Measuring health inequity amongst a cohort of HIV positive mother and child pairs in South Africa: The relationship between household socio-economic status and child health outcomes.

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A mini dissertation submitted to the Health Economics Unit, University of Cape Town, in partial fulfilment of the requirements for the award of a Master of Public Health (Health Economics)

Faculty of Health Sciences

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DECLARATION

I Lungiswa Leonora Nkonki declare that *Measuring health inequity amongst a cohort of HIV positive mother and child pairs in South Africa: The relationship between house hold socio-economic status and child health outcomes* is my work, that it has not been submitted before for any degree or examination in this or any other university, and that all the sources I have used or quoted have been indicated and acknowledged as complete references.

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Date: 24 May 2007

Measuring health inequity amongst a cohort of HIV positive mother and child pairs in South Africa: The relationship between house hold socio-economic status and child health outcomes.

KEYWORDS

South Africa

Equity

Socio-economic status

Child Health

Prevention of mother to child transmission (of HIV)

Public Health

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ABSTRACT

The purpose of this study was to measure health inequity amongst a cohort of HIV positive mother-child pairs in South Africa with a focus on the relationship between household socio-economic status and child health outcomes. This study is a secondary analysis to a prospective cohort study of mothers and infants participating in three of the eighteen national PMTCT sites in South Africa. Women (and their infants) were recruited prior to, or at the time of delivery and followed until the infants were 36 weeks of age. Three sites were purposefully sampled in order to reflect different socio-economic regions, rural-urban locations and HIV prevalence rates. The study made use of principal component analysis (PCA) to measure household socio-economic status. The selection of both variables that are indicators of socio-economic status and the use of PCA as a technique of assigning of weights to the chosen indicators of socio-economic status was informed by the literature. The selection of health outcomes was based on the renewed focus on child health.

This study is organized in five chapters. The first chapter provides the rationale for measuring inequities in child health with particular focus on South Africa and states the aim and objectives. Chapter Two reviews different forms of literature that were pertinent in understanding the importance of child health, the current state of child health and the relationship between inequities and poor child health outcomes. Chapter Three gives a detailed discussion of the data collection and quality control methods employed to achieve good quality data in the primary study . Then it discusses choosing indicators of socio-economic status and intricacies involved in measuring socio-economic status. In

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addition, it outlines the chosen child health outcomes, motivation for their choice and their measurement.

The descriptive statistics and PCA findings are presented in Chapter Four. The results suggest that the wealth index / index 3, which comprises consumer durables (television, refrigerator, radio, phone and car) and infrastructural variables (drinking water, type of toilet, cooking fuel) was internally coherent and robust to other household measures of socio-economic status. The wealth index was compared with a food consumption index (samp, beans, flour, mealie-meal, soup, oil, milk, meat, vegetables, fruit, rice, tea, sugar, eggs). The magnitude of inequities within sites and between sites was smaller with the use of the food index compared to the wealth index.

Enormous disparities were observed in the availability of infrastructure between the least poor and most poor. Inequities were observed in all the measured child health outcomes, with the exception of reported feeding at 12 weeks. Overall, 75 (8.5%) infants died between birth and 36 weeks. Of the 75, 25% of infant deaths were amongst the most poor compared to 11% in the least poor category. Immunisation coverage increased with increasing socio-economic status. Inequities in the distribution HIV transmission were apparent. Again, infants from the most poor households were 1.8 times more likely to be HIV positive compared to their least poor counterparts. Findings from this study reflect the continuing existence of inequities.

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Chapter Five discusses policy implications and recommendations. There have been a number of national interventions aimed at redressing past inequities. However, unjust differences remain. Overall, findings from this study suggest that the underlying inequities that continue to exist in South Africa with regard to socio-economic conditions and poor socio-economic status expose infants to ill health, and that these inequities will need to be addressed in future programme planning before the potential success and improved child health from these programmes are realised for all South Africans.

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List of abbreviations

AIDS	Acquired Immune Deficiency Syndrome
CADRE	Centre for AIDS Development, Research and Evaluation
CHWs	Community Health Workers
DHIS	District Health Information Systems
DHS	Demographic Health Survey
DoH	Department of Health
EBF	Exclusive Breast Feeding
EFF	Exclusive Formula Feeding
GDP	Gross Domestic Product
GOBI	Growth monitoring Oral rehydration therapy Breastfeeding Immunisation
HIV	Human Immuno-deficiency Virus
HST	Health Systems Trust
IQR	Inter Quartile Range
IMR	Infant Mortality Rate
ISEqH	International Society for Equity in Health
LTRI	Lower respiratory tract infections
MDG	Millennium Development Goal
MF	Mixed Feeding

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MICS	Multiple Indicator Cluster Survey
MTCT	Mother-to-child transmission
MRC	Medical Research Council
NPA	National Programme of Action
NGO	Non governmental organization
PCA	Principal Component Analysis
PHC	Primary Health Care
PHR	Partners for Health Reforms
PMTCT	Prevention of Mother to Child Transmission
PNMR	Post-neonatal Mortality Rate
PPIP	Perinatal Problem Identification Programme
SA	South Africa
SADC	Southern African Development Community
SADHS	South African Demographic and Health Survey
SAHR	South African Health Review
SES	Socio -economic status
TV	Television
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
UKZN	University of Kwa-Zulu-Natal
UNICEF	United Nations Children's Fund
UWC	University of the Western Cape
WHO	World Health Organisation

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CHAPTER 1

Introduction

In the period of the 90s and early 2000 equity received scant attention in international health debate compared to efficiency. The international health policy debate focussed almost exclusively on efficiency. Focussing on efficiency meant giving priority to ways of making better use of available resources within the public sector. Two issues surfaced as factors that supported the focus on efficiency. Firstly, the ideological shift to neo-liberal macro-economic policy; secondly the economic constraints that exist in many countries limited resources available to government for financing and providing health services (McIntyre &Gilson, 2002).

There has been a renewed interest in equity. In the past few years, a number of global and regional health equity initiatives have been developed. These include: World Health Organisation (WHO) / Sida Initiative on Equity in Health and Health Care; Rockefeller/Sida/Harvard University Global Health Equity Initiative; (Partners for Health Reforms/ United States Agency for International Development) PHR/USAID multi-country study of Equity of Health Sector Revenue Generation and Allocation; Southern African Development Community (SADC) Regional Network on Equity in Health; and Danida/World Bank Study on Equity in Health in Latin America and the Caribbean. Following these initiatives academia sought to establish directions taken in health equity research including theories, methods, and interventions through conducting annotated bibliography and literature reviews (Macinko & Starfield, 2002; Schellenberg et al., 2003). The published literature reflects that developing countries received even less

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attention compared to developed countries in terms of Equity focus. Furthermore, within the limited research conducted in developing countries, inequities in child health received even less attention. Instead an overwhelming emphasis was put on financing issues on equity.

The resurgence of equity coincided with the use of equity measuring methodologies that contained less measurement error, were less time consuming and more reliable; making it possible to measure inequities even in resource poor settings. Another important factor was that the resurgence of equity coincided with child survival gaining more attention. This dissertation deals with measuring inequities in cohort of mother to child pairs within three purposefully sampled sites in South Africa. This study makes use of a methodology of constructing an index of household economic status based on an asset index built from weights chosen by principal component.

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This chapter provides the rationale for measuring inequities in child health with particular focus on South Africa. It first addresses the question of why child health is important by outlining its function as an indicator of a population's wellbeing and health system functioning. Then it provides information on global disparities in child health and reasons for this situation. Given the existence of low cost interventions to address poor child health outcomes, it highlights the necessity to focus on inequities in order to devise targeted interventions. The chapter then moves on to describe different levels of inequities present in society and gives a brief description of aspects of inequities that are reflected in the literature, focussing on the case of South Africa. The focus is on child

health disparities. Finally, the chapter provides a description of the context of the primary study, which forms the foundation of this research. It outlines the primary study's aims and objectives and concludes with this study's aims.

1.1 Background

1.1.1 Child health

The focus on child health is informed by the fact that child health often serves as a key developmental indicator because it reflects the combined effect of economic development, technological change (broader country technological change), specific technological changes affecting health interventions and the socio-cultural environment (Claeson et al., 2000). This is evidenced by the fact that many preventable diseases can be addressed by improving basic health conditions such as water and sanitation, good nutrition and access to good health resources (Day & Gray, 2005). Child health is thus shaped by an intersection of biological, demographic and socio-economic circumstances. Literature on epidemiology has conceptualized presence of disease to be a process that is rarely caused by a single factor. Hence, for the disease process to occur, several factors often have to occur. Epidemiology uses a variety of terms for factors that result in disease, namely: risk factors, agents, causes, causative forms (Katzenellenbogen, Jourbet & Karim, 2002). For the purposes of this dissertation the term "risk factors" will be used to describe factors that shape child health. Household socio-economic factors that are risk factors for child health are divided into distant and intermediate level factors. The distant level socio-economic factors are low income, poor social status; and lower levels of education and they impact on child health through intermediate level factors such as

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environmental and behavioural risk factors (Mosley & Chen, 1984). Environmental risk factors such as the availability of flush or pit toilets, clean cooking utensils, fuel and ownership of household goods have been examined by several researchers (Pandey et al., cited in Claeson et al., 2000). These environmental risk factors have gained much credibility and recognition for their importance as indicators for economic status. An added advantage in the use of these risk factors is their availability in the Demographic Health Survey (DHS). The use of an asset index as a measure of socio-economic status emerged as unconventional in research about economic disparities. The norm had been to use income or consumption data; even though there were relative merits of using asset, consumption or income data to measure socio-economic status. Several authors suggested that the asset-consumption relationship is quite close (Filmer & Prichett, 1998; Montgomery et al 1997; Wagstaff et al., 1991; Rutstein, 1999). Then Filmer & Prichett (2001) published a first study in a peer reviewed journal demonstrating that the construction of an asset index using the principal component analysis (a statistical technique of creating a weighted index) was not only able to estimate the relationship between wealth and high school enrollment but that it was a better predictor than income and expenditure data. Furthermore, they found that the asset index appeared to be stable and less contaminated with measurement error as a measure of long-run wealth. The applicability of these findings beyond education was realised for instance its applicability to a variety of health outcomes. The World Bank then adopted the tool to measure the relative positions of households using data on durable consumer goods, housing quality, water, and sanitary facilities and other amenities (Gwatkin et al., 2000) and used it consistently to measure household wealth.

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Besides reflecting economic development, child health also serves as an indicator of health systems functioning. Health systems functioning is mirrored or assessed in the quality of and access to medical care and public health practice (World Health Report, 2000). Health systems factors are related to the country/region economic situation. Economic advancement has the potential to yield higher welfare through increased access to medical care, improvement in infrastructural factors and good public health practices and hence to result in lower infant mortality.

Fragile health systems, socio-economic stagnation and poverty have contributed to the lack of progress in the sub-Saharan region. Hence strengthening national health systems was identified as the long term aim of improving child health (Bryce et al., 2003). However, it should be realised that health systems strengthening is not only dependent on economic development. Clearly, economic development is useful as it increases the availability of resources. But if economic development or advancement is not targeted towards strengthening health systems it will not automatically result in stronger health systems. Similarly, socio-economic stagnation does not imply that some level of health systems strengthening cannot be achieved.

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Improving child health indicators also implies that the country is laying foundations on good adult health; additionally, environmental factors and health systems functioning will have a direct positive impact on the health of the adult population because of the correlation between childhood physical and emotional health and adult health later on. Research has shown that slow growth and poor emotional support raise a lifetime risk of poor physical

health and reduce physical, cognitive and emotional functioning in adulthood (Wilkinson & Marmot, 2003).

1.1.2 Inequities in child health

The use of child health indicators is not only limited to reflecting on the existing situation; child health can, through an analysis of its inequities, be an enabling factor in devising strategies to address the poor child health outcomes. Globally, more than 10 million children still die every year. More than half of the deaths are caused by malnutrition, pneumonia, diarrhoea, measles, malaria and Human Immunodeficiency / Acquired Immune Deficiency Syndrome (HIV/AIDS) (World Health Organisation, 2003). Effective low cost interventions such as protection against diphtheria, pertussis, and tetanus immunisation, oral rehydration therapy, appropriate antibiotic treatment for pneumonia and vitamin A supplementation are available, and could prevent at least two-thirds of these deaths (Jones et al, 2003). The challenge has been to deliver these life-saving interventions to children who need them most. The 2003 Child Survival Series highlighted the reality of this challenge where it reported that 26% of the world's children under 2 years did not receive the protection of diphtheria, pertussis, and tetanus immunisation, 28% did not receive oral rehydration therapy as needed for diarrhoea, 40% did not receive antibiotic treatment for pneumonia; 58% did not receive exclusive breastfeeding during the crucial first 4 months of life; 52% did not receive vitamin A supplementation; 32% did not have access to iodised salt; and 25% had malnutrition – which contributes to 60% of child deaths. Given this bleak picture of service delivery coverage, it is thus not suprising that for most countries, advances in reducing child deaths have slowed because efforts to reduce malnutrition and provide appropriate

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interventions to address diarrhoea, pneumonia, vaccine-preventable diseases and malaria have been inadequate (Bryce et al 2003).

The unequal distribution of health outcomes, evidenced by the fact that an overwhelming majority of global children's deaths occurred in developing countries, points to issues of equity. Equity in health has become a global concern. Equity, as defined by the International Society for Equity in Health (ISEqH), "is the absence of potentially remediable, systematic differences in one or more aspects of health across socially, economically, demographically, or geographically defined population groups or subgroups" (International Society for Equity in Health, 2001). Child health accounts for the largest equity gap in health. Children under five years of age account for more than 50% of the global gap in mortality between the poorest and richest quintiles of the world's population. Almost all (99%) of the 10.8 million children under five who died in 2000 were from developing countries. Of these children, 34% died in Asia and 41% in sub-Saharan Africa (Black, Morris & Bryce, 2003). The observed global inequity between countries is mirrored within countries. Evidence shows that unless you prioritise equity, public health interventions tend to perpetuate existing inequities (Victoria et al 2003).

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The key factors in defining inequities are that they should be avoidable and remediable. Since poor child health outcomes are mostly avoidable, remedying inequities in child health outcomes requires interventions specifically targeted at addressing these inequities.

Hence, measuring inequities is essential for informing the design and implementation of interventions.

1.1.3 Measuring inequities

In order to analyse inequities, the first step is to define how to measure them. Health inequities are associated with income, wealth, education, jobs, housing and other environmental conditions, lingering institutional racism and social class barriers. Public health experts' thinking on health inequities has been enriched by an increasing understanding of possible pathways and mechanisms by which socio-economic, educational and other barriers to equal opportunity in society lead to disease and disability and shorten life expectancy. However, the difficulty has been in not knowing which factors were most important in determining health. Furthermore, epidemiologists and public health experts did not know what could be done about factors out of control of health services short of altering basic systems of government. Discussion relating to which factors are most important in determining health still continues. More recently the World Health Organisation has presented an update of social determinants in society today, namely stress, early life, social exclusion, working conditions, unemployment, social support, addiction, healthy food and transport policy (Wilkinson & Marmot, 2003).

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Given that low socio-economic status at both societal and individual level is by far the most overwhelming significant risk factor for health (Auerbach & Krimgold, 2001), it is necessary to situate socio-economic status within the context of health systems as this enables movement towards action, rather than remaining at the level of continually measuring disparities in health and socio-economic status. Poverty and inequity within

countries occur at different levels: the aggregate level (macro level) and the individual level (micro level). A further distinction can be made when examining inequity in health by differentiating between supply side factors, demand side factors, contextual factors and the distribution of health outcomes.

Under the conditions of a well-functioning market, supply side factors are understood to be influenced by factors that affect the amount a producer is willing to produce. A major contributory factor is the opportunity to earn profit, which in turn is influenced by cost of production and technology. However, due to problems related to market failure – among other things, public accountability, informational asymmetry, abuse of monopoly power and failure of strategic policy formulation – healthcare should therefore be distributed differently from other goods. Within the healthcare context supply side factors can be understood as factors that affect the production of healthcare. Therefore supply side factors relate to all the factors that have to do with the provision of healthcare; mainly relating to how the health system is organised and financed. It encompasses factors such as human resource, service provision, geographical distribution of facilities and public/private partnerships. Hence the health system is defined as all actors, institutions and resources that undertake health actions – where a health action is one where the primary intent is to improve health (World Health Report, 2000). Even though the main goal of a health system is to improve population health, there are other intrinsic goals. Murray & Frenk (1999) identified three intrinsic goals of a health system: Firstly, the improvement of the health population (both in terms of levels attained and distribution); secondly, fairness in financing and financial risk protection; i.e. ensuring that poor

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households do not pay a higher share of their discretionary expenditure on health than the richer households, and that all households are protected against catastrophic financial losses related to ill health (Maynard & Bloor, 1995); thirdly enhancing responsiveness of the health system to the legitimate expectations of the population. Responsiveness in that context refers to the non health improving dimensions of the interactions of the populace with the health system, and reflects respect of persons and client orientation in the delivery of health services; among other factors (Collins, Green & Hunter, 1999), the environment in which people are treated, and to ensure that the financial burden of paying for health is fairly distributed across households. Four key functions determine the way inputs are transformed into outcomes that people value – resource generation, financing, service provision and stewardship (World Health Report, 2000).

Demand factors determine individuals' health seeking patterns which are often affected by supply factors. For instance, one of the indicators of health seeking pattern is the Primary Health Care (PHC) utilisation rate; PHC utilisation rate is the average number of visits per person to PHC health facilities per year. Where PHC facilities are located furthest away from the population, individuals residing far tend to utilise health facilities less as it often means long travelling hours and expenditure on transport, translating into a low utilisation rates.

Linked to both supply factors and demand factors is the distribution of health outcomes. Distribution of health outcomes refers to the profile of the burden of disease in different societal groups; possible indicators are for instance mortality trends. The distribution of

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health outcomes indicates the impact that the health system as a whole has had on health. Hence, it is useful for assessing the overall effectiveness of the implemented interventions. Distribution of health outcomes is essential as health outcomes inform the first intrinsic and ultimate goal of health systems, which is maximising the population's health.

It is important to again note that the roots of ill health go far beyond health services to such determinants as income, education and employment as well as to housing, infrastructure and environment and lifestyle. These could be considered contextual factors. The implication of the roots of ill health extending beyond health services is that the necessary policy developments required to reduce inequities will extend beyond the remit of departments of health, some of them falling within government as a whole while others will fall within the range of other government departments. The relationship between supply side factors, demand side factors, contextual factors and distribution of health outcomes is not a linear relationship; often the interactions occur simultaneously, are intertwined and cumulative.

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Although there has been a wide interest in health inequities, the bulk of the work has taken place in developed countries, focussed on supply side factors such as financing mechanisms and little on child health. This was evidenced by a Medline literature search undertaken by Schellenberg and colleagues (Schellenberg et al., 2003). It revealed that an overwhelming 91.8% of studies on this topic were from developed countries (Schellenberg et al., 2003). Studies from African countries have largely focussed on

health sector reform. Research on socio-economic inequities in child health is limited to African countries.

