregnancy confirmation clinic on the commencement of antenatal care. *South African medical journal*. 90(2):153–156.

Jehn, M. & Brewis, A. 2009. Paradoxical malnutrition in mother-child pairs: Untangling the phenomenon of over- and under-nutrition in underdeveloped economies. *Economics and Human Biology*. 7(1):28–35.

Jewkes, R.K., Gumede, T., Westaway, M.S., Dickson, K., Brown, H. & Rees, H. 2005. Why are women still aborting outside designated facilities in metropolitan South Africa? *BJOG: An International Journal of Obstetrics and Gynaecology*. 112(9):1236–1242.

Johnson, R. 2010. Kant's moral philosophy. In E.N. Zalta (ed.). *The Stanford Encyclopedia of Philosophy* (Summer 2010 Edition).

Johnston, D.W., Propper, C. & Shields, M.A. 2009. Comparing subjective and objective measures of health: Evidence from hypertension for the income/health gradient. *Journal of health economics*. 28(3):540–552.

Jones, G., Steketee, R.W., Black, R.E., Bhutta, Z. A. & Morris, S.S. 2003. How many child deaths can we prevent this year? *Lancet*. 362(9377):65–71.

Julnes, G., Konefal, M., Pindur, W. & Kim, P. 1994. Community-based perinatal care for disadvantaged adolescents: Evaluation of The Resource Mothers Program. *Journal of Community Health*. 19(1):41–53.

Jürges, H. 2007. True health vs response styles: Exploring cross-country differences in self-

reported health. *Health economics*. 16(2):163–178.

Jylhä, M., Volpato, S. & Guralnik, J.M. 2006. Self-rated health showed a graded association with frequently used biomarkers in a large population sample. *Journal of Clinical Epidemiology*. 59(5):465–471.

Kane, R.L., Johnson, P.E., Town, R.J. & Butler, M. 2004. A structured review of the effect of economic incentives on consumers' preventive behavior. *American Journal of Preventive Medicine*. 27(4):327–352.

Karlan, D., McConnell, M., Mullainathan, S. & Zinman, J. 2016. Getting To the Top of Mind: How Reminders Increase Saving. *Management Science*.

Katz, J., Lee, A.C., Kozuki, N., Lawn, J.E., Cousens, S., Blencowe, H., Ezzati, M., Bhutta, Z.A., *et al*. 2013. Mortality risk in preterm and small-for-gestational-age infants in low-income and middle-income countries: a pooled country analysis. *The Lancet*. 382(9890): 417–425.

Kela. 2015. *Maternity Packag* [Online], Available: http://www.kela.fi/web/en/maternitypackage [2016, February 29].*e*.

Khaoya, D.W. 2015. Socioeconomic related health inequalities in South Africa. PhD. University of Cape Town.

Khatun, S. & Rahman, M. 2008. Socio-economic determinants of low birth weight in Bangladesh: A multivariate approach. *Bangladesh Medical Research Council Bulletin*. 34(3):81–86.

Kindra, G., Coutsoudis, A., Esposito, F. & Esterhuizen, T. 2012. Breastfeeding in HIV exposed infants significantly improves child health: A prospective study. *Maternal and Child Health Journal*. 16(3):632–640.

King, G., Murray, C.J.L., Salomon, J. A. & Tandon, A. 2004. Enchancing the Validty and Cross-Cultural Comparability of Measurement in Survey Research. *American Political Science Review*. 98(1):191–207.

Kistin, N., Benton, D. & Rao, S. 1990. Breastfeeding rates among black urban low income women: Effect of prenatal education. *Pediatrics*. 86:741–746.

Kita, S., Haruna, M., Matsuzaki, M. & Kamibeppu, K. 2016. Associations between intimate partner violence (IPV) during pregnancy, mother-to-infant bonding failure, and postnatal depressive symptoms. *Archives of Women's Mental Health*.

Klapdor, M. 2014. *Abolishing the Baby Bonus – Parliament of Australia*. [Online], Available: http://www.aph.gov.au/About_Parliament/Parliamentary_Departments/Parliamentary_Library/pubs/rp/BudgetReview201314/BabyBonus [2016, January 04].

Klein, D.A., Arnold, J.J. & Reese, E.S. 2015. Provision of contraception: Key recommendations from the CDC. *American Family Physician*. 91(9):625–633.

Kramer, M., Chalmers, B. & Hodnett, E. 2001. Promotion of Breastfeeding Intervention Trial. *Jama*. 285(4):413–20.

Kramer, M.S. & Kakuma, R. 2012. Optimal duration of exclusive breastfeeding. *Cochrane database of systematic reviews (Online)*. 8(4):CD003517.

Kreider, B., 1999. Latent work disability and reporting bias. *Journal of Human Resources*, pp.734-769.

Kremer, M. & Miguel, E. 2004. The illusion of sustainability. *National Bureau of Economic Research*. No. w10324.

