Household socio-economic status, social support and infant and child growth in urban South Africa: a cohort study from 1990.

by

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ABSTRACT

Background:

The rapid political, economic and social changes experienced by South Africans from 1991, combined with socio-economic inequalities ingrained in South African society at this time, made the early 1990s a unique and well-suited period to investigate child growth inequalities. Furthermore, recent estimates of low birth weight and stunting (≤ 3 years), showing prevalence of 15% (Chen et al., 2006) and 25.5% (Labadarios, 1999) respectively, indicate that poor intrauterine and postnatal growth patterns continue to represent considerable public health issues in this setting.

Methods:

This study aimed to investigate associations of birth measures of household SES and social support with infant/child growth in urban South Africa. Anthropometric, demographic, socio-economic and social support data for quantitative analyses were obtained from the 1990 Bt20 cohort (n=3275). Growth outcomes investigated included SGA (n=1544) and stunting at ages 1 (n=801), 2 (n=621) and 5 years (n=600). Statistical associations were investigated using logistic regression. Where SES or social support predictors were collinear, SES indices for inclusion in regression models were created using principal component analysis. Qualitative data were collected during interviews (n=25) and focus group discussions (n=47) with local Johannesburg/ Soweto residents. Thematic analysis was carried out, with data management facilitated by the use of NVIVO software.

Results:

The likelihood of SGA was positively associated with Indian ethnicity (OR=3.03; 95%CI 1.76 – 5.23) and negatively with multi-parity (OR=0.70; 95%CI 0.52 – 0.94). The likelihood of stunting throughout childhood (yrs 1-5) was negatively associated with female gender (OR=0.20; 95%CI 0.08 – 0.50) (yr 1), an SES index which included water & toilet facilities, ownership of a washing machine and type of cooking fuel (OR=0.16; 95%CI 0.05 – 0.55) (yr 1), mother's education (OR=0.48; 95%CI 0.25 – 0.91) (yr 2), mother's employment (OR=0.56; 95%CI 0.32 – 0.99) (yr 2) and family readiness for the pregnancy (OR=0.45; 95%CI 0.27 – 0.75) (yr 2). Increased likelihood of stunting was associated with SGA delivery (OR=2.81; 95%CI 1.30 – 6.09) (yr 2) (OR=4.98; 95%CI 1.97 – 12.57) (yr 5), living in a home at birth which had broken doors (OR=4.18; 95%CI 1.30 – 13.38) (yr 5) or which was troubled by bed bugs (OR=4.34; 95%CI 1.35 – 13.94). Results from qualitative research highlighted the importance of mother's education, childcare services and mother's readiness and desire for the pregnancy for infant/ child nutrition and caretaking

behaviours. The importance of water and sanitation facilities, medical insurance, mother's employment, childcare services and mother's education for infant/ child illness and growth were also emphasised.

Conclusions:

Many of the policy recommendations that stem from these results have, since 1994, been progressively implemented by the South African government's RDP programmes. In particular, progress has been made on children's education, employment creation, support for small industries and provision of infrastructure (e.g. sanitation). Remaining areas of concern include: infrastructure provision to informal settlements; education for parents and caretakers; large-scale unemployment or underemployment and provision of family planning services for young South African women.

LIST OF ABBREVIATIONS

ANC – Antenatal care

BMI – Body mass index

Bt20 – Birth to Twenty

CDC – Centre for disease control

DEXA - Dual Energy X-Ray Absorptiometry

FGD – Focus group discussion

FTT – Failure to thrive

HDI – Human Development Index

IMR – Infant mortality rate

INI – In-depth interview

IUGR – Intrauterine growth retardation

LBW – Low birth weight

LMP – Last menstrual period

LSDS – Living Standards and Development Survey

PCA – Principal component analysis

RDP – Reconstruction and Development Programme

SADHS – South African Demographic & Health Survey

SES – Socio-economic status

SGA – Small for gestational age

SMME – Small, Medium and Micro Enterprises

UNDP – United Nations Development Programme

WHO – World Health Organisation

GLOSSARY

Checkers, Pick & Pay – South African supermarket chains

Crèche - Day care centre

Geyser – boiler

Grades 1 & 2 – Years 1 & 2 (UK system)

Jik, Jez fluid – bleach cleaning agents

Masonite - plywood, used for roofing in shacks

Matriculation – national school leavers examination, A-level equivalent

Mbombayi – "appear/ disappear overnight", used to describe unregistered crèches

Medical Aid - private medical insurance

Panado – brand of paracetamol

Piecework – informal work (e.g. street vending)

Provincial Hospital – large tertiary hospital, usually serves a large region or province

Spuit – pipette used for enemas, non-Western medical practice

Standards 1–10 – Years 3–12 (UK system)

Well baby clinic – paediatric clinic for immunisations & routine growth monitoring

Yard – Back garden or space, within boundary of owner's property

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1. INTRODUCTION

1.1 INVESTIGATING SES AND INFANT AND CHILD GROWTH IN URBAN SOUTH AFRICA

This study aims to investigate the association between household socio-economic status, social support and outcomes of infant and child growth in urban South Africa. Data used are drawn from the Birth to Twenty (Bt20) cohort study, which was established in 1990 in Johannesburg and Soweto, South Africa. Outcomes of infant and child growth investigated include small for gestational age (SGA) and stunted at 1, 2 and 5 years. These associations are investigated principally using quantitative methods. However, a qualitative research project was also included in this study to obtain perspectives from local Johannesburg and Soweto residents regarding how they perceived certain measures of socio-economic status and social support to be related to infant and child growth in this setting.

Poor intrauterine growth, as represented by SGA delivery, and poor post natal growth during childhood, as represented by stunting, are considerable public health issues in developing country settings as well as in certain sectors of middle income countries (de Onis et al. 1998; de Onis et al. 1993). Although national South African estimates for SGA are not available, prevalence of another measure of small size at birth, low birth weight, is estimated at 15% (Chen et al. 2006). The national prevalence of stunting in children under the age of 3 years is 25.5% (Labadarios 1999). SGA delivery shows associations with increased neonatal and infant mortality e.g. (Kramer et al. 1990) as well as infant morbidity e.g. (Fonseca et al. 1996; Victora et al. 1992). Stunting during childhood shows associations with impaired cognition e.g. (Berkman et al. 2002) and potentially with infectious disease morbidity during childhood e.g. (Kossmann et al. 2000). In addition, both SGA and stunting show associations with adult onset disease (e.g. coronary heart disease, type II diabetes) or adult onset disease risk factors such as hypertension e.g. (Barker 1995).

Issues of infant mortality and morbidity from infectious disease currently represent a considerable health burden in South Africa. Estimates from the South African Demographic and Health Survey (SADHS) carried out in 2003 indicated that infant mortality rates (IMR) were 42.5/1000 live births (SADHS 2003). Estimates from the District Health Information System for Gauteng province, in which Johannesburg and Soweto are located, were 33.5/1000 live births (SADHS 2003). Recent estimates of the incidence of diarrhoea and pneumonia in children under the age of 5 years (for which treatment was sought) was also relatively high at 178.4/1000 and 241.0/1000 respectively and these estimates are thought to underestimate actual morbidity prevalence in South Africa (Ntuli 2002).

The future impact of these poor growth patterns in South Africa may, however, be larger still due to the emergence of adult onset conditions including coronary heart disease, type II diabetes and the metabolic syndrome. The 1998 SADHS report highlighted Ischaemic heart disease as an important cause of death among South African adults and estimated the prevalence of type II diabetes at 8%, hypertension at 13.2% and overweight or obesity at 19.4% and 9.1% among men, while the prevalence among women was estimated at 25.5% and 29.4% for overweight and obesity respectively (SADHS 1998). As such investigation of social and economic correlates of these growth outcomes is of substantial public health importance in South Africa (Bradshaw and Styen 2001).

The association between socio-economic status and measures of size at birth, child growth and malnutrition have been frequently investigated in developing country settings e.g. (Boyle et al. 2006; Kramer 1998). However, the data source used for this study (the Bt20 cohort) is unique and four characteristics make it particularly well-suited to investigate these associations. Firstly, the Bt20 cohort was established at a pivotal socio-political time in South African history, i.e. the last years of the Apartheid regime. This population-based cohort study is also the largest and longest running African cohort study and includes a large multi-ethnic sample of urban infants and children (Yach et al. 1991). In comparison to growth cohorts established prior to or contemporaneous with the Bt20 cohort, this study was also particular in the inclusion of growth information for pre school-aged children (Yach et al. 1991). Finally the inclusion of numerous household economic and, particularly, social measures of socio-economic status is also unique for a developing country cohort study and provides an opportunity to carry out a detailed investigation of such associations, the results of which may usefully inform policy.

1.2 OUTLINE OF THESIS CHAPTERS

This thesis consists of seven chapters. Chapter two includes an overview of the South African context at the time of this study (1990 –1995), an outline of the types of variables used to measure socio-economic and social support as well as an introduction to the main growth outcomes of the study; small for gestational age and stunting. Specifically, in section 2.1 a brief overview of relevant Apartheid policies, which influenced the distribution of socio-economic power, is included. An outline of the demographic, socio-economic and developmental characteristics of South Africa, Gauteng province and the Johannesburg and Soweto region is also provided. This chapter also covers the variables used to summarise socio-economic status and the methods for measuring these variables.

The second section of chapter two (section 2.2) covers the first growth outcome of this study, small for gestational age. Patterns and measures of intrauterine growth are summarised, as are the proximate, socio-economic and social support factors influencing this growth outcome. The second growth outcome of this study, stunting, is reviewed in section three of chapter two (section 2.3). As with intrauterine growth, patterns and measures of postnatal growth are summarised and the health and developmental consequences of stunting are also outlined. The proximate and socio-economic factors influencing stunting are also summarised in this chapter.

Chapter three describes the variety of methods used for data collection, management and analysis for both the quantitative and qualitative elements of this research. Quantitative methods are presented in sections 3.1 – 3.3. Section 3.1 outlines the aims, sampling framework and recruitment methods of the Bt20 cohort study. The measures of household socio-economic, social support, growth and additional data available from the Bt20 cohort are also presented in this chapter. Section 3.2 describes the data cleaning and data management procedures that were applied to the household socio-economic, social support, growth and additional data variables prior to use in analyses. Finally, quantitative data analysis methods are presented in section 3.3. The methods used to sample and recruit participants for the qualitative study are described in section 3.4. The collection of data from these participants used qualitative methods of in-depth interviewing and focus group discussions. Design and piloting of these interview and focus group guides is described as well as data collection and analysis procedures.

Results of quantitative and qualitative analyses are presented in separate chapters. Chapter four presents quantitative results separately for the growth outcomes of SGA, stunted at 1 year, stunted at 2 years and stunted at 5 years of age. Results presented for SGA include those from descriptive, bivariate and multivariate analyses (section 4.1). Bivariate results are presented by exposure variable i.e. proximate, education and employment SES exposures, home characteristic SES exposures, economic SES exposures as well as deprivation and household composition SES exposures. The structure of the presentation of results of stunting at ages 1, 2 and 5 years are similar to that for SGA. Results of stunted at age 1 year are presented in section 4.2, those of stunted at 2 years of age in section 4.3 and those of stunted at 5 years of age in section 4.4.

Results from qualitative analyses are presented in chapter five. The basic results of open coding are summarised in section 5.1. The summary of these results which are relevant to community informants (nurses, teachers and church leaders) is presented in sections 5.2 – 5.4. These three

sections are split into summaries of the effects of household socio-economic and social support measures on diet, illness and stress respectively. The summary of analysis results relevant to mothers and principal caregivers is presented in section 5.5. Again results findings are structured by influence on diet, illness and stress.

Discussion of results is also presented separately for SGA and stunting in sections 6.1 and 6.2. The factors influencing both of these growth outcomes are discussed in the context of existing research. Factors discussed for SGA delivery include ethnicity, parity, maternal smoking behaviour, and mother's desire for the pregnancy. Those discussed for stunting include age, sex, SGA delivery, sanitation and water facilities, mother's education, mother's work, household wealth and family readiness for the pregnancy. A number of strengths and limitations of this research study are also highlighted in this chapter (section 6.3). Finally, study conclusions are summarised in chapter seven. Conclusions for both growth outcomes (SGA and stunted) are presented together. The policy implications for the influence of household socio-economic status and social support on infant and child growth in urban South Africa are presented. Recommendations for future research as well as recommendations of areas where South African government policy may be improved are also outlined.

2. BACKGROUND

As this study aims to investigate the association of household measures of socio-economic status and social support with infant and child growth, it is essential to outline three areas. These include the South African context in which the study took place (particularly relevant to socio-economic and social support exposures used in this study)(see section 2.1), the measurement of exposure variables (i.e. household socio-economic status and social support) (see section 2.2), as well as the definition, measurement and public health importance of the two growth outcomes investigated (i.e. small for gestational age and stunting) (see section 2.3).

The characteristics of the South African setting which are relevant to the exposure measures used in this study include income, wages, employment, education, housing, provision of services by the local authorities and healthcare. These characteristics were largely shaped by economic, social and political policy in the decades preceding the study. As these policies were, in turn, primarily dominated by the National Party's "Apartheid" rule, a brief overview of this historical context is included. An outline of the African National Congress' post-Apartheid Reconstruction and Development Programme (RDP) is also summarised.

The measurement of socio-economic status for use in health outcome research is complex. Socio-economic status is not explicitly defined and although many researchers take the approach that socio-economic status influences health outcomes in a component manner, whereby different aspects of socio-economic status influence health in different ways, the choice of which socio-economic indicators to use and the measurement of these indicators is not frequently driven by theory. This may influence development and implementation of policy based on socio-economic risk factor research. Socio-economic status may also be measured at a number of levels including the household, community, regional and national level.

Traditional measures of household socio-economic status include income, occupational class and education. Additional economic measures, which may be more suitable for use in South Africa, include expenditure and consumption, wealth, financial strain, employment and health insurance. Additional social measures include social exclusion, social ties and integration, social networks and social support. Traditional community-level SES measures relevant to developed world contexts, such as the UK, include the proportion in occupational classes (e.g. manual), proportion of unemployed, proportion which attained a specific education level (e.g. A Level), proportion of home ownership, proportion of car ownership or proportion which are claiming state benefits (Lynch and

Kaplan, 2000). Additional area level measures include economic measures (e.g. income distribution), supply of services (e.g. sewerage), access to services (e.g. healthcare centres, parks), residential segregation and social capital.

Although background information relevant to the two growth outcomes is presented separately, firstly for SGA and secondly for stunting, the areas covered follow the same presentation format. The definition and measurement of both SGA and stunting are presented in an overview of patterns and measures of intrauterine and postnatal growth. The concurrent and future implications of SGA for mortality and morbidity are highlighted, including the effect on neonatal, perinatal and infant mortality; the effect on infectious disease morbidity during infancy; as well as that on chronic disease during adulthood. Similarly, the effect of stunting on child cognition and behaviour, infectious disease morbidity as well as growth and body composition are presented. Finally factors that may potentially influence SGA and stunting incidence are also outlined. For SGA these include obstetric, environmental, maternal and demographic, social support and socio-economic factors. In the case of stunting these include psycho-emotive, nutritional, infectious disease, demographic and socio-economic factors.

2.1 SOUTH AFRICAN CONTEXT AND MEASUREMENT OF SOCIO-ECONOMIC STATUS

SOUTH AFRICAN CONTEXT

APARTHEID – A BRIEF OVERVIEW OF RELEVANT POLICIES

The time period covered by this study (1990 - 1995) was one of considerable change throughout South Africa in general, as well as in the Johannesburg and Soweto areas. Substantial political changes which took place during this period included repeal of the Pass Laws and restoration of South African citizenship to Black nationals of the independent Bantustans, Black African "homelands" (1984). The South African presidency was also transferred from President P. Botha to President F.W. de Klerk. The incoming government acknowledged that power sharing was un-avoidable and negotiations with opposition parties, including the African National Congress, were necessary (1989). This contributed to the un-banning of a number of political opposition parties including the African National Congress and the subsequent release of Nelson Mandela and other political prisoners (1991). During this period the Bantustans (Black African "homelands") were also re-integrated into the Republic of South Africa (1993). In 1994, democratic national elections were held, which resulted in the election of President Mandela and the African National Congress as ruling party (Price, 1991).

Despite these positive changes, during and immediately prior to the study period, the urban areas of South Africa were marked by substantial unrest, insecurity and violence. The period between 1984 and 1989 was particularly tumultuous and resulted in the declaration of two States of Emergency. This period was characterised by frequent strikes, work and school "stay-aways", township barricades, sabotage of government property and boycotts (de Villiers, 1991). During this time police violence and intimidation, suppression of political opposition and suppression of the media were also common; for example, laws were repeatedly relaxed to increase police powers of detention and interrogation (de Villiers, 1991; Price, 1991). Violence between township residents was also common and increased by actions of Black vigilante groups (Price, 1991).

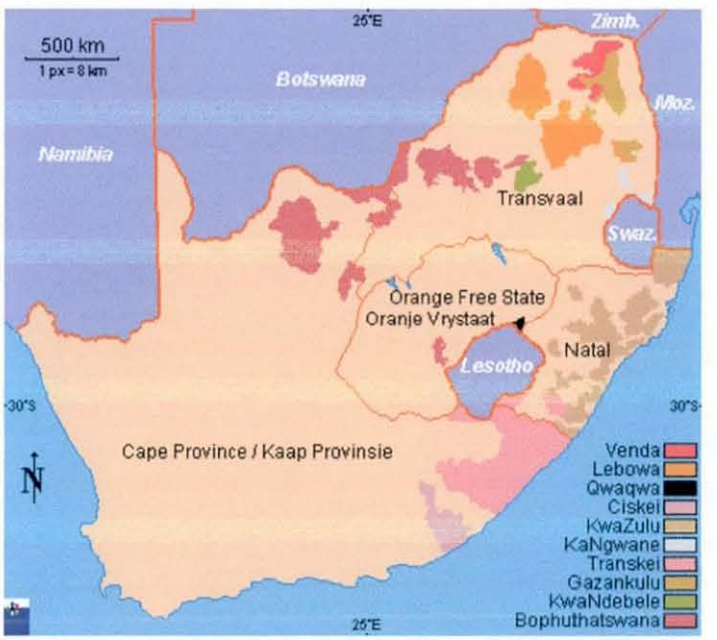
Therefore the time period of this study represented a period of change. However, the conditions prevalent during the study period also represented the culmination of previous political, social and policy decisions. As such it is also essential to emphasise the role of previous policy, especially that of "Apartheid", in shaping the distribution of exposure measures used in this study. Many of the historical influences that helped to shape the distribution of wealth, advantage and power in South Africa in the early 1990s had their origin in the first half of the twentieth century (e.g. the 1913 Land Act in which non-Whites were allocated ownership of only 13% of South Africa). However, it was not until the Nationalist Party came to power in 1948 that these influences were entrenched in official policy and Apartheid became ubiquitous. The establishment of Apartheid and its laws was not simply the result of extreme racial discrimination on the part of White South Africans or a desire for protection of Afrikaner cultural interests. It was also embedded in economic policy of the times and in particular the maintenance of a readily accessible and available pool of cheap labour for South Africa's labour intensive industries (e.g. mineral mining) (Price, 1991).

One of the key original policies of the Apartheid regime was the 1950 Population Registration Act, in which all nationals were allocated to a "population group"; White, Black or Coloured (mixed-race, Malays, Chinese and Indians). From this many other policies ensued that protected the White groups' interests, particularly economic interests, at a (high) cost to those of other groups. For example, the Group Areas Act and Pass Laws controlled access of non-White groups, in particular Black groups, to urban areas; only those with employment passes were permitted to reside and work in these areas. As such, women and families were frequently not admitted and households were split up. For those who were able to enter and work in urban areas, the Pass laws controlled what type of work they may be employed in as well as where they may be housed. Non-whites were often housed on-site or nearby their place of work (e.g. mines) in single-sex (male) hostels.

Others were housed in ethnic-specific townships that were frequently located far away from Johannesburg city centre and the residents' places of work in order to be separate from White residential areas. Furthermore, employees that were no longer fit for work (e.g. illness, injury) as well as those superfluous during periods of economic downturn could also have their passes revoked, entailing the loss of permission to reside in urban areas (Price, 1991).

Through the designation of "homelands", the Bantu Authorities Act (repealed in 1984) additionally controlled where Black groups who did not reside in urban areas could live (figure 2.1.1). These "homelands" were "granted" independence during the 1960s. This required the renunciation of South African nationality and citizenship by Black groups, which reinforced their position as "foreigners" in urban areas and prevented them acquiring land in the "Republic of South Africa". As a result of policies which stemmed from the Population Act, the distribution of employment, income, education, housing and public services including healthcare was strongly biased in favour of White groups, leaving other groups, particularly the Black groups, severely under-served (WHO, 1983). Through Apartheid economic, political and social policies the distribution of resources, wealth, capital as well as knowledge and skills; i.e. of "life chances" (Wright, 1985) were allocated specifically along racial lines and the accumulation of these assets by non-White, and in particular Black, individuals was almost entirely constrained.

Figure 2.1.1 Map of South Africa (pre 1993) showing Apartheid designated Bantustans (African "Homelands")



DEMOGRAPHICS AND SOCIO-ECONOMIC INDICATORS

Demographic Indicators

Statistical information from South Africa, including demographic information, was not routinely collected during the time period of this study. Under the Apartheid regime data from Bantustans was particularly lacking. However a number of sources do provide some data; these include surveys and censuses from 1988, 1990 and 1996 as well as the Living Standards and Development Survey (LSDS) from 1993 and the October Household Survey from 1995. Data from censuses and surveys illustrate the consequences of the Bantu Areas Act, as these indicate that during the study period a very large majority of White South Africans were resident in urban areas, particularly in the Western Cape, Eastern Cape and Gauteng provinces (figure 2.1.2). Conversely, between 40% - 60% of the Black population were resident in Bantustan regions (figure 2.1.1), areas which are currently in the Kwazulu Natal, Mpumalanga, Limpopo and North West provinces (figure 2.1.2).

Figure 2.1.2 Map of South Africa showing provinces (post 1993)

Table 2.1.1 shows the distribution of the South African population by ethnic group during the approximate time period of the study (StatsSA, 1991; Munro, 1992; StatsSA, 1996).Throughout the time period, a Black South African majority is obvious (table 2.1.1). According to the 1996 census, the population of the Gauteng province, in which the Johannesburg area is located (figure 2.1.3), was approximately 7.3 million (StatsSA, 1996). The estimated population for the Johannesburg area, including Soweto (figure 2.1.4), in 1996 was 2.6 million (StatsSA, 1996). The majority of the Johannesburg area population in 1996 was Black (70.2%), while 18.6% of the population was

White. A minority of the population at this time was Coloured (6.5%) or Indian (3.7%) (StatsSA, 1996).

Table 2.1.1 Estimates of the distribution of the South African population by ethnic group in 1988, 1990 and 1996

Ethnic group	1988 n (%)	1990 n (%)	1996 n (%)
Black	28,841,000 (75.5)	29,151,000 (73.8)	31,262,000 (77.0)
White	5,157,000 (13.5)	5,468,500 (14.3)	4,466,000 (11.0)
Coloured	3,285,200 (8.6)	3,594,500 (9.1)	3,654,000 (9.0)
Indian	993,200 (2.6)	1,106,000 (2.8%)	1,218,000 (3.0)
Total	38,200,000 (100)	39,500,000 (100)	40,600,000 (100)

Figure 2.1.3 Map showing location of the Johannesburg area within Gauteng province

Figure 2.1.4 Map showing location of Johannesburg regions including Soweto (regions 6 and 10)

Socio-economic Indicators: Employment, Income and Estimated Wealth

Employment during this time period varied widely by region and by ethnic group. Rural areas, including the Bantustans, experienced high levels of unemployment as well as insecure, seasonal or periodic employment (Price, 1991; Pillay, 1996). As shown in table 2.1.2, White and Indian ethnic groups at this time had high levels of active employment and corresponding low levels of unemployment. On the other hand, figures for unemployment in Black and Coloured ethnic groups were high (Pillay, 1996). As Apartheid laws closely controlled access to formal employment for non-White groups, informal employment (e.g. vending, sewing, taxi driving) played a large role in providing subsistence income to non-White groups during this period. For example, in 1989 informal employment was estimated to have made up 26% of Black income in South Africa (Pillay, 1996). Lack of employment in the formal sector was particularly concentrated in young people; 53% of those unemployed in 1991 were aged 16 – 24 years. This age pattern was also concentrated more strongly in Black groups; 65% of Black young persons were unemployed while 10% of White, 41% of Coloured and 25% of Indian young persons were (Pillay, 1996).

Table 2.1.2 Estimated prevalence of employment and unemployment in persons aged 16-64 years (1991)

	Actively Employed		Unemployed	
	Men	Women	Men	Women
Ethnic group	%	%	%	%
Black	46	27	35	45
White	82	60	5	7
Coloured	65	46	20	25
Indian	74	36	10	20

Monthly household income also showed variation by ethnic group. In 1991 the income of White households was 6.4 times that of Black households, 3.1 times that of Coloured and 1.6 times that of Indian households. Additionally, as non-White households tended to be larger, per capita monthly household income showed even wider discrepancies; 7.4 times more than Black, 4.4 times more than Coloured and 2.4 times more than Indian households (Pillay, 1996). Similar trends are reflected in per capita household expenditure data where White households spent 5.4 times more than Black, 3.7 times more than Coloured and 2.2 times more than Indian households respectively (Pillay, 1996).

Additionally, benefits from employment were not equally distributed throughout the ethnic groups. For example, old age pensions were allocated in a 3.6 : 3.0 : 3.0 : 2.3 ratio for White, Coloureds,

Indians and Blacks respectively, while certain benefits such as unemployment benefit were available only to Whites (Snyman, 1991). Ownership of consumer durables also showed variation between ethnic groups. For example, an estimated total of 91% of White households owned a car in 1991, while 70% of Indian and 10% of Black households did. Similarly over 95% of White and Indian households were estimated to own a fridge, while fewer than 30% of Black households were estimated to do so (Pillay, 1996).

Socio-economic Indicators: Education

Education also showed ethnic variations during this period. During the 1950s, under the Bantu Education Act, President Verwoerd had decreed that Black children were expected to receive education and training in "accordance with policy of the state" i.e. to fulfil the Apartheid state's need for cheap manual labour. As such, education for Black children was provided exclusively by the state and mission and charitable schools were closed. During the 1970s, however, South Africa's changing economic environment (downturn in mineral exports and increase in manufacturing) required an increased number of skilled workers. Consequently, the content and quality of Black children's education improved somewhat to meet this labour demand (Kallaway, 1984; Price, 1991).

Despite this change in policy, many non-Whites remained without access to education. In addition, the quality of schooling received by those with access remained poor. For example, in 1991 25% of women and 30% of men aged 25 – 29 years had obtained less than primary level schooling. Of those aged 30 – 49 years, over 45% of women and 30% of men had obtained less than primary level schooling. While the situation for those aged over 50 years was worse still, where 50% of women and 45% of men received no education and where 30% of both men and women in this age group received less than primary level schooling (Pillay, 1996). The school stay-aways of the 1980s as well as the differential funding allocated to different ethnic groups contributed to this backlog. For example, estimates from 1980 indicate that 2.92% of GNP was spent on education for Whites, 0.70% for Blacks, 0.50% for Coloureds and 0.25% for Indians, while the population of South Africa at this time was 17% White, 70% Black and 13% Coloured or Indian (Pillay, 1996). Furthermore teacher student ratios in 1991 were 1:18 for White schools, 1:25 for Coloured, 1:29 for Indian and 1:46 for Black schools (Pillay, 1996). Therefore, despite the improvements in educational content during the 1980s, it is unlikely that by the 1990s attainment of a specified level of schooling was analogous for all ethnic groups.

Socio-economic Indicators: Housing & provision of public services

Following the repeal of the Bantu Authorities Act in 1984 and the dissolution of the Pass Laws and subsequent control over the movement of non-White South Africans to urban areas, migration to South Africa's urban centres increased dramatically. The arrival of these new migrants compounded existing shortages of adequate, serviced and affordable township housing. As Apartheid law still imposed separate housing zones for different ethnic groups and construction of housing in townships was the responsibility of local authorities (building by other groups or individuals was in fact unauthorised and illegal), slum areas expanded dramatically around existing townships (Price, 1991). Although those living in shacks undoubtedly included the most poor and disadvantaged, lack of land available for building, severe housing shortages and upwardly spiralling rents also forced less poor Black households to live in slum areas (O'Leary, 1998). Estimates from 1993 indicate that 14.8% of Black households nationwide were shacks, while 32.4% of Black households in Gauteng province were shacks (Pillay, 1996).

From the 1980s township service provisions such as electricity, safe drinking water, sewerage and refuse removal were no longer the responsibility of the Apartheid government, but had been handed over to newly formed Black Affairs Administration Boards. These Boards were responsible for self-financing the costs of providing services, housing construction and community improvements and raised revenue by imposing dramatic and sustained rent increases on township residents. As such service provision during the study period for non-White, and in particular in Black, townships was well below that experienced by White residential areas of Johannesburg (O'Leary, 1998).