1.1.4 The case of South Africa; intra-country inequities

South Africa is an example of a developing country where intra-country inequities are large, as shown in a 2004 South African provincial comparison of child mortality rates which confirms the above statement (Day & Gray, 2005). Table 1 highlights two issues: firstly, deteriorating health outcomes with the increase in Infant Mortality Rate (IMR) between 1998 and 2002; secondly, the health disparities in health status amongst children in different parts of this country. The Eastern Cape, Kwa-Zulu Natal, Free State and Mpumalanga were the provinces with the highest IMR. Health status in these four provinces is historically poor. In the early part of the 20th century, 13% of the land area was designated to Black "Homelands" and during the 1960s and 1970s 3.5 million blacks were removed from cities to these nominal homelands (Davenport, 1987; Kaufman, 1998; Platzky & Walker, 1985). Rural areas within the homelands were economically extremely marginalised. Inequities existed in the provision of community level infrastructure, education, occupation opportunities and income. Table 2 shows the inequitable distribution of socio-economic indicators in all nine provinces. Similarly to the IMRs of 2004 presented in Table 1, the Eastern Cape, Kwa-Zulu-Natal, Mpumalanga and Limpompo had a higher percentage of households with no formal schooling, a lower percentage of households using electricity for cooking, a higher percentage of households with no toilet and higher unemployment rates, while Gauteng and the Western Cape were best performers in all the presented socio-economic indicators. The percentage of

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households with piped water was worst in the Eastern Cape at 62.4 %. Even the other poor performing provinces had at least above 70% piped water availability.

In addition to the economic exclusion of the homelands, healthcare provision was very unequally distributed between population groups and residential areas. For example, central cities in "White areas" featured sophisticated curative services rivalling those available in developed countries, while women living in homeland areas were often and still are forced to travel great distances to visit a clinic providing only basic services. The legacy of inequity was inherited by the democratic government post 1994. This is evidenced by the lower levels of IMR, availability of infrastructure, lower levels of unemployment, higher educational levels in the Western Cape and Gauteng. Both Gauteng and the Western Cape are provinces that are historically more advantaged in terms of the health system infrastructure and the population.

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Table 1: A comparison of infant mortality rates[1] in nine provinces

Province	1998[a]	2000[b]	2002[c]
Eastern Cape	61.2	70.9	72.0
Free State	53.0	61.8	63.0
Gauteng	36.3	44.4	46.0
Kwa-Zulu Natal	52.1	68.4	68.0
Limpopo	37.2	51.6	53.0
Mpumalanga	47.3	58.9	59.0
Northern Cape	41.8	46.4	46.4
North West	42.0	55.2	56.0
Western Cape	30.0	31.7	30.0
South Africa	45.0	59.1	59.0

Source: Day C, Gray A, Govender M, Gengiah T, Singh J. Health Legislation. In: Ijumba P, Barron P, editors. South African Health Review 2005. Durban: Health Systems Trust; 2005.

a. SAHR 2000 Ch 4. Comparison of the provincial estimates from different sources revealed that the SADHS 1998 estimates for three provinces required some adjustment.

b. Burden of Disease Prov 2000.

c. HIV indicators 2002. The model does not fit Limpompo Province very well and as a result probably overstates the impact of the epidemic.

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[1] The number of children less than one year old who die in a year, per 1000 live births during that year.

Table 2: Distribution of socio-economic indicators

Province	Education[a] (2001)	Electricity[b] (2001)	Piped water[c] (2001)	No toilet[d] (2001)	Unemployment rate[e] (2004)
EC	22.8	27.8	62.4	30.8	50.0
FS	16.0	47.0	95.7	9.7	38.1
GP	8.4	73.2	97.5	3.6	36.3
KZN	21.9	48.3	73.2	16.2	45.8
LP	33.4	25.0	78.0	23.3	57.0
MP	27.5	40.0	86.7	10.3	41.9
NC	18.2	59.0	96.6	11.2	39.4
NW	19.9	44.6	86.2	9.6	46.1
WC	5.7	78.8	98.3	7.7	22.9

Source: Day C, Gray A, Govender M, Gengiah T, Singh J. Health Legislation. In: Ijumba P, Barron P, editors. South African Health Review 2005. Durban: Health Systems Trust; 2005.

a. Census 2001. Percentage of those aged 20 years or older who have received no schooling.

b. Census 2001. Percentage of households using electricity for cooking.

c. Census 2001. Percentage of households with access to piped water.

d. Census 2001. Percentage of households with no toilet.

e. StatsSA Labour Force Survey, March 2004. Unemployment rate expanded definition.

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1.1. Problem statement and rationale

South Africa is considered to be one of the most unequal societies in the world (Fallon & da Silva, 1994). It is second after Brazil in the most unequal measured in the distribution of income. In South Africa the poorest receive a minuscule share of the national income, for instance a 2.9% share of income or consumption and 15% share as a ratio to an equal proportion (UNDP, 2000). In the past ten years, South Africa has attempted to redistribute resources to the population at large, focussing on reaching both the previously marginalized communities and the indigent. In this regard, important steps

have been: establishing the National Programme of Action (NPA) to implement a "call for children" commitment, providing free medical care for pregnant women and children less than 7 years of age, and establishing a family and children section within the ministry of Welfare (Lockhat & Van Niekerk, 2000). The new government endorsed health for all South Africans, in the form of expanded primary care-based system funded by economic growth. Between 1994 and 1996, more than 100 000 homes, 400 clinics and 4750 health posts were newly built or under construction and the health sector implemented free health care for children under 6 (Benatar et al, 1997). In 1998 the child support grant was introduced. It is a means-tested cash benefit for the poor children between the ages of 0 and 6 years. In spite of all these positive developments, some have argued that racial disparities have persisted under this regime and that children may actually be worse off than before (Desmond, 1998; Ramashia, 1998).

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The steps towards the goal of health for all South Africans unfortunately presented other challenges. Firstly, the expansion of services that previously served a minority to a larger population, severely strained existing health services, reducing their efficacy (Haffejee, 1995). In addition, changes that resulted in budget cuts in provinces that were better-served to create parity with provinces that were less served reduced the overall effectiveness of the existing healthcare institutions (Benatar et al., 1997). Tables 1 and 2 from the previous section demonstrate that the previously better-served provinces are continuing to have better health outcomes and better socio-economic circumstances. However, the figures in both tables could be confounded by race. Furthermore, these provincial averages could potentially mask intra-provincial differences. Evidence shows

that unless equity is prioritized, public health interventions tend to perpetuate the existing inequities (Victoria et al., 2003). An important aspect of persistent inequities is the consequences it has on the families in a disadvantaged position. Poor socio-economic position will be inherited from one generation to the next (passed from parents to their children), which means that surviving children of the disadvantaged households, which are mainly Black, in the absence of a targeted intervention are likely to persist in their disadvantage. They should thus benefit most from the redistribution of resources. It has therefore become important to not only look at national and provincial indicators, but to go beyond and collect data on communities residing in the poorest regions, in order to assess the level at which these communities are benefiting from public health interventions and in turn enjoying better health outcomes.

Data on socio-economic variables are mainly collected as part of national surveys such as the South African Census, Demographic and Health Survey (DHS) and different forms of surveys conducted by Statistics South Africa. These sources have their own inherent limitations, mainly related to underreporting in some provinces especially in the poorest regions. The lack of regular and reliable data makes it difficult to fully assess the effect of current programmes on child health status.

The next question then is how do we measure socio-economic status adequately in a manner that will inform public interventions on appropriate ways of addressing inequities and targeting parts of the community that are in greater need of the interventions? In quantitative studies there is often a trade-off between convenience, affordability and

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rigorous research. Measuring socio-economic status is not immune to this trade-off. To confirm the above statement, measuring socio-economic status directly is problematic at two levels. The first level is data availability: for instance, frequently used indicators of wealth (household income and consumption) are often unavailable and when available, their reliability is often of questionable quality. The second level is data reliability, where the informal sector is the main form of generating income and formal employment is unacceptably low and plays an important role and again data reliability is often in doubt.

The above mentioned difficulties with data availability and reliability in measuring socio-economic status have often complicated conceptually straight forward programme-incidence techniques used to measure coverage-inequality or programme incidence. Coverage-inequality or programme incidence usually relies on survey data about the household's socio-economic status and whether household members have been reached by a particular service programme. The households are divided into groups by socio-economic status, the frequency of programme service use is tabulated for each group, and the intergroup differences are assessed by any of several statistical disparity measures. But the application of techniques has not been practical because of the problematic nature of measuring socio-economic status. As a consequence proxy measures for assessing socio-economic status were created, such as the asset index or wealth index. Recent studies have shown that a wealth index based on data about household assets, attributes, and possessions yields similar results to those produced with income or consumption information (Filmer & Prichett, 2001; Houweling, Kunst & Mackenbach, 2003; Schellenberg et al., 2003; Stewart & Simelane, 2005).

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The existence of proxy measures for socio-economic status such as the asset index has created a scope for measuring the distribution of health outcomes within a given population. The asset index enables practical analysis of health problems that are of greatest importance to the poor simply because questions involved in creating the asset index are source of water, type of roofing, possession of bicycles, radios, and cooking utensils. These usually require minimal administering time and produce credible responses. These developments of using an asset index to measure wealth are important particularly for South Africa given its redistributive policy. Public health policies and interventions should be evaluated in terms of their impact in health inequities.

There is clearly a need to evaluate the extent to which public health interventions are reaching the poor. There is also an urgent need to improve the evidence base on child health and poverty, and to build capacity in measurement of equity indicators.

1.2. Primary study

In 2002, an independent study (the 'Good Start' study) aimed at evaluating the operational effectiveness of the Prevention of Mother to Child Transmission (PMTCT) programme, was conducted at three sites in South Africa namely Rietvlei (used to be under the Eastern cape now Kwazulu Natal, Umlazi (Kwa-Zulu Natal) and the Paarl (Western Cape) by a research consortium comprising Health Systems Trust (HST), University of the Western Cape (UWC), Medical Research Council (MRC) and Centre

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for AIDS Development, Research and Evaluation (CADRE). The study was designed to follow up a cohort of mothers and child pairs from delivery to nine months post delivery. During this period, comprehensive data was collected on Mother-to-Child Transmission (MTCT) rates, maternal and child morbidity and mortality, infant feeding practices, socio-demographic profile, antenatal and postnatal care amongst others. This is believed to be the first study of the operational effectiveness of a PMTCT programme in the country.

The Good Start study was commissioned by the National Department of Health (DoH) following findings from an initial evaluation of the pilot PMTCT programme (Chopra et al 2005). The national PMTCT pilot programme was set up to describe the effectiveness of the national PMTCT programme in reducing mother-to-child transmission of HIV. Findings from an evaluation of these pilot sites showed that few of the 18 sites were able to measure the HIV outcome of children at 12 months and/or 15 months for a variety of reasons that included:

- Inadequacies in the routine monitoring system
- Loss of patient follow-up due to out-migration
- Mothers opting not to disclose their HIV status post-natally
- Children who die may not be captured by the information system

In addition, the national protocol did not include HIV testing at birth or in the immediate post-partum period. This meant that the proportion of children infected with HIV post-

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natally could not be distinguished from those children infected during delivery or in the ante-partum period.

For these reasons, the national research and evaluation framework developed by the HST and the national DoH made provision for a cohort study of mother-child pairs with active follow-up and case findings to determine the impact of the PMTCT programme on vertical transmission rates. In order to estimate the proportion of children infected post-natally through breast milk, the cohort study was designed to measure HIV status at 3-4 weeks, 24 weeks and 36 weeks.

South Africa's infant feeding policy on HIV positive women is to provide free infant formula for 6 months to all those women who choose to formula feed. Initial findings from the 18 pilot sites indicated that a vast majority of HIV positive women were opting to formula feed their children (McCoy et al., 2002). A number of public health professionals have raised concerns about this (Coutsoudis et al., 2001), for the following reasons, firstly it is well known that there are many dangers and harmful effects related to the provision of formula feeding particularly in low socio-economic conditions (WHO Collaborating Study Team on the Role of Breastfeeding on the Prevention of Infant Mortality, 2000). This is partly due to the immunological effects of breast milk, and also due to the exposure of children to diarrhoeal disease resulting from the unsafe (lack of piped water, lack of resources for sterilizing the feeding utensils and lack of cool storage for leftovers) and incorrect preparation of formula milk. Secondly, there are a number of social, cultural and economic constraints on the ability of women to provide exclusive

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formula feeding, with the consequence that they may end up mixing formula feeds with breast milk (which would theoretically increase the risk of post-natal HIV transmission) (Thairu et al., 2005). As in many areas of sub-Saharan Africa, breastfeeding is highly valued and is a normative. Local findings have indicated that most women provide mixed feeding with breast milk, and that this practice is often informed by traditional socio-cultural norms which are often enforced by older women in the community, particularly mother-in-laws (McCoy et al., 2002). Thirdly, anecdotal reports suggest that in some households, formula milk is being shared with family members other than the intended beneficiary (Good Start, 2002) and the resulting problem is mixed feeding. Women introduce other food or start breastfeeding. Finally, there are significant concerns about the lack of a readily available source of nutrition for infants of poor households after six months when the formula is no longer subsidized by government.

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Hence the objectives of the Good Start study were to:

- Measure the early (3-4 weeks) and late (24-36 weeks) vertical HIV transmission within a cohort of HIV positive mothers and their infants.
- Investigate infant feeding patterns and behaviours of HIV+ and HIV- post natally.
- Describe and measure the impact of the PMTCT programme on the health of infants born to HIV positive mothers.
- Provide recommendations for the national Department of Health to strengthen the post-natal component of the PMTCT programme (Chopra et al., 2005).

1.3. Current research

The completion of the Good Start study (described in the previous section) in 2003 together with the availability of simple and useful measures of socio-economic status presented a unique opportunity. The opportunity to evaluate policy not only in terms of effectiveness (i.e. can it work in an operational setting), but also in terms of the impact on distribution of health outcomes. An added advantage of the current study from an equity perspective is the purposive sampling used in the study based on differences with respect to geographic location, provincial resources and HIV prevalence.

It is not enough to simply articulate that inequities exist based on a mixture of individual, household and societal indicators of wealth; it should always be remembered that the ultimate goal is to unpack contributions of different aspects of socio-economic status and their unique contribution to different health outcomes, to begin a process of remedying them.

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Aim of the current research

The aim of this study is to measure health inequity amongst a cohort of HIV positive mother-child pairs in South Africa with a focus on the relationship between socio-economic status and child health outcomes.

Objectives

The objectives are:

- To outline information collected on socio-economic status in the cohort study.

- To describe the socio-economic status of this sample of household using an asset index.
- To determine the relationship between socio-economic status and child health outcomes measured in the cohort study namely:
    - Exclusivity in infant feeding
    - HIV transmission
    - Infant mortality
    - Immunisation coverage at 24 weeks

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CHAPTER 2

Literature Review

This chapter reviews the literature and research which contributes to the approach and supports rationale of this study. In this section the literature directly and indirectly related to the subject of inequities in child health is reviewed. The review focusses on different forms of literature that were pertinent in understanding the importance of child health, the current state of child health, the relationship between inequities and poor child health outcomes. Given that both child health research and equity are disciplines, for child health research, this literature review will focus on the importance of investing in child health and thereafter achieving better child health outcomes. In order to explore the importance of investing in child health, the chapter starts by assessing the varying status of child health in the past 25 years. It then looks at the global state of child health. It is now appropriate to point out that this research was conducted in South Africa and the aim of this study was to influence policy. Given the above aim, it was essential to look at South Africa's commitment to child health and its performance on child health indicators in line with its national goals. As stated earlier in this text that child health research and equity research are disciplines, an overview of the literature on equity is presented as well as relationship between inequities and poor child health outcomes. The chapter concludes by discussing various methods of measuring socio-economic status and the intricacies involved in employing different measures.

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2.1 Child Health

Child health has long been recognized as an important component of a population's development. Rates of infant and child mortality have been seen as measurements of a country's development (Commission on Macroeconomics and Health of the World Health, 2001). A historical perspective tracking key milestones in the campaign for child survival offers valuable insights into what had characterized the achievements in child health and reaffirms the importance of this topic.

1979 was the International Year of the Child, genesis of prioritizing child health. In 1982 James Grant, then UNICEF'S executive director launched an initiative known as the "child survival revolution". He proposed an alternative approach to looking at child health. He proposed a direct attack on infant and child mortality as an instrument for development. This approach was operationalised into two arms: a defined intervention known as GOBI[2] and a strong advocacy component. It is reported that public health specialists (UNICEF, 1996) expressed concern about this approach; as GOBI was viewed as a narrow approach focussed on few primary healthcare ingredients and therefore insufficient. The advocacy component consisted of a variety of allies that were widely representative of society namely; professional associations, trade unions, sports personalities etc., and developed a much broader campaign: 'a grand alliance for children'. The campaign resulted from assembling a technical team called "Task force for Child Survival and Development", which included all the key international organisations,

[2] GOBI: 'G' for growth monitoring to keep a regular check on child well-being; 'O' for oral rehydration therapy to treat bouts of childhood diarrhoea; 'B' for breastfeeding as the perfect nutritional start in life; and 'I' for immunization against the six vaccine-preventable childhood killers. GOBI represented four techniques that were taken from the primary health care package.

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such as the Rockefeller Foundation, UNDP, UNICEF, the World Bank, and WHO. The task force was established to resolve technical issues associated with the campaign and to help build its momentum. It is stated that of the four elements of GOBI, the expanded programme on immunisation had been taken up by the largest number of countries. Concerns were expressed about childhood immunisation taking up a disproportionate share of Public Health resources (UNICEF, 1996).

The end of the 1980s warranted a shift from mainly childhood immunisation to other important aspects of child health such as nutrition and access to safe drinking water. Overall, within the period of 1981-1990, 1.2 billion people worldwide gained access to safe drinking water, 770 million to adequate sanitation, and by 1994, and a further 780 million gained access to water. The child survival and development revolution produced considerable achievements as it had saved 12 million children by the end of the decade (UNICEF, 1996).

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The child survival and development revolution lost its momentum in the early 1990s, and several earlier gains were reversed. Consequently, child health was no longer prioritized as a means to and end of development. Several reasons have been cited: the emergence of the new infectious disease HIV/AIDS, the resurgence of tuberculosis and malaria, and the lack of international leadership (UNICEF, 1996).

In 2003, the Lancet featured a series on child survival in recognition of the lack of, progress in reducing child mortality. The Bellagio Child Survival Study group

emphasised child health as the most pressing dilemma of the new millennium, highlighting the exceptionally alarming state of child health globally (Bellagio Study group on Child Survival, 2003a). To qualify the above statement, the study group employed the conventional epidemiological research inquiry: "What? Where? When? How? Why? and So what?" The series focussed on looking at child survival holistically. Five issues were addressed. The first two issues were "where" and "why" are children dying. It was found that children are dying mainly in poor countries and they are mainly dying from neonatal disorders, pneumonia, diarrhoea, malaria and AIDS (Black, Morris & Bryce, 2003). The distribution of these causes varies from country to country. Identified risk factors were unhygienic and unsafe environments, no breastfeeding and non-exclusive breastfeeding and malnutrition.

The third issue was how many deaths could be prevented if there was universal coverage of maternal and child health services of all proven interventions. It is estimated that about two thirds of child deaths could be prevented by interventions that are available and feasible in low income countries. Jones et al. (2003) point out that there is no need for waiting for new therapies, but that new therapies should remain on the agenda for future effectiveness and efficiency.

The fourth issue addressed delivery through asking the question of whether public health can deliver interventions to families, women and children who need them. The authors adopted an optimistic view given that in the past, high levels of coverage had been achieved. It is then not inconceivable that improved coverage could be achieved again.