Kristensen, N. & Johansson, E., 2008. New evidence on cross-country differences in job satisfaction using anchoring vignettes. *Labour Economics*,*15*(1), pp.96-117.

Lagarde, M., Haines, A. & Palmer, N. 2014. Conditional Cash Transfers for Improving Uptake of Health Interventions in Low- and Middle-Income Countries. *Jama*. 298(16):1900–1910.

Laken, M.P. & Ager, J. 1995. Using incentives to increase participation in prenatal care. *Obstetrics & Gynecology*. 85(3):326–329.

Lau, Y.K. & Ataguba, J.E. 2015. Investigating the relationship between self-rated health and social capital in South Africa: A multilevel panel data analysis. *BMC Public Health*. 15:266.

Le Roux, I.M., Tomlinson, M., Harwood, J.M., O'Connor, M.J., Worthman, C.M., Mbewu, N. *et al.* 2013. Outcomes of Home Visits for Pregnant Mothers and their Infants: A Cluster Randomised Controlled Trial. *AIDS (London, England)*. 27(9):1461–1471.

Le Roux, I.M., Rotheram-Borus, M.J., Stein, J. & Tomlinson, M. 2014. The impact of paraprofessional home visitors on infants' growth and health at 18 months. *Vulnerable Children and Youth Studies*. 9(4):291–304.

Le Roux, K., Le Roux, I.M., Mbewu, N. & Davis, E. 2015. The role of community health workers in the re-engineering of primary health care in rural Eastern Cape. *South African Family*

Practice. 6190(December):1–5.

Lee, L., Rosenzweig, M.R. & Pitt, M.M. 1997. The effects of improved nutrition, sanitation, and water quality on child health in high-mortality populations. *Journal of Econometrics*. 77(1):209–235.

Leibbrandt, M., Wegner, E. & Finn, A. 2011. *The Policies for Reducing Income Inequality and Poverty in South Africa*. Southern Africa Labour and Development Research Unit. Working Paper Series Number 64.

Lester, R.T., Ritvo, P., Mills, E.J., Kariri, A., Karanja, S., Chung, M.H., Jack, W., Habyarimana, J., *et al*. 2010. Effects of a mobile phone short message service on antiretroviral treatment adherence in Kenya (WelTel Kenya1): A randomised trial. *Lancet*. 376(9755):1838–1845.

Levy, D. & Ohls, J. 2007. Evaluation of Jamaica's PATH Program: Final Report. (202). [Online], Available: http://www.mathematicampr.com/publications/PDFs/JamaicaPATH.pdf. [2016, 15 January].

Lim, S.S., Dandona, L., Hoisington, J.A., James, S.L., Hogan, M.C. & Gakidou, E. 2010. India's Janani Suraksha Yojana, a conditional cash transfer programme to increase births in health facilities: An impact evaluation. *The Lancet*. 375(9730):2009–2023.

Lince-Deroche, N., Constant, D., Harries, J., Blanchard, K., Sinanovic, E. & Grossman, D. 2015. The Costs of Accessing Abortion in South Africa: Women's costs associated with second-trimester abortion services in Western Cape Province. *Contraception*. 92(4):339-344.

Lindeboom, M. & Van Doorslaer, E. 2004. Cut-point shift and index shift in self-reported health. *Journal of Health Economics*. 23(6):1083–1099.

Lindeboom, M. & Kerkhofs, M. 2009. Health and work of the elderly: Subjective health measures, reporting errors and endogeneity in the relationship between health and work. *Journal of Applied Econometrics*. 24(6):1024–1046.

Litvack, J.I. & Bodart, C. 1993. User fees plus quality equals improved access to health care: Results of a field experiment in Cameroon. *Social Science & Medicine (1982)*. 37(3):369–383.

Liu, T.C., Chen, B., Chan, Y.S. & Chen, C.S. 2015. Does prenatal care benefit maternal health? A study of post-partum maternal care use. *Health Policy*. 119(10):1382–1389.

Loh, N.R., Kelleher, C.C., Long, S. & Loftus, B. 1997. Can we increase breast feeding rates? *Irish Medical Journal*. 90(3):100-101.

Lund, S., Nielsen, B.B., Hemed, M., Boas, I.M., Said, A., Said, K. & Makungu, M.H. 2014. Mobile phones improve antenatal care attendance in Zanzibar: A cluster randomized controlled trial. *BMC Pregnancy and Childbirth*. 14(29):1–10.

Lunde, L. & Løken, K.V. 2011. *"How are you feeling?" Assessing reporting bias in a subjective measure of health by quantile regression*. Department of Economics, University of Bergen, Working Papers in Economics No. 08/11.

Lunze, K. & Paasche-Orlow, M.K. 2013. Financial Incentives for Healthy Behavior. *American Journal of Preventive Medicine*. 44(6):659–665.

Makiwane, M., Desmond, C., Richter, L. & Udjo, E. 2006. *Is the child support grant associated with an increase in teenage fertility in South Africa? Evidence from national surveys and administrative data*. Pretoria: Human Sciences Research Council.