Socio-economic Indicators: Healthcare

In South Africa health care for those aged below six years of age and pregnant women was free from 1994, and from 1996 primary health care provision was also free at the point of delivery. However, at the time of the birth of the children in this study the services provided were chargeable, although fees could be paid by the state for poor patients on a means-tested basis. Payment of full or partial health service costs was also covered by a system of medical insurance schemes, known as medical aid. Medical aid coverage in 1991 was estimated at 16% nationally, however only 4% of Black South Africans had coverage, while the rate in White groups was 70% (Munro, 1992). During the time period of this study healthcare services were predominately public, with few charitable or mission hospitals. However, the private sector was expanding rapidly providing hospital, community clinic and specialist clinic care. For example, estimates from 1991 indicate that private healthcare

service usage was 39% (O'Leary, 1998). Non-White groups also utilised healthcare services provided by pharmacists and traditional practitioners (O'Leary, 1998).

Although strict racial segregation in access to public hospitals in South Africa no longer applied by 1990, the administration of healthcare services was still controlled by fourteen separate departments of health: one for each of the ten Black "homeland" regions (Venda, Lebowa, Qwaqwa, Ciskei, Kwazulu, KaNgwane, Transkei, Gazandulu, KwaNdebele and Bophuthatswana); and three for the Tricameral parliament groups of White, Coloured and Indian. Public hospitals were under the administration of provincial authorities while those of primary public healthcare services were under that of local authorities. As such health service provision was fragmented, inefficient and frequently duplicated (WHO, 1983). Healthcare service provision during this period was ineffectively distributed between hospital-based curative services and community based primary and preventative services, between geographical areas (both at the provincial and local level) as well as between ethnic groups.

During the time frame of this study the imbalance between tertiary and primary level health service centres had yet to be redressed. At this time the majority of resources were concentrated in the hospital (tertiary) sector which catered for curative services and outpatient care. The primary health sector, which covered preventative services, such as inoculations, as well as maternity and ante-natal care services, was severely under-resourced (WHO, 1983; Snyman, 1991; van Rensburg and Fourie, 1994; Gilson and McIntyre, 2001). In 1985 only 13% of the national healthcare budget was spent in the Bantustans, despite the fact that over a third of the nation's population resided there (Snyman, 1991). At a district level, richer areas were also much better served than poorer areas (Gilson and McIntyre, 2001). Estimates of per capita health expenditure in 1988 illustrate a positive White bias where an average of 596 Rands were spent per White South African, 356R per Indian, 339R per Coloured, while only 95R per Black South African (Munro, 1992). During the late 1980s in the Johannesburg area, 52 medical centres (hospitals and clinics) served half a million White residents, while the 2.5 million Black residents were served by only 14 centres (Munro, 1992).

RECONSTRUCTION AND DEVELOPMENT PROGRAMME

Following the election of the African National Congress to power in 1994, the government established a far-reaching and ambitious collection of development reforms under the umbrella of the Reconstruction and Development Programme (RDP). Some of the key RDP aims which are relevant to this study included child malnutrition, poverty, inequality and discrimination. The policies aimed to meet the basic needs of South Africans in terms of "jobs, land, housing, water, electricity, telecommunications, transport, a clean and healthy environment, nutrition, healthcare and social welfare" (le Roux, 1996). In particular, generation of employment and economic growth, provision of basic social needs (health, education, infrastructure, security/ crime) and an equitable social security support system were given high priority.

Policies to address child malnutrition included, for example, School Feeding Schemes. Those addressing employment generation included: land redistribution; development of the Public Works Programme (which both provided infrastructure and created employment); government backing of labour intensive industries as well as support of Small, Medium and Micro Enterprises (SMME) through organisations such as Local Business Centres (LBC), which provided non-financial support and advice to self-employed businesses (le Roux, 1996). Reforms in the area of health included the abolishment of fees for primary health service provision and the construction of large numbers of community clinics to provide local healthcare centres. From 1995 primary level schooling was made obligatory for all ethnic groups including Africans (Blacks); these reforms developed into free and compulsory schooling for the first 10 years of schooling. The Public works programme was developed to address provision of infrastructure (housing, electricity, water and sanitation). The provision of services was primarily under the remit of one body (e.g. Eskom for electricity, Rand Water for water) while the provision of housing was managed by the Municipal councils. Finally, reforms to the social security support system included establishing equitable access and service provision of statutory grants for social assistance (old age pension, disability, child support) and social relief (unemployment) (le Roux, 1996).

MEASUREMENT OF SOCIO-ECONOMIC STATUS

SOCIO-ECONOMIC STATUS, HEALTH OUTCOMES AND POLICY DESIGN

The research question of this study is concerned with the association between socio-economic status and outcomes of infant and child growth. However, socio-economic status also shows associations of increased morbidity from a number of infectious and chronic diseases e.g. (Winkleby et al., 1992; Victora et al., 1994). Research also indicates that mortality rates including infant mortality e.g. (Adler et al., 1994) and all-cause adult mortality e.g. (Marang van de Mheen et al., 1998) show socio-economic gradients, as do mortality rates due to suicide e.g. (Kasl and Jones, 2000), accidents, violent deaths e.g. (Lynch et al., 1998), cardiovascular disease, diabetes, the metabolic syndrome e.g. (Kaplan and Keil, 1993; Lynch, 1996), chronic diseases including arthritis e.g. (Adler et al., 1994) as well as gastrointestinal and respiratory diseases including tuberculosis e.g. (Cantwell et al., 1998). The effect of socio-economic status on health outcomes may be influenced by access to health promoting goods and services such as nutrition and health services as well as through health promoting behaviours including health seeking behaviours (Lynch and Kaplan, 2000). It is also suggested that socio-economic status may influence health through stress (Berkman and Glass, 2000) and emotional wellbeing (Kubzansky and Kawachi, 2000).

The continued existence of such socio-economic gradients in morbidity and mortality indicates that, despite the plethora of research evidence demonstrating significant associations, SES-related policies and interventions have not, in so far as substantially ameliorating health outcomes is concerned, completely fulfilled their potential. Much of this shortfall may be due to the challenges and difficulties related to policy implementation and uptake. However, effective policy design requires identification of specific risk factors and pathways through which these may influence the outcome and, as such, the way socio-economic exposure is defined, measured and utilised may also be important (Lynch and Kaplan, 2000; Bollen et al., 2001). Although over-simplified, emphasis on three aspects of socio-economic status measurement illustrates how socio-economic measurement may impact the usefulness of results from socio-economic risk factor studies. These aspects include theoretical background (whether SES measures have unitary or component effects), use of SES indices, and the level at which socio-economic status is measured (e.g. household, neighbourhood, region).

Whether socio-economic variables are hypothesised to effect health outcomes in a unitary or component manner may be important (Lynch and Kaplan, 2000). Under unitary approaches,

different measurements of socio-economic status may be used interchangeably as each taps into the underlying effect of socio-economic status. However, when using a component approach the effect of different socio-economic measures is theorised to influence health outcomes in different ways. Under this approach, therefore, the type of socio-economic measure used is critical and it remains important to retain the distinction between different SES measures used.

Although much health outcome research, including that investigating childhood growth outcomes, maintains a component approach (particularly during results interpretation), many studies also use SES indices, in which numerous different socio-economic measures are combined (Lynch and Kaplan, 2000). Such a contradictory approach may reduce the utility of such results for policy (Bollen et al., 2001; Bradshaw and Steyn, 2001; Geyer et al., 2006). For example, when SES indices are used in this manner, it is not possible to identify if all component measures in the index are significantly associated with the outcome. Nor is it possible to identify if all component measures in the index are associated in the same direction (i.e. positively or negatively). If it is the case that not all component measures are significantly associated with the outcome, it is also not possible to distinguish which are contributing and which are not. Therefore, although studies that use SES indices, which are simply collections of component socio-economic measures, may show significant associations with health outcomes, they may in fact not prove useful or helpful for health policy design.

The level at which socio-economic status is measured may also influence how results may inform policy design (Lynch and Kaplan, 2000). Policy designed on the results of studies using, for example, household estimates of income may not necessarily affect the health outcome desired if implemented at the neighbourhood or regional level, as area level measures may reflect contextual factors that are more than the sum of their compositional parts (Macintyre and Ellaway, 2000). Similarly, policy designed around household level measures and implemented at this level may not have the desired influence if the SES measure used was not exclusively located at the household level, such as piped water supply, which also depends on the infrastructure available in the local area.

MEASUREMENT OF SOCIO-ECONOMIC STATUS- HOUSEHOLD LEVEL

Traditional Measures

Three measures of household level socio-economic status, occupational class, income and education level, have been traditionally used in health outcome research in developed country

settings (Lynch and Kaplan, 2000). Measures of occupational class and income have been used for their close association with the material conditions of daily life (e.g. housing, food, medical care) (Lynch and Kaplan, 2000). The use of occupational class and income is also popular due to their reflection of purchasing power and access to heath promoting resources and services (Shaw et al., 1999; Lynch and Kaplan, 2000). Measures of occupational class have also been widely used in developed countries due to their reflection of exposure to occupational-related environmental risk (e.g. carcinogenic dyes, asbestos), exposure to workplace autonomy and stress (Marmot et al., 1997), and their reflection of an individual's relative social standing and status within a social hierarchy (Lynch and Kaplan, 2000). The use of education level has also been popular due to correlation with material conditions and access to higher status occupations and increased income (Shaw et al., 1999). However, the popularity of education level as a measure of socio-economic status is also due to the acquisition of, not only information, but skills and abilities that may be relevant to accessing health promoting goods and services (Cleland and Vanginneken, 1988).

Principally due to this second factor, the acquisition of skills and abilities, educational level has been frequently and successfully used as an indicator of socio-economic status in developing countries (Bollen et al., 2001). In contrast, the use of occupational class measures has been considerably more challenging due to difficulties in collection of high quality data as well as the fact that during the early 1990s no South African equivalent of the UK's occupational class categorisation existed. Principally due to the economic organisation and level of industrialisation of developing countries, the use of occupational class measures of socio-economic status, such as the UK Registrar General's classification (Szreter, 1984), may not be appropriate (Diderichsen et al., 2001). Indeed the utility of occupational class in developing country settings, such as South Africa, has frequently been restricted to categories of agricultural and non-agricultural occupations (Bollen et al., 2001). Such occupational class distinction is, however, of minimal use in the study of urban societies in developing countries.

The use of income in the South African setting may also be challenging. Collection of income in such a setting is difficult as South African households, like those in many developing countries, often have a number of income sources, including formal and informal employment sources as well as benefits (e.g. pensions) (Montgomery et al., 2000). For example, in South Africa in 1989 an estimated 23% of all economic activity occurred in the informal sector (Pillay, 1996). Income levels in South Africa, particularly among the non-White population, may also vary seasonally (e.g. agricultural workers) or more sporadically (due to periods of intermittent unemployment)

(Montgomery et al., 2000). Due to labour market instability, income in one year may also differ considerably to income in subsequent years and as such not provide a stable indication of socio-economic status over time (Montgomery et al., 2000). Furthermore, accurate data collection may be hindered by the tendency for survey participants to frequently under-report their income (Bradshaw and Steyn, 2001). The Bt20 cohort in 1990 attempted to collect income data and staff reported experiencing similar difficulties to those outlined above (Norris, 2004).

Additional Measures- Economic

Other measures of economic status that may be more useful in the South African context include financial strain, medical insurance cover, employment information, expenditure and consumption, and wealth indices. Some of these, particularly financial strain, medical insurance cover and wealth indices may also be less difficult to collect in the South African context.

Measures of financial strain and medical insurance cover are simple to collect using survey methods. Measures of financial strain may include ability to pay for basic needs (e.g. food, rent), ability to pay for household services (e.g. utility bills) as well as ability to pay for healthcare services. The importance of medical insurance as a measure of socio-economic status varies with the country's health system. This type of information is useful, however, for the South African context in the 1990s when most healthcare services were chargeable (see section 2.1 *South African Context- Demographic and Socio-economic indicators*). In developing countries information on employment status (e.g. full-time formal employed, part-time formal employed, informal employment, self-employed, unemployed) may be less difficult to collect than income and may also be more useful as indicators of social standing than occupational class (Bradshaw and Steyn, 2001). As well as information on employment status, details of employment stability, insecurity, safety and autonomy may prove very useful measures of socio-economic status in developing country settings (Kasl and Jones, 2000; Diderichsen et al., 2001).

Household consumption and expenditure are a reflection of income (Bradshaw and Steyn, 2001) but may be less difficult to collect than income in developing countries and are reported to be better indicators of long term household economic status (Deaton, 1992). However, consumption and expenditure information are not problem-free measures, as households in developing countries may acquire goods and services through means other than economic payment (e.g. barter) (Bradshaw and Steyn, 2001). Consumption and expenditure data may also mask inequalities between rich and poor households as poor households tend to spend all available income, while

rich households also save and invest in other assets (e.g. home ownership, investment accounts) (Lynch and Kaplan, 2000; Bradshaw and Steyn, 2001).

Wealth indices (e.g. World Bank indices based on Demographic Health Survey data) usually contain information on access to services and ownership of consumer durables that reflect a household's long term income or expenditure (Bradshaw and Steyn, 2001). The use of wealth indices is popular in developing country settings due to the ease of data collection using survey methods, indeed many studies use already-collected data from DHS surveys. For example, variables included in the South African World Bank index, based on SADHS data, consist of electricity supply, type of fuel used for cooking and heating, type of flooring in the home, type of water facility, type of toilet facility, number of people sharing a sleeping room as well as ownership of a number of assets (donkey or horse, sheep, cattle, radio, TV, telephone, PC, washing machine, bike, motorcycle or car) (Bradshaw and Steyn, 2001). The use of wealth indices is also popular due to the ease of index creation (Filmer and Pritchett, 2001), which is feasible without information on the local cost of consumer durables (see section 3.3. *Quantitative Data Analysis- Principal Component Analysis*). Measures of wealth using this type of index were reported to be similar to those of consumption in a study of 19 developing countries, including South Africa (Wagstaff and Watanabe, 2000), although a different study comparing the World Bank index with expenditure data from the South African Census (1996) concluded that the index was a better reflection of income than of expenditure (Bradshaw and Steyn, 2001).

Additional Measures- Social

Although material conditions play a role in the association between socio-economic status and health outcomes, including growth, the social aspect of SES may also be important (Berkman and Glass, 2000). Much recent research suggests that social integration and inclusion, social networks, social support show positive associations with good health (Berkman and Glass, 2000). Many measures of economic status, such as low income, unemployment, low education levels and low social class are associated with low levels of social integration and social exclusion (Narayan, 2000). Poor social integration may promote feelings of isolation and influence health through psychosocial pathways (Hoffman and Hatch, 1996). Social exclusion from, or inequitable inclusion in, societal experiences such as employment, education and decision making through voting may also influence the psychosocial environment an individual or household is exposed to (Narayan, 2000).

Access to social networks whose members include individuals with skills, knowledge and power may increase the likelihood of access to health promoting resources. This is likely to occur due to the existence of a system of mutual obligations between network members. Access to health promoting resources and services may occur through access to information channels (e.g. information on effects of high salt intake), the influence of network norms (e.g. smoking behaviour) as well as through being the recipient of direct assistance and support. It is suggested that the influence of social support on health outcomes is primarily mediated through stress (Berkman and Glass, 2000). Adequate levels of social support may reduce stress by promoting positive feelings, feelings of self-worth, and a sense of personal control. These may influence appraisal (whether or not an individual perceives a situation as stressful) as well as the coping response initiated if a situation is perceived as stressful (Cohen and Wills, 1985). In fact, social support may have a stress buffering effect, where there is a stress level social support interaction effect (i.e. the effect of a given amount of support differs between groups depending on their level of stress) (Cohen and Wills, 1985).

Although increasing in popularity in research in developed countries, the *social* aspect of socio-economic status has been historically under-investigated and research in developing country settings remains scarce. Measures of social ties and integration, social networks and social support may feasibly be collected using survey methods e.g. (Glass et al., 1997), although some questionnaires are lengthy to administer. Measures of social support include emotional, tangible, appraisal and financial support. These types of social support may be obtained from general network members or intimate members, such as partners or family members, and measures of individual social support may be perceived (based on hypothesised reactions) as well as received (based on actual experience of reactions) (Berkman and Glass, 2000).

MEASUREMENT OF SOCIO-ECONOMIC STATUS- AREA LEVEL

Area level measures of socio-economic status show associations with health outcomes and researchers suggest that this may be partially due to physical features of the shared environment, service provision, socio-cultural features of an area and its reputation or perception by residents and outsiders (Macintyre and Ellaway, 2000). However, as mentioned in section 2.1 *Measurement of Socio-economic status: Socio-economic status, Health outcomes and Policy design*, area levels of SES may be compositional (due to differences in individuals who live in the area) or contextual (due to characteristics of the area over and above individual differences) (Macintyre and Ellaway, 2000).

Area level SES may be measured at almost every level between the household and the nation (e.g. postcode, neighbourhood, county) as well as at international levels (e.g. European Union). Due to the fact that there are so many potential levels of analysis, data collection of area level information is intrinsically difficult (Diez-Roux, 2001). Furthermore, collecting area level SES information is logistically challenging and requires ecological and geographical information, which may frequently be impossible in developing country contexts. Traditional measures of area level socio-economic status frequently used in developed countries include a number of aggregated individual measures such as proportion unemployed, in manual occupational class, achieved A-level qualifications, of home ownership, of car ownership and claiming state benefits (Lynch and Kaplan, 2000). Traditional area level measures also include deprivation indices, for example the Townsend index which measures proportion unemployed, car ownership and home ownership as well as overcrowding (Townsend et al., 1988). Additional economic area level measures may include income distribution, housing values and the proportion of lone parent homes (Lynch and Kaplan, 2000).

Although frequently used in developed countries, many of these economic measures (e.g. income, occupational class, housing values) may be logistically difficult to collect in developing country settings (see section 2.1 *Measurement of Socio-economic status- Household level Traditional Measures*). The collection of area level SES measures in developing countries is also challenging due to the existence of informal housing. Informal housing areas may be unstable and fluctuate in location and population density. The characteristics of informal housing areas is also challenging for data collection, e.g. lack of roads or streets, lack of street names, lack of house numbers. Economic measures which may be less difficult to collect and more appropriate in the South African context include service provision and infrastructure as well as availability of area resources (Lynch and Kaplan, 2000). Measures of service provision and infrastructure may include roads, sanitation facilities (water supply, sewerage), electricity supply and rubbish removal. Availability of area resources may include measures such as schools, medical centres, parks, playgrounds, food retail outlets, alcohol retail outlets, banks and police stations. Measures such as residential segregation (e.g. proportion ethnic groups) and overcrowding may also be useful area level SES measures, although obtaining this information in developing county settings may be challenging.

As with household level socio-economic status, there has, until recently, been a lack of emphasis on the *social* aspect of area level SES measures (Kawachi et al., 1997; Stansfeld, 1997). Recent research on the influence of area level SES measures on health outcomes has focused

increasingly on the concept of social capital. The association of high levels of social capital with positive health outcomes or improved mortality are not, however, unequivocal and findings of positive associations with wellbeing principally come from studies of US populations (Pearce and Smith, 2003). Investigation of the effect of social capital in poor and developing country contexts may be similar to those from the USA, but results may also indicate that social capital has limited effect due to the scarcity of resources that are available to be redistributed and shared among members of communities with high unemployment, insecure employment, low wages and high dependency ratios (du Toit, 2005). In such settings the effect of high levels of social capital may even act as a brake to improvement in health outcomes and accumulation of wealth, as increases in resources may be rapidly redistributed among the community (du Toit, 2005).

Although consensus on the definition of social capital is yet to emerge, Coleman originally described social capital as "features and social structures which act as resources for individuals and facilitate collective action" (Coleman, 1990). Thus, these area level structures may be similar in format and act on wellbeing in similar ways to networks of social support at the individual level (Pearce and Smith, 2003). As the concept of social capital is not clearly defined, its measurement is not uniform. However, key aspects include that it is a measure external to individuals and a public good and frequently included components include civic participation, reciprocity and trust (Kawachi and Berkman, 2000). The World Bank has developed a questionnaire comprised of six sections for the measurement of social capital (WorldBank, 2002). These sections include: groups and networks (membership to groups, contact with close friends and family); trust and solidarity; collective action and cooperation (community activities); information and communication (access to post office, media); social cohesion and inclusion (including a sub section for conflict and violence); empowerment and political action.

Measures available for use in this research from the Bt20 cohort include only household level variables, community level data are not available. However, a wide range of household economic and social measures of SES are available. These include some traditional economic measures such as education and unemployment. Additional economic measures appropriate as estimates of income and wealth in developing countries are also included (e.g. ownership of consumer durables, dwelling characteristics, water and toilet facilities, electricity supply, private medical insurance cover). Unusually for a developing world cohort study, some measures of social SES are also available. These include information on social networks, general social support, intimate partner support and support during pregnancy.

2.3 INFANT AND CHILD GROWTH AND STUNTING

PATTERNS AND MEASURES OF INFANT AND CHILD GROWTH

PATTERNS OF GROWTH

With the exception of those suffering from certain genetic disorders, most infants and children show broadly similar patterns of post-natal growth (WHO 1995). Post-natal patterns of growth fall into three phases, controlled predominately in each phase by a different set of hormones. In the first (infancy) growth is largely influenced by thyroid hormones. Childhood, the second phase, is controlled by both thyroid and growth hormones. The sex hormones mainly control growth during the third phase, puberty (Kaarlberg 1994). Although this infant- childhood- puberty (ICP) approach frequently provides a basis for growth modelling, a more practical and visible division of growth phases is preferable for the description of physical and developmental changes occurring during post-natal growth.

In 1988 Bogin initially suggested five stages of post-natal growth; neonatal, infancy, childhood, juvenile and adolescent (Bogin 1988). As the growth outcomes of this study range from birth to five years of age, the first three stages of this bio-cultural division of post-natal growth are used to describe growth patterns over this time period. Bogin describes the neonatal stage, up to 28 days post-partum, as one of "extra uterine adaptation" with very rapid rates of growth (Bogin 1999). Infancy ranges from 2-26 months and its end is marked by deciduous tooth eruption and the cessation of breastfeeding or replacement feeding, while childhood ranges from the end of infancy to about 7 years (Bogin 1999). The three stages show differing rates of growth and maturation and the timing of growth insults affect growth outcome accordingly (Needleman 2000). Although linear growth may appear to show smooth continuous increases, it is not in fact a continual process of constant increase in length. Growth shows diurnal and seasonal variation (Nabarro et al. 1988; Waterlow 1994). Furthermore, when measured over short intervals, linear growth shows a pattern of discontinuous sporadic increases interspersed with periods of stasis during which growth is not detectable (Lampl 2002).

Growth rates of height and weight during neonatal, infancy and childhood stages

On the whole rates of linear growth, and increases in weight, slow from birth throughout infancy and childhood (table 2.3.1). Despite such slowing, however, growth in length is rapid during the first month while the first three months are a period of very rapid weight gain (Falkner and Tanner 1986). Figures 2.3.1 and 2.3.2 show the velocity curves for height and weight per year throughout the post-natal growth period. The initial sections of the curves show that, although rates of growth

in height remain high during infancy, these are steeply declining (Tanner 1966). During the first year of post-natal life, rates of growth in weight are also high but show a steep decline (Tanner 1966). Throughout the following two years of the infant stage, rates of weight gain stabilize (figure 2.3.2).Between two and three years of age, gain in length shows a more steady increase than increases in weight, which may fluctuate. Growth in length occurs more slowly than weight and as such deficits in length also develop more slowly than those in weight. Older infants (2-3 years) experience a relative increase in leg length to trunk size, in comparison to younger infants. They also show accumulation of fat-free or lean mass in replacement of adipose tissue, which is often viewed as loss of "baby fat" (Falkner and Tanner 1986). The rates of growth in height during childhood decline more slowly and tend to level off (figure 2.3.1). Rates of growth in weight remain low but constant throughout most of the childhood stage (figure 2.3.2). Towards the end of the childhood stage (~ 7 years of age) an increase in growth rates, of weight in particular, occurs, termed the period of adipose rebound (Rolland-Cachera et al. 1984).

Developmental changes during neonatal, infancy and childhood stages

Newborns' initial adaptation to extra-uterine life is challenging, particularly in terms of respiration and temperature control (Bogin 1999). During the first year of life, the infants' respiratory system continues to mature and is susceptible to infection. Maturation of the gastrointestinal system also continues after birth. During the first three months an infant's ability to digest complex molecules is limited and the range of enzymes common in adults do not develop fully until the end of the infant period. Furthermore, during infancy the immune response initiated by the mucosal surfaces of the gastrointestinal system is limited, leaving the infant susceptible to infectious disease (Needleman 2000). In older infants (2-3 years) organ maturation, particularly of the heart and vascular and gastrointestinal systems, continue (Needleman 2000). During this period, the older infant also begins to develop its own immune system (Bogin 1999; Needleman 2000). Infants' teeth begin to emerge from about 5 to 6 months- a process which continues until about 2 ½ - 3 years of age by which time the secondary molars have usually completely erupted (Bogin 1999).

The first twelve months of post-natal life are also marked by brain growth, myelinisation of the central nervous system, development of cognition and maturation of the visual system. The early part of infancy is also a time of increased mobility. Infants may sit up unsupported from about 6 ½ to 7 months. From about 8 months they may begin crawling and walking develops from about 12 months of age (Needleman 2000). Development of cognition, of movement, of fine motor skills and of language all progress quickly during the second year of life. During this period, the older infant's

ability to walk develops rapidly and the majority are capable of running and climbing stairs unassisted by 24 months (Needleman 2000). Infants at two years of age also acquire more motor skills such as grasping and reaching. The development and acquisition of language, vocabulary and grammar accelerates exponentially during this time period (Needleman 2000). Although brain and head circumference growth slow during later infancy and early childhood, myelinisation of the peripheral nervous system continues and fine motor skills are honed. The childhood stage is also marked by the continued development of language as well as rapid psychosocial and psychological development (Needleman 2000).

Table 2.3.1 Approximate gains in length, weight and head circumference per month during infancy and childhood

Age	Approximate gain in Length (cm) per month	Approximate gain in Weight (g) per month	Approximate gain in Head circumference (cm) per month
0 - 3 months	3.5	120	2.00
3 - 6months	2.0	80	1.00
6 - 9 months	1.5	60	0.50
9 - 12 months	1.2	48	0.50
1 - 3 years	1.0	35	0.25
4 - 6 years	0.3	26	0.08

Adapted from (Needleman, 2000)

Figure 2.3.1 Velocity curve for gain in height (Tanner, 1966)

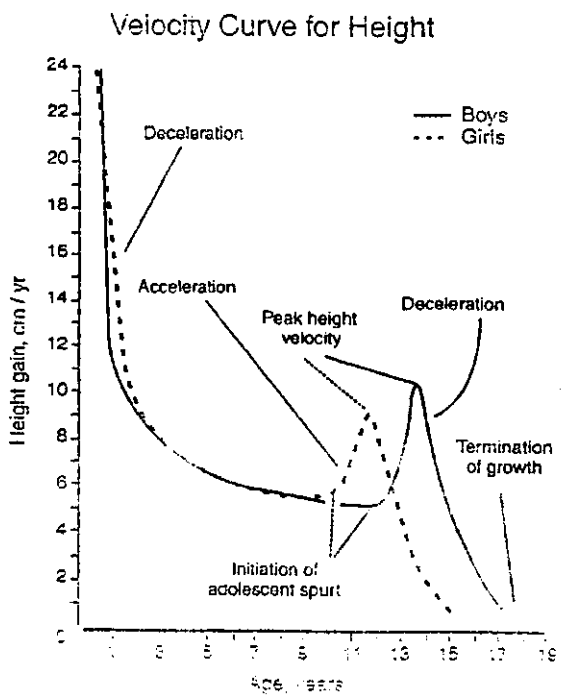
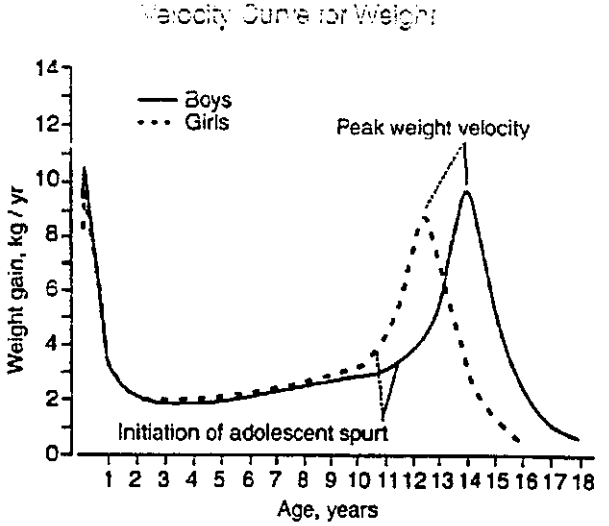


Figure 2.3.2 Velocity curve for gain in weight (Tanner, 1966)



MEASURES OF SIZE AND GROWTH

Size in the post-natal period may be estimated using a large number of measures. These include length or height; weight; head, arm, waist and hip circumferences as well as bihumeral and bi-iliac diameters (Cameron 2002). Skinfold measures may also be used e.g. triceps, subscapular (Cameron 2002). Radiography scanning techniques, such as Dual Energy X-Ray Absorptiometry (DEXA), may provide estimates of body composition including fat mass, lean mass, water percentages and bone density (Cameron 2002).