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Poor coverage was seen as a result of weakness in both provision of and demand for services, and as a consequence of malfunctioning health systems. The overall identified challenge was that efforts devoted to implementation were insufficient, leading to slow implementation. The authors highlight strategies that were seen as the remedy for the ills of the health system (Bryce et al., 2003). For instance, it was hoped that the introduction of Integrated Management of Childhood Illnesses (IMCI) would lead to improvements in health systems (Tulloch, 1999). However, the reviewed evidence did not support this hypothesis. The mode of delivery proved to be essential for the success of the intervention. For example, programmes delivered many different messages with low intensity. The article points, however, to cases of successful delivery strategies. For instance in Brazil, Egypt, Philippine and Mexico, the introduction of diarrhoea control programmes and promotion of rehydration therapy were accompanied by a reduction in mortality rates, polio eradication and the reduction in measles.

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The key important message from this paper is the importance of distinguishing between interventions and delivery strategies. The authors identified lack of a knowledge base for designing, implementing, and sustaining effective delivery strategies as scattered and context-specific. Hence they emphasised that a key research priority was addressing the question of how to effectively scale up the successful experiences of many local projects (Bryce et al., 2003).

The fifth issue on was inequities. The unacceptably wide country differences in child mortality between the poor and the rich countries were highlighted. In high income

countries, six out of 1000 children die before their 5th birthday, whereas in the developing world the rate is 88 per 1000, and in the world's poorest countries 120 per 1000 (Victoria et al., 2003). Child mortality largely occurs within Sub-Saharan (African) countries followed by South Asia. The thrust of the paper was to demonstrate that poor children are disadvantaged every step of the way from exposure to risk factors, to resistance to disease and to receiving care from poorly resourced healthcare centres.

Furthermore, even though there is consensus on the gravity of this problem and the need for interventions to reach the children that need them most, inequities persist even in the light of new interventions. In fact, new interventions tend to perpetuate the existing inequities. The authors provide a description of the interplay between multiple deprivations experienced by poor people through demonstrating that poverty goes beyond low income since low income is associated with low education and low education is associated with exposure. Possible strategies thus included improvement of knowledge and changing of behaviour among pregnant mothers, social marketing of approaches being adapted for public health gain, income generating projects, budget allocations and through making healthcare affordable.

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Several approaches have been proposed for improvement of the health conditions of poor people, but large scale implementation of these approaches has been minimal. It was concluded that both targeting and universal coverage has its pros and cons. As a result, neither is preferable as a status quo before initiatives. The authors argued that equity requires improving accountability through a national political commitment to equity,

information use, tracking progress in the disadvantaged groups and presenting information to inequities to a variety of audiences. The strategies are seen as the advocacy tools that will ultimately hold policy makers accountable for failing to address inequities. In this context, the proposed role of international agencies such as WHO and UNICEF is to address equity through building knowledge and competency among their staff on equity issues, advising governments on dealing with inequity, and presentation of health data by socio-economic status and geographical area (Victoria et al., 2003).

The fifth and concluding article titled "Knowledge into action for child survival", proposed four pre-requisites for transforming knowledge into action for child survival: leadership, strong health systems, adequate and targeted resources and awareness and finally a commitment to action. Lastly the authors call for a concerted action from civil society, academics, international agencies, governments, ministries of health, health professionals to prioritise child health and use the available evidence to take action (Bellagio Study Group on Child Survival, 2003b).

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The common theme throughout the Lancet series was delivery and appropriate targeting of child survival strategies, especially towards the poor and vulnerable. Central to achieving these goals is the measurement of health status and programme use disaggregated by socio-economic status.

2.1.1. South Africa's commitment to child health and performance

The re-emergence of the importance of child health highlighted by the Lancet series and other global initiatives such as the child health Millennium Development Goals (MDG),

created a platform for individual countries to commit to improving child health. South Africa has committed itself to creating an environment that is suitable for children, thereby subscribing to several international goals:

- To reduce perinatal morbidity and mortality;
- To reduce Infant and child mortality and morbidity
- To reduce HIV infection in children
- To improve nutritional status in under-5's
- To prevent and control non-communicable chronic diseases

(Department of Health, 2005).

Selected indicators related to these goals once again reflect inequities between the province the provinces and between metropolitan, rural and town areas in the distribution of health outcomes. The first selected indicator is the mean post-neonatal mortality rate (PNMR). The national PNMR of (2000-2002) from the Perinatal Programme (PPIP) in 73 sentinel sites was 34 per 1000 births. There were notable differences between metropolitan areas (36.2), town (38.6) and rural hospitals (26.7). Interestingly, the rural hospitals had the lowest PNMR (Pattison, 2003). According to Wilkinson et al. (1997), and the Department of Health, Medical Research Council & Measure DHS+ (1998), 80-85% of births occur under the supervision of skilled health workers in health facilities. Thus it is to be expected that the PNMR would be similar across these geographical areas. However, Solarsh and Goga (2004) reported that in rural underserved areas the PNMR of 26.7 per 1000 births may be much lower. Overall, these figures could represent an inaccurate picture of PNMR. Furthermore, it is not clear which direction it would take

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– it could either be an underestimation or overestimation of the PNMR, depending on the region. The potential inaccuracies arise from the fact that the PNMR is calculated using facility-based estimates of perinatal mortality, and facility based estimates could not be representative of the community. Therefore, it is most likely that the 26.7 PNMR in rural areas is an underestimation.

The second goal is the goal of reducing infant, child mortality and morbidity. One of the important indicators is lower respiratory tract infections (LRTI). A national annual incidence of 241 new cases of lower respiratory tract infections (LRTI) per 1000 under-fives in 2002 was reported. Again, there were large variations in incidence between the nine provinces, ranging from 100 to 510 incidence cases per 1000. The Eastern Cape, Gauteng and the Western Cape had 100, 110, and 120 per 1000 incidence cases of LRTI respectively. It is not surprising that Gauteng and the Western Cape had the lowest incidence cases of LRTI given that they are both better resourced provinces. The low incidence of LRTI in the Eastern Cape was suprising in that in most child health indicators the Eastern Cape often performs the worst. The provinces that had the worst rates were North West and Kwa-Zulu Natal at 490, 510 per 1000 incidence cases respectively. Comments from Solarsh & Goga (2004) highlighted data inaccuracies resulting from healthcare providers not adhering to the District Health Information Systems (DHIS) definition of LTRI. The latter scenario highlights the importance of good quality data. Good quality data is essential in any health system, as it informs the monitoring of inequities. Hence, in the absence of insights into inaccuracies in these data

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one could have observed incorrect patterns of inequities in the distribution of health outcomes.

The third goal of the South African DoH is to reduce HIV infection in children. Data from the national PMTCT programme indicate that the HIV transmission rate among the 55% of children that participated and were followed up to 12 months of age was 18%, pointing to a ±28% reduction in MTCT of HIV (Doherty, Besser & Donohue, 2003). The programme has faced several operational challenges relating to human resources, technical equipment and infant feeding. As a result, expansion to provide the full package of the PMTCT programme has been slow in some provinces.

The forth goal is to improve nutritional status in under 5's. The data from a national survey of anthropometric status showed that in 1992, 21.6% of SA children 1 to 9 years of age were stunted, 10.3% were underweight and 3.7 % of children were wasted (Solarsh & Goga, 2004). These estimates are not different from the SADHS survey estimates of 1998. Significant differences were observed; with developed and well resourced provinces performing better than poor and less resourced provinces.

Two important issues emerged from the presentation of these selected indicators. One is the poor performance of South Africa in all indicators and the second one is the inequities in the distribution of health outcomes. South Africa's underperformance in health outcomes had been noted previously; where South Africa had worse health status compared to its neighbouring countries Bostwana and Zimbabwe. Zimbabwe was

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particularly striking given that it had a Gross National Product (GNP) per capita which was four times lower than South Africa. On the other hand, while South Africa is considered a middle income country, its health status indicators were considerably worse than some middle income countries (McIntyre & Gilson, 2002). More recently Bryce et al. (2006) presented a report on monitoring the coverage of key child survival interventions in 60 countries with the world's highest numbers on rates of child mortality. South Africa once again performed very poorly. The Under 5 child mortality rate was reported to have increased from 60 in 1990 to 67 in 2004. Hence the estimated average annual rate of reduction on 1990-2004 was -0.8, falling way below what is required to reach the Millennium Development Goals (MDG) target. The targeted Under 5 mortality rate is 20 by 2015; in order to reach the above mentioned target the average annual rate of reduction needed between 2004 and 2015 would be 11.0.

With regards to the latter, it is important to note that while South Africa is doing well in terms of disaggregating health status by geographical areas (provinces, districts, metropolitan areas and rural areas), information on health status disaggregated by socio-economic status is lacking. The implication of only disaggregating health status by geographical areas is that provinces for instance are not uniform; differences exist. Presenting provincial averages limits the design of effective interventions. Designs of effective equity orientated interventions are limited because provincial data addresses the question of: inequality of what? Which is important but there is the next level of question which is: inequalities among whom? The latter question is important for three main reasons. Firstly, because it helps in explaining how inequities in health might be

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generated. Secondly, it allows one to identify high risk group that would be more likely to suffer from poor health. Thirdly, and most importantly, it allows one to identify inequities that are unjust. Hence Anand argues that any approach to conceptualizing and analyzing inequities should address the two questions stated above: inequity of what and inequity amongst whom (Anand, 2002). The next section will make use of literature in equity to explain the understanding of these two fundamental questions.

2.2. Literature on Equity: the relationship between inequities and child health outcomes

The subject: equity aims to take into account differences between individuals and communities that are considered unfair or unjust. There has been considerable published research on equity. In 2001 Macinko & Starfield (2002) search yielded 642 articles. In 2003 Schellenberg and colleagues conducted a Medline search on equity or inequities in both America and Africa and it yielded 1253 articles (Schellenberg et al 2003). The number of articles yielded by the searches above indicates that extensive literature exists on equity or inequity. However, apart from learning that research has been mainly in developed countries and that the little that has focussed on developing countries has largely focussed on healthcare financing mechanisms, it was unclear what directions are taken in health equity research. Macinko & Starfield (2002) wrote an annotated bibliography presenting an overview of published literature on equity in health. The aim of this article was to show directions taken in health equity research with emphasis on theories, methods, and interventions to understand the genesis of inequities and their remediation. This bibliography was conducted to inform the International Society for Equity in Health. Furthermore, the emphasis was on providing examples of different

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approaches to studying health equity rather than identifying an exhaustive list of equity-related articles. Two main aspects of equity were identified; namely, horizontal equity and vertical equity. Horizontal equity refers to equal treatment of equals. Vertical equity on the other hand refers to unequal treatment of unequal. Therefore vertical equity takes into account that the society is not uniform. Hence different members of the society for instance have different health status and economic opportunity. Thus inevitably their health needs would be unequal. In the case of resource allocation, vertical equity advocates that those with the greater health need should receive a larger portion of resources. The authors found that the published literature largely focussed on horizontal equity.

Given the two main aspects of equity; vertical equity and horizontal equity, fairness was assessed using two approaches defining the origins of inequity and quantifying fairness. In the first approach the following causes were identified: biological variation, informed individual choice; potentially unavoidable causes, potentially avoidable causes and potentially remediable causes. Diderichsen, Evans and Whitehead (2001) highlight that societies' growing capabilities such as the capacity to extend longevity and combat disease have been coupled with variations among the countries and among the countries. Blame for this situation is sometimes directed towards an excessive focus on individuals-their biological and behavioral risks of illness to the relative neglect of population groups and the societal forces that create health divides. The resultant of this view has been a divide amongst health researchers, with some arguing for more clinically relevant research on the proximate causes of illness (Rothman et al., 1998) while others argue for

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health gains that might be achieved by a better understanding of the more distal or upstream determinants of health (McKinlay, 1993; Krieger, 1994).

Having identified the origins of inequity, the next step is to assess, the effect of the inequities on the health status of the group that has systematically experienced them. The identified origins were a mixture of inequalities and inequities. Biological variation, informed individual choice and potentially avoidable causes are considered health inequalities. On the other hand individual choices and potentially avoidable causes are influenced by contextual factors such as characteristics of the health systems, skills of health workers, availability of drugs, literacy levels, unemployment rates and the overall healthcare financing and are considered inequities. Barker (1994) argues that health is a state of being over which an individual has only partial control throughout the life course. For that reason current health and future health are largely influenced by the physical and social environment that we are exposed to during our pre-adult years. The second approach was quantifying fairness through measuring societal preferences for health equity. The magnitude of the value depended on the population interviewed and the characteristics of the population experiencing the inequities. Thus, assessing fairness is inherently a function of societal value judgments. Clearly the concept of health – its definition and measurement – is a fundamental point in the discussion about equity.

The next important issue was the measurement of inequities in health. The literature distinguishes between measuring inequities at individual level and at group level. Individual level data is when the unit of analysis is the individual, whereas group level

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data is when the unit of analysis is a cluster for instance. The former was considered a narrow measure as it only captures health status of individuals, leaving out other societal characteristics and is also limiting in assessing whether the inequalities are inequitable. It was concluded that health inequities are dependent on the type of health measure used and on the population group being investigated.

The bibliography highlighted the dominance of research on equity in access, utilization and financing of health services, in an attempt to unpack inequities in healthcare and their genesis. Initially, education, occupation and / or income, as measures of socio-economic status measured, were highlighted as the most determinant factors of inequities. More recently, additional factors have been identified. They include living conditions and the countries' distribution of income. Hypothesised pathways were political environment, policy context, the extent of primary healthcare provision, geographical distribution of healthcare centers, mix of health services, fairness of health financing, social policies and economic relationships. These hypothesized pathways highlighted the complexity of inequities.

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In terms of policy actions aimed at reducing inequities in health outcome, four strategies were identified: that is increasing or improving the health seeking behavior of those in greatest need; access and quality health service improvement; a pro-poor restructuring of healthcare financing mechanisms and altering broader social and economic structures. The authors identified a tension between absolute and relative definitions in evaluating success, whether success is to be measured by the size of the reduction in the gap

between the better and the worse off groups, or by improvements in the worst group compared to where it started before the intervention.

The weakness of the study described above was mainly around its methodology. The authors did not specify an exclusion criterion for studies that were not reviewed. In addition the inclusion criterion was not based on methodological soundness of the studies nor was it based on study designs. The approach of using expert opinion on selecting the appropriate studies should have been complemented by the description of the criteria that the experts used in deciding on the suitability of the studies. This has implications for the generalisability of the findings. For instance, the overrepresentation of articles from the developed world could be a reflection of the majority of research being conducted in those countries. If caution is not exercised in interpreting these results, assumptions could be made about the applicability of interventions informed by the research from only the developed world that could be based on inequities that arose from different underlying factors.

The first child health revolution highlighted the importance seeing child health as a key ingredient of development. It then prioritized mobilizing different stakeholders and established technical working groups to tackle child health. Furthermore the revolution was strengthened by a focussed package targeted at combating child mortality, which entailed key crucial, available and feasible interventions. Thereafter the re-emergence of child revolution highlighted the unacceptable state of child health globally, with the problem being more acute in Africa. The fact that children are dying from conditions that are preventable, with available, feasible and cost effective interventions is alarming. Of

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great importance are the low coverage levels of these interventions. The implications of low coverage levels are that interventions tend to reach the better off children first. Hence, they do not reach the children that require them most, further widening the equity gaps that already exist. Even though vast inequities have been demonstrated at regional and country level, measuring inequities in child health outcomes has received little attention. These historical lessons have been important in informing the current study, on which gaps should be addressed.

Recently Khan et al., (2005) investigated the relationship between geographic aspects of poverty and health in Tanzania. This piece can be considered as a contribution in elucidating pathways by which inequities in healthcare come to be. The relationship between the concentration of poverty and health outcomes, the availability of primary healthcare services, and quality of care and services utilisation was examined. The findings were that households within the poorest tercile had worse health status compared to households within the least poor tercile. Relatively poor households living in low poverty concentration areas were, on average, better off in terms of a number of health status measures than poor households living in high poverty concentration clusters. After controlling for household level socio-economic status, cluster level data showed that health facilities were located further away from the high poverty concentration clusters compared to the low poverty concentration clusters. The expected result was a relatively egalitarian geographic distribution of primary health care facilities because Tanzania has a socialistic past. Facilities in high poverty concentration areas had fewer healthcare providers and consequently experienced higher workload. Additionally, utilisation of

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selected primary healthcare facilities was found to be low. The authors speculated on the association of the quality of services delivered by health facilities as an important factor in explaining utilisation differences. However this could not be definitely concluded on since only cross-tabulations were performed. Even though the authors did a simple stratification (bivariate analysis), results highlight the consistent disparity that different indicators of health exhibit within this country. In this instance, individual residing within areas of high poverty concentration had worse health status, healthcare facilities were far from them, had understaffed healthcare facilities and primary healthcare utilisation was low. It is thus not suprising that the health status was worse because health status is influenced by service provision and utilisation. This study demonstrated that inequities exist even in the poorest countries. These findings supported the earlier findings on non-homogeneity of poor households, first recognized by Schellenberg et al. (2003). A weakness of the study by Khan et al. (2005) is the failure to acknowledge that the household measure of socio-economic status included both household characteristics and community level characteristics (such as availability of electricity, source of water). It is important to make such a distinction especially when one is looking at child health outcomes. Infrastructural factors have a direct impact. Diarrhoea is a prime example. Houweling, Kunst & Mackenbach (2003) compared four asset indexes as measure of socio-economic status to quantify inequities. The asset indexes comprised of consumer items ranging from a telephone to a television and a car; dwelling characteristics such as flooring material; type of drinking water source and toilet facilities used. The study demonstrated that inequities in under-5 mortality decreased upon the exclusion of water and sanitation items from the index and further decreased upon the exclusion of housing

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items. It was then hypothesized that the relationship between wealth as measured by an index that includes infrastructural factors and under-5 mortality would be explained by variables that have a direct effect on child mortality, apart from their indirect effect as indicators of economic status. In instances where countries have used an asset index that includes infrastructural factors which are also direct determinants of health, it becomes difficult to conclude whether the observed inequalities in mortality can be attributed to direct determinants of health rather than to economic status alone. The implications of these findings are that distinguishing between the rich and the poor will vary with the asset items included in the index. Thus the measure of socio-economic status influences the magnitude of health inequalities, and differences in inequities between countries or time periods may be an artifact of different wealth measures used. Zere & McIntyre (2003) present similar findings to Khan et al. (2005). Their study aimed at quantifying inequalities in health in South Africa by assessing the magnitude of inequalities in malnutrition of under-5 children that are attributable to socio-economic status. They found the following: first, children from the poorest 10% of the population were having 3-8 times more stunting than the richest 10% of the population.

Children in the lowest strata carry a greater burden of malnutrition. In addition stunting and underweight were found to be responsive to improvements in the socio-economic status of the household. The rates of stunting and low weight-for-age were highest amongst the African population group. However, there were greater disparities in nutritional status across income groups within the coloured community compared to the other population groups. Most importantly stunting had the highest prevalence in the

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Eastern Cape and Northern Province and these two provinces have the highest rates of poverty.