Mall, S., Honikman, S., Evans, B., Swartz, L. & Lund, C. 2013. The impact of antenatal mental distress on functioning and capabilities: Views of health care providers and service users in Cape Town, South Africa. *Disability and Rehabilitation*. 8288(September 2015):1–8.

Manandhar, D.S., Osrin, D., Shrestha, B.P., Mesko, N., Morrison, J., Tumbahangphe, K.M. *et al.* 2004. Effect of a participatory intervention with women's groups on birth outcomes in Nepal: Cluster-randomised controlled trial. *The Lancet*. 364(9438):970–979.

Manikkam, L. & Burns, J.K. 2012. Antenatal depression and its risk factors: An urban prevalence study in KwaZulu-Natal. *South African Medical Journal*. 102(12):940–944.

Markestad, T., Skadberg, B., Hordvik, E., Morild, I. & Irgens, L. 1995. Sleeping position and suddent infant death syndrome (SIDS): Effect of an intervention programme to avoid prone sleeping. *Acta Paediatrica*. 84(4):375-378.

Marmot, M. 2005. Public Health Social determinants of health inequalities. *Lancet*. 365:1099–1104.

Marseille, E., Larson, B., Kazi, D.S., Kahn, J.G. & Rosen, S. 2015. Thresholds for the cost-effectiveness of interventions: Alternative approaches. *Bulletin of the World Health Organization*. 93(2):118–124.

May, J. & Timaeus, I.M. 2014. Inequities in under-five child nutritional status in South Africa: What progress has been made? *Development Southern Africa*. 31(6):761–774.

Mayosi, B.M., Lawn, J.E., Van Niekerk, A., Bradshaw, D., Karim, S.S.A., Coovadia, H.M. & South, L. 2012. Health in South Africa : Changes and challenges since 2009. *The Lancet*. 380(9858):2029–2043.

McInnes, R.J., Love, J.G. & Stone, D.H. 2000. Evaluation of a community-based intervention to increase breastfeeding prevalence. *Journal of Public Health Medicine*. 22(2):138–145.

McIntyre, D. & Ataguba, J.E. 2011. How to do (or not to do) ... a benefit incidence analysis. *Health Policy and Planning*. 26(2):174–182.

McQuide, P.A., Delvaux, T. & Buekens, P. 1998. Prenatal care incentives in Europe. *Journal of Public Health Policy*. 19(3):331–349.

Meehan, S.-A., Leon, N., Naidoo, P., Jennings, K., Burger, R. & Beyers, N. 2015. Availability and acceptability of HIV counselling and testing services. A qualitative study comparing clients' experiences of accessing HIV testing at public sector primary health care facilities or non-governmental mobile services in Cape Town, South Afr. *BMC Public Health*. 15(1):845.

Melnikow, J., Paliescheskey, M. & Stewart, G.K. 1997. Effect of a Transportion Incentive on Compliance with the First Prenatal Appointment: A Randomized Trial. *Obstetrics & Gynecology*. 89(6):1023–1027.

Menzies, N., Abang, B., Wanyenze, R., Nuwaha, F., Mugisha, B., Coutinho, A., Bunnell, R., Mermin, J. & Blandford, J.M. 2009. The costs and effectiveness of four HIV counseling and testing strategies in Uganda. *AIDS (London, England)*. 23(3):395–401.

Meyer, A., Van Der Spuy, D.A. & Du Plessis, L.M. 2007. The rationale for adopting current international breastfeeding guidelines in South Africa. *Maternal and Child Nutrition*. 3(4):271–280.

Mhlanga, R.E. 2003. Abortion: Developments and impact in South Africa. *British Medical Bulletin*. 67:115–126.

Mhlanga, R.E. 2008. Maternal, Newborn and Child Health: 30 Years On. In P. Barron, J. Roma-Reardon (eds.). *South African Health Review 2008*. 115–128.

Mills, A., Ataguba, J.E., Akazili, J., Borghi, J., Garshong, B., Makawia, S., Mtei, G., Harris, B., *et al.* 2012. Equity in financing and use of health care in Ghana, South Africa, and Tanzania: Implications for paths to universal coverage. *The Lancet*. 380(9837):126–133.

Moodley, T., Moodley, D., Sebitloane, M., Maharaj, N. & Sartorius, B. 2016. Improved

pregnancy outcomes with increasing antiretroviral coverage in South Africa. *BMC Pregnancy and Childbirth*. 16(1):35.

Morris, S.S., Flores, R., Olinto, P. & Medina, J.M. 2004. Monetary incentives in primary health care and effects on use and coverage of preventive health care interventions in rural Honduras: Cluster randomised trial. *Lancet*. 364(9450):2030–2037.

Morroni, C. & Moodley, J. 2006. Characteristics of clients seeking first- and second-trimester terminations of pregnancy in public health facilities in Cape Town. *South African Medical Journal*. 96(7):574.

Mu, R. 2014. Regional Disparities in Self-Reported Health: Evidence from Chinese Older Adults. *Health Economics*. 23(5):529–549.