Measures used in this study include height and weight. Measures of length or height include supine length (< 2 years of age), standing height (>2 years of age) and sitting height, which compared to standing height indicates leg length. Estimates of height and weight of an individual may be compared to cross sectional growth charts, e.g. WHO/NCHS 1978. The height or weight of an individual relative to the growth chart may be summarised using percentiles (i.e. centile position), comparisons of percentage of the median as well as z-scores (WHO 1995).

For example, the Waterlow classification uses centile position to categorise infants and children as excessively short (stunted) or light (wasted) (Waterlow et al. 1977). The Wellcome classification also uses centile position of weight-for-age to identify under-nutrition, Marasmus and Kwashiorkor (Wellcome Working Party, 1970). The Gomez classification of malnutrition uses percentage of the mean measures (Gomez et al. 1956). Measures using percentage of the median do not correspond to a fixed point on the height or age distributions (WHO 1995). For example, 60% of the median weight-for-age represents less severe malnutrition in older children than it does in younger children

(Dibley et al. 1987). Z-scores compare an individual's measure to that of the reference population median.

$$\text{Z-score} = \frac{\text{Individual value - median of reference population}}{\text{Standard deviation of reference population}}$$

Waterlow *et al.* recommended the use of z-scores as a summary measure based on four characteristics: adherence to a reference distribution, linear scale permitting summary statistics, uniform criteria across indices and usefulness for detecting changes at extremes of the distribution (Gorstein et al. 1994; Waterlow et al. 1977; WHO 1995). Z-score classifications are frequently used to categorise stunting and wasting, as shown in table 2.3.2 (Dibley et al. 1987). For instance, a child with a height for age z-score of ≤ -2 from the reference median (e.g. – 2.5) is categorised as stunted.

Table 2.3.2 Classification of stunting and wasting using z-scores

Weight-for-height z-scores	**Height-for-age z-scores**	
	> -2	**≤ -2**
> -2	Normal	Stunted
≤ -2	Wasted	Stunted & Wasted

Height and weight measures may be combined to obtain ratios such as body mass index (weight/ [height]^2) or sitting height ratio ([sitting height/ stature]100) (WHO 1995). Body mass index (BMI) is especially useful for identifying overweight children. BMI estimates may be compared to growth charts e.g. WHO Multicenter Growth Charts 2006 (WHO 2006). Although BMI is an imperfect measure of adiposity as weight includes lean or fat-free mass as well as fat mass, in children over 2 years of age BMI correlates well with percentage body fat (Ellis et al. 1999; Norgan 1994). In the USA BMI centiles are used to identify overweight. Again due to the inclusion of fat free mass in BMI, quite a high centile is used and those above the 85th percentile are categorised as at risk of overweight while those above the 95th percentile are overweight (Himes and Dietz 1994). These differ to the international classification of overweight in childhood using BMI which tend to be lower than those used in the USA classification (Cole et al. 2000).

Measures of growth velocity require a calculation of rate between at least two serial measurements collected over time. Growth rates for linear growth (length or height), weight and head circumference may be calculated and compared to longitudinal growth charts e.g. (Guo et al. 1991; Praeder et al. 1989; Roche and Himes 1980), although growth rates during the pre-pubertal period

can also use cross sectional charts (Cameron 2002). Rates of growth in weight may show negative growth, i.e. weight loss. However, insults to linear growth and head circumference do not result in loss of length but rather in deceleration or interruption to increases in length (Waterlow 1994). Individual deceleration or acceleration in growth rates are compared to growth charts. On the whole growth rates are expected to track from one time period to the next, along a given percentile (canalisation) or at least within centile bands (e.g. 25th – 50th centile) (Tanner 1966). Deviation from this tracking is identified by centile crossing as well as by change in z-scores over time i.e. accelerated growth (Ong, 2000).

IMPLICATIONS OF STUNTING

Stunted height, as represented by ≤ -2 z-scores of height-for-age, is associated with a number of implications both in the child's future and contemporary to the period at which stunting occurs. These include effects on cognition and behaviour in childhood (Berkman et al. 2002; Chang et al. 2002; Powell et al. 1995); infectious disease in childhood (Ibrahim et al. 1998; Kossmann et al. 2000); growth (Martorell et al. 1994; Mendez and Adair 1999) and body composition (Popkin et al. 1996; Sawaya et al. 1998).

IMPLICATIONS OF STUNTING- COGNITION AND BEHAVIOUR

Studies from developing countries indicate that there are correlations and associations between low height-for-age and reduced cognitive development as indicated by low scores on cognitive tests (Powell et al. 1995). In Guatemala the height of 3 year olds boys and girls was significantly correlated ($p<0.05$) with scores on examinations testing literacy, numeracy and general knowledge (Martorell et al. 1992). A study of cognitive performance at 8 and 11 years in the Philippines showed associations with stunting (≤ -2 z-scores) at two years of age (Mendez and Adair 1999). Adjusted results showed that children stunted at two years, as well as those who remained stunted at 2 and 8 years, had significantly lower mean test scores at 8 years (Mendez and Adair 1999). A study of school children in Jamaica also showed that those stunted at two years had lower scores on tests of maths, spelling, word reading and reading comprehension (Chang et al. 2002). Similar associations were found in a Peruvian study, in which adjusted results indicated that children with severe stunting (≥ -3 z-scores) had even lower test scores than did those who were moderately stunted (≤ -2 z-scores and ≤ - 3 z-scores) (Berkman et al. 2002).

A number of studies from developing countries have also showed associations between stunting and behaviour in early childhood. Poor behaviour in early childhood shows associations with worse

social function in later in life (Fergusson and Horwood 1995; Hutchinson et al. 1997) as well as with poorer school achievement (Chang et al. 2002). In a Kenyan study Whaley *et al.* reported short infants were significantly less reactive and sociable at 6 months of age. Sociability in infancy was associated in this study with verbal competence at 5 years of age (Whaley et al. 1998). In Jamaica, children stunted at two years were rated by parents as having significantly ($p<0.05$) more conduct difficulties, which was in turn significantly associated with school achievement (Chang et al. 2002).

Whether the effects of stunting on cognition reflect a direct effect of under nutrition, particularly protein, calorie and micronutrient deficiency, or are mediated through other environmental factors, e.g. stimulation and exposure to schooling, is currently unresolved. Evidence suggests that the role of protein energy malnutrition as well as insufficiency of micronutrients including iron, zinc and vitamin B12 may be important in the development of cognition during childhood (Black 2003a; Bryan et al. 2004; Powell et al. 1995). However, issues of confounding by SES factors, that are also relevant to cognition, remain (Black 2003b). The role of stimulation of the infant and young child by caregivers in low SES environments may be particularly important as research suggests this is integral to optimal cognitive development e.g. (Walker et al. 2000). Low SES environments are associated with poor schooling (Martorell et al. 1994) and the role of schooling in the association between stunting and cognition may also be important (Mendez and Adair 1999). For example in a Guatemalan study Gorman and Pollitt suggested a buffering effect of schooling, i.e. that cognitive test performance scores were higher in high risk children who had received > 4 years of schooling than in high risk children with fewer years of schooling (Gorman and Pollitt 1996).

IMPLICATIONS OF STUNTING- HEALTH, DISEASE, GROWTH AND BODY COMPOSITION

Associations with infectious disease

Associations have been noted between low weight-for-age (wasting) and infant and child mortality (Pelletier et al. 1993; Pelletier et al. 1995; Schofield and Ashworth 1996), particularly from respiratory infections and diarrhoea (Tupasi et al. 1988; Yoon et al. 1997). A number of studies also show associations between wasting and duration or severity of diarrhoea and respiratory infections (Black et al. 1984; Tupasi et al. 1990; Victora et al. 1994; Wierzba et al. 2001). For example, in an Egyptian study diarrhoeal incidence was significantly increased ($p< 0.01$) in children with weight-for-age z-scores (WAZ) of ≤ -2 (RR= 1.7) (Wierzba et al. 2001). Similarly, in a Brazilian study children with WAZ ≤ -2 were at increased likelihood of pneumonia (OR= 4.77; 95%CI 2.46 – 9.06) (Victora et al. 1994). Research suggests that malnutrition may act by weakening the host's immune defences through reduced immunoglobulin production and impaired cell-mediated immunity

(Chandra 1997; Ferguson 1978). A cycle of malnutrition and wasting may ensue as nutrient mal-absorption may occur with certain diseases, appetite may be suppressed and direct nutrient loss may also occur (vomiting, diarrhoea), all of which may leave the child further immuno-compromised (Scrimshaw et al. 1968) (see also below *Factors influencing stunting- Infectious disease factors*).

Unlike the effect of wasting, that of stunting does not, on the whole, show associations with incidence, duration or severity of infectious disease (Alam et al. 2001; Sepulveda et al. 1988; Wierzba et al. 2001). However, a few studies do suggest an association between stunting and incidence of diarrhoea (Ibrahim et al. 1998; Kossmann et al. 2000) and respiratory infection (Kossmann et al. 2000). In a Somali study stunting (≤ -2 z-scores) at five years of age was associated with increased incidence of acute diarrhoea, but not acute respiratory infection, in the following year (OR= 1.69; 95%CI 1.32 – 2.48). Results were adjusted for age, sex, weight-for-age, breastfeeding, water quality and household crowding (Ibrahim et al. 1998). However, results were not adjusted for previous diarrhoeal experience which is a risk factor for future diarrhoeal incidence (Wierzba et al. 2001). A study in Sudan, however, did adjust for previous morbidity as well as vitamin A status, weight-for-age, breastfeeding, season and socio-economic status (Kossmann et al. 2000). Results indicated that stunting (≤ -2 z-scores) showed positive associations with incidence of diarrhoea (OR= 1.14; 95%CI 1.05 – 1.25), as did severe stunting (-3 z-scores) with incidence of febrile cough (OR= 1.21; 95%CI 1.05 – 1.40) (Kossmann et al. 2000).

Associations with growth and body composition

Linear growth is plastic and recovery from growth faltering may occur through accelerated growth rates (Martorell et al. 1994; Waterlow 1994). Despite this plasticity, however, stunting early in childhood is associated with low height-for-age in later childhood (Adair 1999; Saleemi et al. 2001). For example in the Bt20 cohort, stunting at 2 years (≤ -2 height-for-age z-scores) is positively associated with stunting at 9 years (Cameron et al. 2005). Stunting in early childhood also shows associations with shorter height in adolescence (Proos 1993) and adulthood (Martorell et al. 1992) as well as reduced fat-free mass in adulthood (Martorell et al. 1992). Short stature in adulthood, and reduced fat-free mass in particular, may impair adult work capacity by influencing strength (Martorell et al. 1992) and affecting capacity for aerobic exercise (VO_2 max) (Baracnieto et al. 1984). Short stature and low BMI in women may also affect birth size of their infants, and thus have an intergenerational effect (Emanuel et al. 2004; Hennessy and Alberman 1998) (see section *2.3 Intrauterine growth and small for gestational age- Factors influencing size at birth*).

Recovery growth has been reported in populations where maturation is delayed and the growth period is extended (e.g. historically in slave populations in the USA) (Martorell et al. 1994). Accelerated growth may also occur due to improved conditions of the environment, as in nutritional supplementation trials e.g. INCAP study in Guatemala (Schroeder et al. 1995). Accelerated growth and recovery have also been reported where groups experiencing growth restriction have relocated or migrated to improved environments (Martorell et al. 1994). Recovery from stunting is thus influenced by changes in environmental circumstances or, less commonly, extensions to the growth period. However, the timing of onset of stunting is also associated with severity of stunting and recovery from stunting. For example in a Filipino study those infants who experienced onset of stunting at 6 months in comparison to 18-24 months had significantly lower mean height-for-age z-scores at two years, (-3.44 vs. –2.25). In the same study the persistence of stunting at two years of age was higher in those stunted by 6 months than those who had experienced the onset of stunting at 18-24 months (6% vs. 19% recovery by 2 years) (Mendez and Adair 1999).

The effect of stunting with body composition at a later age remains equivocal. The area is one which has attracted much recent interest due to the fact that obesity in adulthood is associated with a number of health risks including the metabolic syndrome (Reynolds and He 2005), type II diabetes (Geiss et al. 2006), cardiovascular disorders (Poirier et al. 2006), CHD (Eckel and Krauss 1998) and stroke (Goldstein et al. 2006) (see also section *2.3 Intrauterine growth and small for gestational age- Implications of size at birth and future effects)*. A number of cross-sectional studies report associations between stunting in early childhood and overweight or obesity in later childhood (Popkin et al. 1996) and adulthood (Sawaya et al. 1995; Sawaya et al. 1998). Popkin *et al.* report that in a number of countries (Russian, Brazil, China and South Africa) stunting at 3-6 years is significantly associated with obesity at 7-9 years (OR= 2.6; 95%CI 2.0 - 3.5) (Popkin et al. 1996). Stunting at two years of age in Brazil has also been shown to be significantly associated with obesity in adulthood (Sawaya et al. 1998). Further studies in Brazil suggest that this increased prevalence of obesity in adults who were stunted as children may occur through impaired fat oxidisation, resulting in increased fat storage (Hoffman et al. 2000). Longitudinal studies from Jamaica (Walker et al. 2002) and South Africa (Cameron et al. 2005), however, report no significant associations between stunting and later adiposity. Walker *et al.* reported no association between stunting at 9 – 24 months and BMI, fat distribution or total body fat at ages 7 – 11 years (Walker et al. 2002). In a study using the Bt20 cohort Cameron *et al.* report no association between stunting at two years and BMI, body composition or fat patterning in pre-pubertal children aged 7 – 9 years (Cameron et al. 2005). Recent South African research (cross sectional) from the THUSA BANA

study in the North West Province also reported no significant association between stunting and BMI of overweight or above in older children (10 – 15 years) (Mukuddem-Petersen and Kruger 2004).

FACTORS INFLUENCING STUNTING

Stunting is a feature of a very large number of conditions including congenital malformations, chromosome abnormalities, endocrine disorders as well as chronic medical illnesses (Needleman 2000). However, as this study aims to investigate the exogenous factors influencing the linear growth of otherwise generally healthy infants and children, such conditions are not included in this overview. Genetics plays key roles in both the control of growth within an individual and between-population variability in growth. However, the relative contribution of genetic inheritance to between-population variability in growth is overshadowed by that of exogenous environmental factors- and where environmental constraints on growth are removed, populations show similar potential for growth (Frongillo and Hanson 1995; Habicht et al. 1974; Keller 1988; Martorell 1985).

The influence on stunting of a variety of factors is briefly reviewed below. As the majority of childhood stunting is prevalent in developing countries, the review focuses on these settings. The factors reviewed include proximate influences of psychosocial and emotional factors, such as deprivation, neglect and abuse; nutritional factors and infectious disease factors. The influences of demographic factors are also summarised, including those of child's age, sex, parity and low birth weight. The household level socio-economic factors influencing stunting are also outlined. The influence of most of these factors has been repeatedly investigated in developing countries. However three areas which remain almost wholly un-investigated are:

1. The role of social support and networks- particularly for emotional support, childcare support/ assistance (Engle 1991; Nakahara et al. 2006), advice on childcare practices and financial assistance (e.g. for accessing medical services).
2. The role of familial stress related to living in impoverished conditions, insecure employment and lack of autonomy in decision making and/or childcare responsibilities (Begin et al. 1997; Engle 1993).
3. The influence of community or area level measures of SES, for example access to health centres or community supply of clean water, sewerage and rubbish disposal (Chopra 2003) as well as public transportation services.

PSYCHO-EMOTIVE FACTORS

Growth in height and weight show negative associations with poor psycho-emotive environments, including those where infants or children are exposed to neglect and abuse (Karp et al. 1989; Oates and Kempe 1997). Discussion of two conditions, psychological short stature and failure to thrive (FTT), illustrates the effect that psycho-emotive factors may have on infant and child growth.

Older children (>3 years) living under emotionally stressful or disturbing conditions may have a height-for-age which falls below the 3rd percentile (psychological short stature) (Bogin 1999). Research shows that removal of such children from their stressful environment to a more secure environment (e.g. foster home), resulted in spontaneous acceleration of growth and restoration of height (King and Taitz 1985; Wyatt et al. 1997). The effect on growth of removing children from environments of psycho-emotive stress appears not to be constrained to very stunted or wasted children, but to be present throughout the range of childhood size. Studies from Spain indicate that even marginally short (– 1.29 z-scores) and underweight (– 0.75 z-scores) infants who had suffered neglect and emotional abuse showed catch-up to normal height and weight after one year in foster care (Olivan 2003). Furthermore in a UK study Wyatt *et al.* reported that, on placement in foster care, improvements in growth and stature also occurred in children who showed normal baseline stature and weight (Wyatt et al. 1997).

Growth patterns represented in FTT include weight and height for age below the 3rd percentile, although loss in weight is usually more pronounced (Wilcox et al. 1989). FTT usually affects younger infants (<2 years) and may have organic (i.e. malnutrition), non-organic or mixed organic and non-organic origins. The principal factor contributing to non-organic FTT is impaired mother-infant interactions (Roche and Sun 2003). Studies from both developed and developing countries show associations between maternal mental health and infant growth and development (Harpham et al. 2005; Murray et al. 1996; Patel et al. 2003). For example, a recent study from Pakistan indicated that maternal depression was significantly associated with underweight at six and twelve months (OR= 4.0; 95%CI 2.1 – 7.7 and OR= 2.6; 95%CI 1.7 – 4.1 respectively) as well as with stunting at six and twelve months (OR= 4.4; 95%CI 1.7 – 11.4 and OR= 2.5; 95%CI 1.6 – 4.0 respectively) (Rahman et al. 2004). Research suggests that maternal depression may influence infant growth by affecting the emotional quality of maternal-infant interactions, including interest and caring attitude (de Villiers and Senekal 2002), stimulation (Bettes 1988), response to infant needs (Livingood et al. 1983) and mother-infant engagement (Cooper et al. 1995).

As the above studies illustrate, psycho-emotive factors such as abuse and neglect undoubtedly affect the quality of childcare received, e.g. feeding, bathing/sanitation and health-seeking e.g. (Livingood et al. 1983). It has also been suggested that effects of psycho-emotive factors on growth may act directly on growth through decreased activity of the hypothalamic growth centre and reduced secretion of hormones that promote growth (e.g. GH, IGF) (Green et al. 1984). More recent work from Dominica showed that GH secretion fell with increasing levels of cortisol steroid and that high or fluctuating levels of cortisol in children were also associated with increased morbidity (Flinn and England 1997). In this Caribbean study levels of cortisol steroid, which is produced in response to stress, were positively associated with unstable households (Flinn and England 1997). Emotional disturbances, abuse and neglect may also influence growth by affecting an infant's or child's nutrition and digestion- through a decrease in both the secretion of digestive enzymes and the absorption of nutrients in the gastrointestinal tract (Parisi, 1980).

NUTRITIONAL FACTORS

The role of nutrition on linear growth and stunting has been an especially prolific area of study. Nutritional needs of infants and children, particularly for weight gain, are high. However, these groups are also susceptible to insufficient nutrition as frequent feeding is required due to limited gastric capacity. They are also susceptible to infection because of their immature gastrointestinal and immune systems (Martorell and Habicht 1986).

Studies of infant growth and nutrition in developing countries have particularly focused on the role of breastfeeding. Breast milk quality, even in nutritionally compromised mothers, is high and contains antibacterial agents as well as lymphocytes which help protect the infant from infection (Binns 1998; Chen and Scrimshaw 1983; Padmadas et al. 2002). Breast feeding is associated with reduced risk of stunting, especially stunting in the first 6 months of life (Adair and Guilkey 1997). A study from Pakistan concluded that optimal breast feeding practices are associated with decreased risk of linear growth retardation (Saleemi et al. 2004). In a study from Egypt increased duration of breast feeding and adequate weaning were also associated with increased height at 2-3 years (Neumann and Harrison 1994). Stunting is also associated with early introduction of complementary feeding (i.e. cessation of exclusive breastfeeding). For example, in Pakistan introduction of complementary feed earlier than 4 months increased risk of stunting (RR = 2.03; $p<0.001$) (Saleemi et al. 2001). Similar results are reported from India, where stunting was associated with early (<2 months) introduction of complementary feeding (Padmadas et al. 2002). Stunting is also associated with inappropriate weaning practices including low energy

complementary feeding foods (Kikafunda et al. 2006) as well as insufficient frequency and volume of supplementary feeds (Umeta et al. 2002).

Initial studies of the role of nutrition in older infants and children investigated the effect of energy (calories) and protein or essential amino acids on linear growth (Hernandez and Argente 1992). These were found to play an important role in linear growth. For example in the INCAP supplementation trial in Guatemala those fed *Atole* (an energy and protein supplemented drink) grew better than the control group supplemented with *Fresco* (calorie supplemented drink) (Schroeder et al. 1995). Up until three years of age, supplementation in the *Atole* group influenced linear growth with 100kcal/ day yielding 9mm, 5mm and 4mm increases in supine length at ages 1, 2 and 3 years respectively (Schroeder et al. 1995). More recent work has also included investigating the role of micronutrients (Allen 1994), in particular the effects of zinc and vitamin A e.g. (Ferguson et al. 1993). Supplementation trials of zinc showed associations with increased gain in length, for example in Iran (Ronaghy et al. 1974). However, no effect of zinc supplementation on linear growth were seen in a Gambian study (Bates et al. 1993). The effect of vitamin A is also equivocal as supplementation trials have had contradicting effects in different settings, perhaps because children in some settings had multiple, rather than single, deficiencies (Allen 1994). The role of diet quality has also been investigated more recently (Allen et al. 1992; Neumann and Harrison 1994). For example, high quality diets with significant quantities of animal products, vegetables and fruit were associated with improved linear growth in Mexico (Allen et al. 1992), Ethiopia (Umeta et al. 2002) and Kenya (Neumann and Harrison 1994).

Although energy and protein malnutrition show associations with stunting (Waterlow 1992) studies in Mexico, for example, have shown that children may have sub optimal intake of calories, without becoming stunted (Wyatt and Tejas 2000). Results of supplementation trials have also demonstrated that energy and protein are not wholly responsible for growth faltering (Allen 1994). In the INCAP trial, children were divided into four groups based on calorie and protein intake. Although those receiving the most energy and protein grew better and reduced their stunting status from –3 z-scores to –2 z-scores, they remained stunted despite the fact that their energy and protein intakes met recommended levels (Martorell 1985). Noting that both the *Atole* and *Fresco* groups were equally likely to suffer morbidity from diarrhoea and respiratory infections, Martorell *et al.* suggested that infectious disease may have played a large role in preventing growth recovery in this Guatemalan population (Martorell 1985).

INFECTIOUS DISEASE FACTORS

The synergistic relationship between low weight-for-age and infectious disease has long been established (Scrimshaw et al. 1968). However, during periods of illness linear growth can also show patterns of deceleration. This may be due to a number of mechanisms including reduced food intake, increased energy expenditure, due to immune activity, especially fever and malabsorbtion of nutrients (Martorell et al. 1980; Mata 1992; Stephensen 1999; Stephenson et al. 1993). Associations between morbidity from infectious disease and stunting have particularly focused on investigations of parasitic infections, diarrhoea and gastrointestinal infections as well as respiratory infections.

Infection with parasites, particularly helminths (e.g. *Ascaris* and *Tricharis*), is associated with impaired growth (Stephenson et al. 1993). For example, sex-adjusted results from a study of school children in Peru reported that co-infection with *Ascaris* and *Tricharis* was associated with increased likelihood of stunting (OR= 1.95; 95%CI 1.35 – 2.82) (Casapia et al. 2006). Both diarrhoea and respiratory infections have shown associations with growth faltering (Adair and Guilkey 1997; Rowland et al. 1988). Slower rates of linear growth have been seen in children with high prevalence of diarrhoea and respiratory infection (Martorell et al. 1975). Studies from Brazil and Malawi suggest that the severity of infection may have an influence on linear growth (Espo et al. 2002; Victora et al. 1990). In comparison to Brazilian children not admitted to hospital, those who were admitted for either diarrhoea or pneumonia had significantly ($p<0.001$) lower z-scores for height-for-age (Victora et al. 1990). In a Malawi study children experiencing over 6 episodes of diarrhoea per year were more likely to be stunted (≤ -2 z-scores) (OR = 2.8; 95%CI 1.3 – 6.2) (Espo et al. 2002). Similarly, in another Malawi study children experiencing over 2.4 episodes of diarrhoea a month were more likely to be severely stunted (-3 z-scores) (OR= 3.4; 95%CI 2.2 – 5.2) (Maleta et al. 2003). Some evidence exists to suggest that early onset of diarrhoeal episodes (<6 months of age) is associated with more long-term effects on height (not recovered at 3 years of age), while later onset of diarrhoea has a transient effect on height (Checkley et al. 2003). However on the whole, although respiratory infections and diarrhoea affect linear growth during periods of illness, effects are not generally long-lasting and, given sufficient disease-free time, accelerated growth occurs in between infectious disease episodes (Black et al. 1984; Briend, 1998; Briend et al. 1989).

Although levels of clinical disease in infants and children show associations with stunting, the prevalence of stunting in a number developing country settings appears disproportionate to the observable disease burden experienced- e.g. Gambia (Lunn et al. 1991). Many infants and children

in the developing world experience much higher prevalence and extended duration of sub-clinical disease, as indicated by biological markers such as high white cell counts or erythrocyte shedding rates, than of disease diagnosed by symptoms (Briend 1998; Lunn et al. 1991). The role of damage to mucosa of the gastrointestinal tract, potentially by sub-clinical infection by micro-organisms, is a more recent field of investigation which may more adequately explain patterns of linear growth retardation in some developing countries (Goto et al. 2002; Lunn et al. 1991; Menzies et al. 1999). Studies in Gambia for example indicate that stunting is associated with damage to the gastrointestinal tract, including atrophy of villi on the surface of the gastrointestinal tract and increased leakiness of the mucosal surface (Lunn 2000). Such damage may have effects on both infection and malabsorbtion or nutrient loss. For example, increased membrane leakiness may predispose to infection while damage to villi may provide reduced surface area for nutrient absorption but also affect the function of enzymes such as lactase (Lunn 2000). Researchers suggest that such abnormal gastrointestinal makeup may be caused by repeated sub clinical infection by micro-organisms such a *Helicobacter pylori* and *Giardia intestinalis* acquired (oral-faecal) from contaminated food, water and feeding utensils (Lunn 2000; Menzies et al. 1999).

DEMOGRAPHIC FACTORS- AGE, SEX, PARITY AND BIRTH WEIGHT

The prevalence of stunting varies with a child's age. Principally, rates are low during early infancy (< 6 months) and increase during later infancy and childhood up until the age of 4 - 5 years, when rates stabilise or decline (Bloss et al. 2004; Hernandez-Diaz et al. 1999; Ojofeitimi et al. 2003; Padmadas et al. 2002; Shah et al. 2003). Rates are particularly high during the second year of life (Daniels et al. 1991; Martorell and Habicht 1986; Shrimpton et al. 2001). For example, in a study from Uganda the likelihood of stunting, adjusted for household wealth and maternal education, was significantly higher for those aged between 12-17 months and 18-23 months, than for younger infants (OR= 3.0; 95%CI 1.6 – 5.8 and OR= 5.1; 95%CI 2.6 – 9.8 respectively) (Wamani et al. 2004). Effects of a child's age are linked to nutrition and infection factors, particularly to breastfeeding behaviour; timing of introduction of complementary feeding; type, quantity and frequency of complementary feeds provided (see section 2.3 *Factors influencing stunting- Nutritional Factors*) as well as hygienic preparation, storage and delivery of complementary foods (Abate et al. 2001).

The evidence on the effect of sex of the child on stunting is mixed with many, but not all, studies reporting increased risk of stunting for male infants. The finding of increased male susceptibility was first reported over fifty years ago when Greulich reported that, in comparison to females, male

infants and children exposed to wartime conditions in Guam showed increased susceptibility to infection and malnutrition, including stunting (Greulich 1951). Certain current studies from African countries also report similar findings (Pongou et al. 2006; Shrimpton et al. 2001). For example, Shrimpton *et al.* reported increased likelihood of stunting in Ugandan boys (OR= 2.6; 95CI 1.5 – 4.4) (Shrimpton et al. 2001). Suggestions for differential growth, morbidity and mortality rates between the sexes include male physiological immaturity which may influence immune resistance and incidence of infectious disease (Stinson 1985).