Income related inequalities increased with the degree of urbanization of the household areas of residence. The poorest bear the heaviest burden of stunting and underweight in all three areas of residence. Income related inequities were lowest in rural settings and highest in metropolitan areas. This study highlighted four important results. First, the positive correlation between household socio-economic status inequities and income related inequities since they both found pro-rich inequities. Second, the high concentration of stunting within poverty stricken provinces .Thirdly, the highest rates of stunting were seen in a previously marginalized and largely poor population. The magnitude of inequities varied in different population groups and in residential areas. This finding requires special attention as it highlights the importance of context specific interventions and should inform strategies aimed at addressing inequities. The first three results were expected results. Poor children have been shown to have worse health outcome compared to their better-off counterparts. Geographic, population group, household socio-economic status and income consistently confirmed the inequities.

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The WHO Bulletin recently published an advocacy piece on measuring inequities, advocating for equity-sensitive monitoring of the maternal and child health Millennium Development Goals (Wirth et al., 2006). The study group made use of Demographic and Health Surveys (DHS) data. The aim of tis study was to demonstrate measuring inequities is feasible, even in low-income and data-poor countries. Six countries was assessed using

11 health indicators and six social stratifiers. Both simpler and slightly complex stratification were perfomed to highlight the complexity of vulnerability. Given the complexity of health disadvantage, both the independent and interactive effect of social stratifiers was assessed. Not surprisingly, the results highlighted the complex and intertwined nature of inequities. Stratification by wealth, ethnicity, maternal education status, sex, region and urban/ rural residence yielded statistically significant differences across a wide range of health indicators in six countries. Ethnic, educational and regional variations were more pronounced than were the disparities attributable to differences in wealth. Within-country differences were also revealed. Different health indicators yielded different patterns of inequity. This was translated into interesting movements in observed inequities. For instance, in Cambodia, assessment of AIDS knowledge, delivery by a skilled attendant and under-5 mortality showed that AIDS knowledge was high and somewhat evenly distributed across socio-economic groups. On the other hand, rates of delivery by a skilled birth attendant and Under 5 mortality rate were grossly inequitable. Hence inequity in one health indicator did not imply inequity in another health indicator within the same country. These findings were in line with the findings of Houwelling, Kunst & Mackenbach (2003). The authors strongly argued against reliance on single indicators. They claimed to have demonstrated the importance of using comprehensive measures. As highlighted previously, socio-economic status is a complex variable to measure, with individual indicators having their own limitations. Therefore different measures serve as proxies for different aspects of socio-economic status. Different interactions with varying health outcomes were thus observed. But, argue the authors, the ultimate goal in trying to understand inequities origins and their size is that they should

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be remedied. Therefore seeking the most comprehensive indicators across a variety of health outcomes could be useful in mapping the ideal scenario for an equitable society. But it does little in terms of informing policy makers on appropriate feasible action required to reduce acute inequities. The authors have demonstrated the usefulness of the DHS data. It should be noted however, that the DHS data has its own limitations such as its sampling framework, data incompleteness and the fact that the DHS is not designed to look at inequities. Another surprising aspect was the absence of measures of infrastructure such as running water, sanitation and hygiene.

Continuing with the theme of the complexity of social stratifiers and health disadvantage demonstrated above. Taking the example of South Africa, Burgard & Treiman (2006) examined the trends and racial differences in infant mortality in South Africa, using data from 1987-1989 and from the 1998 South Africa Demographic and Health Surveys (SADHS). The average educational attainment was significantly higher in the 1998 sample for all age groups except for whites. The educational levels of Black and Coloured children in the 1998 sample were significantly higher and had improved significantly, whilst those of Asians did not change and white children showed a slight reduction. Black children were most likely to live in households with less than optimal sanitation conditions: in the 1987-89 samples, 60% lived in households with both clean water and a toilet, compared with 88% of Coloured children, 99% of Asian and 97% of White children. For Black and Coloured children, there was a significant increase between the two survey periods in the likelihood of living in households with both clean water and a toilet. The percentage of Black children residing in households with both clean water and a toilet improved from 60% (1987-89) to 65.1% (1998) and for Coloured

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children it moved from 88% (1987-89) to 93.8%. Logistic regression revealed there was a very substantial gradient in the risk of mortality – more than six times greater for Blacks than for Whites, with the other groups falling in-between.

Indeed, South Africa has had a political system of racial discrimination which entrenched privilege and increased inequities between different race groups, resulting in social inequality modeled along racial lines. This has resulted in the different patterns of morbidity and mortality among the different race groups as demonstrated in the above study. The advantage of tracking progress using race is likely to be short lived. As the advent of democracy has brought with it a quest for new identity free from racial labeling of the past, many persons are refusing/ not identifying themselves in terms of race. In addition race categories are not homogeneous. Whilst race and class differentiations used to almost completely overlap, this is to some extent no longer the case. There is a real danger that the continued use of race-based classification will obscure the relationship between poverty and ill-heath. Collection of health statistics using racial categories is now less practiced. Given the above argument, the value of looking at health outcomes using racial categories is questionable; it is for this reason that the value added by the use of race in measuring inequities is unclear.

Health disadvantage in child survival exists at every step along the pathway from exposure to risk factors, lowered resistance, inequities in coverage of preventative programmes, seeking appropriate healthcare and lastly obtaining effective treatment (Victoria et al., 2003).

In summary, the above literature has highlighted important concepts and practical experiences of researching inequities. Firstly, there is consensus in concluding on

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whether inequalities are inequitable. The key deciding factor is looking at whether the inequalities are unjust and potentially remediable. Potentially remediable as a characteristic in concluding whether inequalities are inequities is essential because when measuring inequities the ultimate goal is to remedy them. Therefore irremediable inequalities cannot be acted on. Secondly, there is also a pattern linking socio-economic status and poor health. The literature has demonstrated that socio-economic status is the most significant risk factor for ill health. At the same time, it has it has demonstrated the multifaceted complex nature of this topic. In its complexity and multifacetedness it was quite clear that poor socio-economic status is related to poor health, inadequate supply of health services and reduced demand of health services. The next section will focus on measuring inequities.

2.3 Measurement of socio-economic status

Socio-economic status is a latent variable, and therefore all measures are proxy measures. Each method has its inherent complications. Many authors have attempted to elucidate the pathways by which inequities in health come to be and to be perpetuated (McKinley& McKinley, 1997; Forester et al., 1999; Marmot et al., 1998; Wilkinson, 1996). One of the most prevalent theories concerns the role of socio-economic status, measured by education, occupation, income and wealth (Stewart & Simelane, 2005). Demographers measure SES using occupation, education, income, wealth, consumption or expenditure. Each measure is hypothesised to interact differently with health care. Occupation reflects the earning potential based on the attributes of economic activity of each household member. This in turn can impact on decision making of household consumption, which

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could include healthcare. Education on the other hand has two pathways. The first one relates to the fact that education is indirectly linked to occupation. Higher education increases one's opportunities of getting employed and earning an income. The second pathway relates to education being seen as an enabling factor in understanding health messages and thus increased chances of behaviour change (Bollen et al., 2001). Maternal education has been used independently as a predictor of child health outcomes such as infant mortality and others (Bawah, 2002; Montgomery et al., 2000). It has also been the focus in many developing countries in the absence of reliable income data. A study evaluating the components of different socio-economic status on growth stunting found the mothers' educational status to be the best predictor of child health outcomes in rural Uganda (Wamani et al., 2004).

Income is an important and desirable measure of SES. It reflects the household's purchasing power and it can allow households to purchase health producing services that can better health status (Gornick et al., 1996). Income has two dimensions: transitory income and permanent income. The former can be obtained from surveys and is considered to be variable from year to year reflecting accidents and chance events and it is not the basis of household consumption (Morris et al., 2000). The latter is not readily observed and reflects the nonhuman capital in the household, the earning potential of household members based on their attributes and it is considered to vary less considerably. Both concepts are most likely to have different relationships with household consumption and in turn have a unique relationship with health outcomes. Overall, criticism of transitory income as an indicator of SES is its variability over the

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life course due to both internal (health) and external factors (recessions) (Stewart & Simelane, 2005).

The use of income as a proxy measure for socio-economic status is problematic both in developing and developed countries. The main difficulties in using income as a proxy measure for socio-economic status are sources of data collection, measurement error and the reliability of the collected data. Difficulties related to the above three areas differ between the developing and developed countries. In developing countries, formal employment is less common. Lack of formal employment is compounded by multiple and changing sources of income and home production. Whereas in the developed countries problems experienced with the use of income data are measurement of self employment, informal economic activity and reluctance to disclose income (Quantitative Techniques for Health Equity Analysis Technical notes #4, 2004). As a consequence, the developing and developed countries' choices of measure for socio-economic status tend to be mainly influenced by the availability of data. Hence in developed countries income measurement is more common than expenditure; unlike in developing countries where there are a high proportion of formal sector and consumption patterns are complex. On the other hand, in developing countries consumption data is favoured over income. Availability of both income and expenditure data is not the only challenge with these measures; when available their reliability is often questionable.

The alternative has been to derive indexes of living standards. They have gained considerable merit for convenience (quick, easy and use a simple data collection method).

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The variables used to derive the indexes are easier to observe than income. Often, possession of durable goods and living conditions are used. Households are often asked if they own a radio, fridge etc., or asked about the type of toilet they use. These variables suffer less measurement and reporting error compared to income and expenditure. Once the researcher has decided on the variables that will be used to derive the index, the next step is to decide on a method of aggregating such proxies. The most commonly used method is to assign coefficients, or weights, to those observed variables, and sum them up. Several methods are used for assigning the weights; assigning a monetary value for durable goods, arbitrary approach, predicting consumption, from statistical considerations, such as the principal component analysis; or from other considerations, such as putting all coefficients to one. The most commonly used method for assigning weights is the principal component analysis (PCA). This method uses statistical techniques to determine the weights in the index. PCA suffers from an underlying lack of theory to motivate either the choice of variables or weights (Quantitative Techniques for Health Equity Analysis Technical notes # 4, 2004).

A breakthrough in proxy measures was the study by Filmer & Pritchett (2001), which has since been widely quoted in studies measuring SES using an asset index score. The study constructed a linear index from a set of asset indicators using principal component analysis to derive the weight of each variable. An important finding of this exercise was the coherence with current consumption expenditure. The findings were in favour of the index working as well as, or better than traditional expenditure based measures in predicting educational enrolment status in India. Thereafter Stewart & Simelane (2005)

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assessed the validity of a commonly used asset index as a proxy for socio-economic status. They concluded that the asset index and household income are extremely similar measures. Yet, both measures make a unique contribution in models of child mortality.

Even though there is generally an appreciation of the practicality and convenience of asset index scores and their contribution towards unpacking inequities, there are also valid concerns regarding the use of different variables to construct these scores in different studies. For instance World Bank staff has constructed an index that comprises consumer durables, water and sanitation facilities, housing quality and other amenities (Gwatkin et al., 2000). Other researchers have used much shorter lists (Bicego & Boerma, 1993; Timeus & Lush, 1995; Brockerhoff & Hewett, 2000; Justesen & Kunst, 2000; Devin & Erickson, 1996; Yassin, 2000; Hoa, Hojer & Persson, 1997). Hence the question: does the choice of living standard measure matter?

The first argument is that different approaches give different perspectives on the same issue. In turn, different perspectives lead to conflicting conclusions. The sensitivity of findings to the measurement of living standards is a matter of concern. Evidence is context specific; in some contexts it can drive conclusion in important ways, whereas in others it bears no significant difference (Houweling, Kunst & Mackenbach, 2003).

However, there is a lack of evidence on the extent to which the use of different measures of economic status affects the observed magnitude of health inequalities. Findings from Houweling, Kunst & Mackenbach (2003) revealed that differences observed in health

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inequalities could be attributed to the characteristics of the socio-economic variables. The characteristics were seen in terms of the relationship of the variable to the health outcome in question and the extent to which the variables are an indication of community wealth or household wealth. Results from this study contrasted with the findings of Filmer & Pritchett (2001), who found the ranking of households robust for the items included. Other criticisms of the article were that Filmer & Prichett (2001) only concluded from the analysis of one country, and did not analyse the sensitivity of the association of such ranking with health outcome like mortality.

Schellenberg et al. (2003) & Chowdbury et al. (2006) highlighted the convenience and usefulness of making use of the asset index in tracing how well health programmes reach the poor. However the weakness of these studies lies in a lack of clarity in their definition of socio-economic status. For instance, in the former study, the authors combined different measures of socio-economic status namely, household assets, income sources and level of education reached into a single measure of household wealth.

This literature review has highlighted that socio-economic status involves many dimensions. Income and expenditure have been shown to be difficult to collect data on, and to be unreliable. Asset indexes do not have the same limitations as income and expenditure data. However, many issues remain to be resolved, such as which items should be included in an index and how they should be weighted.

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CHAPTER 3

Methodology

This chapter provides an outline of the research design and methodology, the rationale of the methodology and its suitability for gathering the data needed to answer the research questions. This study takes the form of a secondary analysis. Firstly, the chapter outlines the primary study (Good Start study) and then describes the current study and justifies the methodology. It begins by briefly describing South Africa with a focus on economic indicators and health systems organisation.

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3.1 South Africa

South Africa's total population is just over 47 million (Statistics South Africa, 2006). Its GDP per capita was 8, 5 US$ in 2004. The total health expenditure as a percentage of GDP is 8.7%. The general government expenditure on health is 39% and the private expenditure on health is 61.4%. Private sector expenditure on health as a percentage of total expenditure on health rose from 55.2 in 1998 to 59.4 in 2002. Donor funding is insignificant, with an upper limit not exceeding 0.4% as a percentage of total health expenditure (WHO, 2006). Despite South Africa being ranked as a middle income country, enormous inequities exist in the distribution of socio-economic resources (Statistics South Africa, 2000). Post 1994, the South African government has made considerable efforts to reduce disparities. Strategies specific to health care were establishing the National Programme of Action (NPA) to implement a "call for children" commitment, providing free medical care for pregnant women and children under seven

years of age, and establishing a family and children section within the Ministry of Welfare (Lockhat & Van Niekerk, 2000). The new government introduced a plan that supports health for all South Africans, in the form of an expanded primary care based system.

3.1.1 Current state of epidemiology in South Africa

The current epidemiological state is concerning. A report by Bradshaw et al (2006) highlighted the simultaneous triple burden of infectious diseases related to poverty, emerging chronic diseases, and injuries. This is being compounded by the HIV/AIDS epidemic which is likely to double mortality rates, undermine gains in child survival, and halve life expectancy. Model estimates of the impact of the HIV/AIDS epidemic in South Africa have indicated that the overall infant mortality may have been falling slightly until about 1995, and then appears to have been risen and, by the end of the decade, to have surpassed levels of mortality in the early 1990s (Dorrington et al., 2002). Currently, the infant mortality is 48 per 1000 live births (Bradshaw et al., 2006). A comprehensive model of the HIV/ AIDS epidemic in South Africa has indicated that the incidence of HIV may already have peaked and begun to decrease; however, the number of people dying from AIDS each year has only begun to rise (Dorrington et al., 2002). 5.4 million South Africans were predicted to be HIV infected by mid-2006 (Dorrington, Johnson, Bradshaw & John-Daniel, 2006) but the number of HIV infected people is beginning to stabilise. The observed stabilisation has been attributed to the number of new infections slowing down to a point where it nearly matches the number of people dying. Findings from the antenatal HIV prevalence are in agreement with the findings from Dorrington, Johnson, Bradshaw & John-Daniel (2006). The antenatal HIV prevalence of women

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attending public health clinics has been on the rise. It started from less than 1% in 1990 to 26.5 % in 2001 (Department of Health, 2003). The more recent data on antenatal HIV prevalence suggest a continued increase from 27.9 (26.8-28.9) in 2003 to 30.2 (29.1-31.2). However, the prevalence in the youngest age group (teenagers) was estimated to be 15.1 % in 2005 compared to 16.1% in 2004, which confirms that the incidence of HIV is stabilising (Department of Health, 2005).

3.2 Primary study

The primary study (Good Start study) was a prospective cohort study. It was designed to determine the operational effectiveness of the PMTCT programme.

The objectives of this study were:

- To measure the total and post-partum vertical HIV transmission rate in a cohort of mother-child pairs at nine months.
- To describe infant feeding patterns (from birth to 9 months) of HIV positive and negative women, as well as their social, cultural and economic determinants.
- To describe the experience of HIV positive women in relation to disclosure and post-natal health seeking behaviour.
- To describe and compare morbidity, nutritional status and health care seeking behaviour amongst a cohort of mother-child pairs.

The study commenced in 2002 and was completed in 2004. Three South African sites were purposefully selected to reflect different socio-economic regions, health infrastructure, rural-urban locations and HIV prevalence.

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Table 3: Description of study sites

Site	Area	Antenatal prevalence of HIV
Kwa-Zulu-Natal	Umlazi (Peri-urban)	41%
Eastern Cape	Rietvlei (Rural)	28%
Western Cape	Paarl (Mixed peri-urban/rural)	15%

Source; Department of Health. (2005). National HIV and Syphilis Sero-prevalence Survey of Women Attending Public Antenatal Clinics in South Africa-2004. Summary Report. Pretoria, South Africa

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Participants were recruited from local PMTCT sites either antenatally or post delivery. Follow-up home visits were conducted until 36 weeks (9 months) after delivery (See Table 4: Data collection techniques). The sample sizes in table one were calculated to determine overall transmission at 36 weeks, of ±3.5% overall and ±5.0-7.5% per site. In other words, the study was powered at ±3.5 % overall and ±5.0-7.5% significance level. The overall loss-to-follow-up was 21%. The acceptable cut-off point for loss-to-follow up is 20 %. Beyond this level, concerns arise as it is thought that selection bias could have been introduced. However, the expected loss- to- follow-up on this study was 30%, and furthermore loss- to- follow-up was non-differential between the HIV+ and HIV- mother and child pairs (Chopra et al., 2005).

Data collection

All data were collected by either trained field researchers or trained community health workers (CHWs) using structured interviews with the mother or caregiver of the infant at the time of each visit. All interviews were in the preferred language of the subject (Xhosa, Zulu, Afrikaans or English).

Table 4: Data collection techniques

Recruitment and informed signed consent by qualified field researcher	• Either Antenatally at 34-36 weeks (preferred) or after delivery, prior to discharge
Perinatal medical record review by qualified field researcher	• Post-delivery - including antenatal, intra-partum, post-partum, PMTCT and any other relevant records
Semi-structured questionnaire and observation conducted by qualified field researcher	• After delivery, prior to discharge • 3 weeks post-delivery • 24 weeks post-delivery • 36 weeks post-delivery
HIV status of infants of HIV positive mothers & Hemocue test HGB (all infants)	• 3 weeks post-delivery • 24 weeks post-delivery • 36 weeks post-delivery
Viral load of HIV positive mothers & Hemocue test HGB (all mothers)	• 3 weeks post-delivery • 36 weeks post-delivery
Structured questionnaire conducted by local community health workers during home visits	• Fortnightly for first 9 weeks • Monthly from 12 weeks to 9 months

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Study Profile of the Goodstart study

A total of 891 women were enrolled in the Good Start study, 8 of whom did not complete the initial interview and were removed from the data base, hence a total of 883 women were enrolled with the initial interview. Of these, 626 (70.3%) had complete follow-up (36 week visit completed by the field researchers). There were 75 (8.5%) infant deaths. Infant death is considered a study outcome, so it is not considered a loss, but those infants were no longer available for follow-up visits. Twenty (2%) of the mothers died between delivery and 36 weeks postpartum. Seven of the infants remained in the study after a maternal death and the caregiver was interviewed, but no further maternal viral load data would be available. The other 13 infants were withdrawn from the study based on the decisions of the family members looking after the infant.