Myer, L. & Harrison, A. 2003. Why do women seek antenatal care late? Perspectives from rural South Africa. *Journal of Midwifery and Women's Health*. 48(02):268–272.

Myer, L., Stein, D.J., Grimsrud, A., Seedat, S. & Williams, D.R. 2008. Social determinants of psychological distress in a nationally-representative sample of South African adults. *Social Science and Medicine*. 66(8):1828–1840.

Nannan, N., Norman, R., Hendricks, M., Dhansay, M.A., Bradshaw, D. & South African Comparitive Risk Assessment Collaboration. 2007. Estimating the burden of disease attributable to childhood and maternal undernutrition in South Africa in 2000. *South African Medical Journal*. 97(8):733–793.

National Department of Health. 2007a. *South Africa Demographic and Health Survey 2003*. Statistics South Africa: Pretoria.

National Department of Health. 2007b. *Guidelines for maternity care in South Africa*. Third ed. Pretoria: Department of Health.

National Department of Health. 2012a. *Strategic Plan for Maternal, Newborn, Child and Women' s Health (MNCWH) and Nutrition in South Africa*. Pretoria: Department of Health.

National Department of Health. 2012b. District Health Information System (DHIS) database [dataset]. Pretoria: National Department of Health.

National Department of Health. 2013. *Infant and Young Child Feeding Policy*. Pretoria: Department of Health.

National Planning Commision. 2011. *National Development Plan: Vision for 2030*. Vol. 15. Pretoria: Department of Health.

Nettleman, M.D., Ayoola, A.B. & Brewer, J.R. 2009. Utilization of Home Pregnancy Testing Among Women at Risk for Unintended Pregnancy. *Women's Health Issues*. 19(4):263–267.

Nkonki, L.L., Daniels, K.L. & PROMISE-EBF Study Group. 2010. Selling a service: Experiences of peer supporters while promoting exclusive infant feeding in three sites in South Africa. *International Breastfeeding Journal*. 5(1):17.

Nkonki, L.L., Daviaud, E., Jackson, D., Chola, L., Doherty, T., Chopra, M., Robberstad, B. & Group, P.-E.S. 2014. Costs of promoting exclusive breastfeeding at community level in three sites in South Africa. *PloS One*. 9(1).

Nommsen-Rivers, L.A. & Dewey, K.G. 2009. Development and validation of the Infant Feeding Intentions scale. *Maternal and Child Health Journal*. 13(3):334–342.

OECD. 2011. Health at a Glance 2011: OECD Indicators. In OECD Publishing. 36–38.

Okafor, I.P., Olatona, F.A. & Olufemi, O.A. 2014. Breastfeeding practices of mothers of young children in Lagos, Nigeria. *Nigerian Journal of Paediatrics*. 41(1):43–47.

Orner, P., Cooper, D., Myer, L., Zweigenthal, V., Bekker, L.-G. & Moodley, J. 2008. Clients' perspectives on HIV/AIDS care and treatment and reproductive health services in South Africa. *AIDS Care*. 20(10):1217–1223.

Özler, B. 2007. Not separate, not equal: Poverty and inequality in post-Apartheid South Africa. *Economic Development and Cultural Change*. 55(739):1–41.

Palmer, S. & Torgerson, D.J. 1999. Economics notes: Definitions of efficiency. *British Medical Journal*. 318(7191):1136.

Pattinson, R.C. 2012. *Saving mothers 2008–2010: Fifth report on the confidential enquiries into maternal deaths in South Africa*. Pretoria: National Department of Health.

Peracchi, F. & Rossetti, C. 2012. Heterogeneity in health responses and anchoring vignettes. *Empirical Economics*. 42(2):513–538.

Pillay, Y. & Barron, P. 2011. *The implementation of PHC re-engineering in South Africa*. [Online], Available: http://www.phasa.org.za/the-implementa- tion-of-phc-re-engineering-in-south-africa/ [2015, December 05].

Prata, N., Gessessew, A., Cartwright, A. & Fraser, A. 2011. Provision of injectable contraceptives in Ethiopia through community-based reproductive health agents. *Bulletin of the World Health Organization*. 89(8):556–564.

Pugh, L.C. & Milligan, R.A. 1998. Nursing intervention to increase the duration of breastfeeding. *Appl Nurs Res*. 11(4):190–194.

Ramchandani, P.G., Richter, L.M., Stein, A. & Norris, S.A. 2009. Predictors of postnatal depression in an urban South African cohort. *Journal of Affective Disorders*. 113(3):279–284.

Ramkissoon, A., Searle, C., Burns, C. & Beksinska, M. 2010. Sexual and reproductive health and rights. *South African Health Review*, 2010.

Ranganathan, M. & Lagarde, M. 2012. Promoting healthy behaviours and improving health outcomes in low and middle income countries: A review of the impact of conditional cash transfer programmes. *Preventive Medicine*. 55(SUPPL.): S95–S105.