However, many studies indicate that the association between sex of the child and stunting is inconsistent. In a study of stunting incidence in the Cebu cohort (Philippines), Adair *et al.* reported that males were at significantly increased risk of stunting ($p<0.01$) during the first year of life, while females were so during the second year (Adair and Guilkey 1997). Other studies report no significant differences between the sexes (Bloss et al. 2004; Bronte-Tinkew and deJong 2004), while research from South Asia in particular reports increased likelihood of stunting in female infants e.g. (Chen et al. 1981). Researchers suggest that gender bias may result in differential post-breastfeeding feeding and health seeking behaviours for boys and girls in this region (Chen et al. 1981; Miller 1997; Rousham 1999). It must be noted, however, that differential treatment is not ubiquitous throughout South Asia and the evidence on female child discrimination is mixed (Griffiths et al. 2004; Rousham 1996). Research indicated that feeding behaviours are influenced by household socio-economic status, variation in availability of resources for the household, seasonal variability in food resources, household structure, parity, sibship, sex of other children in the household, mother's autonomy, mother's employment status and mother's education level (Griffiths et al. 2002; Rousham 1999).

Unlike the mixed results concerning the relationship between sex of the child and stunting, studies consistently report positive associations between stunting and increased parity, birth order or number of younger siblings (Ojofeitimi et al. 2003; Sereebutra et al. 2006). For example, in a Brazilian study the likelihood of stunting was significantly increased in third or fourth born children (OR= 2.04; 95%CI 1.15 – 3.62 and OR= 2.34; 95%CI 1.28 – 4.28 respectively) (Aerts et al. 2004). In a Nigerian study the likelihood of stunting was similarly increased in children with four or more siblings (OR= 1.86; $p<0.05$) (Ukwuani and Suchindran 2003). Increased numbers of young children in a household may influence infection rates of both diarrhoea (Victora et al. 1992) and pneumonia (Fonseca et al. 1996) as well as allocation of resources including food, health care and parental time for caretaking behaviours (Bronte-Tinkew and deJong 2004; Ukwuani and Suchindran 2003).

Stunting in infancy and childhood (< 5 years) also shows positive associations with decreased birth weight, and in particular low birth weight (< 2,500 grams) (Adair and Guilkey 1997; Aerts et al. 2004; Saleemi et al. 2001). For example, in a Brazilian study Marins *et al.* reported a significant positive association between LBW and stunting in children under five years of age (OR= 2.9; 95%CI 1.9 – 4.3) (Marins and Almeida 2002). A study of children under five years of age in South Africa also reported that those born LBW were at increased likelihood of stunting (OR= 5.25; 95%CI 3.10 – 8.87) (Chopra 2003). Stunting also shows associations with maternal stature. For example, in a study from Pakistan infants born to mothers shorter than 145 centimetres in height were at increased likelihood of stunting at one year of age (OR= 1.98; p=0.002) (Saleemi et al. 2001). Similar results were found in children aged under five years in Mexico (OR= 2.04; 95%CI 1.59 – 2.62) (Hernandez-Diaz et al. 1999). However, studies investigating maternal height rarely include information on LBW or SGA and as shorter mothers tend to give birth to lighter infants, the effect of maternal stature is likely to be mediated through LBW or SGA delivery (see section 2.3 *Factors influencing size at birth- Maternal factors*).

SOCIO-ECONOMIC FACTORS

Primarily due to the large influence in developing country settings of socio-economic status on infant and child nutrition, caretaking practices including health seeking behaviour and morbidity, stunting shows significant associations with a variety of socio-economic factors. Although less frequently investigated in developing country settings, stunting does show associations with some area-level SES measures. These primarily include service provision (electricity, water and sanitation, rubbish removal) and proximity of health service centres. Household level SES measures which show associations with stunting in developing country settings include water and sanitation facilities, income, measures of household expenditure and household wealth, maternal employment status and maternal education level. Associations between social measures of SES including social support lack investigation in developing country settings. However, these factors are anticipated to have some effect on child growth, considering the role that psycho-emotive factors play on caretaking behaviours (see section 2.3 Factors influencing stunting – Psycho-emotive factors).

<u>Area-level SES</u>

On the whole, associations between household level SES and stunting in developing countries have been much more thoroughly investigated than the effects of community level SES measures. A number of factors which influence this include: logistical challenges of collecting area-level data

in developing country settings; difficulty in defining the appropriate level of area-level socio-economic status to investigate (e.g. postal code, census tract, county); identifying if area-level measures represent contextual or compositional measures; identifying measures of area-level SES that are appropriate to the study question as all variables may not influence all outcomes; and identifying variables that are appropriate for the social setting under examination (e.g. being the worst off in a well-off community may be worse that the best off in a poorer community) (Diez-Roux 2001). Such challenges have also influenced the data source for this research, the Bt20 cohort, for which community or higher area level data is not available.

Despite these challenges, a few studies from African countries exist and suggest a contextual effect on stunting (Boyle et al. 2006; Fotso and Kuate-Defo 2005; Mahmud Khan et al. 2006). In Zaire, Bertrand *et al.* reported a positive association between stunting in children under 5 years of age and lack of water, sanitation, rubbish removal services and electricity supply to the neighbourhood (Bertrand et al. 1988). A study of a number of African countries, based on Demographic Health Survey (DHS) data reported an independent association with area supply of water services, electricity and telephone connection (Fotso and Kuate-Defo 2005). One South African study reported increased likelihood of stunting in under 5 year olds who lived over an hour away from a health clinic (OR= 1.80; 95%CI 1.13 – 2.89), adjusted for maternal education, presence of toilet and LBW (Chopra 2003). Research on health service usage and proximity to health care services from developing countries suggests that distance and ease of access to public clinics influence health seeking and treatment behaviours (Mahmud Khan et al. 2006), for example de-worming treatment for helminth infection in Bangladesh (Rousham 1994).

Water and Sanitation

In developing country settings characteristics of the household's water supply and means for excreta disposal have been consistently shown to influence stunting (Daniels et al. 1991; Nanan et al. 2003; Pongou et al. 2006). In a study from Peru, after adjustment for maternal education and household income, children under 2 years of age were significantly shorter if they came from homes without a mains sewerage connection, without a mains water connection and if their home had a small sized container to store water (Checkley et al. 2004). Results of a South African (Kwazulu Natal) study of children aged between 3 months and 5 years of age, reported that, despite adjustment for a number of socio-economic measures, children from homes without access to a toilet were at significantly increased risk of stunting (OR= 1.46; 95%CI 1.02 – 2.08) (Chopra 2003). Similarly in a study from Brazil, children from homes with fair or unsatisfactory conditions in

terms of water, sewerage and electricity supply were at increased likelihood of stunting (OR= 2.08; 95%CI 1.35 – 3.20 and OR= 2.75; 95%CI 1.70 – 4.43 respectively) (Aerts et al. 2004). In a longitudinal study (0 - 18 months) of children in Sudan, Merchant *et al.* reported that stunting was significantly less likely in homes with an indoor tap and toilet (OR= 0.79; 95%CI 0.69 – 0.90) (Merchant et al. 2003).

The influence of water and sanitation services on stunting in studies which control for other socio-economic measures is undoubtedly mediated through reduced infection rates due to reduced faecal-oral contamination, increased personal and domestic cleanliness and improved hygiene behaviours, especially those related to food preparation and delivery (Huttly et al. 1997). In a recent review of water, sanitation and hygiene behaviour interventions Fewtrell *et al.* reported that diarrhoeal morbidity was reduced through all of the following: water supply (quantity), water quality (treatment of water at point of use), sanitation, hygiene education and hand washing (Fewtrell et al. 2005). Indeed, previous reviews indicated similar conclusions, for example, Esrey *et al.* reported that increased water quantity was associated with reduced morbidity from helminth infections and diarrhoea (Esrey et al. 1991), hygienic disposal of excreta was associated with decreased diarrhoeal morbidity (Esrey 1996), while provision of sanitation services was associated with decreased diarrhoeal morbidity and mortality as well as decreased severity of hookworm infections (Esrey et al. 1991).

Huttly *et al.* reported that improved hygiene behaviour in the home was also associated with decreased diarrhoeal morbidity, indeed the WHO recommends hand washing as a key behaviour to promote child health (Huttly et al. 1997). An example of a slum study from Ethiopia illustrates the point well. In a slum community in Addis Ababa hygiene behaviours related to child feeding and food storage were significantly associated with malnutrition (Abate et al. 2001). Malnutrition in this setting was negatively associated with caretakers who washed their hands before feeding children (OR= 0.44; $p<0.001$), whereas storing food uncovered or for a period of more than 24 hours after preparation was associated with increased likelihood of malnutrition (OR= 3.52; $p<0.001$ and OR=2.86; $p<0.05$ respectively) (Abate et al. 2001).

Household Income, Expenditure and Estimated Wealth

As outlined previously (see section 2.1 *Measurement of Socio-Economic Status- Traditional Measures*), collection of accurate income and expenditure data in developing country settings is challenging. Therefore, although some studies of child malnutrition in developing countries use

income or expenditure data to investigate the association between wealth and stunting, many more studies use estimates of household wealth as a proxy of income. In a study from rural Pakistan, low paternal income was associated with an increased likelihood of stunting (OR= 1.35; 95%CI 1.12 – 1.66), after adjustment for maternal education and child's age (Shah et al., 2003). In a Brazilian study, Marins *et al.* reported that children under 5 years of age were at increased likelihood of stunting if household income was below the minimum wage (adjusted for maternal education and LBW) (OR= 1.8; 95%CI 1.3 – 2.5) (Marins and Almeida, 2002). In a study of household expenditure in South Africa (1993), stunting was eight times more prevalent in the poorest 10% of households than in the richest 10% (Zere and McIntyre, 2003).

A number of studies have used DHS data to examine the association between household wealth and child malnutrition in developing countries e.g. (Boyle et al. 2006; Fotso and Kuate-Defo 2005). In a study of forty-two developing countries, including African countries, Boyle *et al.* reported that even on adjustment for child's age, maternal education and national GDP, household wealth (ownership of consumer durables and dwelling condition) was significantly ($p<0.001$) and positively associated with height-for-age (Boyle et al. 2006). In a study of Burkina Faso, Cameroon, Egypt, Kenya and Zimbabwe, Fotso *et al.* reported a significant negative association between increased household wealth and stunting (Fotso and Kuate-Defo 2005). Household wealth was summarised using an index of possessions, drinking water source, toilet facility and flooring material (Fotso and Kuate-Defo 2005). Similar results have been reported for Tanzania (Mahmud Khan et al. 2006), where the household wealth index used also included measures of dwelling condition and ownership of durables.

In a recent study of childhood stunting in areas of urban and rural Bangladesh stunting was significantly ($p<0.05$) associated with a measure of household wealth (RR= 1.88 urban; RR=1.95 rural) (Giashuddin et al. 2005). In this study household wealth was summarised using tertiles of an index, which was made up of ownership of consumer durables (TV, car, radio) and dwelling conditions (electricity supply, type of toilet, piped drinking water, floor material). In a study of stunting in under 5 year olds in Cambodia, Hong *et al.* reported that stunting was associated with household wealth as measured by consumer durable ownership (OR= 2.05; 95%CI 1.28 – 3.28) (Hong and Mishra 2006). Results in this Cambodian study were adjusted for water and toilet facilities, child's age, sex, birth order, breastfeeding, mother's age, BMI and education level. Results from a recent Ugandan study, however, reported that the positive association between low household wealth and stunting was no longer significant on adjustment for maternal education level

(Wamani et al. 2004). The unadjusted likelihood of stunting between the highest and lowest quintile of household wealth was OR=2.1; 95%CI 1.2 – 3.7 and household wealth was measured by dwelling characteristics (number of rooms, material for wall, flooring and roof) and ownership of durables (radio, phone, fridge, bike, motorbike, car, boat, clothing cupboards, hurricane lamp and fuel) (Wamani et al. 2004).

Increased household income, estimated through actual income, expenditure or household wealth measures, may influence stunting through increased purchasing power to obtain goods and services that may improve material conditions and promote nutritional wellbeing and good health (Boyle et al. 2006). A recent Tanzanian study reported that health seeking behaviour for fever or malaria was significantly ($p<0.01$) positively associated with increased household wealth (Njau et al. 2006). In this study household wealth was measured using an index which summarised house construction, utilities and ownership of consumer durables. In a rural Indian study, increased household income was associated with increased expenditure on child health care (Berman et al. 1997). In a recent slum study from Nairobi (Kenya), Taffa *et al.* reported that children (< 5 years) from homes in the lowest tertile of monthly expenditure were significantly less likely to be taken to a health facility for treatment of recent illness or injury (OR= 0.63; 95%CI 0.46 – 0.88) (Taffa and Chepngeno 2005). Results were adjusted for age and sex of the child, maternal education and age as well as illness severity (Taffa and Chepngeno 2005). A study from Ethiopia also reported that household income showed a significant ($p<0.05$) positive association with preventative health seeking behaviour (immunization and attendance at growth monitoring appointments) for children aged under 3 years (Armar-Klemesu et al. 2000).

Maternal Employment

Employed maternal employment status shows both positive and negative associations with stunting in the developing world. For instance, increased income through maternal employment was associated with reduced stunting in Guatemala (Engle 1991). Increased family income from maternal employment may increase the family's ability to purchase or access health promoting goods and services. In addition to increased family income, Engle in the Guatemalan study referenced also suggested that the positive relationship between child's height-for-age and income from mother's employment may be due to increased financial decision-making power available to employed versus unemployed mothers. In comparison to households where only the father earns income, Engle suggests that resources are allocated more frequently and appropriately to meet the basic needs of children in households where the mother also earns income (Engle 1993).

Unemployed maternal employment status may also negatively impact on a child's height-for-age through impaired mother-infant or mother-child interactions that can arise under conditions of unemployment or underemployment due to issues of depression, poor mental well-being (see section 2.3 *Factors influencing stunting- Psycho-emotive factors*), social isolation, reduced social networks and eroded self-esteem (Bartley et al. 2005). Although extensive studies of the psychosocial and psychological effects of unemployment and underemployment have been carried out in developed countries (Kasl and Jones 2000), these issues have yet to be addressed in developing country settings and evidence from South Africa in particular is lacking. Research from developed countries indicates positive associations between depression, poor mental well-being, low self confidence, higher externality (locus of control of one's life is outside oneself) and unemployment or underemployment (Kasl and Jones 2000). It is suggested that the effects on unemployed individuals of job loss and long-tem unemployment, above and beyond economic hardship, may include loss of daily structure (e.g. time structure), loss of contact and shared experience with others and loss of a sense of personal status and self-identity (Bartley et al. 2005). Furthermore, such negative psycho-emotive and psychological effects may also be experienced by individuals in high unemployment environments where the risk or threat of job loss is high (Kasl and Jones 2000).

The anticipated effects of unemployment would suggest a positive relationship between employed maternal employment status and a child's height for age. However, studies of maternal employment do not always report positive associations with height-for-age. For example, results from India indicate that children of mothers who worked were at increased likelihood of stunting (OR= 1.16; 95%CI 1.00 – 1.35), after adjustment for SES and weaning behaviour (Padmadas et al. 2002). The direction of association between maternal employment and malnutrition or stunting in developing country settings is influenced by a number of factors including the location of work, whether children may accompany the mother to the workplace, type of work (i.e. does it allow concurrent supervision of children), availability of appropriate alternative childcare and hours worked (Joekes 1989). These factors influence caretaking and feeding behaviours, particularly breastfeeding which if terminated early may have a large impact on child growth (see section 2.3 *Factors influencing stunting- Nutritional factors).* Ukuwani's study of Nigerian children clearly illustrates the complexity of mother's employment as a variable (Ukwuani and Suchindran 2003). In this study mother's employment away from the home and where she could not bring the child to work was associated with wasting (OR= 1.87; $p< 0.05$) (Ukwuani and Suchindran 2003).

The influence of caretaking behaviours may also impact on stunting. The mother is acknowledged as the favoured caretaker, however, in developing countries including South Africa caretaking responsibilities may be delegated to other adults, either within or outside the family unit, to childcare services such as crèches as well as to pre-teen (peer) carers (Joekes 1989). Growth, nutrition and disease experiences of children under certain types of alternative care in the developing world, namely crèche (day care centre) and peer care by pre-teen children (often older siblings) are worse than those of infants and children cared for by their mothers. Pieterson *et al.* reported in a study of state-funded crèches in the Cape Town area (South Africa) that sanitation facilities (toilets) were inadequate and that although the majority of meals tested provided a third of age-specific RDA for protein, none provided sufficient energy or micronutrients (Piertersen et al. 2002). Use of crèches may also influence morbidity from infectious disease. For example, attendance at crèches or day care centres was associated with increased likelihood of pneumonia in two Brazilian studies (Fonseca et al. 1996; Victora et al. 1992). Indeed in the study by Fonseca *et al.* attendance at a crèche was the second strongest factor associated with pneumonia, after weight-for-height (OR= 5.22; 95%CI 2.13 – 12.79) (Fonseca et al. 1996). Peer childcare in particular is associated with prevalence of stunting (Engle 1991; Lamontagne et al. 1998). For example, a study from Nepal reported increased likelihood of peer caretaking with stunting in children under two years of age after adjusting for SES, feeding practices and disease episodes experienced (OR= 3.63; 95%CI 1.21 – 10.90) (Nakahara et al. 2006).

Maternal Education

One of the most consistent findings between SES and stunting in developing countries is that of maternal education. Recent studies from a variety of countries including Ecuador (Larrea and Kawachi 2005), Guatemala (Sereebutra et al. 2006), Brazil (Marins and Almeida 2002), India (Padmadas et al. 2002), Pakistan (Shah et al. 2003), Nigeria (Ojofeitimi et al. 2003), Uganda (Wamani et al. 2004) and Cameroon (Pongou et al. 2006) show negative associations between increased levels of maternal education and child stunting. A recent study from South Africa reported that stunting was significantly less likely in children under 5 years of age whose mother had more than five years education (OR= 0.62; 95%CI 0.42 – 0.91) (Chopra 2003).
Maternal education may impact stunting through caretaking, particularly feeding and hygiene behaviours and health seeking behaviours, which in turn impact nutrition status and infectious disease morbidity. For example, in a slum community from Addis Ababa maternal education was significantly ($p<0.05$) associated with improved feeding practices (i.e. breastfeeding, timing and type of complementary food) and improved home hygiene behaviour (i.e. cleanliness of home,

child, mother, washed food utensils and covered water storage) (Armar-Klemesu et al. 2000). Le Vine *et al.* reported that in a Mexican study mothers with 6-9 years of schooling were significantly ($p<0.01$) more likely than mothers with less schooling to seek clinic-based treatment within three days for symptoms of vomiting, fever and diarrhoea (Levine et al. 1991). In a study from the Cebu cohort (Philippines) maternal education level influenced diarrhoeal morbidity through improved nutrition (increased calories) and improved disposal of excreta (Cebu Study Team, 1991).

The influence of maternal education on stunting may have an economic component, enabling improved employment, opportunities and material conditions (Cleland and van Ginneken 1988; Shaw et al. 1999), which may in turn enable health promoting behaviours (as outlined in section 2.3 *Socio-economic factors- Household income, expenditure and estimated wealth*). The experience of schooling may also influence nutrition and health seeking behaviours through improved cognitive faculties that enable mothers to obtain relevant health promoting information from sources outside of school (Cleland and van Ginneken 1988; Thomas et al. 1990). A Zambian study reported that literacy skills gained in school, particularly the ability to comprehend decontextualised language, influenced mothers' abilities to understand healthcare messages which were mainly disseminated through the media (e.g. newspapers and radio) and orally from health care workers (Stuebing 1997). Cleland and others also suggest that education may influence health through increased contact with the outside world, participation in society outside the home unit and access to networks of people that may not otherwise be available (Cleland and van Ginneken 1988). Finally, the impact of maternal education is also suggested to work through an increased sense of independence, personal control, social confidence and autonomy (Cleland and Vanginneken 1988; Ross and VanWilligen 1997).

Evidence suggests that caretaking behaviour relating to child diet is influenced by autonomy available to mothers, particularly over intra-household allocation of resources and decision-making power vis-a-vis household food expenditure (Engle 1991). In a study from rural Chad, Begin *et al.* reported that the height of children under the age of three years was significantly ($p< 0.01$) taller if the mother had influence over the type of food provided (Begin et al. 1997). Begin *et al.* also reported that in the same area stunting in children under six years of age was significantly ($p< 0.05$) negatively associated with mother's ability to make decisions over household food expenditure, despite adjustment for household socio-economic status (Begin et al. 1998). In a UNICEF report Ramalingaswami *et al.* suggest that lack of autonomy to "act in their children's best interest" may contribute to the very high levels of malnutrition seen in South Asia (Ramalingaswami et al. 1996).

3. METHODS

In order to address this study's research questions, quantitative methods were predominately used. However, qualitative methods were also used, principally to aid interpretation of quantitative results. Pearson Chi-squared (χ^2) tests and logistic regression were used to investigate the associations between SES and social support exposures and growth outcomes of small for gestational age and stunted in a sample of infants and children from the "Birth to Twenty" (Bt20) cohort study (1990-2010). Qualitative data were collected during focus group discussions and in-depth interviews with local residents of Johannesburg and Soweto. Thematic analysis of transcriptions was facilitated by the use of N*VIVO software.

This section introduces the data source for quantitative analysis (Bt20 cohort study) and outlines data collection of quantitative variables used in this research. Methods used to clean and manage these quantitative variables prior to quantitative analysis are also detailed. Bivariate and multivariable quantitative analysis methods used to analyse these data are then presented at length. Finally, methods of data collection, management and analysis used in the small-scale qualitative study are described. A postscript on ethical clearance and permission seeking is also included.

3.1 QUANTITATIVE DATA SOURCE & DATA COLLECTION

DATA SOURCE

THE "BIRTH TO TWENTY" COHORT STUDY - AIM AND SAMPLING

Bt20, then known as the "Birth to Ten" project, was established in 1990 in Johannesburg and Soweto as a cohort study which would recruit urban neonates and monitor their growth and development until ten years of age [iii]. The study had the overall aim of "*determining the biological, environmental, economic and psychosocial factors associated with the survival, health, well-being, growth and development of children living in an urban environment*" (p.212 (Yach et al., 1991)). Bt20 was distinctive, as prior work on the physical growth and development of urban children had been restricted to samples of school children, with few studies including information from pre-school years. Additionally, at that time no large-scale longitudinal studies of the effect of perinatal or parental factors on child growth had been established in a developing country (Yach et al., 1991).

[iii] In 2000 "Birth to Ten" was extended for an additional decade and re-named "Birth to Twenty" (http://www.wits.ac.za/birthto20).

Public sector health service facilities in Johannesburg and Soweto in 1990 were administered by both provincial and local authorities. In addition, health service facilities were fragmented by residential area, and as such by "population group" or ethnicity (Yach et al., 1990). Distinctively, the sampling process for Bt20 enrolment was not dependent on, or segregated by, administration body. Neither was it segregated by residentially-defined health service boundaries. Instead the study aimed to use a *"unified metropolitan approach"* to recruit singleton births from all ethnicities ("Black", "Coloured", "Indian" and "White") in all suburbs served by the Johannesburg and Soweto City Health Authorities, including those of Coronation, Diepkloof, Dobsonville, Eldorado Park, Klipspruit, Lenasia extensions 1-7, Meadowlands and Riverton (Yach et al., 1991) [iv].

THE "BIRTH TO TWENTY" COHORT STUDY - RECRUITMENT

At establishment of the cohort study, legislation in South Africa required all delivery centres to notify the state of new live births (Harris et al., 1997). As such it was possible to use routine notification data to obtain birth information for the Bt20 study. However a pilot study, to determine the time frame for recruitment in order to obtain sufficient births, was necessary prior to commencement of the cohort (Fonn et al., 1991). Based on this, the Bt20 cohort obtained birth information on all singleton births that occurred in public delivery centres in the Johannesburg/ Soweto metropolis over a seven week period (23rd April 1990 and the 10th June 1990) [v]. Once multiple births were excluded, a total of 5,449 births occurred in the metropolis during this period [vi].

The Bt20 study also required recruitment of infants' mothers. Another pilot study was carried out to determine the timing and frequency of contact of pregnant women with ante-natal service centres, where mothers of appropriate labour date could be enrolled into the study and baseline data collected (Fonn et al., 1991). Based on this study, pregnant women between 26-30 weeks gestation with a due date within the cohort study start dates were approached at ante-natal care centres for enrolment. Of those participants who enrolled ante-natally, 4,029 gave birth during the relevant time period, representing 74% of the total number of singleton births in that period (Richter et al., 1995). However, as the growth and development of urban children was a key focus of the study,

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[iv] The use of "White", "Black", "Coloured" and "Indian" reflects categorisation used in South Africa at, and prior to, the establishment of the "Birth to Twenty" study, based on 1950 Population Registration Act. It is utilised only because data in the "Birth to Twenty" cohort is so categorised.

[v] In effect, recruitment occurred only over six weeks due to a strike by health service workers between the 1st and 10th May 1990. A study has demonstrated that significant bias in the sampling of birth data was not introduced by this strike (Richter et al., 1995).

[vi] Home births not attended by a registered midwife were also excluded. Between 1987 and 1988 this accounted for 0.54% of total births in Johannesburg. A corresponding figure for Soweto is not available, although it is assumed to be higher.

membership to the cohort excluded non-resident births. Residents of the Johannesburg/Soweto metropolis were defined as those mother and infant pairs still resident in the area six weeks postpartum (Yach et al., 1991). Almost 20% of the enrolled mother and infant pairs for whom birth and baseline data was available did not remain in the metropolis, leaving 3,275 infants to form the core of the Bt20 cohort study (Richter et al., 1995).

Due largely to the fact that private health facilities were not included in the enrolment of mothers and the consequent collection of baseline data, some differences between the Bt20 cohort and the population of general births during the relevant time period exist. A significantly smaller proportion of White births which occurred during the relevant time period were enrolled in the cohort study. Additionally, significantly fewer of those births enrolled occurred in suburban Johannesburg and inner city health service facilities. As a result, members of the White and Indian ethnicities are under-represented in the Bt20 cohort (Richter et al., 2004).

DATA COLLECTION

HOUSEHOLD SES AND SOCIAL SUPPORT DATA

Socio-economic and social support data was collected only at the household level in the Bt20 cohort, as such no measures of community SES were available for use in this study. Household SES and social support data were drawn from two questionnaires carried out at baseline (ante-natal) and six months postpartum. The baseline data questionnaire was administered to pregnant women at ante-natal care centres during the months of March-May 1990. The six month questionnaire was administered at the homes of the participants from October-December 1990. Both were multi-focal and adapted from questionnaires used in the European longitudinal study of pregnancy and childhood (Golding, 1989). Questionnaires were translated from English into Afrikaans, Sotho and Zulu, back-translated and altered for inadequate or inappropriate translation. They were then tested by Bt20 fieldworkers and again adjusted for ease of administration. Both questionnaires were administered by trained interviewers and where possible in the preferred language of the interviewee. However, when this was not Afrikaans, English, Sotho or Zulu the interviewer translated directly from the English questionnaire (Yach et al., 1991).

Neither the baseline, nor six month, questionnaires were designed to collect solely SES and social support data. Instead questionnaires covered a range of topics. However, many questions did address household SES and social support, providing a unique, rich and ranging source of social

and economic information. Tables 3.1.1 – 3.1.3 show the SES and social support variables, extracted from the questionnaires, which are used in this research.