At the end of the study, the total number of children with outcome data was 701 (78.7%). (626 completed visits plus 75 infant deaths). In total, at 36 weeks post delivery there were 182 mother and child pairs who were lost to follow-up or who withdrew from the study. This loss/withdrawal rate of (21%) was lower than the estimated loss calculated during the study planning phase (30%). In the context of research studies conducted in non operational settings, an acceptable loss-to-follow-up is anything below 20%. However, in this study the expected loss- to- follow- up was higher than the norm. The decision to estimate the loss-to- follow- up at 30% was informed by insights gained from the evaluations of the 18 pilot sites. The pilot sites had shown a substantial loss-to-follow-up due to loss of patient follow-up and out migration to an extent where it featured as one of the reasons that the HIV outcomes of children at 12 and/or 15 months could not be measured. This indicated that in operational settings loss-to-follow-up would be high

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compared to a research study. Follow-up data up to the time of loss/withdrawal is included in analyses. It is important to look at loss-to- follow-up within studies because a substantial loss-to-follow-up is known to result in selection bias; especially if the loss-to-follow-up is differential between the groups. If the loss-to-follow-up is systematic amongst one group within the study population, then that limits the external validity of the study; that is, the study cannot be generalisable to the study population. But there was no differential in loss-to-follow-up between the HIV-positive and HIV-negative mothers across all three sites (see Table 5) and overall (21% vs 19%, p=0.57). There were substantial differences between the HIV-positive and HIV-negative mothers with regard to infant deaths (10% vs 3.7%, p=0.003) Table 5 shows the total number completing the 3, 24 and 36 week visits and loss-to-follow-up rates by site and HIV status.

Table 5: Study profile of the Good Start study

Site	Paarl	Rietvlei	Umlazi	Total
	N = 200	N = 266	N = 417	N = 883
Enrolled	149 HIV +	192 HIV +	324 HIV +	665 HIV +
	51 HIV -	74 HIV -	94 HIV -	218 HIV -
Loss-to-follow-up @ 36	14%HIV +	23% HIV +	23% HIV +	21% HIV +
weeks.	10% HIV -	16% HIV -	27% HIV -	19% HIV -
Overall loss-to-follow-up				
per site	13%	21%	24%	21%

3.3 Secondary study

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The Good Start study used HIV transmission and infant death by 36 weeks and HIV transmission as an outcome in evaluating the PMTCT programme success. However, underlying inequities continue to exist in South Africa with regard to socio-economic conditions and healthcare quality. Inequities in these areas could impact negatively on the success of the PMTCT programme. Hence it is important to measure these inequities in order to facilitate redressing them. In this study the aim is to measure inequity amongst a cohort of HIV positive and negative mother and child pairs in South Africa. Household wealth was the chosen proxy for socio-economic status. Inequity was analysed with regard to exclusivity in feeding, HIV transmission, infant mortality, and immunisation coverage at 24 weeks. The sample consisted of both HIV positive and negative women. The majority of the women were HIV positive. The HIV negative women were recruited in order to avoid potentially stigmatizing the research. The analysis included all the women. The only outcome measure that did not include HIV negative women was HIV transmission. Therefore the sample size varies depending on the outcome measures.

3.3.1 Methodology of measuring wealth

In Chapter Two, different methods of measuring socio-economic status were described. Of great importance, was the shift from the income and expenditure data to indexes of living standards. The attractiveness of indexes of living standard as measure of socio-economic status lies in the availability, reduced measurement error and reporting error as compared to income and expenditure data. The first step was to decide on which variables were going to be used to derive an index. The desirable choice is that all variables describe a common phenomenon, and the primary application that this research is looking at is household wealth.

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Four indexes were generated. The decision to have four indexes was informed by the current debates on measuring poor-rich inequities in developing countries. Within these debates two issues were highlighted as important with regards to indicators of choice. Firstly since the main objective is to measure household wealth, the variables have to be indicators of socio-economic status. It has become apparent that some of the variables that are indicators of socio-economic status are not only indicators of socio-economic status. In addition, some indicators of socio-economic status have other properties; for instance water and sanitary facilities are also directly linked to child health and survival, since lack of these facilities exposes infants to infections. Therefore, Mosley & Chen (1984) highlighted the importance of differentiating between indicators that impact directly or indirectly on health outcome in studies where the health outcome is child health.

The second issue is the inclusion of variables that are publicly provided or dependent on the availability of infrastructure at community level such as electricity, water and sanitary facilities. Distinguishing between household wealth and community wealth has become an important distinction in the literature, and researchers are expected to clarify whether they are to measure household wealth or community wealth. Following the above argument, if the aim is to measure household wealth, the asset index ideally should exclude indicators that work directly on health outcome and variables that are publicly provided or are reliant on availability of infrastructure at community level. Exclusion of these indicators is expected to yield smaller inequities in outcomes such as infant

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mortality. It has been shown that water and sanitation has decreased the under-5 mortality. This was attributed to the relationship between wealth as measured by the index that constitutes water, and sanitation and the under-5 mortality would be explained by variables that have an effect on child mortality apart from their indirect effect as indicators of socio-economic status (Houweling, Kunst & Mackenbach, 2003). The literature pays more attention to whether the asset index is reflective of the household's wealth or community health from a point of view of how the assets were financed. The source of finance for the assets is not essential because what we are interested in is the relative advantage that having these items present to the household, and not who paid for them. For instance a household of high income earners within an area that does not have running water, electricity and adequate sanitation would be subject to the same constraints as the other dwellers residing within the same community. In addition, they would be disadvantaged compared to their counterparts who reside within an area that have these publicly provided indicators. Therefore a comprehensive asset index should acknowledge that infrastructural assets play a role in living standards. For the reasons specified above, the first index only included consumer durables. An index was constructed with the following items: fridge, radio, TV, stove, telephone / cell phone and car. The choice of items was not based on any economic value of the items themselves; it was based on the availability of items, which were only indicators of socio economic status on the original data set and hence all were selected.

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The second index comprised of only infrastructural characteristics otherwise known as community wealth, namely main source of water, type of toilet and main fuel used for cooking.

The third index was the combination of Index One and Index Two.

The fourth index was a food inventory index consisting of food items present at these households at 24 weeks. (Field researchers observed these food items in the participant's households).

The decision to include the food inventory index was informed by two issues: data availability and the current state of food security in South Africa. Food prices have been escalating, creating a food security crisis. Food price increases have been reported to be more devastating on the working class and the ultra poor. For instance, workers spend more than a third of their income on food. The ultra-poor spend over 50 percent of their income on food and up to 20 per cent on maize meal alone. Given the above figures, food makes up such a high proportion of the poor's spending that it has devastating effects on the living standards of the poor. It was then logical to include the food inventory index to assess whether it would have any correlation to the chosen measure of socio-economic status in this study.

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Table 6: Asset items included in the indexes

Asset items included in the different PCA's	PCA 1	PCA 2	PCA 3	PCA 4
television	x		x	
refrigerator	x		x	
radio	x		x	
phone	x		x	
car	x		x	
drinking water		x	x	
type of toilet		x	x	
cooking fuel		x	x	
samp				x
beans				x
flour				x
maize meal				x
soup				x
oil				x
milk				x
meat				x
veg				x
fruit				x
rice				x
tea				x
sugar				x
eggs				x

X shows the items that were included in the respective asset indices.

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Once a decision was reached about which items to include in the index, the next step was to choose the method of dertemining the weights. The method of choice was a statistical technique called principal component analysis (PCA). PCA is a tool for summarising variability among a set of variables. It seeks to describe the variation of a set of multivariate data in terms of a set of uncorrelated linear combination of the original variables, where each consecutive linear combination is derived so as to explain as much as possible of the variation in the original data, while being uncorrelated with other linear combinations (Filmer & Prichett, 2001).

The asset index A_i for individual i is;

$$A_i = \sum_k \left[f_k \frac{(a_{ik} - \bar{a}_k)}{s_k} \right],$$

a_{ik} is the value of asset k for household i (above: individual), $\bar{a}_k$ is the sample mean, s_k is the sample standard deviation and f_k is the scoring factor for the first asset as determined by the procedure.

PCA was used to construct a single SES score for each index described in the section above. PCA extracts from a set of variables a few orthogonal linear equations to capture their common information.

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The first linear combination of variables (the first principal component [c_1]) contains the most information on the variation in the underlying set of variables. The x_{ij} terms refer to variable i for household j, and the y_{hi} terms refer to the factor loadings (linear coefficients) for component h and variable i.

The first linear combination is written as follows

$$C_1 = y_{11} x_{1j} + y_{12} x_{2j} + \ldots + y_{1n} x_{nj}$$

3.3.2 Other measures of socio-economic status

3.3.2.1 Maternal education

The primary study measured the women's education levels as the highest school standard passed. Under the current educational system in South Africa, primary education is comprised of the first four standards (Std) (Sub A, Sub B, Std 1 and Std 2). The next level is the higher primary with three levels (Std 3, Std 4, and Std 5). The last level is the high school, alternatively known as Secondary school, and covering the last five years of schooling (Std 6, Std 7, Std 8, Std 9, Std 10 - also known as Matric). In order to enter tertiary education, it is necessary to have successfully completed five full years of High/ Secondary school. The question was phrased in a manner that excluded Sub A and Sub B. Hence education was divided into 3 categories:

1. No education and primary education (which only comprised of standard 1&2)
2. Higher primary standard 3-9
3. Matric (Standard 10) was considered a separate category.

3.3.2.2 Household income

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Participants were asked to approximate the total household monthly income including all sources of income. However, information on household size was not collected. If the interest is in measuring household income, taking income alone without household size ignores the differences in household composition. Furthermore, it assumes the same utility for one monetary value. For instance, a household of 5 with a total monthly income of R5000 is better off than a household 10 with the same monthly income. In order to get correct estimates, it is necessary to adjust household estimates of aggregate consumption to reflect household size and composition. This is usually done by using a deflator, or an equivalence scale (Quantitative Techniques for Health Equity Analysis, 2004). But for reasons stated above none of these adjustments were conducted.

3.3.3 Child health outcomes

Four child health outcomes were measured. Child health outcomes were segregated into three outcome indicators and a utilization indicator. The choice of these outcome measures was mainly influenced by the PMTCT context. The South Africa PMTCT package includes HIV testing, antiretroviral prophylaxis, infant feeding counseling (presenting women with the option of exclusive formula feeding or exclusive breastfeeding), and provision of free formula to women who opt not to breastfeed. The most challenging part of the programme has been infant feeding for several reasons; avoidance of breastfeeding eliminates the risk of postnatal transmission of HIV. However, a meta analysis (WHO Collaborative Study Team on the Role of Breastfeeding on the Prevention of Infant Mortality, 2000) found that there was a six fold increased risk of mortality due to diarrhoeal disease in the first six months of life for infants who were not breastfeed when compared to infants who were breastfed, and a corresponding

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twofold increased risk of pneumonia deaths. Hence, based on this argument, it was sensible to choose outcome measures in line with the existing policy dilemmas. Infant feeding in the context of HIV, HIV transmission, infant death, and immunisation coverage is the crux of child health in South Africa currently.

Outcome indicators

Below is the description of the outcome indicators:

- **Infant mortality 0-9 months overall stratified by socio-economic status**

  1 representing a number of infants deaths from 0-9 months

  0 representing a number of live infants enrolled into the cohort study

- **HIV transmission- overall**

  1 representing a number of infants who were shown to be HIV infected by any assay (at 3, 24 or 36 weeks).

  0 representing a number of infants who were HIV uninfected at 36 week visit and those HIV uninfected at 24 week visit with no 36 week visit and no breastfeeding recorded from 20 week visit forward.

- **Changes in infant feeding 0-9 months, stratified by socio-economic status.**

Exclusive breastfeeding (EBF)

Exclusive breast feeding was defined as feeding on breast milk only in the 4 days before the study visit (3, 24, and 36 weeks). Infants who had only been given medications parallel to exclusive breastfeeding were considered to be exclusively breastfed. In addition infants who had only

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one lapse from exclusive breastfeeding with the addition of a non-milk fluid only were also considered to be exclusively breastfeed.

Exclusive formula feeding (EFF)

Exclusive formula feeding was defined as no breast milk in the 4 days before the study visit (3, 24 and 36 weeks)

Predominantly breastfed

Predominantly breastfed was defined as feeding on breast milk and/or water, tea, juices or medication, but no non-human milks or foods in the 4 days before the study (3, 24 and 36 weeks)

Mixed feed (MF)

Mixed feeding was defined as on breast milk plus medications, water, teas, juices, non-human milks or foods in the 4 days before the study visit (3, 24 and 36 weeks).

Utilisation indicator

- **Immunisation coverage**

  Number of infants who have received complete immunisation (BCG, OPV0, OPV1, OPV2, OPV3, DTP1, DTP2 and DTP3 at 24 weeks.

3.4 Missing values

The socio-economic status score could only be calculated for children with complete data for all the components; therefore children with missing data for any component of the score had a missing score. The analysis was not restricted to children with complete data

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for all variables, but was done separately for each variable. Consequently the number of children with missing data varies through the results.

3.5 Data Analysis

Investigators from the previous study had ongoing data checks, cleaned the data and had interim analysis to identify problems early. Analysis was carried out using Stata version 8 (StataCorp, 2003).

Exploratory data analysis was conducted using frequency tables. Numerical data were summarized using descriptive statistics such as the mean, median, standard deviation and range. Categorical data was summarized using percentages. The Shapiro-Wilk test and histograms were used to detect departures from normality. Linear associations between numerical variables were assessed by means of correlation analysis. Pearson's product moment correlation coefficient was calculated for normally distributed data and Spearman's rank correlation for skewed data. To determine statistical significance, on 0.05 cut off was used as the guide in assessing statistical significance. However, the exact p-values were presented together with the confidence intervals.

Variables entered on index one were individual binary indicators. Infrastructural variables (drinking water, type of toilet and type of fuel used for cooking) inputted on index two were originally captured (in the primary study) as discrete variables (see illustration1 below). However, for this analysis, dummy variables of each category of the discrete category were created (see Illustration 2 below).

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Illustration 1: Original format of the data set

What type of toilet do you use in the child's house?

(One response only)

1.	Flush toilet
2.	Pit latrine
3.	Ventilated pit latrine
4.	None
91.	Other
99.	Don't know

Illustration 2: Conversion of the original data set to dummy variables for use in PCA.

Flush toilet	**Yes**
	No
Pit latrine	**Yes**
	No
Ventilated pit latrine	**Yes**
	No

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Only three dummies for all three infrastructural variables were used, namely access to a flush toilet, piped water and electricity. This choice was influenced by two reasons. Firstly, none, other and do not know, became a natural elimination as they ranged from 0 - 2.8. Hence the PCA dropped them due to zero variance.

The second reason is related to the technicalities of using PCA for non continuous data. PCA was developed for samples from multivariate normal distribution data and most of the theoretical results, including the implicitly used consistency of the estimates of the factor loadings, were derived under the normality assumption. Kolenikov & Angeles (2004) point out the shortcomings of using discrete data in PCA in a form of dummy variables. Their main concern is the introduction of spurious correlations. They point out that dummy variables from the same factor are negatively correlated. In the presence of negative correlation, the PCA is unable to distinguish the main source of variance; that is, whether the variance is due to the correlation with the unobserved welfare (as we want it to be) or due to the correlations among the variables that belong to the common categorical variable.

In the initial analyses, all the dummy variables were entered for each discrete variable. The PCA generated incorrect estimates of the socio-economic status. Indeed, the PCA could not ascertain whether the variance was due to unobserved welfare. This was evidenced by the inconsistencies in the weightings allocated to respective variables. For instance the following inconsistencies were observed for water source piped water in the yard, piped public, (borehole/river, stream/water tanker) and other received -0.45, 0.23, 0.34, and 0.02 respectively.

Given the above two arguments, only one dummy was used for each infrastructural variable. Dummy variables used for each category were:

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- main source of drinking water [1= piped water inside the house, 0= (piped water inside the yard, piped water public, borehole/well, river/stream, water tanker/browser and rain water)]
- type of toilet [1= Flush toilet, 0= (pit latrine and ventilated pit latrine)]
- and main fuel used for cooking [1=Electricity, 0= (gas, paraffin, charcoal and wood)]

The other advantage of this method was a clean separation of the least poor from less poor, very poor, poor and most poor.

The unit of analysis can either be the household, comprising all family members living together or an individual within the household. The literature suggests that the choice of individual versus household can make a significant difference in grouping populations into quintiles. This had been observed in Benefit Incidence Analysis studies where a more pro-poor incidence of social spending on education could result, for instance when quintiles are defined by households rather than by individuals. Demery (2000) found this to be the case in Cote d'Ivore where the poorest quintile, defined by households, gained 29 percent of benefits from primary education compared with 19 percent when the quintile is defined by individual. Demery (2000) recommends defining quintiles by individuals (i.e. population quintiles) when a service is provided to individuals (e.g. students enrolled at a school but by households (i.e. household quintiles) when a service is provided to households (e.g., water and sanitation services). For the present analysis the unit of analysis was the household.

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The indexes were compared in the following respects. Firstly, the percentage of variance in the asset items that could be explained by the first principal component was calculated. Then, variables that received the highest weighting were assessed, focussing on whether the variables with the highest weights would be considered to advantage anyone who possesses them, given our context. For instance, a refrigerator is a relatively expensive item and hence not reflective of least poor household. In PCA 3 the refrigerator received the highest score.

The reliability of the asset index was assessed in two dimensions: its internal coherence, and its robustness. Internal coherence was assessed through looking at whether the asset index produced clean separations across the least poor to the most poor for assets that are indicative of least poor and assets that are indicative of most poor.
The robustness of the index was assessed by looking at the relationship between other socio-economic measures and the index of choice using cross-tabulations. The focus was on education, income and food inventory.

Having assessed the validity of the PCA and its reliability, the second feature to be examined was whether it was possible to stratify the population into five equally large wealth groups so that each household could be classified as most poor, very poor, poor, and less poor or least poor.

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To assess for trend on the observed inequities, a nonparametric test for trend across ordered groups was used. This test, developed by Cuzick (1985), is an extension of the Wilcoxon rank-sum test and is a useful adjunct to the Kruskal-Wallis test.

Chapter three has explained in depth the research methodology of the study, the next chapter will show detailed results of the research.

3.6 Ethics

The primary study (Good Start study) was granted ethical permission by the University of the Western Cape for the pilot stage and UKZN for the actual study. One standard informed consent and information form was developed in English and translated into the study languages (Xhosa, Zulu, and Afrikaans). There was one overall signed consent form at enrollment into the study, with verbal consent at each visit or data collection point thereafter, including prior to every blood sample or other specimen collection. If the mother refused consent for continued involvement then she and her baby were terminated from the study, with data up to the point of termination available for analysis. If the mother did not consent to blood spot testing only, during a visit then that blood spot was not obtained.

Permission to conduct a secondary analysis on this primary study was requested from the lead organisation and permission was granted by the Health Systems Trust. Ethical approval was granted by the Research Ethics Committee of the Faculty of Health Sciences, University of Cape Town, prior to the commencement of the secondary analysis.

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3.7 Data Limitations

This study was an observational study and no intervention was provided. However, mothers were visited by field researchers at their homes and were given compensation for their time, which was a total amount of R120 or a food coupon to an equivalent amount. Given low disclosure levels amongst HIV positive women, field researchers reported that women valued the data collection visits. It can be argued that this interaction could have served as a form of intervention since the women had someone to talk to about their status. This could have introduced bias in their health seeking behaviour.