Rice, N., Robone, S. & Smith, P.C. 2012. Vignettes and health systems responsiveness in cross-country comparative analyses. *Journal of the Royal Statistical Society. Series A: Statistics in Society*. 175(2):337–369.

Rogers, M.M., Peoples-Sheps, M.D., Suchindran, C. 1996. Impact of a social support program on teenage prenatal care use and pregnancy outcomes. *Journal of Adolescent Health*. 19(2):132–140.

Rollins, N.C., Coovadia, H.M., Bland, R.M., Coutsoudis, A., Bennish, M.L., Patel, D. & Newell, M.-L. 2007. Pregnancy outcomes in HIV-infected and uninfected women in rural and urban South Africa. *Journal of Acquired Immune Deficiency Syndromes*. 44(3):321–328.

Van Rooyen, H., McGrath, N., Chirowodza, A., Joseph, P., Fiamma, A., Gray, G., Richter, L. & Coates, T. 2013. Mobile VCT: Reaching men and young people in urban and rural South African pilot studies (NIMH Project Accept, HPTN 043). *AIDS and Behavior*. 17(9):2946–2953.

Rosenthal, M.B., Li, Z., Robertson, A.D. & Milstein, A. 2009. Impact of financial incentives for prenatal care on birth outcomes and spending. *Health Services Research*. 44(5 PART 1):1465–1479.

Rossen, L., Hutchinson, D., Wilson, J., Burns, L., Olsson, C.A., Allsop, S., Elliott, E.J., Jacobs, S., *et al*. 2016. Predictors of postnatal mother-infant bonding: The role of antenatal bonding, maternal substance use and mental health. *Archives of Women's Mental Health*.

Rotheram-Borus, M.J., Le Roux, I.M., Tomlinson, M., Stewart, J., Mbewu, N., Connor, M.J.O.,

Comulada, S., Roux, K. Le, et al. 2011. Philani Plus (+): A Mentor Mother Community Health Worker Home Visiting Program to Improve Maternal and Infants' Outcomes. *Prevention Science*. 12(4):372–388.

Rotheram-Borus, M.J., Richter, L.M., van Heerden, A., van Rooyen, H., Tomlinson, M., Harwood, J.M., Comulada, W.S. & Stein, A. 2014. A Cluster Randomized Controlled Trial Evaluating the Efficacy of Peer Mentors to Support South African Women Living with HIV and Their Infants. *PLoS One*. 9(1):e84867.

Rotheram-Borus, M.J., Tomlinson, M., Le Roux, I. & Stein, J.A. 2015. Alcohol Use, Partner Violence, and Depression. A Cluster Randomized Control Trial Among Urban South African Mothers Over 3 Years. *American Journal of Preventive Medicine*. 49(5):715–725.

Rychetnik, L., Frommer, M., Hawe, P. and Shiell, A., 2002. Criteria for evaluating evidence on public health interventions. *Journal of epidemiology and community health*, *56*(2), pp.119-127.

Salomon, J.A., Mathers, C.D., Chatterji, S., Sadana, R., Ustun, T.B. & Murray, C.J. 2003. Quantifying Individual Levels of Health: Definitions, Concepts, and Measurement Issues. In C.J.L. Murray, D.B. Evans (eds.). *Health Systems Performance Assessment: Debates, Methods and Empiricism*. Geneva: World Health Organization.301–318.

Santo, L.C.D.E., De Oliveira, L.D. & Giugliani, E.R.J. 2007. Factors associated with low incidence of exclusive breastfeeding for the first 6 months. *Birth*. 34(3):212–219.

Sarkisian, C.A., Lee-Henderson, M.H. & Mangione, C.M. 2003. Do Depressed Older Adults Who Attribute Depression to "Old Age" Believe It Is Important to Seek Care? *Journal of General Internal Medicine*. 18(12):1001–1005.

Sattar, N., Clark, P., Holmes, A., Lean, M.E.J., Walker, I. & Greer, I.A. 2001. Antenatal waist circumference and hypertension risk. *Obstetrics and Gynecology*. 97(2):268–271.

Sauerborn, R., Adams, A. & Hien, M. 1996a. Household strategies to cope with the economic costs of illness. *Social Science and Medicine*. 43(3):291–301.

Sauerborn, R., Nougtara, A., Hien, M. & Diesfeld, H. 1996b. Seasonal variations of houshold costs of illness in Burkina Faso. *Social Science and Medicine*. 43(3):281–290.

Schnippel, K., Mongwenyana, C., Long, L.C. & Larson, B.A. 2015. Delays, interruptions, and losses from prevention of mother-to-child transmission of HIV services during antenatal care in Johannesburg, South Africa: A cohort analysis. *BMC Infectious Diseases*. 15:46.

Scorgie, F., Blaauw, D., Dooms, T., Coovadia, A., Black, V. & Chersich, M. 2015. "I get hungry all the time": Experiences of poverty and pregnancy in an urban healthcare setting in South Africa. *Globalization and Health*. 11(1):37.