Table 3.1.1 SES variables used in this research, obtained from baseline (ante-natal) questionnaire

General category	Detail of variables	General category	Detail of variables
Water & Toilet	Type of toilet	Economic variables	Electricity
	Sole/ shared access to toilet		Tenureship of dwelling
	Type of water source		Medical aid insurance
	Sole/ shared access to water source		Domestic helper
Other household Variables	Type of dwelling	Mother's education	Schooling level completed
	Number sleeping rooms		Further education
	Separate kitchen	Partner's education	Schooling level completed
Cooking Fuel	Electricity		Further education
	Gas	Mother's employment	Working/ Unemployed
	Paraffin		Frequency of pay
	Coal		
	Wood	Partner's employment	Working/ Unemployed
	Brazier		Frequency of pay
Consumer Durable Ownership	TV		
	Radio	Deprivation	Alcohol/ Drug abuse in family
	Car		Physical abuse of mother by partner
	Phone		Lack of money for basic needs
	Washing machine		Unmanageable debt
	Fridge		Unwilling separation from children
	Children's toys		

Table 3.1.2 Social support variables used in this research, obtained from baseline (ante-natal) questionnaire

General category	Detail of variables
Support from partner	Marital status
	Living with a partner
	Talk to partner about problems
	Financial support from partner
	Partner helps with childcare
	Partner helps with housework
Wider social support	Number of people to talk to about problems
	Number of people to seek help from
	Membership of organisation
Support during Pregnancy	Want to be pregnant at time of pregnancy
	Family financial and emotional readiness for pregnancy
	Partner is ready for pregnancy

Table 3.1.3
SES and social support variables used in this research, obtained from six month post-partum questionnaire

General category	Detail of variables
Childcare	Person child usually lives with
	Person who cares for child during day
	If mother not main caregiver, why not?
Grandparent's education	Grandmother education level
	Grandfather education level
Characteristics of dwelling	Type of roofing material
	Ceiling present
	Rating of condition of house
	Damage to house/ repairs needed
	Leaks in house
	House troubled by pests
Household Composition	Age of household members
	Sex of household members
	Relation to Bt20 child
Pregnancy support	Someone other than medical staff present at labour
	Still at school when discovered pregnancy

GROWTH DATA AND ADDITIONAL VARIABLES

At establishment of the Bt20 cohort, the intent was to obtain the majority of the growth information from data routinely collected within public sector health facilities. In order to investigate the feasibility of this intent, pilot studies were carried out (Fonn et al., 1991). These aimed to determine:

1. The availability and quality of routinely collected delivery data from health facilities and health authority sources.
2. The timing and frequency of visits by new mothers and infants to post-natal clinics, termed "Well baby" clinics, where growth was routinely monitored.

With reference to the first aim, results of the pilot study indicated that the availability and quality of routinely collected delivery data (i.e. birth weight, ethnicity, obstetric and delivery information) from health facilities and health authority services was adequate for use in the Bt20 study. As such, birth weight data for the cohort study was obtained from a number of sources including delivery centre records (obstetric and neonatal) as well as the governmental registry of births (Richter et al., 1995). Although considered adequate, a number of limitations exist with the data obtained routinely through these sources (Harris et al., 1997). Particularly relevant to this study, was the numerous sources from which birth weight notification could be drawn (Ellison et al., 1997a; Ellison et al., 1997b). As a result, Bt20 researchers used an algorithm to draw birth weight data from the most reliable source available for each cohort participant (Norris, 2004).

The use of monthly-calibrated electronic scales is recommended for the collection of birth weight measurements, which should be taken with the baby in the nude and recorded to the nearest 10 grams (Roche and Sun, 2003). In addition, in order to reduce measurement error, the mean of three birth weight measurements is recommended (Cameron, 2002). Birth weights were collected in Johannesburg and Soweto delivery centres in 1990 and 1991 by medical staff (usually nurses) principally using beam scales and recorded to the nearest 10 grams (Norris, 2004). However, recording of the mean of a number of birth weight measures was not common at this time and the birth weight of restless infants was measured by calculating the difference between the caregiver's weight with and without the infant (Norris, 2004).

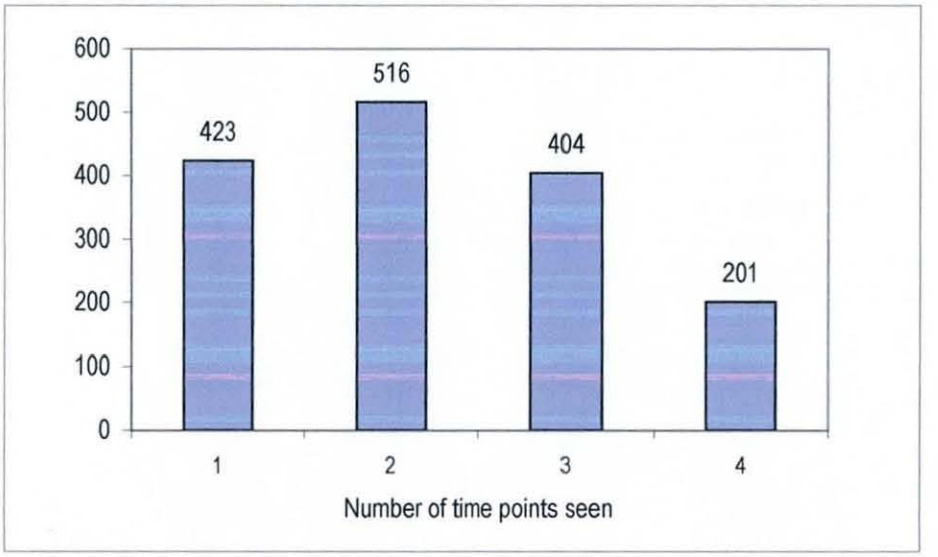
With reference to the second aim, results of the pilot study indicated that the quality of the routinely collected anthropometric data from the government paediatric clinics (termed "Well Baby" clinics) was problematic. Results of the pilot reported that in the clinics visited both the equipment and the techniques used to obtain growth measurements lacked standardisation. As such, anthropometric measurements beyond birth were collected by the Bt20 research team itself, rather than being sourced from data routinely collected by the healthcare sector. During data collection trained Bt20 staff visited participants at their homes and used standardised techniques (portable infantometer and microtoise) to measure the recumbent length or height of cohort members and both length and height were recorded to the nearest 0.1 centimetre. Length was collected at the one year data collection point (which included children from 6 to 18 months) while standing height was collected at the five year data collection point (which included children from 4.5 to 5.5 years). At the two year data collection point (which included children from 1.5 to 2.5 years) mixed methods of length and height collection were used, depending on the child's ability to stand unaided. The use of such a mixed method is clearly not ideal as systematic differences of increased size when measured by length of between 0.4 and 0.8 centimetres have been reported in other studies (Buyken et al., 2005). Reporting which measurements were obtained by which method (recumbent or standing) is recommended, but was unfortunately not recorded in the Bt20 data collection (Norris, 2004).

Sources of measurement error principally include instrumental errors i.e. use of an imprecise instrument, and observer errors, which may differ between different observers and between the same observer over a number of subsequent measurements. Instrumental error in the collection of height data in this study was minimised by use of standardised field equipment. Although Bt20 staff were trained in data collection methods, no records of either inter or intra-observer technical error measurements (TEM) or differences in TEM between the field team and anthropometry expert (N.

Cameron) are available (Norris, 2004). Without such estimates of TEM it is not possible to comment on whether any mis-measurement of height was random or differential, however random or non-differential mis-measurement of measures such as height usually results in regression to the mean (Kirkwood and Stearne, 2003). Furthermore, in terms of anthropometric measurements, height and weight tend to be the two most reliably collected variables (Ulijaszek and Kerr, 1999).

The data used represents a mixed longitudinal sample in which a number of children were seen at all outcome time points i.e. birth, 1, 2 and 5 years (n=201). However, as figure 3.1.1 shows, a number of children were only seen at one (n=423), two (n=516) or three (n=404) time points.

Figure 3.1.1 Graph showing frequency of inclusion in each growth data collection time point



Additional variables used in this research were gestational age, child's date of birth, sex, ethnicity, maternal age at delivery, parity and maternal smoking behaviour. All of these variables, except maternal smoking behaviour, were recorded by delivery centre staff on neonatal and obstetric delivery centre records and subsequently recoded in governmental birth registries (Norris, 2004). Gestational age was calculated largely using last menstrual period (LMP), few estimates were made using palpitation or ultrasound. Ethnicity was recorded by delivery centre staff and categorisation corresponded to the Apartheid ethnic group classification (Black, Coloured, Indian or White). Maternal smoking behaviour was collected during the baseline Bt20 questionnaire and reported whether or not the mother had ever smoked.

3.2 QUANTITATIVE DATA CLEANING AND MANAGEMENT

DATA CLEANING

DATA CLEANING PROCESS

Following collection, data from paper records were entered to create an electronic database. Data are, therefore, stored both in electronic and paper format at the Bt20 research centre in Johannesburg. As it is common for errors to occur during data entry, it was essential that electronic data underwent cleaning prior to analysis.

Extensive data cleaning of SES and social support variables was necessary as these had been little used by previous researchers. Cleaning of variables collected in the baseline and six month questionnaires was carried out by P. Griffiths and B. Willey (Johannesburg, August/ September 2003). A complete technical report is available and the procedure involved four stages.

1. Drawing a random sample of participants and cross-checking the content of electronic data with the content of data held in paper format.
2. Carrying out range checks for categorical variables and investigating outlying/ improbable values in continuous variables.
3. Checking the "missing" category of variables and entering data into electronic format when it existed in paper format.
4. Completing internal consistency checks.

Cleaning of birth weight, gestational age, child's date of birth, child's age, sex of child, height, ethnicity, mother's age, parity and mother's smoking behaviour was carried out by Bt20 researchers at the University of Witwatersrand and M. Simpson, Loughborough University.

SES & SOCIAL SUPPORT - RANDOM SAMPLES

A total of three exclusive 5% random samples were drawn from baseline questionnaire data. An *a priori* level of two "badly entered" cases per 5% sample was set as the threshold to investigate a further 5% sample. A "badly entered" case was defined as having five or more incorrectly entered variables.

Examples of some errors highlighted by this process included the identification of: three "badly entered" cases; unsystematic and inconsistent categorisation of marital status as well as a number of other small data entry errors (e.g. ID 1539063 partner's education was *don't know* in database,

but *matriculation* on questionnaire). Such small data entry errors were corrected to correspond with data in the paper format. The inconsistent coding of marital status as *civil, common law* and *traditional* was resolved by using one code- *married*, as distinguishing between these types of marriage was not important enough to warrant re-entry of the variable. Finally, the three "badly entered" cases were completely re-entered.

As the six month questionnaire data had not undergone any previous cleaning, a 10% sample was drawn and cross checked with the data in paper format. Examples of errors highlighted from this included: one "badly entered" case; inconsistent classification of partner's employment as well as a number of small data entry errors. Again small errors were simply corrected and the "badly entered" case re-entered. Inconsistent categorisation of partner's type of employment was addressed by re-entry of the variable using the South African Census classification of jobs (which had already been applied to mother's type of employment).

SES & SOCIAL SUPPORT - RANGE CHECKS, MISSING VALUES & CONSISTENCY CHECKS

Range checks ensured that codes allocated in electronic data matched possible categories of that variable. Investigation of outliers and improbable values ensured that these were not simply data entry errors. Overall, few data entry errors were highlighted in this stage. Populating missing variables ensured that "missing" in the electronic format was also "missing" in the paper format. Again, few errors arose with missing variables that were not in "badly entered" cases.

As a final stage in data cleaning, internal consistency checks were carried out. Certain variables were logically linked, for example *pmored* and *peducat*. If a mother reported not knowing if her husband/ partner had received further education after school (*pmored*), it would not be expected that she provide detail of what type of further education he received (*peducat*). Syntax was written (Stata 8.0) and new variables created to identify ID numbers with inconsistent or illogical combinations of responses. Due to time constraints only fifteen cases were checked for each illogical combination. However, where four or more of these fifteen cases showed mistakes, the remaining cases were also checked. Where errors were found in the electronic data of a particular ID number, the rest of the SES and social support variables in that ID number (i.e. participant) were also cross checked with data held in paper format.

GROWTH AND ADDITIONAL VARIABLES

Cleaning of these variables was carried out by drawing a 5% or 10% random sample and comparing electronic data to data in paper format. Cleaning of birth weight data also included investigating outliers using distribution plots. Additionally, cleaning of height data included investigating longitudinal height velocities, cross-sectional examination of BMI as well as longitudinal examination of BMI trends.

DATA MANAGEMENT

Data management was carried out using Stata 8.0 statistical package (StataCorp., 2004). All management and analyses were carried out using the original database and consistently undertaken using syntax-based programming files, or "do files" The use of do files allowed a record of how variables were managed to be kept, and also ensured reproducibility of analyses.

SES AND SOCIAL SUPPORT EXPOSURE VARIABLES

Data management of SES and social support measures included combining existing variables to create new ones. For example, household register data was used to create variables indicating if the father was a usual resident of the household (figure 3.2.1).

Figure 3.2.1 Creating a variable to indicate if the father was reported as a usual household resident

Start	Stage 1	Stage 2	Stage 3
Household registry data (up to 20 members) Name Sex (*hsex*) Age (*hage*) Relation to Bt20 child (*hrel*)	Creation of father Present e.g. dad in house=1 if *hrel1*=2 ... *hrel20*= 2	Creation of missing category information missing if *hrel1*=99 ... *hrel20*=99	Creation of no father present e.g. dad in house=0 if "dad in house" variable is not equal to yes or missing

Data management also included merging or collapsing levels of certain categorical variables. This was necessary as data became too sparsely spread, with certain categories containing very little or no data. For example, mother's schooling was re-categorised to combine those completing Grade 2 and below and those with no formal education; those completed Standards 1- 4; those completed 5 - 9 and those completed Matriculation (table 3.2.1).

Table 3.2.1 Re-categorisation of mother's education variable

Mother's education
0 = <Grade 2 & no formal education
1 = Standard 1-4
2 = Standard 5-9
3 = Matriculation

Because it is necessary that categories of variables used in Principal Component analysis are consistently ordered (either from best to worst or vice versa), ordering categorical variables was also a key aspect of data management. The processes of re-categorisation, grouping and ordering SES and social support variables were carried out in collaboration with the current South African Bt20 research team, who provided advice and input from a South African perspective. The process of ordering levels of variables was also informed by the results of qualitative analysis (see chapter 5.3 *Rank orders of categorical variables*).

Finally, data management also included the grouping of socio-economic and social support variables into a number of themes or conceptual categories. Preliminary themes were created in collaboration with Bt20 researchers in South Africa. The strong associations between variables placed within the same theme were confirmed using Pearson χ^2 tests. Themes included: maternal education, partner's education, maternal grandparent's education, maternal employment, partner's employment, water/ toilet facilities, economic household measures and ownership of consumer durables, home characteristics and condition of the home structure, household composition, social situation in pregnancy, childcare, wider social support, social support from partner and deprivation. This process was useful for investigating co-linearity and identifying highly correlated variables that were candidates for principal component analysis (Jolliffe, 1986; Dunteman, 1989).

GROWTH OUTCOME AND ADDITIONAL VARIABLES

Stunted, or low height-for-age, is defined as less than –2 height-for-age z scores from a reference population median (Dibley et al., 1987). As South African population growth references do not exist, international ones were used for comparison with the Bt20 data and to create age and sex-specific z scores. A –2 z score cut off point, from the CDC/ WHO 1978 and CDC/ NCHS 2000 references, was then used to create a binary outcome of *not stunted / stunted* at each age. As height of infants and children was measured over a period of months, individuals within each age group include those aged 0.50-1.49 for 1 year olds, 1.50-2.49 for 2 year olds and 4.50-5.49 for 5 year olds. Birth

weight, gestational age and sex were used to categorise infants as small for gestational age (SGA). The sex-specific cut off points for defining this binary outcome of "SGA/ not SGA" used the 10th percentile of foetal growth curves developed by Alexander *et al.* (Alexander et al., 1996).

During data management of additional variables, gestational age was used to create a new variable identifying pre-term infants. Pre-term was defined as <37 weeks gestation and term as 37-41 weeks. Birth weight was also used to create *not LBW/ LBW*, where low birth weight (LBW) was <2500 grams. Parity of the mother was originally recorded by individual live birth (1-8 births). This was re-categorised during data management to create a binary variable distinguishing between primiparous and multiparous mothers. Mother's age at delivery (14-44 years) was also re-categorised into five year age bands and then later into a binary variable identifying young mothers (<20 years vs. 20-44 years).

3.3 QUANTITATIVE DATA ANALYSIS [vii]

BIVARIATE ANALYSIS

DESCRIPTIVE ANALYSIS AND UNADJUSTED MEASURES OF ASSOCIATION AND EFFECT

In order to compare the means of birth weight, gestational age and height-for-age z-scores as distributed throughout the additional variables, t test statistic and corresponding 95% confidence intervals were calculated [viii]. The difference between stunted at ages one, two and five years as defined by both the CDC/ WHO 1978 and CDC/ NCHS 2000 population growth references was investigated using z test statistic and 95% confidence intervals for the difference between two proportions (Kirkwood and Sterne, 2003).

The association between the many measures of SES and social support and outcomes of SGA and stunted at one, two and five years was initially investigated at bivariate level using χ^2 tests, and where sample sizes were small, Fisher's exact tests [ix]. The association of, both SES and social support exposures and growth outcomes, with additional variables (e.g. mother's age at delivery) was also investigated using χ^2 and Fisher's exact tests.

[vii] Methods described apply to analyses of both SGA and stunting outcomes and where differences occur additional information is provided.

[viii] Additional variables included sex, ethnicity, maternal age at delivery, parity and maternal smoking for birth weight, gestational age and height and small for gestational age, low birth weight and pre-term delivery for height.

[ix] The use of Fisher's exact test is recommended when overall sample sizes are below forty or where expected values of cells are below five.

The χ^2 and Fisher's exact tests were used to investigate the association between two or more categorical variables, whose distribution can be summarised in a "row by column" (r x c) table. The null hypothesis of each test is of no association between the row and column classification- that the distribution of one variable is independent of the other(s). Both tests compared the observed data in the cells of the table with expected values, that would be seen if the null hypothesis was true, and provided a probability level which aided interpretation of whether or not the distribution of one variable was independent of that of the other (Altman, 1991; Clayton and Hills, 1993; Armitage and Berry, 2002; Kirkwood and Sterne, 2003).

Rejecting the null hypothesis of the χ^2 or Fisher's exact tests, on the basis of test results, suggested an association between the variables, but did not provide a measure of effect. The measure of effect used throughout this research, to quantify the strength and direction of association between exposures and outcomes, was the odds ratio. Odds ratios, 95% confidence intervals [x] and χ^2 test statistics [xi], for both the effect of SES and social support exposures on growth outcomes and the effect of additional variables on exposures and outcomes, were calculated.

Odds of disease (Ω) refer to the probability that an individual experiences disease, over the probability that they do not. *($\Omega = p / 1 - p$) where p= probability of disease.* Odds of disease can be calculated for exposed and unexposed individuals, e.g. *odds of disease in unexposed =($\pi_0 / 1 - \pi_0$) where π_0 =risk of disease in unexposed.* The odds ratio (Ψ) is the ratio of the odds of disease in the exposed, over the odds of disease in the unexposed. It reveals how much more or less common an outcome is among the exposed, compared to the unexposed and may be summarised by: $\Psi = \{(\pi_0 / 1 - \pi_0) / (\pi_1 / 1 - \pi_1)\}$ (Clayton and Hills, 1993; Kirkwood and Sterne, 2003).

MANTEL-HAENSZEL ADJUSTED MEASURES OF EFFECT

In order to obtain improved measures of association and effect, it was necessary to investigate potential confounding of the exposure's effect on the outcome. Confounders were defined as those variables that were associated with both the outcome and the exposure [xii], and where there was no

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[x] 95% confidence intervals were calculated using the Woolf method.

[xi] χ^2 test H_0 is that $\Psi = 1$ as an odds ratio of one indicates equal odds of disease in the exposed and unexposed (Clayton and Hills, 1993; Kirkwood and Steame, 2003).

[xii] These associations were investigated during bivariate analysis using χ^2 or Fisher's exact tests.

effect of exposure or outcome on the confounder (i.e. in theory, the confounder was not on the causal pathway between the exposure and outcome).

Once a potential confounder was identified, odds ratios stratified by the confounding variable were calculated. The result of this stratification was an odds ratio estimate for each strata of the potential confounder. Some variation of effect estimates across the strata is expected in most stratified analysis, due to sampling variation (Rothman and Greenland, 1998). Therefore, a test for homogeneity, using the χ^2 distribution on one degree of freedom, was carried out to determine if the stratum-specific estimates were statistically "similar" or "different". $\chi^2_{MH} = \{ (| \sum a - \sum Ea | - 0.5)^2 / \sum Va \}$ where the null hypothesis assumes one underlying effect of the exposure on the outcome, throughout the strata and :

a = observed number of exposed cases
Ea = expected number of exposed cases
Va = variance of exposed cases

When odds ratios were different, and the data were not too sparsely distributed across the strata, stratum-specific odds ratios were reported and the potentially confounding variable was identified as an effect modifier. However, if they were similar, stratum-specific odds ratios were pooled, thus obtaining a summary odds ratio (Mantel-Haenszel odds ratio). Odds ratios were pooled using a weighting process whereby strata which were more accurately determined (that had more data and narrower confidence intervals) received a larger weight (Kirkwood and Sterne, 2003).

Pooled MHOR $= \sum \{ (w j * OR j) / \sum w j \}$
$w j$ = *weight* $= \{ (Do j * H_1 j) / N j \}$
$Do j$ = *unexposed cases*
$H_1 j$ = *exposed controls*
$N j$ = *total number of subjects*

The pooled summary MH odds ratio was then compared to the unadjusted odds ratio obtained during bivariate analysis. When the two differed substantially (e.g. 10% - 15%), a confounding association was reported (Agresti, 2002; Armitage and Berry, 2002; Kirkwood and Sterne, 2003). Using Mantel- Haenszel odds ratios was appropriate for investigating the potentially confounding effect of one variable on outcomes of SGA and stunted at 1,2, and 5 years. However, to investigate

the effect of a number of exposures and potentially confounding variables it was necessary to use multivariable analysis methods (logistic regression).

MULTIVARIABLE ANALYSIS

LOGISTIC REGRESSION AND CONCEPTUAL FRAMEWORK FOR MULTIVARIABLE ANALYSIS

Multivariable analysis was carried out using Stata 8.0. Seven main logistic regression analyses were carried out: one with the binary outcome of SGA and six with the binary outcome of stunting. Two analyses were carried out at each age of one, two and five years- the first using stunting defined by the CDC/ WHO 1978 references and the second by the CDC/ NCHS 2000 references.

Logistic regression is part of a larger family of models, generalised linear models, and its parameters, log odds, are estimated using likelihood methods (Clayton and Hills, 1993). Due to their modelling and structural properties, mainly the fact that probabilities may fall in the range of $-\infty$ to $+\infty$, log odds and log odds ratios were used instead of odds ratios, although results are presented in odds ratios. Therefore, a logit transformation was used $logit\ (p) = log_e\ [(p) / (1 - p)]$.

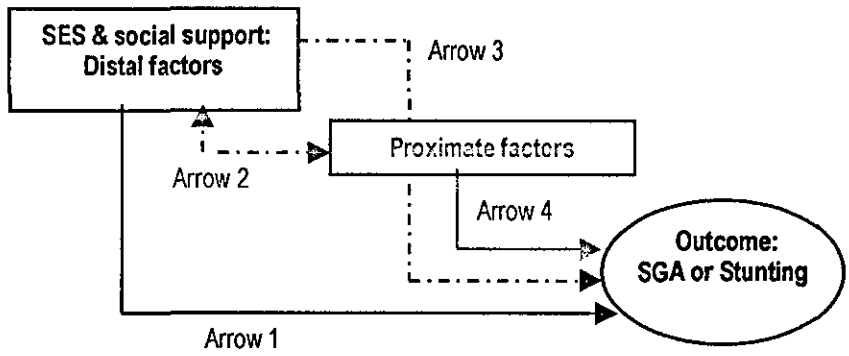
Each of the logistic regression analyses were conducted in two stages. In the first stage only significant SES and social support exposure measures were included. In the second, significant SES and social support exposures remained, but in addition, other risk factors or potential confounders were added [xiii]. The reason logistic regression models were developed in these stages was that the entire logistic regression analysis was based on a conceptual framework (figure 3.3.1). This framework aimed to classify sets of exposure, potential confounder and independent risk factor variables as being distally or proximately related to the outcomes of SGA and stunted at one, two and five years (Victora et al., 1997). It also aimed to illustrate the potential pathways through which SES and social support measures may be acting to influence growth.

Within this framework other risk factors for the outcomes that were associated with the SES and social support exposures were considered as potential confounders (arrow 2). Other risk factors for the outcomes, which were not associated with the SES and social support exposures, were conceptualised as independent risk factors (arrow 4). Finally, the effect of SES and social support exposures on the growth outcomes examined was conceptualised as being mediated through those

[xiii] Significant variables were defined as <0.05 p-value level in χ^2 or Fisher's exact tests.

other risk factors that were associated with SES and social support, but also feasibly located on the causal pathway between SES and social support and the growth outcomes (arrow 3).

Figure 3.3.1 Conceptual framework for logistic regression



Adapted from (Victora et al., 1997)

PRINCIPAL COMPONENT ANALYSIS

Exposure variables, additional risk factor variables and potentially confounding variables, with a p-value of < 0.05 in the χ^2 or Fisher's exact tests, were included in logistic regression analysis. In some cases, a number of SES or social support exposure variables, which were associated with the outcomes at a p-value level of < 0.05, were also significantly and highly associated with one another. Carrying out logistic regression under these conditions was problematic due to co-linearity. Principal component analysis (PCA) with a correlation matrix was used in these cases, to obtain uncorrelated principal components for inclusion in logistic regression analyses [xiv].

PCA is a data reduction technique which uses principal axis transformation to derive a small number of uncorrelated linear combinations, or principal components (PC), from the original set of correlated variables (Jolliffe, 1986; Dunteman, 1989). There are no underlying statistical models or hypothesis tests involved in PCA, rather the analysis aims to derive uncorrelated principal components that retain as much of the variation in the original variables as possible. In fact, the principal components are derived in descending order of latent roots (eigenvalues), whereby the first PC accounts for the most variation in the original correlated variables. Each principal component is composed of several eigenvectors or latent vectors/ weights, which summarise the relationship of the original variables to the PC, and can be used to produce a score. The weights assigned to each of the variables included in the score are determined by the variance and are not

[xiv] Significant association was defined as p-value < 0.001 in χ^2 or Fisher's exact tests. Highly correlated was defined as 90% -100% definition of one category of a variable by the other in the r x c table.

equal. In this research scores of the first principal component were divided into tertiles and these tertiles were used in logistic regression analyses (Filmer and Pritchett, 2001)[xv].

LOGISTIC REGRESSION - MODEL BUILDING

Logistic regression model building was undertaken using a forward fitting approach. Starting with the most statistically significant variable, variables were progressively added in decreasing order of significance. At each stage the Wald test p-value level, odds ratio estimates and 95% confidence intervals were examined and variables were retained if their p-value level remained < 0.05. The Wald test uses quadratic approximations of the log likelihood to calculate the approximate log likelihood ratio at the parameter's null value – the value at which there is no effect. The degree of support for the null hypothesis, that the true log odds ratio is zero (or true odds ratio is one), can be measured using the Wald test by comparing the log likelihood ratio to a χ^2 distribution to obtain a p-value.

Missing values in the Bt20 cohort data are not consistent across all variables. Some individuals have missing values for one variable, but complete data for another (for an example see table 3.3.1). Therefore including missing values as a separate category may increase sample size and power of statistical tests. The unadjusted effect of missing category of SES, social support and proximate exposures on growth outcomes was investigated in bivariate analysis. Effect measure estimates and significance of associations (i.e. odds ratios, 95% confidence intervals and p-values) were compared between the analyses that included and excluded missing values, and when these were substantially altered (>10% change), missing values were excluded.

Table 3.3.1 Distribution of missing values across variables from Stunting at 2 years analysis

Variable	Total sample size	Response n(%)		Missing n(%)
Maternal education	621	< Matric 440 (70.85%)	Matric 180 (28.99%)	1 (0.16%)
Partner frequency of pay	621	< Monthly 195 (31.40%)	Monthly 224 (36.07%)	202 (32.53%)
Mother still at school when fell pregnant	621	No 294 (47.34%)	Yes 104 (16.75%)	223 (35.91%)
Drug and/ or alcohol abuse in family	621	No 501 (80.68%)	Yes 113 (18.20%)	7 (1.13%)

[xv] Indices of ownership of consumer durables created in this research differ to those frequently used in socio-economic research as weights are neither assigned equally to each variable, nor defined relative to the local price of consumer durables. However, studies show that indices created by PCA, as used in this research, show good correlation with those that are constructed using local pricing techniques (Bollen et al., 2001).

A number of variables in particular had large numbers of missing values and these are identified in results tables by the title of "missing/ system missing". Large numbers of missing values were due to three main reasons: poorly answered questions, linking questions and questions from the six month questionnaire. Large numbers of missing values were due to poorly answered questions in only one of these variables, that measuring whether the mother was separated unwillingly from her child.

More frequently missing values were due to linking questions. Data entry of responses to linking questions did not distinguish between "true missing" and "not applicable" (i.e. respondent not eligible to respond to linking question). Variables that have large numbers of missing values due to linking questions include partner's level of schooling, partner's level of further education, frequency of mother's and partner's pay, partner's employment, employment of domestic worker, medical aid cover, partner's help with childcare and partner's help with housework. SES and social support data were drawn from both birth and six month questionnaires (see section *3.1 Quantitative data source and data collection- Data collection*). The six month questionnaire was completed by a sub section of the study sample. However, data entry did not identify this sub sample to allow them to be distinguished from the main study sample. Variables affected by this included grandparents' level of schooling, if the mother was at school when she fell pregnant, if the mother was accompanied during labour or delivery, type of childcare, type of roofing, if the home had a ceiling as well as all variables measuring the condition of the home.