The overall loss-to-follow-up was 21%. The acceptable cut-off point for loss-to follow up is 20 %, beyond this level concerns arise as it is thought that selection bias can be introduced. However, the expected loss-to-follow-up on this study was 30% and further loss-to-follow-up was non-differential between the HIV positive and HIV negative mother and child pairs.

Studies looking into inequities are often done on national household survey data with large sample size. Researchers conducting these studies are often faced with the challenge of estimating health outcomes. The strength of this study was the use of prospective data for health outcomes as opposed to estimates mostly employed in household surveys.

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CHAPTER 4

Results

This chapter analyses and interprets the results. The findings are explained by descriptive statistics and, to a lesser extent, measures of association.

4.1 Study profile

Table 7: Baseline characteristics of cohort women

Maternal factors	
Mean maternal age in years (SD)	25.1(5.53)
Formal education<8 years	487 (56.2%)
Approximate monthly income (R/ month) median (IQR)	735 (0-20 000)
Piped water	279 (35.63%)
Flush Toilet	358 (45.72%)
Use of Electricity/ Gas for cooking	343 (45.19%)

Table 7 presents baseline characteristics of cohort women. A mean age of 25 was observed. It was encouraging to note that the sample was not mainly teenagers. 56.2% of women had formal education. Poverty indicators indicated that this sample comprised of largely poor women living in underdeveloped areas. Only 35.63 % of women had piped water. The approximate total household monthly income ranged from no income to R20 000 per month. The household monthly income of R20 000 was an outlier observation.

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4.2 Asset index

Index One can be considered a more accurate measure of household wealth as it comprises of assets/ goods (consumer durables) that are indicators of socio-economic status alone, whereas Index Two comprised of variables that are not only indicators of socio-economic status but also have a direct effect on child health outcomes. In addition, they can be an indicator of community wealth. The two indexes (Index One and Two) were short and consisted of more homogeneous sets of items. As a consequence the categorization of households into 5 wealth groups was not possible. As a result, only Index Three was cross-tabulated with health outcome data. The percentage of variance that could be explained by the first principal component was highest for Index Two (69%). The percentage of variance decreased with the inclusion of consumer durable goods Index 3 (42%).

Table 8: Scoring factors and summary statistics for variables entering the computation of the first principal component.

	Scoring factors	Mean	Std.Dev
Fridge	0.382	0.484	0.5
Radio	0.231	0.658	0.475
TV	0.368	0.475	0.499
Stove	0.357	0.592	0.491
Phone	0.329	0.437	0.496
Car	0.161	0.073	0.26
Fuel	0.36	0.454	0.498

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Toilet	0.358	0.482	0.498
Water	0.379	0.354	0.478

Each variable was a binary variable taking a value of 1 if true, and 0 otherwise. The scoring factor is the weight assigned to each variable.

Radio had the highest proportion of ownership; 65.8% of the sample owned a radio. The radio was followed by stove ownership at 59.2%. 48.4% of the sample owned a refrigerator. It was interesting to note that the variables/assets that had the most ownership were consumer durables. The bottom half mainly comprised of variables indicative of infrastructure at community level namely; toilet (48.2%), type of fuel (45.4%) and water (35.4%). However, the TV (47.5%), phone (43.7%) and the car (7%) were also within this bottom half.

Fridge had the highest score of 0.382 followed by water with 0.379, a TV with 0.368, fuel with 0.3560 and a toilet with 0.358. It was interesting to note that the variables with the highest scores represented both variables that are only indicators of socio-economic status only and variables that are both indicators of socio-economic status and child health outcomes.

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4.3 The reliability of the asset index

4.3.1 Internal coherence for PCA 3

Least poor indicators

The index produced sharp differences across groups in nearly every asset - refrigerator ownership of 0% in the most poor compared to 100% in the least poor. 41.1% of the most poor possessed radio's compared to 91.4% possession amongst the least poor. 0% of the

most poor had piped water compared to 96.7% of the least poor. Even the car ownership, which had least variance due to very low ownership rates, produced consistent findings with other assets. 21.19% of the least poor possessed a car and the most poor possessed no car.

Table 9: Ownership of least poor indicators

Asset ownership	Most poor	Least poor
Refrigerator	0%	100%
Radio	41.1%	91.3%
Car	0%	21.19%

Variables indicative of poor conditions

The use of piped-public, borehole/well and river stream as the main source of water decreased with increasing socio-economic status. 34.4 % of the most poor compared to 0% of the least poor were using piped-public, river and stream and 21.2 % were using a borehole/ well. 80.8% of the most poor were using pit latrines compared to the 3.3% of the least poor. Wood usage as a source of fuel for cooking was 71.5% for the most poor compared to 0% amongst the least poor.

Table 10: Ownership of variables indicative of poor living conditions

Ownership of Pro- most poor indicators	Most poor	Least poor
Piped-public	34.4%	0%
Borehole/ well	21.2%	0%
River and stream	34.4%	0%

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Pit latrine	80.0%	3.3%
Wood	71.5%	0%

4.3.2 Internal coherence for PCA 4

Similarly to Index Three, Index Four produced sharp differences in food items that are considered basic and also luxuries. Samp presence in the household that day was 13.3 % amongst the most poor compared to 64.6% amongst the least poor. The presence of maize-meal was not markedly different amongst the most poor compared to the least poor; it was 69.5 and 97.6 respectively. Only 7.8 % of the most poor had meat compared to 96.1% of the least poor. The distribution of milk presence was skewed towards the least poor. Only 8.6 % of the most poor had milk compared to 89.8%. Lastly, 40.6% of the most poor had sugar compared to the overwhelming 100% of the least poor. It is important to note that all food item presence increased with increasing socio-economic status.

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Table 11: Distribution of food possession in the most poor quintile vs the least poor quintile

Food possession	Most poor	Least poor
Samp	13.3%	64.6%
Maize-meal	69.5%	97.6%
Meat	7.8%	96.1%
Milk	8.6%	89.8 %

Sugar	0 %	100

4.4 Equity

Equity was assessed by dividing the third index into quintiles, so that each household was classified as most poor, very poor, poor, less poor and least poor in terms of socio-economic status.

Table 12: Distribution of sample by wealth quintile

	Categories	Number (%)*(n=755)
Wealth quintiles	Most poor	151(20%)
	Very poor	152(20.1 %)
	Poor	150(19.9 %)
	Less poor	151(20%)
	Least poor	151(20%)

* The variables used to construct the Wealth measure were asked at three weeks. Completed visits at three weeks were 786. Of the 786 completed interviews, 31 were excluded due to missing data.

4.4.1 Robustness

The index of choice was in agreement with other measures of socio-economic status, namely education (last standard passed), food consumption (PCA 4 consumption) and income. For instance, Fig. 1 reflects levels of education increasing with increasing wealth quintile. Only 6.2% of the most poor had matric compared to 35% of the least poor whereas, 32% of the most poor had primary education as their last standard passed compared to 14.5 % of the least poor.

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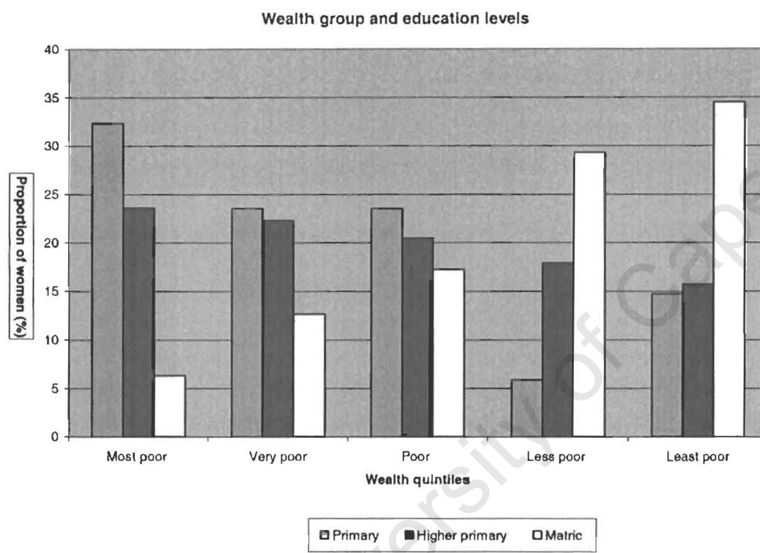
Fig. 1 Socio-economic quintiles and last standard passed



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Equity was assessed by dividing the first principal component into quintiles, so that each household was classified as most poor, very poor, poor, less poor and least poor in terms of socio-economics status.

Table 13: Distribution of sample by wealth quintile (PCA 4 food item index)

	Categories	Number (%)(n=637)
Wealth quintiles	Most poor	128(20.1%)
	Very poor	127(19.9%)
	Poor	130(20.4%)
	Less poor	125(19.6%)
	Least poor	127(19.9%)

*The food items used to construct the consumption index were observed by field researchers at 24 weeks. Completed visits at 24 weeks were 650. Of the 650, 13 were excluded due to missing data.

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The consumption index (PCA4) had a weak relationship with the chosen measure of wealth PCA 3. The Spearman correlation coefficient was 0.299(p-value 0.000).

In order to check the strength of the correlation, income was correlated with the proxy index. Both proxy index (for PCA3) and income were not normally distributed. Hence the Spearman rank correlation coefficient was 0.4201 (p-value 0.0000). This weak relationship is not surprising given that income is subject to measurement error and reporting error. However, it should be noted that the proxy index is moving in the same direction as income; in other words, income and the proxy index have a positive linear relationship.

4.5 Wealth quintiles by sites

The importance of looking at geographical location when dealing with inequities has been highlighted as important, where stratifying by wealth only masked greater inequities that were observed once the geographical substrata were added. Due to a small sample size the inequities in child health outcomes and utilisation indicator could not be stratified by site. Therefore the next option was to sub stratify the wealth index and food possession by site. The two food possession indices were compared to assess whether there would be differences in the observed inequities between and within the sites compared to the wealth index. The next set of results deals with the distribution of wealth across the three sites as measured by the wealth index and food possession index. Table presents wealth stratified by site.

Table 14: Sites by wealth index

		Wealth group									
Site	n	Most poor	%	Very poor	%	Poor	%	Less poor	%	Least poor	%
Paarl	189	21	11	33	17.5	40	22	50	26	45	24
Rietvlei	221	123	56	55	24.9	27	12	14	6.3	2	0.9
Umlazi	345	7	2	64	18.6	83	24	87	25	104	30

11% of the sample from Paarl was in the poorest category and 24% of this population was in the least poor category. Only 0.9% was in the least poor category in Rietvlei, compared to a 56% that were in the most poor category. In Umlazi, only 2% were in the most poor category. The within-site differences were high in Rietvlei and Umlazi.

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Rietvlei was largely poor whereas Umlazi was largely least poor. Paarl appeared to be less inequitable. Rietvlei, Paarl and Umlazi had vast differences in the most poor category - 56%, 11% and 2% respectively. Similarly, the least poor category reflected similar inequities where Rietvlei, Paarl and Umlazi had 0.9 %, 24%, 30% respectively. Umlazi appears to be the most better-off site.

Table 15: Sites by food possession (Pro-staple food items) at 24 weeks

		Possession of Pro-staple food items									
Site	n	Most poor	%	Very poor	%	Poor	%	Less poor	%	Least poor	%
Paarl	167	23	14	29	17.4	35	21	41	25	39	23
Rietvlei	172	33	19	40	23.3	26	15	28	16	45	26
Umlazi	296	74	25	56	18.9	68	23	56	19	42	14

Rietvlei had 19% of its respondents belonging to the most poor category, compared to 26% in the least poor category. In Paarl, 14% were in the most poor category compared to 23% in the least poor category. 25% of the Umlazi sample was in the most poor category, whereas 14% were in the least poor category. Inequities within sites were not vast. The inequity between sites was not vast either especially between Paarl and Rietvlei. Overall Umlazi appeared to be worse off compared to these other two sites and Rietvlei was better off.

Table 16: Sites by possession of all food items

		Possession of all food items

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Site	n	Most poor	%	Very poor	%	Poor	%	Less poor	%	Least poor	%
Paarl	165	27	16	31	18.8	34	21	40	24	33	20
Rietvlei	176	30	17	38	21.6	30	27	31	18	47	27
Umlazi	296	71	24	59	19.5	64	22	55	19	47	16

Rietvlei had 17% of its sample in the most poor category and 27% in the least poor category. Paarl had 16% in the most poor category and 20% in the least poor category. Umlazi had 24% in the most poor category, compared to the 16% in the least poor category. The inequity between sites was not vast either, especially between Paarl and Rietvlei. Overall, Umlazi appeared to be worse off compared to these other two sites, and Rietvlei was better off.

Interestingly, on the wealth index Umlazi was the better-off site compared to both Paarl and Rietvlei. Whereas on the food index Umlazi was the worst off site and Rietvlei better off.

4.6 Wealth quintiles and health outcomes

Infant deaths decreased with increasing socio-economic status. A quarter of the deaths were amongst the most poor compared to 11% in the least poor category. The observed trend on the inequities on the distribution of infant deaths approached the 5% significance level (p=0.06). In addition the exposed infants (most poor) were 2.3 times more likely to die in the period of zero to nine months compared to the unexposed (least poor).

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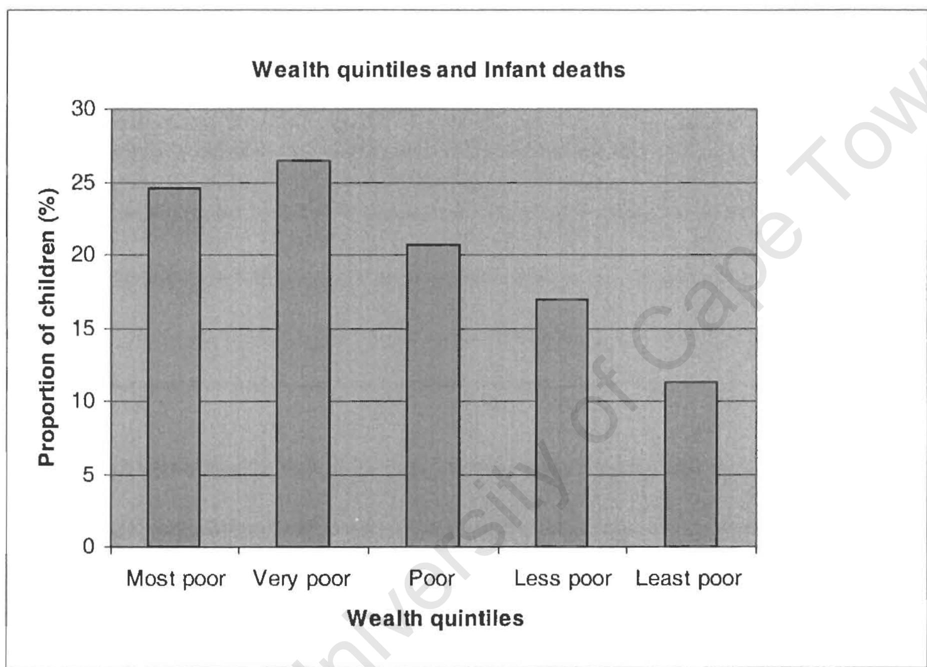
Fig 2 Socio-economic differences in infant deaths



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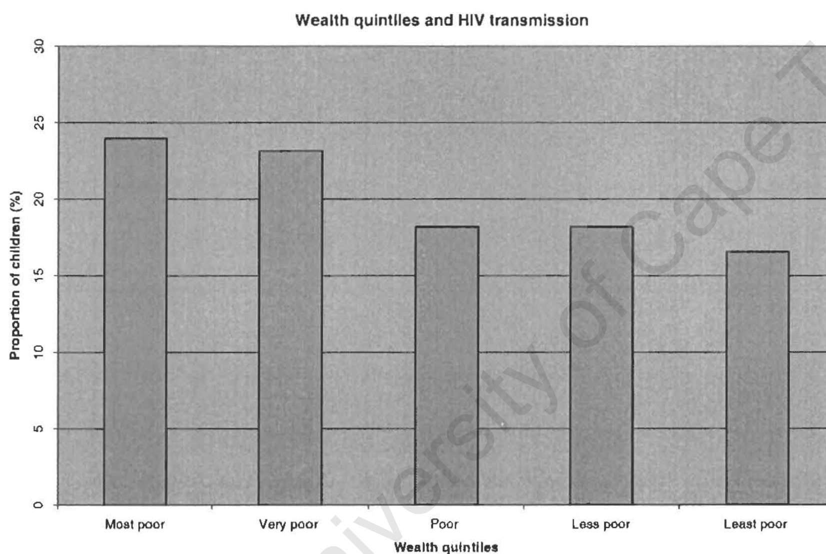
P = 0.06

Odds ratio 2.3 95% CI (0.78; 7.4)

See appendix B3.1 for calculation of the odds ratio and confidence interval

HIV transmission at 36 weeks (Fig 3) decreased with increasing socio-economic status. The observed inequities in HIV transmission were statistically significant at p=0.05. Transmission amongst the poor was 23.97 and the least poor had 16.53. The most poor mothers were 1.8 times more likely to transmit the HIV their infants.

Fig 3: Socio-economic differences in HIV transmission



P= 0.05

Odds ratio 1.8 95%CI (0.889; 3.747)

See appendix B3.2 for calculation of the odds ratio and confidence interval

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Table 17: Socio-economic differences in feeding groups at 12 weeks

	Socio-economic status quintiles										
	n	Most	%	Very	%	Poor	%	Less	%	Least	%	p-

		poor		poor				poor		poor	value
Feeding	630										
EBF	39	7	18	6	15.4	7	18	7	18	12	31
PBF	49	15	30.6	9	18.4	8	16.3	9	18.4	8	16
MF	224	45	20.1	39	17.4	47	21	44	19.6	49	22
EFF	318	70	22	68	21.4	53	16.7	64	20.1	63	20

There were no observed patterns within the feeding groups in relation to wealth quintiles. Reported exclusive formula feeding was evenly distributed across all wealth quintiles. Under ideal conditions, or in a developed country, these findings would be exciting and encouraging as they would suggest an equitable access to an important child health intervention. However, within a developing country context with the magnitude of inequities demonstrated in this sample, it is an issue of concern, due to uncertainties about the safety of formula preparations. In other words, can formula be prepared safely without exposing the child to infections such as diarrhoea and respiratory infections that arise from improper sanitary conditions, lack of proper storage and lack of clean water? Within this sample, the most poor performed poorly in all aspects of safety indicators. 80.8% of the most poor used of pit latrines, 71, 5% used wood, 0% had piped-water in the yard and 21.2 % were using borehole/ well. It is therefore a great concern that in less optimal conditions there is an equal use of feeding formula.