Sen, A. 2000. *Social exclusion: concept, application and scrutiny*. Social Development Papers No. 1. Office of Environment and Social Development Asian Development Bank.

Sen, A. 2002a. Why health equity? *Health Economics*. 11(8):659–666.

Sen, A. 2002b. Health: Perception versus observation. *British Medical Journal*. 324(August 2006):860–861.

Shahid, N.S., Greenough, William, B., Samadi, A.R., Huq, M.I. & Rahman, N. 1996. Hand washing with soap reduces diarrhoea and spread of bacterial pathogens in a Bangladesh village. *Journal of Diarrhoeal Diseases Research*. 14(2):85–89.

Shisana, O., Rhele, T., Simbayi, L.C., Zuma, K., Jooste, S., Zungu, N., Labadarios, D. & Onoya, D. 2012. *South African national HIV prevalence, incidence and behaviour survey*. Cape Town: HSRC Press.

SHOPS project. 2015. Pregnancy Tests Increase Contraceptive Clients among Health Workers: Evidence from a Randomized Controlled Trial in Madagascar. [Online], Available:https://www.usaid.gov/sites/default/files/documents/1864/Mad_Pregnancy%20Tests%20Increase%20Contraceptive%20Clients%20among%20Health%20Workers.pdf [Accessed: 05 October, 2016].

Sidley, P. 1996. South Africa plans to liberalise abortion law. *British Medical Journal*. 313(7064):1034.

Sindelar, J. 2010. Paying for performance: The power of incentives over habits. *Health Economics*. 17(4):449–451.

Smith, A.M. 2016. Healthcare reform priorities for South Africa: Four essays on the financing, delivery and user acceptability of healthcare. PhD. Stellenbosch University.

Smith, P.B., Weinman, M.L., Johnson, T.C. & Wait, R.B. 1990. Incentives and their influence on appointment compliance in a teenage family-planning clinic. *Journal of Adolescent Health Care*. 11(5):445–448.

Snell, B.J., Krantz, M., Keeton, R., Delgado, K. & Peckham, C. 1992. The association of formula

samples given at hospital discharge with the early duration of breastfeeding. *Journal of Human Lactation*. 8(2):67-72.

Sober, S. & Schreiber, C.A. 2009. Postpartum Contraception. *Clinical Obstetrics and Gynecology*. 57(4):763–776.

Solarin, I. & Black, V. 2013. "They told me to come back": Women's antenatal care booking experience in inner-city Johannesburg. *Maternal and Child Health Journal*. 17(2):359–367.

Spiers, P.S. & Gunteroth, W. 1994. Recommendations to avoid the prone sleeping position and recent statistics for sudden infant death syndrome in the United States. *Archives of Pediatrics & Adolescent Medicine*. 148(2):141-146.

Stanback, J., Spieler, J., Shah, I. & Finger, W.R. 2010. Community-based health workers can safely and effectively administer injectable contraceptives: Conclusions from a technical consultation. *Contraception*. 81(3):181–184.

Stein, Z. & Kuhn, L. 2009. Breast feeding: A time to craft new policies. *Journal of Public Health Policy*. 30(3):300–310.

Stein, D.J., Koen, N., Donald, K.A., Adnams, C.M., Koopowitz, S., Lund, C., Marais, A., Myers, B., *et al*. 2015. Investigating the psychosocial determinants of child health in Africa: The Drakenstein Child Health Study. *Journal of Neuroscience Methods*. 252:27–35.

Stevens-Simon, C., Connor, P. & Bassford, K. 1994. Incentives enhance postpartum compliance among adolescent prenatal patients. *Journal of Adolescent Health*. 15:396–399.

Strauss, J. & Thomas, D. 1998. Health, Nutrition, and Economic Development. *Journal of Economic Literature*. 36(2):766 – 817.

Subramanian, S. V., Subramanyam, M.A., Selvaraj, S. & Kawachi., I. 2009. Are self-reports of health and morbidities in developing countries misleading? Evidence from India. *Social Science & Medicine*. 68(2):260–265.

Tabana, H., Nkonki, L., Hongoro, C., Doherty, T., Ekström, A.M., Naik, R., Zembe-Mkabile, W., Jackson, D., *et al*. 2015. A cost-effectiveness analysis of a home-based HIV counselling and testing intervention versus the standard (facility based) HIV testing strategy in rural South Africa. *PLoS ONE*. 10(8).

Tandon, A., Murray, C., Salomon, J. & King, G. 2002. Statistical models for enhancing cross-

population comparability. Global Programme on Evidence for Health Policy Discussion Paper No. 42. World Health Organization, Geneva, Switzerland. [Online], Available: http://www.who.int/entity/healthinfo/paper42.pdf.

Tan-Torres Edejer, T., Baltussen, R., Adam, T., Hutubessy, R., Acharya, A., Evans, D.B. & Murray, C.J.L. 2003. *WHO Guide to Cost-Effectiveness Analysis*. World Health Organization, Geneva.