EFFECT MEASURE MODIFICATION, LIKELIHOOD RATIO & GOODNESS OF FIT TESTS

Logistic regression assumes proportionality of odds (Clayton and Hills, 1993). To investigate effect measure modification and this assumption, Likelihood Ratio Tests were carried out on those associations between exposures and outcomes and those between potential confounding variables and outcomes, for which some precedent for expecting effect measure modification existed. The Likelihood Ratio test is very similar to the Wald test and also uses the log likelihood ratio at the null value of the parameter, but this is calculated from the maximum likelihood curve, not its approximation. The null hypothesis is that there is no departure from odds ratio multiplicatively and the test was carried out by comparing the model fitted with an interaction parameter to that without. Exclusion of missing values on certain variables occurred to ensure that the tests were carried out on the same sample.

Final models included proximate risk factors and more distal (SES and social support) risk factors for growth outcomes. When distal level variables (SES and social support) remained significantly associated with the outcome in these final models, the effect on growth outcomes of including these variables was investigated using Likelihood Ratio tests. Models including both proximate and distal level variables were compared to those including only proximate level variables. Again, exclusion of missing values on certain variables occurred to ensure that the tests were carried out on the same sample. The resulting p-value and odds ratio estimates were examined and the degree of alteration to the odds ratios was assessed. Finally a Pearson's goodness of fit χ^2 test and the resulting p-value was used to assess the goodness of fit of the logistic model $\chi^2 = \sum[(O_j - E_j)^2]/(E_j)$. Goodness of fit tests investigate how effective the model is, based on the variables included in it, at describing the outcome. The null hypothesis of the test is that the model is a good fit and that values predicted under the model are similar to those observed in the data.

3.4 QUALITATIVE METHODS

The qualitative component of the research aimed to inform quantitative analysis by:

1. Investigating if and how local residents perceived measures of SES and social support (collected in the Bt20 study) to be related to infant/ child growth and health.
2. Investigating if perceived SES effects on infant/ child growth and health varied by mothers' SES category.
3. Obtaining local opinions on how to rank the different levels of a number of categorical SES measures.

This qualitative research project was carried out for the most part by the principal investigator. However, two local female African South African research assistants were also enlisted to help with recruitment of participants and collection of data, particularly during focus group discussions. Although one research assistant was trained in qualitative methods (Master's student) the emphasis during recruitment interviews was on hiring personable assistants who would be able to engage with the participants. The aims and key interests of the research project were explained to both assistants. In particular, key questions in guides (e.g. not introductory or general topic questions) were highlighted and the importance of encouraging participants to respond with more than one word answers or "don't knows" as well as probing for more complete answers were also emphasised. Methods for data recruitment and collection were also explained and a mock session of a focus group discussion was held with African language-speaking Bt20 staff, to familiarise both the principal investigator and the research assistant translating with the mechanics and challenges of carrying out focus group discussions in this setting.

DATA SOURCE

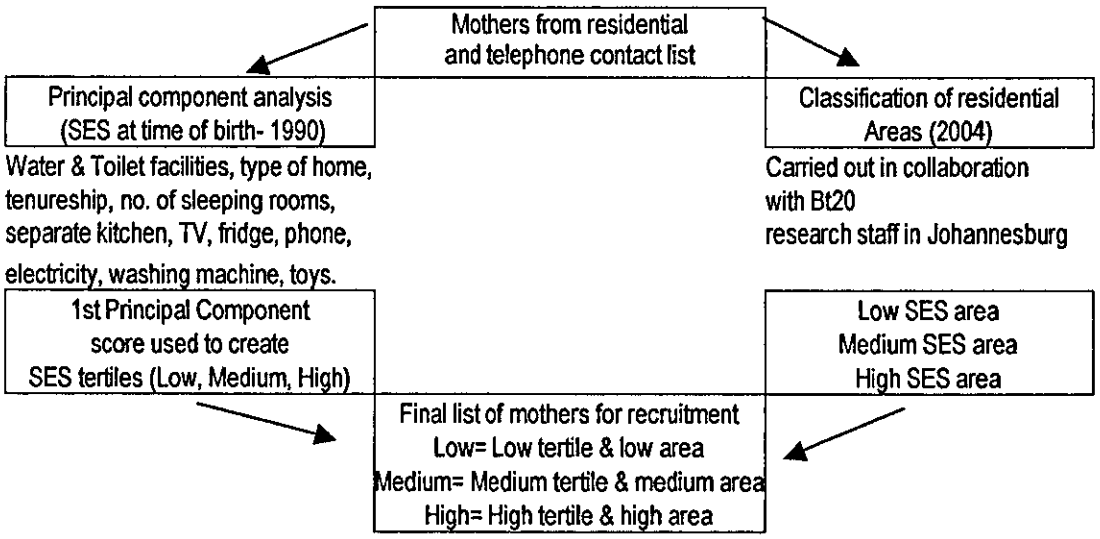
SAMPLING OF MOTHERS

In order to obtain a range of views, local residents recruited to participate in this project included mothers and key community informants (school teachers, church leaders and healthcare nurses). Mothers were drawn from a range of SES backgrounds and as one of the key aims was to inform quantitative analysis carried out on data form the Bt20 cohort, the sampling endeavoured to reflect the SES composition of the Bt20 cohort study where more mid and low SES groups than high SES groups were represented.

An initial sampling frame for the mothers was obtained from the residential and telephone contact list for Bt20 study participants. The residential contact list was divided during a two stage process,

into three groups- broadly representing high, mid and low SES. In the first stage tertiles (low, mid, high) from an SES index were used. The SES index was created using principal component analysis and used socio-economic information from 1990 (Filmer and Pritchett, 2001). Variables included in the index were water and toilet facilities, type of home, tenureship, the number of sleeping rooms, whether the home had a separate kitchen, ownership of a television, fridge, telephone, washing machine, toys and electricity supply. In the second stage categorisation of mothers' residential areas (current residence) into tertiles of low, mid, high SES areas, was carried out. This second stage was conducted in collaboration with Bt20 staff, who were long time locals of Johannesburg and Soweto. A final list of mothers eligible for recruitment was created where mothers whose category of current residential area matched the tertile of the SES index (figure 3.4.1).

Figure 3.4.1 Development of sampling list to recruit mothers for Focus group discussions



SAMPLING OF KEY COMMUNITY INFORMANTS

The project aimed to recruit key community informants who worked in a variety of socio-economic environments. As with the recruitment of mothers, the recruitment of key informants aimed to include more participants from mid and low SES environments, than from high ones. Sampling of school teachers and church leaders aimed to draw participants from similar residential areas (proxy for SES) as those from which participating mothers came. Lists of schools and churches and their contact details were obtained through the phone book as well as through internet searches. Nurses were not, however, drawn from differing residential areas, rather their SES classification was limited to public or private health service providers. Nurses were drawn from public hospitals in Johannesburg and Soweto (Johannesburg General and Chris Hani Baragwanath Hospitals) as well

as from public community clinics in Soweto (Health Service District 10). Nurses in the private sector were drawn from private clinics in Johannesburg.

RECRUITMENT

Two local residents, both female and multi-lingual (covering Afrikaans, Sotho, Zulu and Xhosa languages between them) assisted in recruitment of participants. Mothers from the sampling list, as well as primary schools and church leaders from relevant residential areas, were recruited by telephone to participate in focus group discussions and in depth interviews. Nurses were contacted in person at Johannesburg and Chris Hani Baragwanath public hospitals, public clinics in Region 10 (Soweto) and private clinics in Johannesburg.

During telephone calls and personal meetings participants were informed of the nature of the study, the types of topics that would be covered and what participating in a focus group discussion or interview would entail (see Appendices A-C, Participant information sheets). At this time participants were also invited to ask questions or seek further clarification. Mutually convenient appointments were made for interested parties to participate in the study.

DATA COLLECTION

FOCUS GROUP DISCUSSION GUIDE & INTERVIEW QUESTIONNAIRE DESIGN

Focus group discussions (FGD) were the data collection method of choice, however due to the logistical difficulty in recruiting large numbers of healthcare nurses, teachers and church leaders willing and available to participate in group discussions, in-depth interview (IDI) collection methods were used for these participant categories. IDI questionnaires and FGD guides were developed based on design concepts presented in the literature (Stewart and Shamdasani, 1990; Foddy, 1993; Kreugar, 1998; Kreugar and Casey, 2000; Bloor et al., 2001). Guides and interviews include sections to investigate potential links to child growth and health and to address aims of ranking orders for categorical variables (table 3.4.1).

The focus group discussion guide was developed specifically for sessions with principal care-givers and the content of the guide was tailored to this group. For example, topics of hired childcare services (nanny, crèche, childminder) and their influence on child growth were not included in care-giver's focus group discussions as this was expected to be a sensitive issue, which the mothers would be less open to discussing. Such topics were, however, addressed in the healthcare nurse

interviews. Table 3.4.1 shows that the topics addressed in data collection sessions, by type of participant and by study aim.

Table 3.4.1 Topics addressed in data collection sessions, by participant type and study aim category

Study aim Category	Category of participant			
	School teachers	Church leaders	Healthcare nurses	Mothers
Link to child growth and health	Mother's education	Mother's education	Mother's education	Mother's education
	Mother's work	Mother's work	Mother's work	Mother's work
	Electricity supply	Electricity supply	Water facilities *	Water facilities *
	Type of home *	Type of home *	Toilet facilities *	Toilet facilities *
	Tenureship *	Tenureship *	Childcare	Consumer durables *
	Condition of home	Condition of home	Cooking fuel	Marital status
	Type of roofing *	Type of roofing *	Medical aid	
	Drugs/ Alcohol	Drugs/ Alcohol	Social support in pregnancy	
Ordering of Variables	Type of home *	Type of home *	Water facilities *	Water facilities *
	Tenureship *	Tenureship *	Toilet facilities *	Toilet facilities *
	Type of roofing *	Type of roofing *	Childcare	

* Topics addressed through pile sorting exercise.

FOCUS GROUP DISCUSSIONS & IN-DEPTH INTERVIEWS – PILOTING & DATA COLLECTION

Prior to piloting, the FGD guide and interview questionnaires were examined by research staff in South Africa, to address any issues of cultural sensitivity. A pilot FGD was held in English with eight mothers, while two pilot in-depth interviews were carried out, one with a healthcare nurse and one with a community member (see Appendices D-F, Pre-pilot interview and focus group guides). Pilot sessions were intended to investigate the time frame for completing a session, to investigate the ease of administering and answering the questions and to determine if questions were easily comprehensible to participants.

Following pilot sessions, discussions and interviews were transcribed and feed-back meetings were held with the research assistants and South African research staff. Guides and questionnaires were altered according to feed-back and changes mainly involved temporal ordering of questions (from most to least critical), shortening and re-phrasing of questions in FGD guides and in-depth interviews to improve clarity, as well as the removal of non-critical questions in order to cut interview/ discussion session length.

Approximately 90 mothers were contacted by telephone and informed about the study. Of these 55 mothers agreed to participate and attend a focus group discussion. Among those mothers who

declined to participate, two reasons were principally cited; unable to get permission to attend from employer and lack of alternative childcare. Despite telephone reminders the day before the focus group and delayed starting time to wait for late comers, seven mothers (all allocated to low SES group) who had agreed to participate were no-shows on the day. Therefore, a total of 47 mothers attended focus-group discussions, a range of six to nine mothers took part in each of the seven sessions. Sessions were held in a community hall room close to Chris Hani Baragwanath Hospital in Soweto and lasted for two hours. Informed consent was obtained and the participants were assured that their personal results and identity would be kept strictly confidential. Participants were also asked to keep the opinions of other participants confidential.

The flow of group discussions was directed by the FGD guide (see Appendix G). Participants were asked to discuss different issues raised and share their opinions with the group. In addition to discussion, certain topics were addressed through a group pile sorting process (table 3.4.1) of photo cards (see Appendix H). During this participants were asked to sort and group picture cards and then explain their reasons for the grouping pattern observed. While the second research assistant acted as note taker, the main research assistant helped facilitate the focus group discussions, by translating or elaborating on a question in local African languages. This assistant also provided short summary translations of responses that were not in English. As such, sessions were a mix of English and mostly Zulu and Sotho, as the participants moved very easily from one language to another- a practice also common in everyday conversation in this region of South Africa.

All community participants approached agreed to participate and a total of 25 in-depth interviews were conducted. Twelve of these were held with healthcare nurses, eight with primary school teachers and five with church leaders (see Appendices I and J). Interviews lasted between thirty and forty minutes and were carried out at the participant's place of work or home. All IDI participants were English-speakers and therefore the in-depth interviews were conducted in English. Participants of in-depth interviews were encouraged to discuss their opinions on the relevant topics as well as to take part in pile sorting exercises.

DATA ANALYSIS

TRANSCRIPTION OF DISCUSSIONS

Following completion of data collection, tape recordings of focus group discussions and in-depth interviews were translated where necessary and then transcribed into electronic format (Microsoft Word). Transcription of FGD retained SES classification and distinguished between the interviewer and participants, but not between different participants. Transcription of interviews distinguished the category of participant (teacher, nurse or church leader). Information identifying the suburb SES classification, or health service provider type in the case of healthcare nurses, was also retained on IDI transcriptions. Quality of the interview transcriptions was assessed by re-listening to all interview tape recordings and ensuring transcription was accurate and complete, making alterations where necessary. The transcription of English language conversation as well as the translation and transcription of African language conversation in FGD were also carefully checked and corrected when necessary.

OPEN CODING

Effect on child growth and health:

Data were analysed using principles of thematic analysis (Rice and Ezzy, 1999; Kreugar and Casey, 2000). Open coding was initially carried out by hand on printed transcriptions, however, N*Vivo software was subsequently used to facilitate management of codes and retrieval of text. Sixteen principal theme headings were pre-determined from question topics included in the FGD guides and IDI questionnaires. These pre-determined themes were based on the project's main research aims and included topics such as water and toilet facilities, maternal education and social support in pregnancy (table 3.4.1). Sub themes within these main themes were coded using an open coding system and descriptions were allocated to each main theme and sub theme (Strauss and Corbin, 1998). In order to investigate the clarity of main and sub theme coding descriptions, a second researcher blind coded a selection of transcripts. On the whole a relatively high degree of agreement was found between code allocations. However, description of a number of codes required elaboration. For example, two sub codes of the main code of childcare were altered from "attention to child- ratio carers/ children" to "attention to child- ratio of carers/ children", "individual attention" and "quality of care- training, registered, supervision" to "quality of care provider- training, registered, supervision, not siblings".

Comparisons between SES categories:

In order to investigate if opinions expressed by mothers during FGD differed by SES classification, comparisons were made between the groups of different SES tertile. A matrix approach to analysis was undertaken by comparing responses stratified by different categories of SES (Miles and Huberman, 1994).

Ranking orders for categorical variables:

The rank order of a number of categorical variables (water, toilet, cooking fuel, type of home, tenureship, roofing material and child care) was investigated during focus group discussions and interviews using oral listing and pile sorting with photo cards. Participant explanations for the ranking order were obtained during open coding of transcriptions. These explanations were included along with summaries of the ranking order of the variables in the results.

ETHICAL APPROVAL AND PERMISSION

Ethical approval for the Bt20 cohort study was obtained from the ethics board of the University of Witwatersrand, Johannesburg (protocol number: M980810). The ethics boards of both Loughborough University and the University of Witwatersrand (protocol number: 03-11-40) granted ethical clearance for the qualitative study. In the Bt20 study, written informed consent, which covered participation of both infant and mother, was obtained from mothers approached at ante-natal care clinics, prior to enrolment. Written informed consent was also obtained from participants in the qualitative study. This was obtained after the aims and details of the research had been explained and before data collection began. In addition, permission to interview teachers was obtained from headmasters or principals of schools concerned. Permission to interview Johannesburg and Soweto city health personnel was obtained from the Chief Executive Officer of Johannesburg General Hospital, the Associate Director of Chris Hani Baragwanath Hospital, the Regional Health Manager of Region 10 (Soweto) as well as from directors of private health clinics sampled.

4. QUANTITATIVE RESULTS

Results are presented separately for the four outcomes of SGA and stunted at one, two and five years of age. Results of descriptive, bivariate and multivariate analyses are presented. Where appropriate, 95% confidence intervals and p-values are shown [xvi]. The results of one way adjusted odds ratios using Mantel-Haenszel (MH) are on the whole not presented, as exposures in analyses are adjusted simultaneously for numerous variables. MH odds ratios are however presented where necessary to clarify results of effect modification.

4.1 SMALL FOR GESTATIONAL AGE RESULTS

Of the 3,275 members of the core Bt20 cohort, 1,544 were included in this analysis. These had complete information on birth weight, sex and gestational age (necessary to calculate outcome of SGA) and at least partially complete information on demographic, SES and social support variables (drawn from the antenatal questionnaire).

RESULTS OF DESCRIPTIVE ANALYSIS OF OUTCOME VARIABLE

BIRTH WEIGHT

Table 4.1.1 shows means and standard deviations of birth weight stratified by proximate exposures as well as the proportion of infants born LBW (< 2,500g). The mean birth weight of female newborns in this sample was lighter than that of males ($p< 0.05$) although the proportion LBW was not different between the sexes (see also figure 4.1.2). Indian and Coloured newborns had lighter mean birth weights than White or Black newborns ($p< 0.05$). Indian newborns had the lightest mean birth weight (2,837 g), which was also lighter than that of Coloured newborns ($p< 0.05$) (see also figure 4.1.3). No differences in proportion of LBW births were seen between the four ethnic groups (table 4.1.1). Differences in mean birth weight of newborns by maternal age at delivery were seen, where those infants born to mothers under 20 years were lighter ($p< 0.05$). Those mothers age <20 years at delivery also showed a higher proportion of LBW delivery than older mothers ($p<0.000$). For those mothers over 20 years of age, no differences in mean birth weight were seen between different categories of age at delivery (table 4.1.1). Newborns of primiparous mothers as well as those whose mothers reported having ever smoked had lighter ($p< 0.001$ respectively) mean birth weights than multiparous mothers and those who reported having never smoked (see also figures 4.1.4 and 4.1.1). However, no difference in proportion of infants born LBW was seen between these groups (table 4.1.1).

[xvi] Reported p-values are two-tailed unless otherwise stated.

Table 4.1.1 Mean birth weight (g) of newborns and proportion LBW by proximate exposures

Category	Sample size (n)	Mean Birth weight (g)	SD	LBW n(%)
Male	773	3176.1	489.3	53 (6.9)
Female *	771	3099.7	459.9	61 (7.9)
Black	1238	3160.6	460.1	80 (6.5)
White	89	3228.6	515.2	5 (5.6)
Coloured	143	3040.7	545.4	17 (11.9)
Indian *	74	2837	422.9	12 (16.2)
≤ 19.99 yrs * †	233	3040.8	445.7	18 (7.7)
20-24.99 yrs	508	3131.1	460.1	40 (7.9)
25-29.99 yrs	416	3157.7	499.6	32 (7.7)
>30 yrs	386	3184.8	482.7	24 (6.2)
1st live birth *	639	3069	459.8	58 (9.1)
> 2 live births	905	3186.6	481.9	56 (6.2)
Never smoked *	1391	3152.6	466.9	94 (6.8)
Ever smoked	137	3007.7	553.5	18 (13.1)

* Mean birth weight p-value< 0.05
† LBW p-value < 0.05
SGA = Small for gestational age
LBW = Low birth weight (<2,500g)

Figure 4.1.1 Distribution of birth weight (grams) in study sample

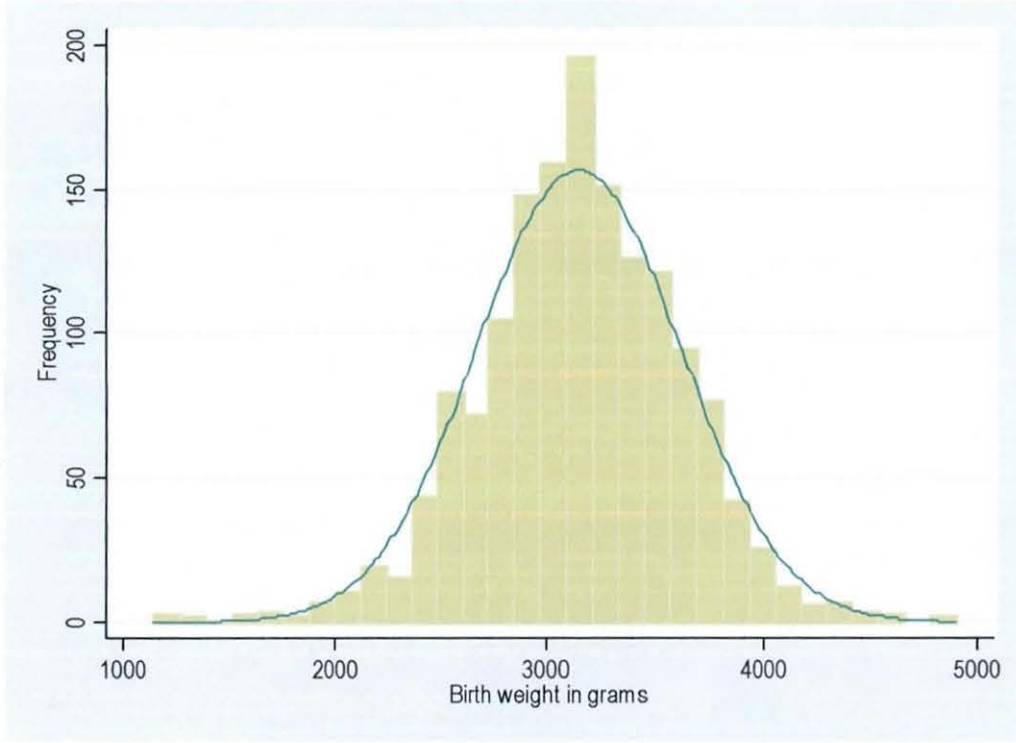


Figure 4.1.2 Distribution of birth weight (grams) by sex

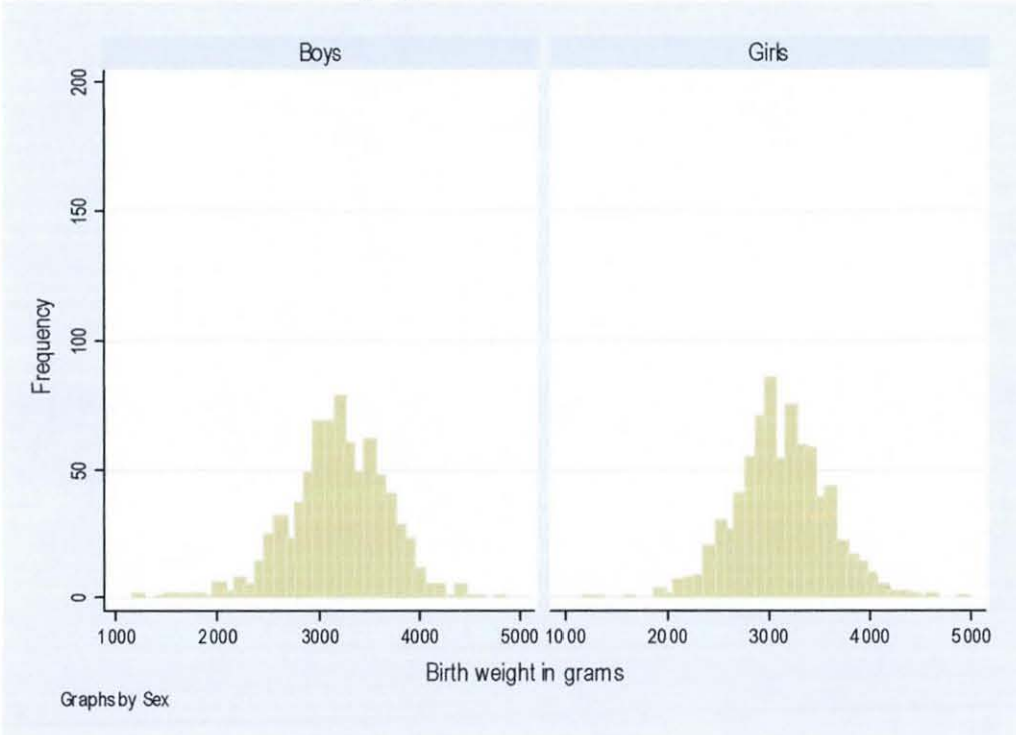
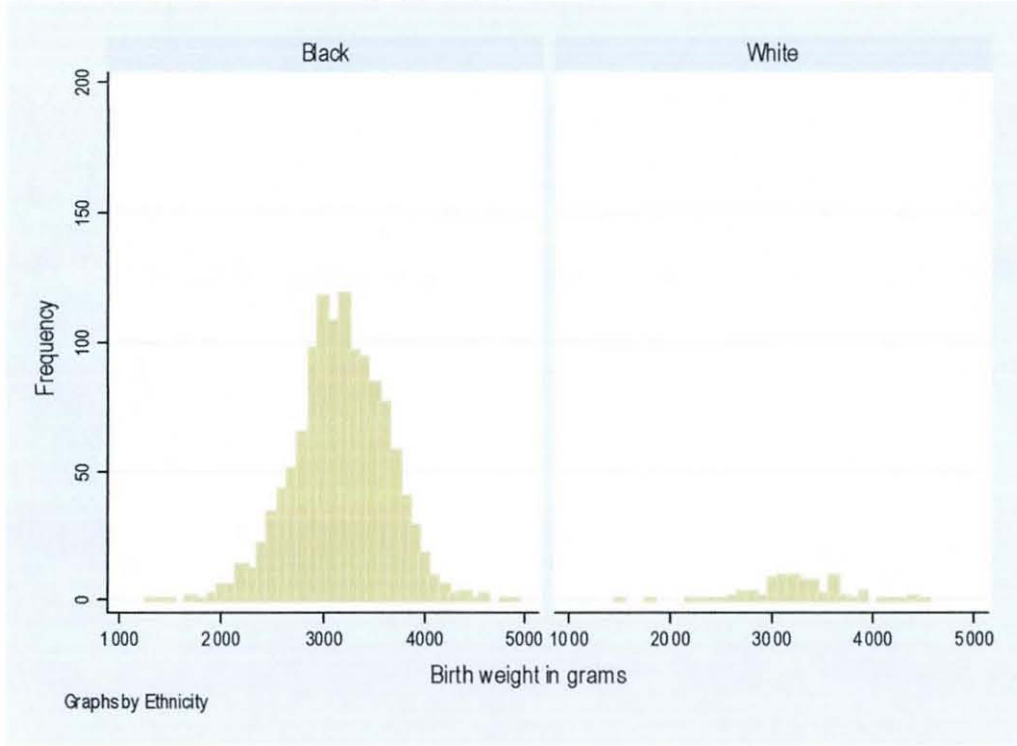