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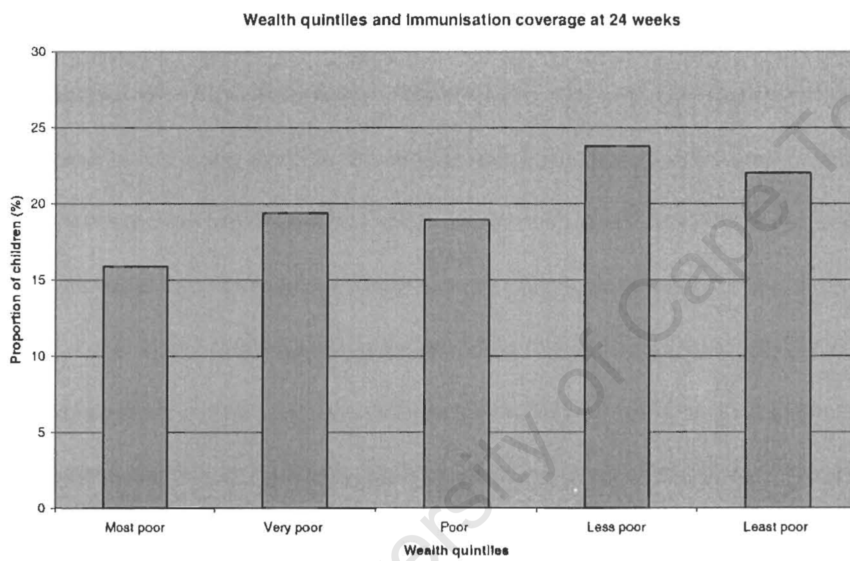
Immunisation coverage increased with increasing socio-economic status. Only 15.9 % of the most poor had completed immunisation at 24 weeks compared to 22.3% of the least poor. The observed inequity trend was statistically significant at p= 0.00.

Fig 4 Socio-economic differences in immunisation coverage



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P= 0.00

Odds ratio 0.4 95 CI (0.246; 0.776)

See appendix B3.3 for calculation of the odds ratio and confidence interval

CHAPTER FIVE

Discussion

5.1 The success of the chosen measure of socio-economic status

The first sets of objectives were mainly concerned with deciding a sensible measure of wealth within this sample. Four measures of socio-economic status were identified: wealth index (consumer durable goods and publicly provided goods), education, and income and food consumption. In this South African sample consisting of three purposefully sampled sites, the choice of consumer durables and publicly provided goods was a sensitive measure of household wealth for this context. In addition, Index Three was internally coherent and robust to other measures of socio-economic status. The household wealth index was positively correlated with all the other measures of socio-economic status, namely education, income and consumption. It was encouraging to note that they were moving in the same direction even though both income and possession were weakly correlated to household wealth measured in this study.

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Food security is an important aspect of poverty in South Africa. Estimates suggest that approximately 1.5 million South African children experience malnutrition, 14 million people are vulnerable to food insecurity and 43% of households suffer from food poverty (where monthly food spending is less than the cost of a nutritionally adequate very low-cost diet). More than 10% of children aged between 1-9 years are underweight and more than 20% of the children are affected by stunting as a result of malnutrition (Human Sciences Research Council, 2004). This study was not designed to investigate these

questions. This is an area that requires further exploration with a stronger tool and study design.

A comparison of the wealth index and food index yielded interesting results. Firstly, the magnitude of inequities within sites and between sites was smaller with the use of the food index compared to the wealth index. The change in magnitude within the sites was in Rietvlei and Umlazi. In Reitvlei for instance, 56% of the sample was most poor and secondly, the site that was most poor in the wealth index measure became the least poor with the use of the food index. And the site that was the least poor in the wealth index was the most poor in the food index. Clearly Rietvlei dwellers possess the least assets and lack basic infrastructure but nonetheless they had food in their cupboards and vice versa for Umlazi. The first question is what influenced the change in the observed inequities in the wealth index compared to when the food index was used? The second question is what influenced the shift of the least poor site with the wealth index to the most poor site when the food index was used? And the shift of the poorest site with the use of the wealth index to be the least poor site with the use of the food index. Two possible explanations were hypothesised. The first hypothesis was that individuals residing within an urban area could be eating out or buying on demand. However, in these communities the least poor do not represent the rich as indicated by the median income of R735. The second hypothesis relates to the type of food items included in the index. Economists distinguish between different types of goods on the basis of the extent to which demand for some goods varies with increase in income. Two types of goods will be discussed - normal goods and inferior goods. Normal goods are goods for which demand increases with

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increasing income. Inferior goods are goods that when income increases their consumption is reduced. Whether a good is inferior or not depends on the level of income. There are many goods for which demand decreases as income increases. In the case of this study, it could happen that poor individuals consume more of food items such as samp, maize-meal, flour and beans as income increases. But after a point, the consumption of samp/ maize-meal/bean would probably decline as income continued to increase. However, the food index consisted of food items required for nutritionally balanced meals. Even though overall the food items were basic, there were items that could be considered as "luxurious" in a poor society such as eggs, milk, sugar, meat and tea.

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The sensitivity of the associations of these different measures of socio-economic status with health outcomes measured in this study was not analysed. Bollen and colleagues (2002) demonstrated that the effect of economic status varied with the measure used and that the PCA-based method was most predictive. Houweling, Kunst & Mackenbach (2003) went a step further through their in-depth comparison of asset indices to show that even for this specific type of measure, the specific indicators influence the magnitude of observed inequalities. The index of choice included indicators that can be considered to be directly involved in the causal pathway of health outcomes. Researchers make a conceptual distinction between factors that have a direct relationship to health outcomes apart from their indirect relationship as socio-economic indicators such water supply, sanitation and electricity. Hence, some researchers would prefer an asset index that does not include direct determinants. It can be argued that all socio-economic measures are in

the causal pathway to undesirable health outcomes. The interactions and the manner in which these measures influence health outcomes and whether they are household characteristics or individual characteristics become important. Hence the inclusion of factors (source of water, type of toilet and main fuel) that act directly on health was not unfitting; these are community level factors that are also strong indicators of living standards. Therefore, excluding them from the analysis would mean excluding information that maybe highly relevant for assessing socio-economic status. Excluding education on the other hand was a sensible choice. Maternal education is known to be a highly significant correlate of child mortality. Higher levels of education in women are associated with increased autonomy, decision making power, a better ability to acquire and process new information and different attitudes towards health problems and health services than in women with minimal education. In addition, education is an individual characteristic not a household characteristic, even though it has been shown to have positive externalities to the entire household. However, when the PCA is applied to a homogeneous set of items it can produce odd results.

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5.2 Explaining the findings

5.2.1 Disparities in the availability of basic infrastructure similar to results from other studies

An important finding from this work was that an overwhelming majority of the most poor lacked basic infrastructure. For instance 0% of the most poor had piped water in their dwellings compared to 97% of the least poor. 34% of the most poor compared to 0% of the least poor were using piped-public, river and stream and 21% were using a borehole/ well. 80.8% of the most poor were using pit latrines compared to 3% of the least poor.

Wood usage as a source of fuel for cooking was 72% for the most poor compared to 0% amongst the least poor. Norman et al (2006) found that about 51% of the South African population had access to regular water supply and basic sanitation but 4% had no improved water supply and no sanitation. The majority of diarrhoeal disease (84%) was attributable to unsafe water sanitation and hygiene. In addition, approximately 9.3% of deaths and 7.4% of DALYs in children under-5 were attributable to this risk factor. Phashwana-Mafuya (2006) found that communities in the rural Eastern Cape neither had enough water (93%) nor treated drinking water (71%); a sizeable number did not store drinking water safely; (93%) had no proper disposal of waste water and solid waste in the rubbish pit (79%) where there are no toilets. Finally Mathee, Joffe & Naidoo (2006) acknowledged remarkable environmental health achievements in South Africa over the past decade. However, they highlighted an outstanding developmental agenda that remains and continues to pose, on a daily basis, environmental health hazards to large numbers of young South Africans. Cited in their presentation were the 2005 estimates of more than 9 million people still in need of a basic water supply, while more than 16 million people were in need of sanitation services.

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5.2.2 Disparities in the distribution of health outcomes

The second sets of objectives in this study were mainly concerned with using the wealth measure constructed from the first set of objectives to assess inequities in child health outcomes highlight those correlated. Only one indicator was not affected by household wealth: reported feeding at 12 weeks. Even though from an equity point of view this finding was encouraging, from a child health perspective it was concerning. Infant feeding recommendations from international organisations (World Health Organisation

and the United Nations Children Fund) provide idealistic recommendations of how HIV positive women should be advised: avoidance of all breastfeeding is recommended if replacement feeding is acceptable, feasible, affordable, sustainable and safe (AFASS) (WHO, 2000). Evidence from the existing programmes indicates that replacement feeding is often not AFASS, especially for poor women. In fact, in South Africa more and more HIV women from rural areas not meeting the four locally defined conditions necessary for safe replacement feeding (access to clean water, refrigerator, fuel for boiling water and regular source of income) are choosing to formula feed. Findings from this study are in agreement with local findings (McCoy et al 2002).

Infant deaths were by far the most disturbing finding. Overall, 75 (8.5%) infants died between birth and 36 weeks. Of the 75, 25% of infant deaths were amongst the most poor compared to the 11% which were in the least poor category.

In 1994, the government extended free basic healthcare to pregnant women and children under the age of six. Even in the absence of these major financial barriers, poor-rich differences existed in completed immunisation coverage at 24 weeks taken as a proxy for utilisation of health services. Immunisation coverage increased with increasing socio-economic status.

Inequities in the distribution HIV transmission were apparent. Again infants from the most poor households were 1.8 times more likely to be HIV positive compared to their least poor counterparts.

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The difference between the most poor infants and least poor infants was the likelihood of getting ill and utilisation of prevention strategies. The differences between rich and the poor are not new. The importance of these findings is in highlighting the heterogeneity of communities that are considered to be uniformly poor. These findings are in agreement with the findings by Schellenberg et al (2003).

The importance of economic status has long been recognized. The following statement bears testimony to the realization of the importance of economic status in health.
Twenty-five years ago, Theodore Cooper, then U.S Assistant Secretary for Health, observed:

> "It is one of the great and sobering truths of our profession that modern health care probably has less impact on the population than economic status, education, housing, nutrition and sanitation. Yet we have fostered the idea that abundant, readily available high quality healthcare would be some kind of panacea for the ills of society and the individual" (Auerbach & Krimgold, 2001, p.2)

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The above statement is as true today as it was then. Findings from this research confirm that subjects with low socio-economic status had more infant deaths, were less likely to have completed immunisation at 24 weeks, and were more likely to be HIV positive.

5.3 Policy implications

The appropriateness of feeding choice is a very intricate policy dilemma. HIV positive women from households with low socio-economic status in the South African context

would lack basic infrastructural resources required to safely use formula feed. If one were to follow AFASS, formula feeding would be inappropriate and breastfeeding exclusively would be the most appropriate choice in this context. The availability of anti-retroviral treatment has meant that the risk of MTCT can be reduced to below 2% in developed countries (Lallemant et al, 2004; Dabis et al, 2005). To achieve the above stated success of PMTCT, a functional PMTCT programme requires a number of steps to be undertaken:

a) Good quality HIV testing at antenatal care units
b) Acceptance and correct administration of antiretroviral therapy
c) Safe and appropriate obstetric practices
d) Continuity of care with counselling and continuous support for optimal infant feeding, regardless of infant feeding choice and postnatal care for mother and baby.

Local findings have demonstrated missed opportunities within the PMTCT programme that were manly due to health systems reasons. The health systems failures fell into two categories and included women not receiving their HIV test results until after delivery and the second category was women who knew their status but did not take Nevirapine. The latter category was a result of health staff giving the women incorrect instructions about when to take the tablet and not supplying the women with the tablet. The missed opportunities resulted in incorrect or no administration of antiretroviral therapy (Nkonki et al., 2006). This scenario typifies the inappropriateness of blanket roll-out of interventions to all provinces even though they have differing needs. Again, the cascading events leading to poor health outcomes experienced by poor children

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previously described in child health literature is mirrored here, where poor children are more exposed to risks for disease, less likely to be resistant to infectious disease, and least likely to uptake new and preventative interventions (Wagstaff et al., 2002). The literature on infant feeding is focussing on changing or influencing the individual's behaviour through various messages targeted towards empowering women in making appropriate and sustainable choices given their context, whereas we should be judging the appropriateness of the intervention at the site/community level. Aiming to only influence individuals' behaviour in an indigent society shifts the burden of difficult decision making from health systems to patients. Interventions should therefore be rolled out discriminately in order to ensure that in instances where the health system is crumbling, the intervention is tailored to give special emphasis to those health systems aspects that can compromise the intervention.

Recent findings show that even with the developments made post 1994; there are communities in South Africa that still lack basic infrastructural services. Advocacy around the provision of basic infrastructural services such as running water, adequate sanitation and electricity is required urgently. Findings from this study demonstrated that inequities still exist and affect the most poor. Children from the most poor households had worse health outcomes compared to their least poor counterparts. It is important to monitor health outcomes with equity sensitive indicators. However, if they are not followed with action aimed at remedying them.

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5.4 RECOMMENDATIONS

This section outlines recommendations arising from this research. The recommendations are:

- The measurement of socio-economic status will continue to be an evolving process mainly influenced by data availability. In the meantime, feasible, affordable and reliable measures of socio-economic status that are applicable for our resource setting exist. However, this does not mean that the choice should be seen as mechanical or mutually exclusive. The rationale for the choice is what should be emphasized. Given that there are useful measures in our setting, consistent monitoring of 'child health in this case is required at both provincial and district level, to adequately assess the beneficiaries of child health programmes.
- Further research is required to assess food security in different settings within South Africa that is, in rural, peri-urban and urban areas. To firstly assess the extent to which food security is a problem in these different settings. Secondly, to design intervention tailored to suit differing community needs.
- The roll-out of child health programmes should be equity sensitive; that is, programme planners should realise one-size-fits-all rollout strategies are not effective in reaching communities that have suffered chronic deprivation and marginalization. Thus, it is important to recognize underlying lack of basic infrastructural services such as running water, adequate sanitation and electricity would undermine child health programmes especially PMTCT. Therefore, to

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ensure that children who are in greater need of health interventions access and benefit from health interventions, delivery strategies should be informed by principles of vertical equity.

- Broader sharing of findings of this nature to civil society, other governmental departments is essential. In order to ensure broader cooperation in delivering basic infrastructure such as running water, adequate sanitation and electricity are addressed, especially in cases where these compromise the success of health interventions such as in the case of this study, where resources are made available in improve child health and yet their benefits are not realised due to persistent injustices.
- Overall, findings from this study suggest that the underlying inequities that continue to exist in South Africa with regard to socio-economic conditions and poor socio-economic status exposes infants to ill health and that these inequities will need to be addressed in future programme planning before the potential success and improved child health from this programme are realised for all South Africans.

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APPENDICES

APPENDIX A: DATA COLLECTION TOOLS

These are tools from the primary study (Good Start study). The tools are First interview, 3 weeks, 24 weeks and 36 weeks interview. The questionnaires included here are not the full version questionnaires, only sections with relevant information to the current study were included.

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A.1 FIRST INTERVIEW WITH MOTHER

BARCODE:

Interviewer code:

MOTHERS'S INITIALS: Init: _____

DATE OF INFANTS BIRTH (dd/mm/yyyy): DOB: ___/___/_____

DISCHARGE DATE- MOTHER (dd/mm/yyyy): DDM: ___/___/_____
DISCHARGE DATE- BABY (dd/mm/yyyy): DDB: ___/___/_____

1. General characteristics (of the mother):

1.1 Age: _________years

MOTHER'S DETAILS (***Mothers only - Not primary caregivers***)

1.2 Last Standard Passed

1.3 Marital Status *(One response only)*

1.	Single – Never married
2.	Married – monogamous relationship
3.	Married – polygamous relationship
4.	Widowed
5.	Divorced/separated
6.	Co-habiting
93.	No response

1.4 Mother's main activity during the day *(One response only)*

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A.2 HOME VISIT: 3 Weeks Post-Discharge

Verbal consent obtained for continued study participation (home visits & DBS)

BARCODE: [ ]

Interviewer code [ ]

MOTHERS'S INITIALS: Init: _____

DATE OF HOME VISIT (dd/mm/yyyy): DHV1. ___/___/_____

1. STATUS OF MOTHER *(One response only)*	1. Alive	2. Dead If yes fill in death notification form	96. Unable to locate If yes complete loss-to-follow-up form

2. STATUS OF BABY *(One response only)*	1. Alive	2. Dead If yes fill in death notification form	96. Unable to locate If yes complete loss to f/up form

3. If unable to locate mother- reason why: *(One response only)*

1.	Heavy rains
2.	Mother left the area
3.	Mother refusing to respond
91.	Other

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Household Information:

What is the main source of water used for drinking in the child's household at this time?

(One response only)

1.	Piped – inside house
2.	Piped – yard
3.	Piped – public
4.	Borehole / well
5.	River / Stream
6.	Water tanker / Bowser
7.	Rainwater tank
91.	Other
99.	Don't know

1. Container with lid/cap	Co[illegible] w[illegible] lid/cap	[illegible] water)	99. [illegible]on't [illegible]now

4.3 What type of toilet do you use in the child's house?

(One response only)

1.	Flush toilet
2.	Pit latrine
3.	Ventilated pit latrine
4.	None
91.	Other
99.	Don't know

4.4 What is the main fuel used for cooking in the child's house?

(One response only)

1.	Electricity
2.	Gas
3.	Paraffin
4.	Charcoal
5.	Wood
91.	Other
99.	Don't know

4.5 Do you use (at least 1x /week) a fridge or freezer for household food in the child's house?

0. No	1. Yes	99. Don't know

4.6 Is anyone living in the household currently employed?
(permanent, part-time, piece work)

0. No	1. Yes	99. DKN

What is the approximate total monthly household income? R

Do you have any of the following?

2.	Radio
3.	Television

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4.	Stove
5.	Telephone/cell phone
6.	Car

Blood Test

Blood samples were taken at 3, 24 and 36 weeks visits. Therefore the below section on taking blood samples was only under the 3 weeks tool.
If mom is HIV+ then do Dried Blood Spots from baby for HIV and measure Hb
If Mom is HIV- then just do Hb

I would now like to take a few drops of blood from (name of baby) heel?

Date & Time of Specimen (PCR) ______________________

Date & Time of Specimen (Hb) _______________ Hb result -------------------------

Date & Time Specimen sent to Lab _____ _______________

____

THANK MOM FOR THE INTERVIEW.
EXPLAIN TO MOM THAT A CHW WILL BE VISITING HER EVERY MONTH AND THAT YOU WILL RETURN WHEN BABY IS 9 MONTHS OLD.
(If mom is HIV+, reassure her that her status is confidential and that the CHW will not know her status unless she (the mom) decides to disclose to the CHW)
ASK HER IF SHE HAS ANY QUESTIONS?
GIVE HER YOUR CONTACT DETAILS IN CASE THERE IS ANY PROBLEMS REGARDING THE STUDY?

COMMENTS & NOTES:

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A.3 HOME VISIT: 24 Weeks

Verbal consent obtained for continued study participation (home visits & DBS)

BARCODE: [ ]

Interviewer code [ ]

DATE OF HOME VISIT (dd/mm/yyyy): ___/___/_____

1. STATUS OF MOTHER *(One response only)*	1. Alive	2. Dead If yes fill in death notification form	96. Unable to locate If yes complete loss-to-follow-up form

2. STATUS OF BABY *(One response only)*	1. Alive	2. Dead If yes fill in death notification form	96. Unable to locate If yes complete loss to f/up form

If unable to locate mother- reason why: *(One response only)*

1.	Heavy rains
2.	Mother left the area
3.	Mother refusing to respond
91.	Other

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CHILD IMMUNIZATION

Ask to see the infant's RTHC:

YES, SEEN 1
YES, NOT SEEN 2

NO............................ 3

	CODE	DATE OF IMMUNIZATION
A. BCG	01	
B. OPV0	02	
C. OPV1	03	
D. OPV2	04	
E. OPV3	05	
F. DTP1	06	
G. DTP2	07	
H. DTP3	08	

How many times has the child been to the clinic as recorded on the RTHC? *(if DKN enter 99)* [ ]

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Food Security

Would it be OK for me to see your food cupboard?