Tarozzi, A., Mahajan, A., Blackburn, B.G., Kopf, D., Krishnan, L. & Yoong, J. 2014. Micro-loans, Insecticide-Treated Bednets, and Malaria: Evidence from a Randomized Controlled Trial in Orissa, India. *American Economic Review*. 104(7):1909–1941.

The inter-agency task team for prevention and treatment of HIV infection in pregnant women, mothers, and their children. 2011. *Preventing HIV and unintended pregnancies: Strategic framework 2011 – 2015*.

The World Bank. 2014a. *How does the World Bank classify countries?* [Online], Available: https://datahelpdesk.worldbank.org/knowledgebase/topics/19280-country-classification [2016, May 23].

The World Bank. 2014b. GDP per Capita. [Online], Available: http://data.worldbank.org/indicator/NY.GDP.PCAP.CD. [2016, May 20].

Thornton, R.L. 2008. The Demand for, and Impact of, Learning HIV Status. *The American Economic Review*. 98(5):1829–1863.

Tomita, A. & Burns, J. 2013. Depression, disability and functional status among community dwelling older adults in South Africa: Evidence from the first South African National Income Dynamics Study. *International Journal of Geriatric Psychiatry*. 28(12):1270–1279.

Tomita, A., Labys, C.A. & Burns, J.K. 2015. Depressive Symptoms Prior to Pregnancy and Infant Low Birth Weight in South Africa. *Maternal and Child Health Journal*. 19(10):2179–2186.

Tomlinson, M., O'Connor, M.J., Le Roux, I.M., Stewart, J., Mbewu, N., Harwood, J. & Rotheram-Borus, M.J. 2014. Multiple Risk Factors during Pregnancy in South Africa: The Need for a Horizontal Approach to Perinatal Care. *Prevention Science*. 15(3):277–282.

Tomlinson, M., Rotheram-Borus, M.J., Harwood, J., Le Roux, I.M., O'Connor, M. & Worthman, C. 2015. Community health workers can improve child growth of antenatally-depressed, South African mothers: a cluster randomized controlled trial. *BMC Psychiatry*. 15(1):225.

Torloni, M.R., Betrán, A.P., Horta, B.L., Nakamura, M.U., Atallah, A.N., Moron, A.F. & Valente, O. 2009. Prepregnancy BMI and the risk of gestational diabetes: A systematic review of the literature with meta-analysis. *Obesity Reviews*. 10(2):194–203.

Trussell, J., Grummer-Strawn, L., Rodriguez, G. & Vanlandingham, M. 1992. Trends and Differentials in Breastfeeding Behaviour: Evidence from the WFS and DHS Stable. *Population Studies*. 46(2):285–307.

Tsai, A.C., Tomlinson, M., Dewing, S., Le Roux, I.M., Harwood, J.M., Chopra, M. & Rotheram-Borus, M.J. 2014. Antenatal depression case finding by community health workers in South Africa: Feasibility of a mobile phone application. *Archives of Women's Mental Health*. 17(5):423–431.

Tulsky, J.P., Pilote, L., Hahn, J.A., Zolopa, A.J., Burke, M., Chesney, M. & Moss, A.R. 2000. Adherence to isoniazid prophylaxis in the homeless: a randomized controlled trial. *Arch Intern Med*. 160(5):697–702.

Tylleskär, T., Jackson, D., Meda, N., Engebretsen, I., Chopra, M., Diallo, A., Doherty, T., Ekström, E., *et al.* 2011. Exclusive breastfeeding promotion by peer counsellors in sub-Saharan Africa (PROMISE-EBF): A cluster-randomised trial. *The Lancet*. (Aug 5;378(9789)):420–427.

United Nations. 2015. Transforming our world: the 2030 Agenda for Sustainable Development. *United National Resolutions 70/1: Geneva.*

Van der Berg, S., Louw, M. & Yu, D. 2008. Post-transition poverty trends based on an alternative data source. *South African Journal of Economics*. 76(1):58–76.

Van der Berg, S., Siebrits, K. & Lekezwa, B. 2010. Efficiency and equity effects of social grants in South Africa Stellenbosch Economic Working Papers: 15 / 10. *Stellenbosch Economic Working Papers*.

Van der Berg, S. 2014. Inequality, poverty and prospects for redistribution. *Development Southern Africa*. 31(2):197–218.

Van Doorslaer, E. & Gerdtham, U.G. 2003. Does inequality in self-assessed health predict inequality in survival by income? Evidence from Swedish data. *Social Science and Medicine*. 57(9):1621–1629.

Van Doorslaer, E., Wagstaff, A., Bleichrodt, H., Calonge, S., Gerdtham, U.G., Gerfin, M., Geurts, J., Gross, L., *et al.* 1997. Income-related inequalities in health: some international

comparisons. *Journal of Health Economics*. 16(1):93–112.

Van Doorslaer, E., Koolman, X. & Jones, A.M. 2004. Explaining income-related inequalities in doctor utilisation in Europe. *Health Economics*. 13(7):629–647.