Figure 4.1.3 Distribution of birth weight (grams) by ethnicity



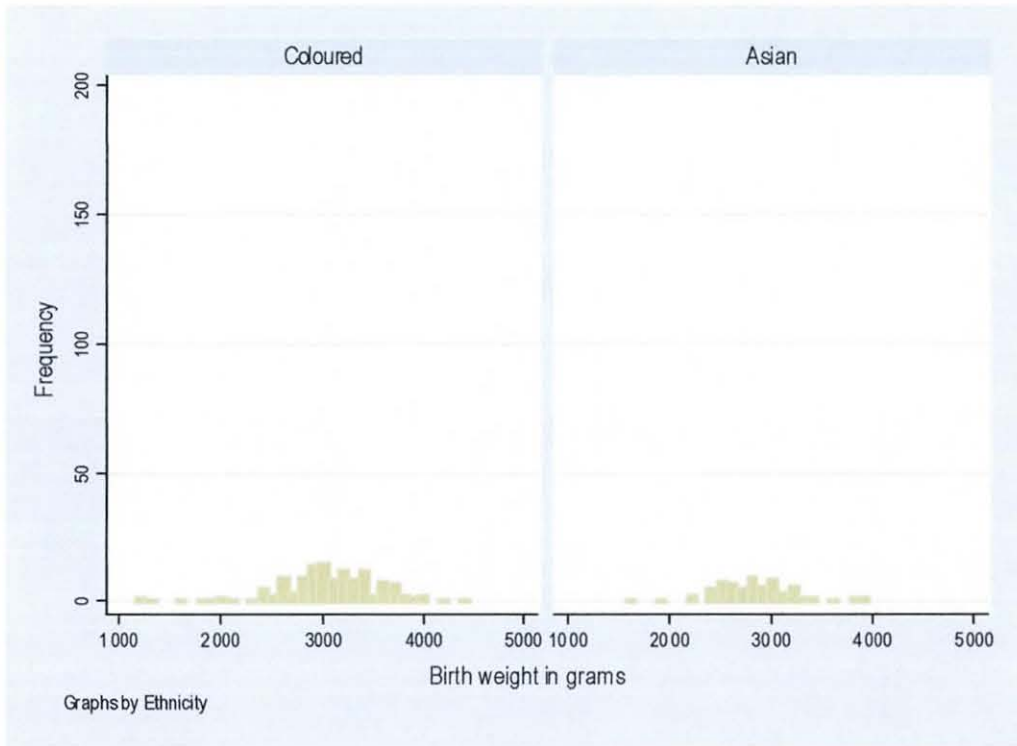


Figure 4.1.4 Distribution of birth weight (grams) by parity

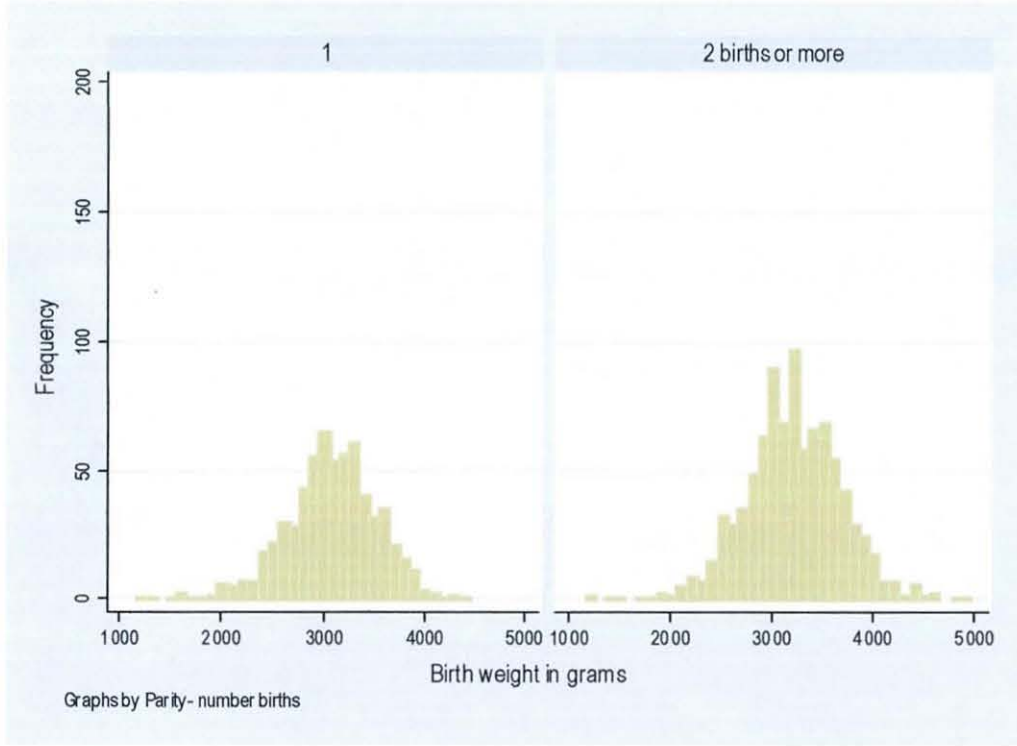
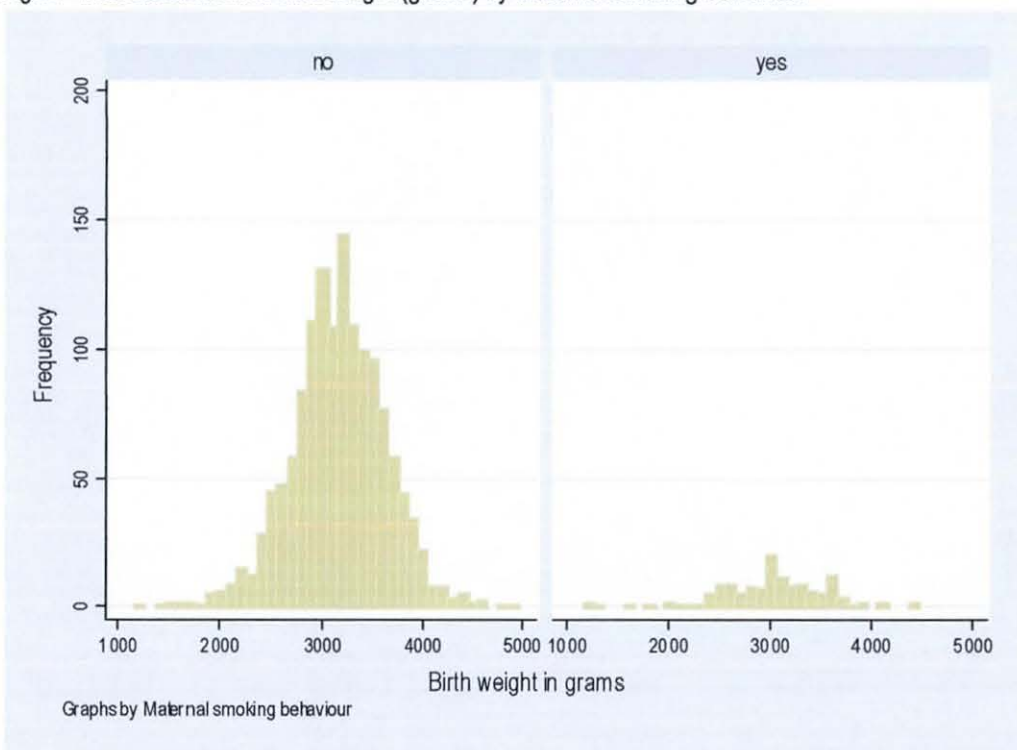


Figure 4.1.5 Distribution of birth weight (grams) by maternal smoking behaviour



GESTATIONAL AGE, PRE-TERM AND SMALL FOR GESTATIONAL AGE

Table 4.1.2 shows the mean and standard deviation of gestational age in weeks, stratified by proximate exposures. This table also shows the proportion of births which were pre-term (< 37 weeks gestation). In this sample, there was no difference in mean gestational age or in proportion of pre-term births between male and female newborns. Black newborns, with a mean of 38.1 weeks, had an earlier mean gestational age than the other ethnic groups ($p< 0.05$). In comparison to Black newborns, fewer White newborns were pre-term, while more Coloured and Indian newborns were born before 37 weeks gestation (table 4.1.2). Newborns born to mothers under the age of 20 also had earlier mean gestational age than those born to older mothers ($p< 0.05$). However, no difference in the proportion of pre-term births was found between categories of mother's age at delivery. Newborns of primiparous mothers and those who reported having ever smoked showed earlier mean gestational ages ($p< 0.05$ respectively), but no differences in proportion of pre-term births were seen between these groups (table 4.1.2).

Table 4.1.2 Mean length of gestation (weeks) of newborns and proportion pre-term by proximate exposures

Category	Sample size (n)	Mean gestational age(weeks)	SD	Pre-term n(%)
Male	773	38.3	1.6	70 (9.1)
Female	771	38.3	1.5	71 (9.2)
Black * †	1238	38.1	1.4	114 (9.2)
White	89	39.1	1.5	4 (4.5)
Coloured	143	38.8	2.3	14 (9.8)
Indian	74	38.6	1.8	9 (12.2)
≤ 19.99 yrs *	233	37.9	1.7	30 (12.9)
20-24.99 yrs	508	38.3	1.7	52 (10.2)
25-29.99 yrs	416	38.5	1.3	26 (6.3)
>30 yrs	386	38.3	1.5	33 (8.5)
1st live birth *	639	38.2	1.7	64 (10.0)
> 2 live births	905	38.4	1.5	77 (8.5)
Never smoked *	1391	38.3	1.5	112 (8.8)
Ever smoked	137	38.6	2.3	16 (11.7)

* Mean gestational age p-value < 0.05
† Pre-term p-value < 0.05
SGA = Small for gestational age
Pre-term = <37 weeks gestation

Birth weight showed a weak positive correlation with gestational age in this sample ($r^2= 0.15$). Figure 4.1.6 shows the mean birth weight for each gestational age, while figure 4.1.7 shows the distribution of birth weight by gestational age, marking the line of linear prediction and 95%CI of the

mean. The wide confidence intervals at younger and older gestational ages illustrate the small sample sizes at these gestational ages, as shown in table 4.1.3.

Figure 4.1.6 Mean birth weight (grams) of newborns by gestational age (weeks)

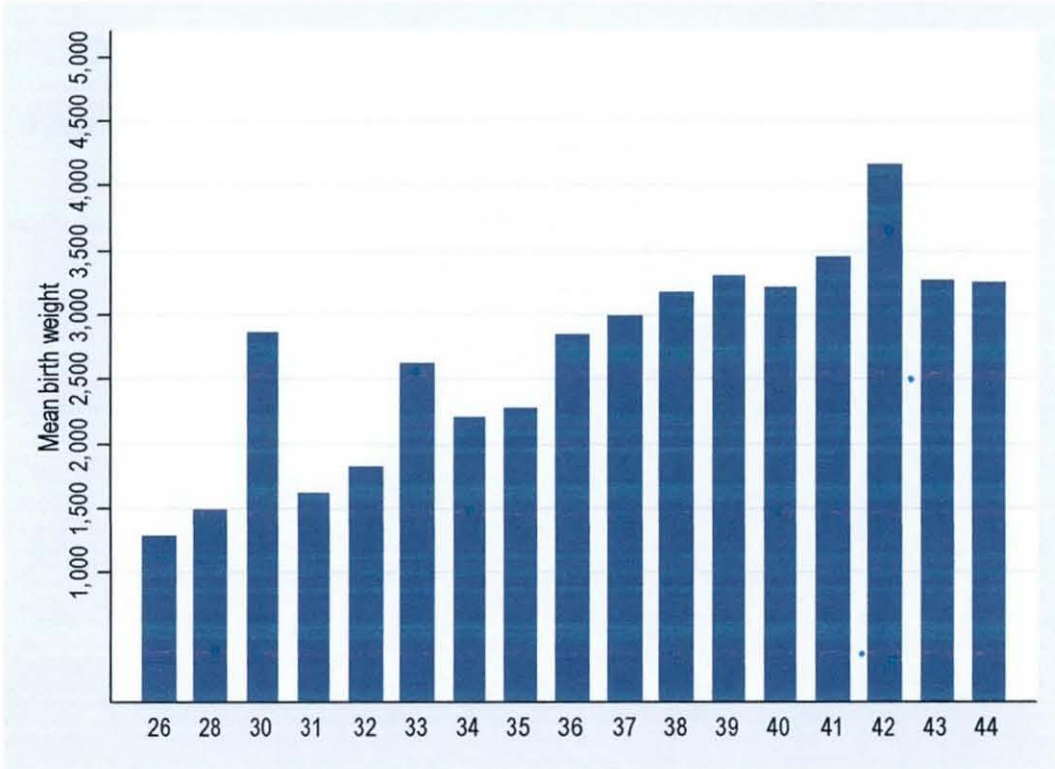


Figure 4.1.7
Distribution of birth weight by gestational age showing linear prediction and 95%CI of birth weight mean

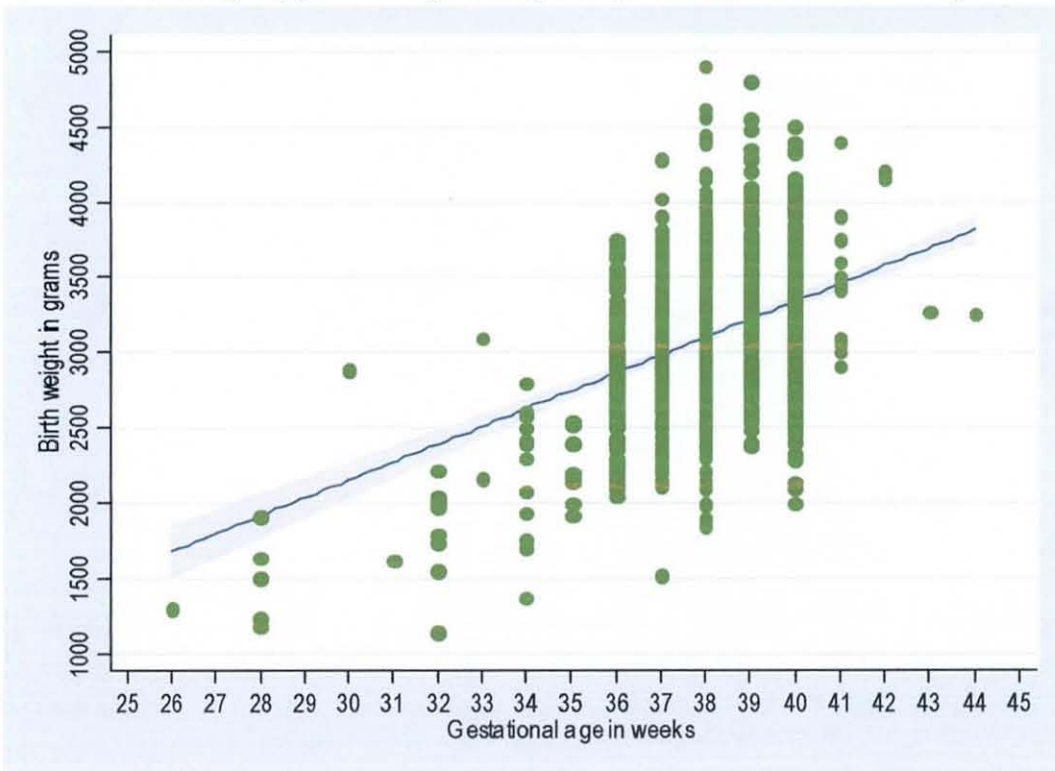


Table 4.1.3 Mean birth weight by gestational age

Gestational age (weeks)	Sample size (n)	Mean birth weight (grams)
28	4	1495.4
29	0	0.0
30	1	2880.0
31	1	1620.0
32	9	1834.9
33	2	2632.5
34	13	2210.8
35	11	2280.0
36	98	2865.6
37	158	3002.9
38	672	3182.1
39	147	3311.3
40	413	3203.2
41	11	3462.7
42	2	4175.0
43	1	3270.0
44	1	3250.0

Figure 4.1.8 shows the distribution of birth weight by gestational age, marking the 10th percentile cut off for small for gestational age for both boys (red) and girls (green) (Alexander et al., 1996).

Figure 4.1.8
Graph showing 10th percentile of birth weight by gestational age for boys and girls (Alexander et al., 1996)

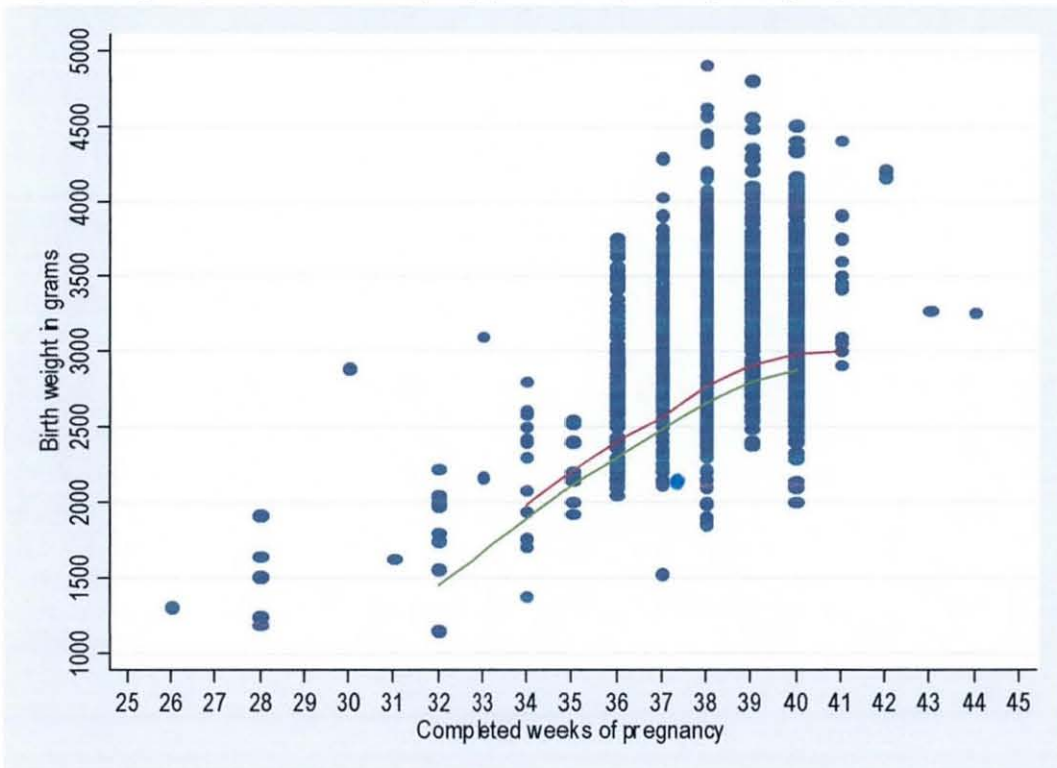


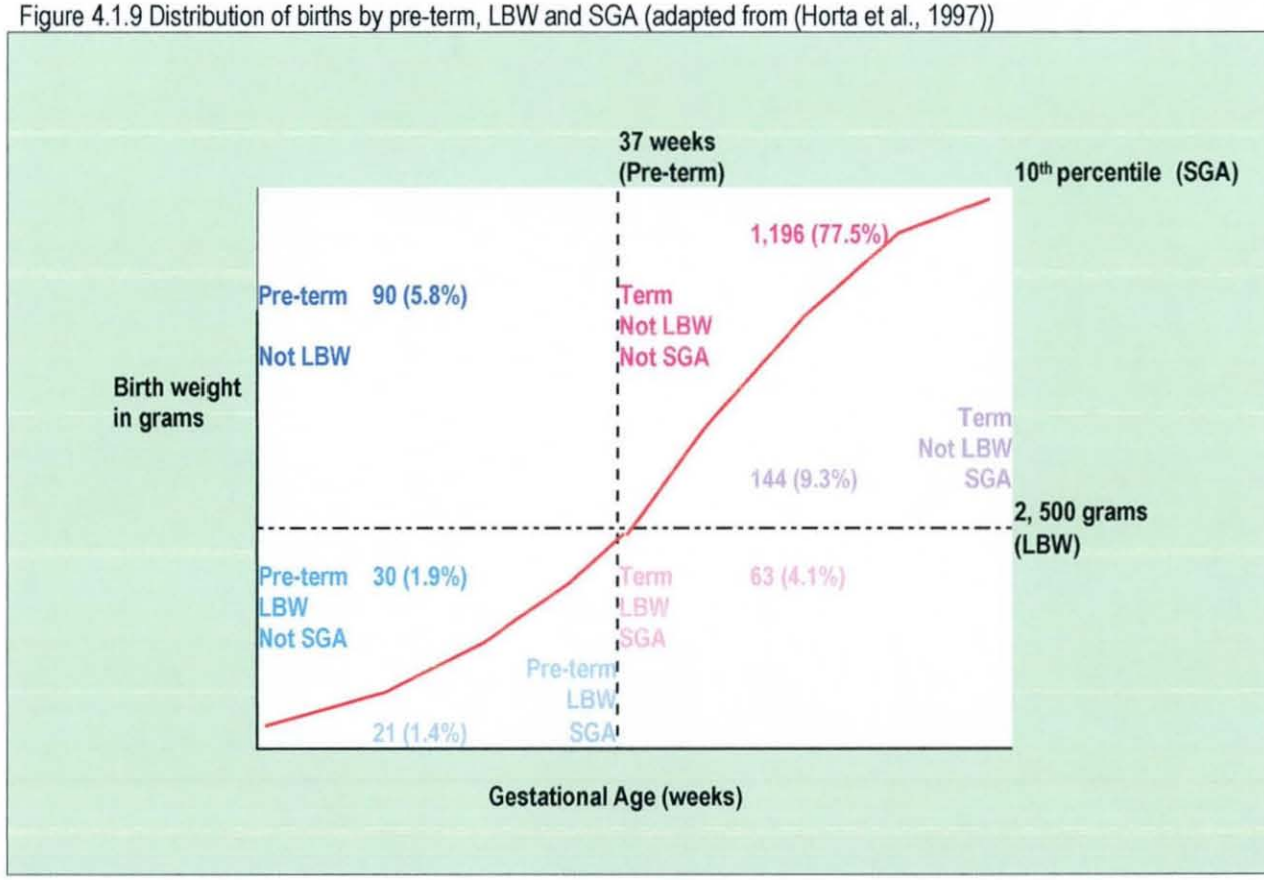
Table 4.1.4 shows that a total of 228 infants (14.8%) were born SGA in this sample. The majority of small for gestational births were born post 37 weeks gestation and weighed over 2,500 grams at delivery (table 4.1.3). Figure 4.1.9 (adapted from (Horta et al., 1997) shows that the majority of the study sample were term, not LBW and not SGA births (77.5%). Over 5% were born pre-term but not LBW or SGA. Almost 2% were born pre-term, LBW but not SGA, while 1.4% were born pre-term, LBW and SGA (figure 4.1.9).

Table 4.1.4 Distribution of SGA infants by LBW and pre-term

Categories	SGA n=228 (14.8%) n (%)	Not SGA n=1316 (85.2%) n (%)
Not LBW	144 (63.2)	1286 (97.7)
LBW	84 (36.8)	30 (2.3)
Not pre-term	207 (90.8)	1196 (90.9)
Pre-term	21 (9.2)	120 (9.1)

LBW = Low birth weight
Pre-term = < 37 weeks gestation

Figure 4.1.9 Distribution of births by pre-term, LBW and SGA (adapted from (Horta et al., 1997))



BIVARIATE RESULTS: UNADJUSTED MEASURES OF ASSOCIATION AND EFFECT

Tables 4.1.5 – 4.1.11 show the distribution of proximate, socio-economic and social support exposures in the general cohort as well as the distribution of SGA by exposure variables. These tables also show unadjusted odds ratios of the effect of these exposures on SGA. Results of bivariate analysis show unadjusted associations between SGA delivery and the following exposures: ethnicity, parity, maternal smoking behaviour (table 4.1.4) and mother's desire for the pregnancy (4.1.10).

PROXIMATE EXPOSURES

Table 4.1.5 shows that there was a majority of Black infants (80.2%) as well as majority of infants born to mothers who reported having never smoked (90.1%). In comparison to Black infants, Coloured and Indian infants were at an increased likelihood of SGA, (OR = 1.90; 95%CI 1.24 – 2.92) and (OR = 3.36; 95%CI 2.01 – 5.63) respectively. Very small sample sizes (n=9) were available for SGA in the White ethnic group, therefore the study was underpowered to adequately investigate associations with this group. Those infants born to multiparous mothers were at a reduced likelihood of SGA (OR = 0.74; 95%CI 0.55 – 0.98). Infants born to mothers who reported having ever smoked were at increased likelihood of SGA (OR = 1.79; 95%CI 1.17 – 2.75).

Table 4.1.5 Distribution of proximate exposures by SGA outcome and unadjusted odds ratios

Proximate Exposures	Study pop. (n=1544) N (%)	SGA (n = 228) N (%)	Not SGA (n = 1316) N (%)	Crude OR (95 %CI)	p-value
Sex					
Male	773 (50.1)	122 (53.5)	651 (49.5)	1.00	
Female	771 (49.9)	106 (46.5)	665 (50.5)	0.85 (0.64, 1.13)	0.260
Ethnicity					
Black	1238 (80.2)	163(71.5)	1075 (81.7)	1.00	
White	89 (5.8)	8 (3.5)	81 (6.2)	0.65 (0.31, 1.37)	0.256
Coloured	143 (9.2)	32 (14.0)	111 (8.4)	1.90 (1.24, 2.92)	0.003
Indian	74 (4.8)	25 (11.0)	49 (3.7)	3.36 (2.01, 5.63)	0.000
Maternal age at delivery					
≤ 19.99 yrs	233 (15.1)	42 (18.4)	191 (14.5)	1.00	
20-24.99 yrs	508 (32.9)	64 (28.1)	444 (33.8)	0.65 (0.43, 1.00)	0.050
25-29.99 yrs	416 (26.9)	67 (29.4)	349 (26.5)	0.87 (0.57, 1.33)	0.530
30-34.99 yrs	263 (17.0)	39 (17.1)	224 (17.0)	0.79 (0.49, 1.28)	0.337
≥ 35 yrs	123 (8.0)	16 (7.0)	107 (8.1)	0.68 (0.36, 1.27)	0.223
Missing	1 (0.1)	0 (0.0)	1 (0.1)	Insufficient data	
Parity					
1 live birth	639 (41.4)	109 (47.8)	530 (40.3)	1.00	
≥ 2 live births	905 (58.6)	119 (52.2)	786 (59.7)	0.74 (0.55, 0.98)	0.033
Mother's smoking behaviour					
Never smoked	1391 (90.1)	195 (85.5)	1196 (90.9)	1.00	
Ever smoked	137 (8.9)	31 (13.6)	106 (8.0)	1.79 (1.17, 2.75)	0.007
Missing	16 (1.0)	2 (0.9)	14 (1.1)	0.88 (0.20, 3.89)	0.862

SGA = Small for gestational age

EDUCATION AND EMPLOYMENT SES EXPOSURES

Table 4.1.6 shows that the majority of mothers in this study had a level of schooling between Standards 5 - 9 (67.5%), with few below Standard 4 or no formal education (7.0%). However, most had no further education beyond matriculation level at school (74.8%) and few attended university (2.3%). The majority of mother's partners also had a level of schooling between Standards 5 – 9 (46.5%), although 32.0% achieved matriculation level. The proportion of partners attending university was slightly higher than that of mothers at 3.8%. Over 60% of partners were employed while 36.7% of mothers reported that they were "earning money" (table 4.1.6). No associations below the 0.05 p-value level were seen between SGA delivery and education and employment exposures (table 4.1.6). However, as the odds ratios of mother's work are large and the confidence intervals near the null (OR= 1.40; 95%CI 0.99 - 1.96), the analysis may have been underpowered to detect an effect of mother's work on SGA delivery that may have been seen had a larger sample size than n=92 been available.

HOME CHARACTERISTICS SES EXPOSURES

Table 4.1.7 shows that the majority of participants lived in a house or cottage (71.5%), however 17.8% lived in a shack, room or garage. Most homes had two rooms that were used for sleeping (42.7%), while almost 75% had a separate kitchen for cooking. Almost 32% and 33% of homes had shared or sole use to an indoor hot tap or indoor flush toilet, respectively. The majority rented their dwelling from the local authority (37.8%), with 25.1% reporting that they owned their own home. No associations below the 0.05 p-value level were seen between SGA delivery and home characteristics (table 4.1.7).

ECONOMIC SES EXPOSURES

As shown in table 4.1.8, few participants lacked electricity supply in their home (6.6%). A majority used gas or electricity as their main cooking fuel (80.4%), while over 19% used other fuels including wood, coal and paraffin. The majority owned a television (67.9%), however ownership of other consumer durables such as cars and washing machines was lower (31.2% and 17.9% respectively). The majority did not employ a domestic worker (80.7%) or have Medical Aid cover (74.0%). No associations below the 0.05 p-value level were seen between SGA and these economic SES exposures (table 4.1.8).

DEPRIVATION AND HOUSEHOLD COMPOSITION SES EXPOSURES

Table 4.1.9 shows that over 17% of this sample reported that, in the six months before the survey, their family had had too little money to obtain basics (e.g. food). Over 19% reported that there was a drug or alcohol problem in the family. No associations below the 0.05 p-value level were seen between deprivation measures and SGA delivery (table 4.1.9).

Table 4.1.10 shows that a very large majority of households reported that the mother was a member and usual resident of the household (99.5%). Fewer households reported the presence of a father (46.4%). Over 49% reported that a grandmother was present, while almost 28% reported that a grandfather was (table 4.1.10). At least one sibling under the age of five years was reported in 21.6% of households at the time of the survey. No associations below the 0.05 p-value level were seen between SGA delivery and household composition exposures (table 4.1.10).