0. No	1. Yes	99. Don't know

- *If Yes, Note presence or absence of items on list*

Food Inventory List (circle yes or no in each column):

Item	(A) In Cupboard	
Staples		
HV. SAMP	Yes	No
HV. Beans	Yes	No
HV. Flour	Yes	No
HV. Mealie Meal	Yes	No
HV. Soup	Yes	No
HV. Sugar	Yes	No
HV. Eggs	Yes	No
HV. Rice/Sorghum	Yes	No
HV. Tea/Coffee	Yes	No
HV. Peanut Butter	Yes	No
HV. Oil	Yes	No
HV. Milk	Yes	No
HV. Formula	Yes	No
Other		
Meats	Yes	No
Vegetables	Yes	No
Fruits	Yes	No

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APPENDIX B: STATA OUTPUTS

B1 Data exploration of SES variables

B1.1 Frequency tables

. tab waters

Q41 main source of water for drinking	Freq.	Percent	Cum.
Piped-inside	279	35.63	35.63
Piped-yard	196	25.03	60.66
Piped-public	169	21.58	82.25
Borehole	48	6.13	88.38
River	83	10.60	98.98
Water tanker	2	0.26	99.23
Rain water	3	0.38	99.62
Other	3	0.38	100.00
Total	783	100.00	

. tab toilets

Q43 type of toilet	Freq.	Percent	Cum.
Flush toilet	358	45.72	45.72
Pit latrine	339	43.30	89.02
VPitlatrine	37	4.73	93.74
None	27	3.45	97.19
Other	22	2.81	100.00
Total	783	100.00	

. tab cookfuels

Q44 main fuel used for cooking	Freq.	Percent	Cum.
Electricity	343	45.19	45.19
Gas	44	5.80	50.99
Paraffin	213	28.06	79.05
Charcoal	1	0.13	79.18
Wood	157	20.69	99.87
Other	1	0.13	100.00
Total	759	100.00	

tab fridge

4.12 possess fridge	Freq.	Percent	Cum.
0 does not possess	405	51.53	51.53
1 possesses item	381	48.47	100.00
Total	786	100.00	

tab radio

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```
4.12 possess radio |      Freq.     Percent        Cum.
-------------------+-----------------------------------
0 does not possess |        264       33.59       33.59
  1 possesses item |        522       66.41      100.00
-------------------+-----------------------------------
             Total |        786      100.00

tab  tv

   4.12 possess tv |      Freq.     Percent        Cum.
-------------------+-----------------------------------
0 does not possess |        408       51.91       51.91
  1 possesses item |        378       48.09      100.00
-------------------+-----------------------------------
             Total |        786      100.00

tab stove

4.12 possess stove |      Freq.     Percent        Cum.
-------------------+-----------------------------------
0 does not possess |        322       40.97       40.97
  1 possesses item |        464       59.03      100.00
-------------------+-----------------------------------
             Total |        786      100.00

tab phone

4.12 possess phone |      Freq.     Percent        Cum.
-------------------+-----------------------------------
0 does not possess |        442       56.23       56.23
  1 possesses item |        344       43.77      100.00
-------------------+-----------------------------------
             Total |        786      100.00


tab car

  4.12 possess car |      Freq.     Percent        Cum.
-------------------+-----------------------------------
0 does not possess |        730       92.88       92.88
  1 possesses item |         56        7.12      100.00
-------------------+-----------------------------------
             Total |        786      100.00

swilk proxy_index_pca3

                   Shapiro-Wilk W test for normal data
    Variable |    Obs       W           V         z       Prob>z
-------------+-------------------------------------------------
proxy_inde~3 |    755    0.96323     17.958     7.069  0.00000

. swilk income

                   Shapiro-Wilk W test for normal data
    Variable |    Obs       W           V         z       Prob>z
-------------+-------------------------------------------------
      income |    696    0.57686    191.958    12.823  0.00000

spearman   proxy_index_pca3 income

 Number of obs =      667
Spearman's rho =        0.4201

Test of Ho: proxy_index_pca3 and income are independent
    Prob > |t| =        0.0000

. sum income

    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
      income |       696    1078.217    1222.772          0      20000
```

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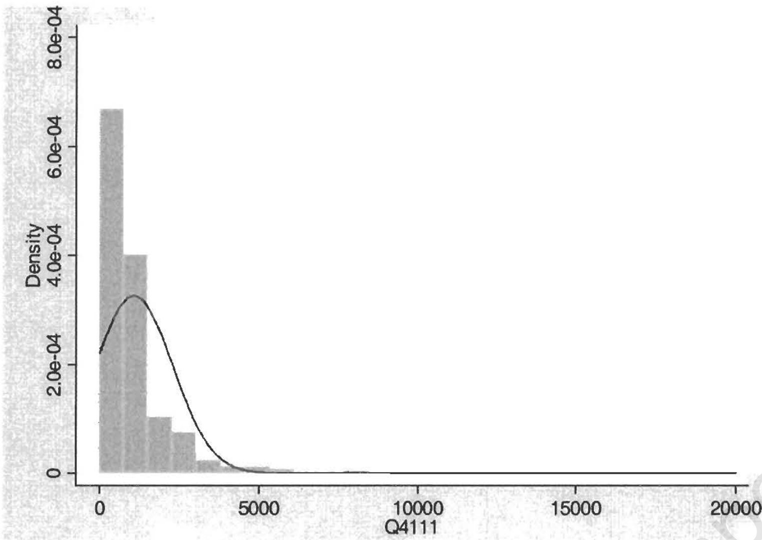
```
. histogram income, normal
(bin=26, start=0, width=769.23077)
```



tab education group

edugroup	Freq.	Percent	Cum.
1	2	0.23	0.23
2	37	4.18	4.41
3	141	15.93	20.34
4	491	55.48	75.82
5	214	24.18	100.00
Total	885	100.00	

tab education groupnew

edugroupnew	Freq.	Percent	Cum.
1	39	4.41	4.41
2	632	71.41	75.82
3	214	24.18	100.00
Total	885	100.00	

```
spearman   proxy_index_pca3 quint_pcac4

 Number of obs =      610
Spearman's rho =        0.2992

Test of Ho: proxy_index_pca3 and quint_pcac4 are independent
    Prob > |t| =        0.0000
```

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B2 PCA's of the four different indexes

B2.1 PCA 1

```
pca fridge radio tv stove phone car
(obs=786)

             (principal components; 6 components retained)
Component     Eigenvalue       Difference      Proportion     Cumulative
-------------------------------------------------------------------------
     1         2.61972          1.71281         0.4366          0.4366
     2         0.90691          0.10507         0.1512          0.5878
     3         0.80184          0.13662         0.1336          0.7214
     4         0.66522          0.06044         0.1109          0.8323
     5         0.60478          0.20326         0.1008          0.9331
     6         0.40152                .         0.0669          1.0000

                Eigenvectors
    Variable |     1           2           3           4           5           6
-------------+------------------------------------------------------------------
      fridge |  0.48121    -0.11688    -0.24125    -0.40665     0.23284     0.69065
       radio |  0.33585    -0.06106     0.92798     0.07918    -0.00077     0.12670
          tv |  0.48982    -0.12919    -0.05966    -0.34573     0.35001     0.70554
       stove |  0.39799    -0.28246    -0.23608     0.82445     0.16066     0.02370
       phone |  0.44129     0.03888    -0.13965    -0.06589     0.87828    -0.09237
         car |  0.25016     0.94055    -0.04305     0.15743     0.16152     0.00807

score proxy_index_pca1
             (based on unrotated principal components)
             (5 scorings not used)

                Scoring Coefficients
    Variable |     1
-------------+----------
      fridge |  0.48121
       radio |  0.33585
          tv |  0.48982
       stove |  0.39799
       phone |  0.44129
         car |  0.25016

tab  quint_dur

5 quantiles |
         of |
proxy_index |
       _dur |      Freq.     Percent        Cum.
------------+-----------------------------------
          1 |        186       23.66       23.66
          2 |        143       18.19       41.86
          3 |        154       19.59       61.45
          4 |        257       32.70       94.15
          5 |         46        5.85      100.00
------------+-----------------------------------
      Total |        786      100.00
```

B2.2 PCA 2

```
pca watcat1 toicat1 cookcat1
(obs=755)

             (principal components; 3 components retained)
Component     Eigenvalue       Difference      Proportion     Cumulative
-------------------------------------------------------------------------
     1         2.00622          1.39041         0.6687          0.6687
     2         0.61581          0.23785         0.2053          0.8740
     3         0.37796                .         0.1260          1.0000

                Eigenvectors
```

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Variable	1	2	3
watcat1	0.60583	0.32046	-0.72821
toicat1	0.59661	0.42254	0.68229
cookcat1	0.52634	0.84780	0.06480

```
score proxy index_pca2
          (based on unrotated principal components)
          (1 scoring not used)
```

Variable	Scoring Coefficients 1	2
watcat1	0.60583	-0.32046
toicat1	0.59661	0.42254
cookcat1	0.52634	0.84780

```
tab quint_pca2
```

5 quantiles of proxy_index _pca2	Freq.	Percent	Cum.
1	250	32.98	32.98
2	101	13.32	46.31
3	175	23.09	69.39
4	232	30.61	100.00
Total	758	100.00	

B2.3 PCA 3

```
. pca    fridge radio tv stove phone car watcat1 toicat1 cookcat1
(obs=755)
```

(principal components; 9 components retained)

Component	Eigenvalue	Difference	Proportion	Cumulative
1	3.79147	2.70705	0.4213	0.4213
2	1.08443	0.19666	0.1205	0.5418
3	0.88776	0.11080	0.0986	0.6404
4	0.77696	0.04560	0.0863	0.7267
5	0.73136	0.11913	0.0813	0.8080
6	0.61224	0.19151	0.0680	0.8760
7	0.42073	0.04238	0.0467	0.9228
8	0.37835	0.06166	0.0420	0.9648
9	0.31669	.	0.0352	1.0000

Variable	Eigenvectors 1	2	3	4	5	6
fridge	0.38235	0.10882	-0.00371	0.09137	-0.46895	-0.32395
radio	0.23112	0.38570	-0.57542	-0.36229	0.56431	-0.03907
tv	0.36820	0.22551	-0.17399	-0.09019	-0.41422	-0.34749
stove	0.35759	-0.25429	-0.24397	0.53483	0.14234	0.16296
phone	0.32987	0.25937	0.07069	-0.13614	0.26839	0.84740
car	0.16099	0.64157	0.49373	0.46272	0.28358	-0.14307
watcat1	0.36035	-0.31650	0.35038	-0.24973	0.24910	-0.06237
toicat1	0.35776	-0.23255	0.39655	-0.35038	0.22786	-0.04997
cookcat1	0.37996	-0.30122	-0.22427	0.38527	0.05814	-0.03574

Variable	Eigenvectors 7	8	9
fridge	0.62143	-0.00351	-0.35008
radio	0.11884	0.00778	-0.03591
tv	0.65584	0.09523	0.20892
stove	-0.22874	0.17987	-0.57481

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```
       phone |   0.02635    0.00224    0.09779
         car |   0.02884   -0.00781    0.05305
     watcat1 |   0.07708    0.68454    0.21065
     toicat1 |  -0.21760   -0.61780    0.23336
    cookcat1 |   0.24988   -0.32889    0.62522

score proxy_index_pca3
            (based on unrotated principal components)
            (8 scorings not used)

               Scoring Coefficients
    Variable |      1
-------------+----------
      fridge |   0.38235
       radio |   0.23112
          tv |   0.36820
       stove |   0.35759
       phone |   0.32987
         car |   0.16099
     watcat1 |   0.36035
     toicat1 |   0.35776
    cookcat1 |   0.37996

tab quint_pca3

5 quantiles |
         of |
proxy_index |
      _pca3 |      Freq.     Percent        Cum.
------------+-----------------------------------
          1 |        151       20.00       20.00
          2 |        152       20.13       40.13
          3 |        150       19.87       60.00
          4 |        151       20.00       80.00
          5 |        151       20.00      100.00
------------+-----------------------------------
      Total |        755      100.00
```

B2.4 PCA 4

```
pca sampc beansc flourc mealiemc soupc sugarc eggsc ricec teac fruitc vegc meatsc milkc
oilc
(obs=637)

            (principal components; 14 components retained)
Component    Eigenvalue     Difference    Proportion    Cumulative
------------------------------------------------------------------
     1        3.72381        2.49004       0.2660         0.2660
     2        1.23377        0.09511       0.0881         0.3541
     3        1.13865        0.14631       0.0813         0.4354
     4        0.99234        0.09045       0.0709         0.5063
     5        0.90189        0.04892       0.0644         0.5707
     6        0.85297        0.05492       0.0609         0.6317
     7        0.79805        0.01255       0.0570         0.6887
     8        0.78550        0.06608       0.0561         0.7448
     9        0.71942        0.04072       0.0514         0.7962
    10        0.67869        0.06279       0.0485         0.8446
    11        0.61591        0.06747       0.0440         0.8886
    12        0.54844        0.02465       0.0392         0.9278
    13        0.52379        0.03701       0.0374         0.9652
    14        0.48678              .       0.0348         1.0000

               Eigenvectors
    Variable |      1          2          3          4          5          6
-------------+------------------------------------------------------------------
       sampc |   0.19275    0.11815    0.60845   -0.32876   -0.15836   -0.36150
      beansc |   0.30029    0.10172    0.39215   -0.05872    0.25691    0.19063
      flourc |   0.22332    0.04503    0.40789    0.07856   -0.33507    0.46834
    mealiemc |   0.16011   -0.27589    0.18076    0.69815    0.24834   -0.18776
```

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```
       soupc |  0.28576  -0.15752   0.00326  -0.03772   0.60685  -0.00652
      sugarc |  0.33159  -0.31275  -0.07645   0.03708  -0.34309   0.05874
       eggsc |  0.25486   0.36874  -0.09975  -0.09722   0.10925   0.26535
       ricec |  0.29213  -0.31145  -0.06576  -0.39354   0.11684   0.13336
        teac |  0.28603  -0.33169  -0.05022   0.21979  -0.38120   0.00450
      fruitc |  0.23670   0.47468  -0.18767   0.13178  -0.19284  -0.26086
        vegc |  0.26040   0.15745  -0.26632   0.07631  -0.13332  -0.50232
      meatsc |  0.32035   0.23139  -0.23268   0.08084   0.05435   0.17029
       milkc |  0.30827   0.19999  -0.04620   0.11196   0.14067   0.33210
        oilc | -0.22796   0.29714   0.30312   0.37040   0.02001   0.16437

             Eigenvectors
    Variable |     7         8         9        10        11         12
-------------+-----------------------------------------------------------
       sampc |  0.04093  -0.13305  -0.17317  -0.08276   0.22706  -0.20495
      beansc |  0.24030  -0.04694   0.03553   0.13476   0.53859   0.24422
      flourc | -0.50302   0.27159   0.17899  -0.09852   0.08152  -0.08836
    mealiemc | -0.36340  -0.23541  -0.14013   0.10714   0.08856   0.13908
       soupc |  0.09020   0.38675   0.03017  -0.14767   0.34135  -0.39863
      sugarc |  0.19082   0.09826  -0.07292   0.02663   0.18287  -0.13252
       eggsc | -0.08672  -0.62496   0.11179   0.32711   0.33005  -0.14929
       ricec | -0.10180   0.16197   0.18380   0.38901   0.12689   0.53507
        teac |  0.46730  -0.17330   0.00914   0.06836   0.00181  -0.05688
      fruitc | -0.05953   0.33289  -0.39207   0.01674   0.30884   0.37203
        vegc | -0.16916   0.04891   0.69685  -0.07281   0.10098  -0.13567
      meatsc |  0.00610   0.17108  -0.31318   0.30603   0.46257  -0.36761
       milkc |  0.23957  -0.15249   0.08590  -0.66733  -0.01975   0.29963
        oilc |  0.43023   0.28126   0.34600   0.35173   0.22120   0.03440

             Eigenvectors
    Variable |    13        14
-------------+--------------------
       sampc |  0.36574   0.17694
      beansc | -0.44584  -0.10970
      flourc | -0.09311  -0.22866
    mealiemc |  0.11868   0.14620
       soupc | -0.08784  -0.24539
      sugarc | -0.48260   0.57258
       eggsc | -0.20130  -0.08942
       ricec |  0.30837   0.08841
        teac |  0.21709  -0.55541
      fruitc | -0.12599  -0.20691
        vegc |  0.07291   0.06877
      meatsc |  0.37055   0.20914
       milkc |  0.22155   0.21821
        oilc |  0.11730   0.17816

score proxy_index_pca4
            (based on unrotated principal components)
            (13 scorings not used)

             Scoring Coefficients
    Variable |     1
-------------+----------
       sampc |  0.19275
      beansc |  0.30029
      flourc |  0.22332
    mealiemc |  0.16011
       soupc |  0.28576
      sugarc |  0.33159
       eggsc |  0.25486
       ricec |  0.29213
        teac |  0.28603
      fruitc |  0.23670
        Vegc |  0.26040
      meatsc |  0.32035
       milkc |  0.30827
        oilc | -0.22796

tab quint_pca4
```

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5 quantiles of proxy_index _pca4	Freq.	Percent	Cum.
1	128	20.09	20.09
2	127	19.94	40.03
3	130	20.41	60.44
4	125	19.62	80.06
5	127	19.94	100.00
Total	637	100.00	

B3 Measures of association

B3.1 Infant deaths

```
cci 13 6 138 145
```

	Exposed	Unexposed	Total	Proportion Exposed
Most poor	13	6	19	0.6842
Least poor	138	145	283	0.4876
Total	151	151	302	0.5000

	Point estimate	[95% Conf.	Interval]	
Odds ratio	2.27657	.7786364	7.49518	(exact)
Attr. frac. ex.	.5607427	.2842965	.8665809	(exact)
Attr. frac. pop	.3836661			

Chi2 (1) = 2.75 Pr>chi2 = 0.0971

B3.2 HIV transmission

```
cci 29 20 59 74
```

	Exposed	Unexposed	Total	Proportion Exposed
Most poor	29	20	49	0.5918
Least poor	59	74	133	0.4436
Total	88	94	182	0.4835

	Point estimate	[95% Conf.	Interval]	
Odds ratio	1.818644	.8899227	3.747045	(exact)
Attr. frac. ex.	.4501398	.1236931	.733123	(exact)
Attr. frac. pop	.2664093			

Chi2 (1) = 3.15 Pr>chi2 = 0.0759

B3.3 Immunisation

```
cci 72 100 51 31
```

	Exposed	Unexposed	Total	Proportion Exposed
Most poor	72	100	172	0.4186
Least poor	51	31	82	0.6220
Total	123	131	254	0.4843

	Point estimate	[95% Conf.	Interval]

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```
     Odds ratio |         .4376471       |  .2455398    .7761433  (exact)
Prev. frac. ex. |         .5623529       |  .2238567    .7544602  (exact)
Prev. frac. pop |         .3497561       |
                +-------------------------------------------------
                          chi2 (1) =     9.19 Pr>chi2 = 0.0024
```

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