Van Schaik, N., Kranzer, K., Wood, R. & Bekker, L. 2010. Earlier HIV diagnosis – are mobile services the answer ? *South African Medical Journal*. 100(10):671–674.

Van Soest, A., Delaney, L., Harmon, C., Kapteyn, A. and Smith, J.P., 2011. Validating the use of anchoring vignettes for the correction of response scale differences in subjective questions. *Journal of the Royal Statistical Society: Series A (Statistics in Society)*, *174*(3), pp.575-595.

Ververs, M.T., Antierens, A., Sackl, A., Staderini, N. & Captier, V. 2013. Which Anthropometric Indicators Identify a Pregnant Woman as Acutely Malnourished and Predict Adverse Birth Outcomes in the Humanitarian Context? *PLoS Currents*. 7(5) (June).

Von Fintel, M. 2015. Social mobility and cohesion in post-apartheid South Africa. PhD. Stellenbosch University.

Wagstaff, A. 2002. Poverty and health sector inequalities. *Bulletin of the World Health Organization*. 80(2):97–105.

Wagstaff, A., Paci, P. & Van Doorslaer, E. 1991. On the measurement of inequalities in health. *Social Science and Medicine*. 33(5):545–557.

Wagstaff, A. & Van Doorslaer, E. 2000. Equity in health care finance and delivery. In A. Culyer & J.P. Newhouse (eds.). *Handbook of Health Economics*. Vol 1B. Amsterdam *et al.*: Elsevier. 1803–1862.

Wang, L.M. 2003. *Determinants of child mortality in LDCs - Empirical findings from demographic and health surveys*. Vol. 65.Washington, DC: The World Bank.
Western Cape Department of Health. 2014. *Annual Performance Plan 2014*. Cape Town.

Whiteman, M.K., Tepper, N.K., Kottke, M., Curtis, K.M., Goedken, P. & Mandel, M.G. Marchbanks, P.A. 2015. Using a Checklist to Assess Pregnancy in Teenagers and Young Women. *Obstetrics and gynecology*. 123(4):777–784.

Wittenberg, M. 2011. The Weight of Success: The Body Mass Index and Economic Well-being in South Africa. A Southern Africa Labour and Development Research Unit Working Paper Number 65. Cape Town: SALDRU, University of Cape Town.

Wittkowski, A., Gardner, P.L., Bunton, P. & Edge, D. 2014. Culturally determined risk factors for postnatal depression in Sub-Saharan Africa: A mixed method systematic review. *Journal of Affective Disorders*. 163(2014):115–124.

Woodward, A. & Kawachi, I. 2000. Why reduce health inequalities? *Journal of Epidemiology and Community Health*. 54(12):923–929.

Woolard, I. 2002. *An overview of poverty and inequality in South Africa*. Working Paper prepare for DFID (SA).

World Health Organization. 1999. *HIV in Pregnancy: A Review*. Geneva: World Health Organization.

World Health Organization. 2003. *Pregnancy, childbirth, postpartum and newborn care: a guide for essential practice*. Geneva: World Health Organization.

World Health Organization. 2008. *WHO Study on global AGEing and adult health (SAGE)*. [Online], Available: http://www.who.int/healthinfo/sage/en/ [2013, January 01].

World Health Organization. 2010. *Guidelines on HIV and infant feeding*. Geneva: World Health Organization.

World Health Organization. 2015. *World Health Statistics*. Geneva: World Health Organization.
Zembe-Mkabile, W., Ramokolo, V., Sanders, D., Jackson, D. & Doherty, T. 2015. The dynamic relationship between cash transfers and child health: Can the child support grant in South Africa make a difference to child nutrition? *Public Health Nutrition*. 19(2):1–7.

Zere, E. & McIntyre, D. 2003. Inequities in under-five child malnutrition in South Africa. *International Journal for Equity in Health*. 2(1):7.

Zhang, H., Bago D'Uva, T.M., Van Doorslaer, E. 2015. The gender health gap in China: a decomposition analysis. *Economics and Human Biology 18 (2015) 13–26*

Zimmer, Z. & House, J.S. 2003. Education, income, and functional limitation transitions among American adults: Contrasting onset and progression. *International Journal of Epidemiology*. 32(6):1089–1097.

Datasets:

National Department of Health. 2003. South Africa Demographic and Health Survey 2003.

Department of Health: Pretoria.

Southern Africa Labour and Development Research Unit. 2012. National Income Dynamics Study 2012, Wave 3 [dataset]. Cape Town: Southern Africa Labour and Development Research Unit [producer]. Cape Town: DataFirst [distributor].

United Nations Development Programme. 2014. Human Development Indicators, 2014. [Online], http://hdr.undp.org/en/data [2016, June 01].

World Health Organization. 2008. *WHO Study on global AGEing and adult health (SAGE)*. [Online], Available: http://www.who.int/healthinfo/sage/en/ [2013, January 01].