Table 4.1.6 Distribution of education and employment exposures by SGA outcome and unadjusted odds ratios

Education & employment	Study pop. (n=1544) N (%)	SGA (n=228) N (%)	Not SGA (n=1316) N (%)	Crude OR (95 %CI)	p-value
Mother's Schooling					
≤ Std 4 & no formal edu	109 (7.0)	16 (7.0)	93 (7.1)	1.00	
Std 5-9	1042 (67.5)	163 (71.5)	879 (66.7)	1.08 (0.62, 1.88)	0.792
Matriculation	392 (25.4)	49 (21.5)	343 (26.1)	0.83 (0.45, 1.53)	0.550
Missing	1 (0.1)	0 (0.0)	1 (0.1)	Insufficient data	
Mother's further education					
No further education	1155 (74.8)	175 (76.7)	980 (74.5)	1.00	
Course not completed	50 (3.3)	10 (4.4)	40 (3.0)	1.40 (0.69, 2.85)	0.352
In-service training	51 (3.3)	4 (1.8)	47 (3.6)	0.48 (0.17, 1.34)	0.151
Technicon & college	85 (5.5)	11 (4.8)	74 (5.6)	0.83 (0.43, 1.60)	0.582
University	36 (2.3)	4 (1.8)	32 (2.4)	0.70 (0.24, 2.01)	0.504
Other	100 (6.5)	10 (4.4)	90 (6.8)	0.62 (0.32, 1.22)	0.164
Missing	67 (4.3)	14 (6.1)	53 (4.1)	1.48 (0.80, 2.72)	0.206
Partner's Schooling					
≤ Std 4 & no formal edu	63 (4.1)	7 (3.0)	56 (4.3)	1.00	
Std 5-9	718 (46.5)	110 (48.3)	608 (46.2)	1.45 (0.64, 3.26)	0.370
Matriculation	495 (32.0)	72 (31.6)	423 (32.1)	1.36 (0.60, 3.11)	0.462
Missing/ system missing	268 (17.4)	39 (17.1)	229 (17.4)	1.36 (0.58, 3.21)	0.478
Partner's further education					
No further education	725 (47.0)	117 (51.3)	608 (46.2)	1.00	
Course not completed	43 (2.8)	7 (3.1)	36 (2.7)	1.01 (0.44, 2.33)	0.980
In-service training	90 (5.8)	12 (5.2)	78 (5.9)	0.80 (0.42, 1.52)	0.492
Technicon & college	97 (6.3)	11 (4.8)	86 (6.5)	0.66 (0.34, 1.28)	0.221
University	59 (3.8)	7 (3.1)	52 (4.0)	0.70 (0.31, 1.58)	0.387
Other	94 (6.1)	7 (3.1)	87 (6.6)	0.42 (0.19, 0.93)	0.027
Missing/ system missing	436 (28.2)	67 (29.4)	369 (28.1)	0.94 (0.68, 1.31)	0.728
Mother's work					
Unemployed	567 (36.7)	69 (30.3)	498 (37.8)	1.00	
Housewife	398 (25.8)	65 (28.5)	333 (25.3)	1.41 (0.98, 2.03)	0.066
Earning money	567 (36.7)	92 (40.3)	475 (36.1)	1.40 (0.99, 1.96)	0.051
Missing	12 (0.8)	2 (0.9)	10 (0.8)	1.44 (0.31, 6.74)	0.639
Frequency of mother's pay					
Monthly	391 (25.3)	62 (27.2)	329 (25.0)	1.00	
< monthly	170 (11.0)	28 (12.3)	142 (10.8)	1.05 (0.64, 1.70)	0.856
Missing/ system missing	983 (63.7)	138 (60.5)	845 (64.2)	0.87 (0.62, 1.20)	0.389
Partner employed					
Partner not working	267 (17.3)	39 (17.1)	228 (17.3)	1.00	
Partner employed	931 (60.3)	135 (59.2)	796 (60.5)	0.99 (0.67, 1.46)	0.965
Missing/ system missing	346 (22.4)	54 (23.7)	292 (22.2)	1.08 (0.69, 1.69)	0.732
Frequency of partner's pay					
Monthly	565 (36.6)	80 (35.1)	485 (36.9)	1.00	
< monthly	473 (30.6)	75 (32.9)	398 (30.2)	0.87 (0.62, 1.23)	0.445
Missing/ system missing	506 (32.8)	73 (32.0)	433 (32.9)	0.89 (0.63. 1.27)	0.533

SGA = Small for gestational age

Table 4.1.7 Distribution of home characteristic SES exposures by SGA outcome and unadjusted odds ratios

Home characteristics	Study pop. (n=1544) N (%)	SGA (n=228) N (%)	Not SGA (n=1316) N (%)	Crude OR (95 %CI)	p-value
Type of home					
Shack	127 (8.2)	22 (9.6)	105 (8.0)	1.00	
Room or Garage	149 (9.6)	20 (8.8)	129 (9.8)	0.74 (0.38, 1.43)	0.370
Flat	92 (6.0)	20 (8.8)	72 (5.5)	1.32 (0.67, 2.61)	0.414
House shared with another family	58 (3.8)	9 (4.0)	49 (3.7)	0.88 (0.37, 2.05)	0.761
Cottage or House	1104 (71.5)	156 (68.4)	948 (72.0)	0.78 (0.48, 1.28)	0.333
Missing	14 (0.9)	1 (0.4)	13 (1.0)	0.37 (0.04, 2.99)	0.330
Tenureship					
Rented from another person	471 (30.5)	70 (30.7)	401 (30.5)	1.00	
Provided by employer	69 (4.5)	13 (5.7)	56 (4.2)	1.33 (0.69, 2.56)	0.393
Rented from local authority	584 (37.8)	86 (37.7)	498 (37.8)	0.99 (0.70, 1.39)	0.951
Owned	387 (25.1)	52 (22.8)	335 (25.5)	0.89 (0.60, 1.31)	0.552
Missing	33 (2.1)	7 (3.1)	26 (2.0)	1.54 (0.64, 3.70)	0.327
Number of sleeping rooms					
1	429 (27.8)	71 (31.1)	358 (27.2)	1.00	
2	659 (42.7)	96 (42.1)	563 (42.8)	0.86 (0.61, 1.20)	0.376
≥3	445 (28.8)	60 (26.3)	385 (29.3)	0.78 (0.54, 1.14)	0.204
Missing	11 (0.7)	1 (0.5)	10 (0.7)	0.50 (0.06, 4.01)	0.510
Separate kitchen					
No	378 (24.5)	61 (26.8)	317 (24.1)	1.00	
Yes	1155 (74.8)	166 (72.8)	989 (75.1)	0.87 (0.63, 1.20)	0.402
Missing	11 (0.7)	1 (0.4)	10 (0.8)	0.52 (0.06, 4.15)	0.530
Water facility					
Shared use of outside tap/ other source	233 (15.1)	36 (15.8)	197 (14.9)	1.00	
Sole use of outside tap	442 (28.6)	53 (23.3)	389 (29.6)	0.74 (0.47, 1.18)	0.207
Shared or sole use of inside cold tap	363 (23.5)	54 (23.7)	309 (23.5)	0.96 (0.60, 1.51)	0.849
Shared or sole use of inside hot tap	493 (31.9)	84 (36.8)	409 (31.1)	1.12 (0.73, 1.72)	0.591
Missing	13 (0.9)	1 (0.4)	12 (0.9)	0.46 (0.06, 3.64)	0.447
Toilet facility					
Bucket or other source	15 (1.1)	2 (0.9)	13 (1.0)	1.00	
Shared use of outdoor flush toilet	243 (15.7)	39 (17.1)	204 (15.5)	1.24 (0.27, 5.74)	0.781
Sole use of outdoor flush toilet	703 (45.5)	91 (39.9)	612 (46.5)	0.97 (0.21, 4.36)	0.965
Shared use of indoor flush toilet	59 (3.8)	13 (5.7)	46 (3.5)	1.84 (0.36, 9.36)	0.457
Sole use of indoor flush toilet	510 (33.0)	82 (36.0)	428 (32.5)	1.24 (0.27, 5.63)	0.775
Missing	14 (0.9)	1 (0.4)	13 (1.0)	0.50 (0.04, 6.59)	0.591

SGA = Small for gestational age
SES = Socio-economic status

Table 4.1.8 Distribution of economic SES exposures by SGA outcome and unadjusted odds ratios

Economic exposures	Study pop. (n=1544) N (%)	SGA (n=228) N (%)	Not SGA (n=1316) N (%)	Crude OR (95 %CI)	p-value
Electricity supply					
No	102 (6.6)	21 (9.2)	81 (6.1)	1.00	
Yes	1437 (93.1)	207 (90.8)	1230 (93.5)	0.65 (0.39, 1.07)	0.090
Missing	5 (0.3)	0 (0.0)	5 (0.4)	Insufficient data	
Cooking fuel used					
Other (brazier, coal, paraffin, wood)	298 (19.3)	40 (17.5)	258 (19.6)	1.00	
Electricity/generator or gas	1241 (80.4)	188 (82.5)	1053(80.0)	1.15 (0.80, 1.66)	0.451
Missing	5 (0.3)	0 (0.0)	5 (0.4)	Insufficient data	
Employ domestic help					
No	1246 (80.7)	181 (79.4)	1065 (80.9)	1.00	
Yes	196 (12.7)	33 (14.5)	163 (12.4)	1.19 (0.79, 1.79)	0.398
Missing/ system missing	102 (6.6)	14 (6.1)	88 (6.7)	0.94 (0.52, 1.68)	0.825
Medical aid cover					
No	1143 (74.0)	169 (74.1)	974 (74.0)	1.00	
Yes	283 (18.3)	48 (21.1)	235 (17.9)	1.18 (0.83, 1.67)	0.362
Missing/ system missing	118 (7.7)	11 (4.8)	107 (8.1)	0.59 (0.31, 1.13)	0.106
Television in home					
No	483 (31.3)	71 (31.1)	412 (31.3)	1.00	
Yes	1049 (67.9)	157 (68.9)	892 (67.8)	1.02 (0.75, 1.38)	0.892
Missing	12 (0.8)	0 (0.0)	12 (0.9)	Insufficient data	
Radio in home					
No	272 (17.6)	45 (19.7)	227 (17.2)	1.00	
Yes	1262 (81.8)	183 (80.3)	1079 (82.0)	0.85 (0.60, 1.22)	0.390
Missing	10 (0.6)	0 (0.0)	10 (0.8)	Insufficient data	
Phone in home					
No	740 (47.9)	108 (47.4)	632 (48.0)	1.00	
Yes	790 (51.2)	120 (52.6)	670 (50.9)	1.05 (0.79, 1.39)	0.744
Missing	14 (0.9)	0 (0.0)	14 (1.1)	Insufficient data	
Fridge in home					
No	507 (32.8)	76 (33.3)	431 (32.8)	1.00	
Yes	1026 (66.5)	152 (66.7)	874 (66.4)	0.99 (0.73, 1.33)	0.928
Missing	11 (0.7)	0 (0.0)	11 (0.8)	Insufficient data	
Washing machine in home					
No	1250 (81.0)	187 (82.0)	1063 (80.8)	1.00	
Yes	277 (17.9)	40 (17.5)	237 (18.0)	0.96 (0.66, 1.39)	0.826
Missing	17 (1.1)	1 (0.5)	16 (1.2)	0.35 (0.05, 2.70)	0.296
Car in home					
No	1047 (67.8)	159 (69.7)	888 (67.5)	1.00	
Yes	481 (31.2)	69 (30.3)	412 (31.3)	0.93 (0.69, 1.27)	0.668
Missing	16 (1.0)	0 (0.0)	16 (1.2)	Insufficient data	
Children's toys in home					
No	646 (41.8)	92 (40.3)	554 (42.1)	1.00	
Yes	884 (57.3)	135 (59.2)	749 (56.9)	1.08 (0.81, 1.45)	0.576
Missing	14 (0.9)	1 (0.5)	13 (1.0)	0.46 (0.06, 3.59)	0.450

SGA = Small for gestational age
SES = Socio-economic status

Table 4.1.9 Distribution of deprivation SES exposures by SGA outcome and unadjusted odds ratios

Deprivation exposures	Study pop. (n=1544) N (%)	SGA (n=228) N (%)	Not SGA (n=1316) N (%)	Crude OR (95 %CI)	p-value
Family has recently had too little money for basics					
No	1255 (81.3)	188 (82.5)	1067 (81.1)	1.00	
Yes	266 (17.2)	37 (16.2)	299 (17.4)	0.92 (0.63, 1.34)	0.655
Missing	23 (1.5)	3 (1.3)	20 (1.5)	0.85 (0.25, 2.89)	0.796
Mother recently separated unwillingly from children					
No	1257 (81.4)	184 (80.7)	1073 (81.5)	1.00	
Yes	52 (3.4)	6 (2.6)	46 (3.5)	0.76 (0.32, 1.81)	0.534
Missing	235 (15.2)	38 (16.7)	197 (15.0)	1.12 (0.77, 1.65)	0.545
Drug or alcohol problem in family					
No	1220 (79.0)	187 (82.0)	1033 (78.5)	1.00	
Yes	299 (19.4)	35 (15.4)	264 (20.1)	0.73 (0.50, 1.08)	0.112
Missing	25 (1.6)	6 (2.6)	19 (1.4)	1.74 (0.69, 4.43)	0.236
Mother recently physically abused by partner					
No	1388 (89.9)	207 (90.8)	1181 (89.7)	1.00	
Yes	88 (5.7)	12 (5.3)	76 (5.8)	0.90 (0.48, 1.68)	0.744
Missing	68 (4.4)	9 (3.9)	59 (4.5)	0.87 (0.42, 1.78)	0.704

SGA = Small for gestational age
SES = Socio-economic status

Table 4.1.10 Distribution of household composition SES exposures by SGA outcome and unadjusted odds ratios

Household composition	Study pop. (n=1544) N (%)	SGA (n=228) N (%)	Not SGA (n=1316) N (%)	Crude OR (95 %CI)	p-value
Mum reported resident					
No mum reported	1 (0.1)	0 (0.0)	1 (0.1)	1.00	
Mum reported	1536 (99.5)	226 (99.1)	1310 (99.5)	Insufficient data	
Missing	7 (0.4)	2 (0.9)	5 (0.4)	Insufficient data	
Father reported resident					
No father reported	816 (52.8)	117 (51.3)	699 (53.1)	1.00	
Father reported	717 (46.4)	109 (47.8)	608 (46.2)	1.07 (0.81, 1.42)	0.634
Missing	11 (0.8)	2 (0.9)	9 (0.7)	1.33 (0.28, 6.23)	0.718
Grandfather reported resident					
No grandfather reported	1107 (71.7)	160 (70.2)	947 (72.0)	1.00	
Grandfather reported	425 (27.5)	66 (29.0)	359 (27.3)	1.09 (0.80, 1.48)	0.595
Missing	12 (0.8)	2 (0.8)	10 (0.7)	1.18 (0.26, 5.46)	0.829
Grandma reported resident					
No grandma reported	775 (50.2)	105 (46.0)	670 (50.9)	1.00	
Grandma reported	758 (49.1)	121 (53.1)	637 (48.4)	1.21 (0.91, 1.61)	0.183
Missing	11 (0.7)	2 (0.9)	9 (0.7)	1.42 (0.30, 6.66)	0.657
At least 1 sibling ≤5yrs resident					
No young sibling reported	1198 (77.6)	184 (80.7)	1014 (77.0)	1.00	
At least 1 young sibling reported	334 (21.6)	42 (18.4)	292 (22.2)	0.79 (0.55, 1.13)	0.205
Missing	12 (0.8)	2 (0.9)	10 (0.8)	1.10 (0.24, 5.07)	0.901

SGA = Small for gestational age
SES = Socio-economic status

SOCIAL SUPPORT EXPOSURES

Table 4.1.11 shows that when surveyed during their pregnancy 56.8% of mothers were either unsure or did not desire their pregnancy. Over 26% reported that they were unsure or did not believe the family and financial conditions were ready to receive a new baby. The majority were single (62.4%) while 47.2% were not living with a partner (table 4.1.11). However, 83.5% believed that the child's father or their partner would provide financial support for the child, while 42.6% and 35.8% believed their partner would help with child care or housework. Over 62% of mothers in this study reported that their partner's behaviour never made things more difficult for her. A large majority (80.3%) reported that they had a number of people from whom they could ask for help. Over 84% reported that they had a number of people to whom they could talk to about problems. The majority reported being a member of an organisation such as a church (70.0%). In comparison to infants born to mothers who reported that they were unsure or did not desire their pregnancy, those born to mothers who did were at reduced likelihood of SGA (OR = 0.74; 95%CI 0.55 – 0.99) (table 4.1.11). This was the only association between SES or social support exposures and SGA below the 0.05 p-value level that was seen in this sample (tables 4.1.6 - 4.1.11).

Table 4.1.11 Distribution of social support exposures by SGA outcome and unadjusted odds ratios

Social support Exposures	Study pop. (n=1544) N (%)	SGA (n=228) N (%)	Not SGA (n=1316) N (%)	Crude OR (95 %CI)	p-value
Mother's desire for pregnancy					
Unsure/ no	877 (56.8)	144 (63.2)	733 (55.7)	1.00	
Yes desires pregnancy	622 (40.3)	79 (34.6)	543 (41.3)	0.74 (0.55, 0.99)	0.046
Missing	45 (2.9)	5 (2.2)	40 (3.0)	0.64 (0.25, 1.64)	0.346
Family & finances ready for preg.					
Unsure/ no	406 (26.3)	68 (29.8)	338 (25.7)	1.00	
Yes	1109 (71.8)	155 (68.0)	954 (72.5)	0.81 (0.59, 1.10)	0.178
Missing	29 (1.9)	5 (2.2)	24 (1.8)	1.03 (0.38, 2.81)	0.945
Partner desire for pregnancy					
Unsure/ no	175 (11.3)	29 (12.7)	146 (11.1)	1.00	
Yes	1310 (84.8)	190 (83.3)	1120 (85.1)	0.85 (0.56, 1.31)	0.469
Missing	59 (3.9)	9 (4.0)	50 (3.8)	0.91 (0.40, 2.05)	0.813
Mother's marital status					
Single	964 (62.4)	134 (58.8)	830 (63.1)	1.00	
Previously married	35 (2.3)	7 (3.1)	28 (2.1)	1.55 (0.66, 3.62)	0.309
Married	532 (34.5)	86 (37.7)	446 (33.9)	1.19 (0.89, 1.60)	0.237
Missing	13 (0.8)	1 ((0.4)	12 (0.9)	0.52 (0.07, 4.01)	0.520
Mother's cohabitation status					
Not living with partner	728 (47.2)	103 (45.2)	625 (47.5)	1.00	
Living with partner	746 (48.3)	112 (49.1)	634 (48.2)	1.07 (0.80, 1.43)	0.638
Missing	70 (4.5)	13 (5.7)	57 (4.3)	1.38 (0.73, 2.62)	0.316
Partner contribute financially to child					
Don't know/ no	173 (11.2)	28 (12.3)	145 (11.0)	1.00	
Yes	1290 (83.5)	192 (84.2)	1098 (83.4)	0.90 (0.59, 1.40)	0.653
Missing	81 (5.3)	8 (3.5)	73 (5.6)	0.57 (0.24, 1.31)	0.180
Partner helps with childcare					
No	354 (22.9)	56 (24.6)	298 (22.6)	1.00	
Yes	658 (42.6)	98 (43.0)	560 (42.6)	0.93 (0.65, 1.33)	0.696
Missing/ system missing	532 (34.5)	74 (32.4)	458 (34.8)	0.86 (0.59, 1.25)	0.432
Partner helps with housework					
No	597 (38.7)	89 (39.0)	508 (38.6)	1.00	
Yes	552 (35.8)	85 (37.3)	467 (35.5)	1.04 (0.75, 1.43)	0.817
Missing/ system missing	395 (25.5)	54 (23.7)	341 (25.9)	0.90 (0.63, 1.30)	0.587
Things made harder by way partner acts					
Always/ Sometimes	508 (32.9)	69 (30.3)	439 (33.4)	1.00	
Never	963 (62.4)	150 (65.8)	813 (61.8)	1.17 (0.86, 1.60)	0.307
Missing	73 (4.7)	9 (3.9)	64 (4.8)	0.89 (0.42, 1.88)	0.769
Mother has network to request help from					
No-one	161 (10.4)	22 (9.7)	139 (10.6)	1.00	
Unsure/ maybe	125 (8.1)	27 (11.8)	98 (7.4)	1.74 (0.93, 3.25)	0.078
Number of people	1240 (80.3)	177 (77.6)	1063 (80.8)	1.05 (0.65, 1.69)	0.835
Missing	18 (1.2)	2 (0.9)	16 (1.2)	0.79 (0.17, 3.69)	0.764
Mother can talk to someone about problems					
No-one	126 (8.2)	15 (6.6)	111 (8.4)	1.00	
Unsure/ maybe	94 (6.1)	20 (8.8)	74 (5.6)	2.00 (0.95, 4.19)	0.061
Number of people	1302 (84.3)	192 (84.2)	1110 (84.4)	1.28 (0.73, 2.24)	0.387
Missing	22 (1.4)	1 (0.4)	21 (1.6)	0.35 (0.04, 2.85)	0.307
Mother belongs to organisation (e.g. church)					
No	432 (28.0)	64 (28.1)	368 (28.0)	1.00	
Yes	1081 (70.0)	157 (68.9)	924 (70.2)	0.98 (0.71, 1.34)	0.885
Missing	31 (2.0)	7 (3.0)	24 (1.8)	1.68 (0.69, 4.06)	0.247

MULTIVARIATE RESULTS: ADJUSTED MEAURES OF ASSOCIATION AND EFFECT

COMBINED EFFECT ON SGA OF PROXIMATE, SES & SOCIAL SUPPORT EXPOSURES

When the significant proximate exposures (ethnicity, parity and maternal smoking behaviour) were included in logistic regression models with mother's desire for pregnancy, the effect of this social support exposure on SGA was attenuated to (OR=0.89; 95%CI 0.65 – 1.22) (table 4.1.12). This change in odds ratios was largely due to this social support exposure's close association with ethnicity (χ^2 = 116.11, p< 0.001), where Coloured and Indian mothers were less likely than Black mothers to report that they were ready for their pregnancy (OR = 0.23; 95%CI 0.25 – 0.36) and (OR = 0.11; 95%CI 0.05 – 0.24) respectively (data not shown). The very small sample sizes (e.g. n= 7 in Indian & want pregnancy; n= 24 in Coloured & want pregnancy) provided insufficient power to investigate interaction between this measure of social support in pregnancy and ethnicity.

The effect of multiparity, adjusted for mother's desire for pregnancy, ethnicity and maternal smoking, remained protective (OR = 0.70; 95%CI 0.52 - 0.94). Table 4.1.12 shows that the effect of maternal smoking behaviour on SGA was attenuated in this final model to (OR= 1.69; 95%CI 0.99 – 2.89) due to its close association with ethnicity (χ^2 = 584.99, p<0.001).Compared to Black mothers, both Coloured and Indian mothers were more likely to report having ever smoked, (OR = 15.85; 95%CI 7.47 – 33.63) and (OR = 43.21; 95%CI 22.59 - 82.65) respectively (data not shown). Table 4.1.8 shows that the adjusted effect of Coloured ethnic group on SGA was attenuated to (OR= 1.51; 95%CI 0.92 – 2.48) largely due to its close association with maternal smoking behaviour (χ^2 = 584.99, p<0.001). However, Indian infants remained at increased likelihood of SGA after adjustment for mother's desire for pregnancy, parity and maternal smoking behaviour (OR = 3.03; 95%CI 1.76 - 5.23) (table 4.1.8). Goodness of fit test (χ^2 = 32.46, p=0.7957) indicated that this final model was a good fit for the data and adequately explained the variation in the data.

Table 4.1.11 Adjusted measures of effect of both proximate and social support exposures on SGA (n = 1544)

Variables	Categories	OR (95 %CI)	p-value
Mother's desire for pregnancy	No/unsure	1.00	
	Yes desires pregnancy	0.89 (0.65, 1.22)	0.477
	Missing	0.79 (0.30, 2.07)	0.638
Parity	1 live birth	1.00	
	≥ 2 live births	0.70 (0.52, 0.94)	0.017
Mother's smoking behaviour	Never smoked	1.00	
	Ever smoked	1.69 (0.99, 2.89)	0.056
	Missing	0.52 (0.11, 2.46)	0.409
Ethnicity	Black	1.00	
	White	0.46 (0.20, 1.05)	0.065
	Coloured	1.51 (0.92, 2.48)	0.106
	Indian	3.03 (1.76, 5.23)	0.000

4.2 STUNTED AT ONE YEAR OF AGE RESULTS

Of the total 3,275 participants included in the cohort study, a total of 801 infants were included in the one year analysis (defined as 0.50 – 1.49 years). Those included had complete sex, height and age data (necessary for classification of stunting outcome) and at least partially complete demographic, SES and social support data, obtained from the antenatal and six month questionnaires. Those included in the analysis ranged in age from 0.76 – 1.40 years.

RESULTS OF DESCRIPTIVE ANALYSIS OF OUTCOME VARIABLE

HEIGHT-FOR-AGE AND STUNTED OUTCOME AT ONE YEAR OF AGE

Height-for-age z-scores

Table 4.2.1 shows means and standard deviations of height-for-age z-scores, stratified by proximate exposures. The mean height-for-age z-score did not differ between males and females. In comparison to Black infants, both White and Coloured infants had larger height-for-age z-scores than Black infants ($p<0.001$ and $p=0.019$ respectively). However, no other differences between infants of different ethnic groups were seen (see also figure 4.2.3). Infants born SGA had a mean height-for-age z-score of –0.99 and were shorter ($p< 0.001$) than those born appropriate for gestational age (see also figure 4.2.4). Similarly, both low birth weight infants and pre-term infants had smaller height-for-age z-scores ($p<0.001$) than those weighing over 2,500 g or aged over 37 weeks at delivery (table 4.2.1). The mean height-for-age z-score of infants in this sample was not different between those born to mothers who reported having ever or never smoked, those born to mothers who were primi or multiparous, or those born to mothers of different ages at delivery (table 4.2.1).

Table 4.2.1
Mean height-for-age z-score for infants aged 1 year (0.5 – 1.49 yrs) by proximate exposures

Proximate exposure Category	Sample size (n)	Mean Height-for-Age Z-scores	SD
Male	395	-0.51	1.17
Female	406	-0.37	1.05
Black	615	-0.52	1.11
White †	47	0.09	1.22
Coloured *	99	-0.24	1.01
Indian	40	-0.28	1.04
Not SGA	657	-0.35	1.09
SGA †	121	-0.99	1.08
Not LBW	732	-0.38	1.08
LBW < 2500 g †	67	-1.13	1.14
Term 37-41 weeks	701	-0.40	1.09
Pre-term < 37 weeks †	75	-0.93	1.21
≤ 19.99 yrs	133	-0.53	1.23
20-24.99 yrs	238	-0.50	1.08
25-29.99 yrs	226	-0.40	1.03
≥30 yrs	204	-0.36	1.15
1st live birth	348	-0.47	1.16
≥ 2 live births	453	-0.42	1.07
Never smoked	719	-0.46	1.10
Ever smoked	72	-0.24	1.12

* p-value< 0.05
† p-value< 0.001
SGA = Small for gestational age
LBW = Low birth weight

Figure 4.2.1 Distribution of height-for-age z-scores at 1 year in study sample

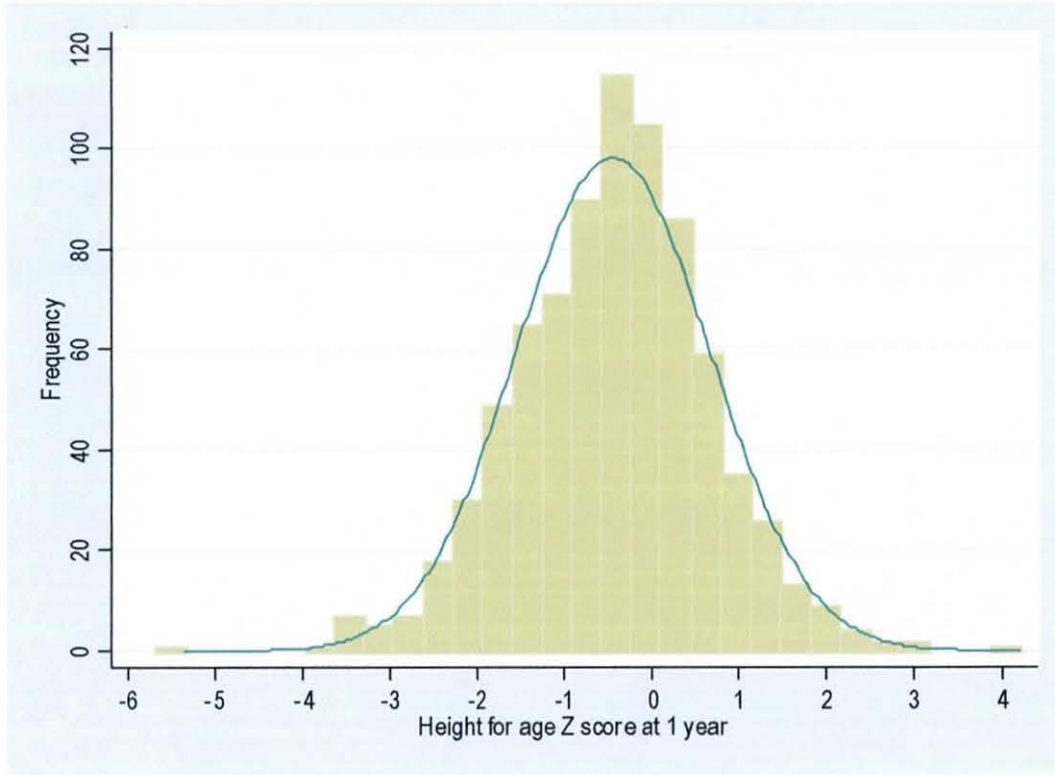


Figure 4.2.2 Distribution of height-for-age z-scores at 1 year by sex

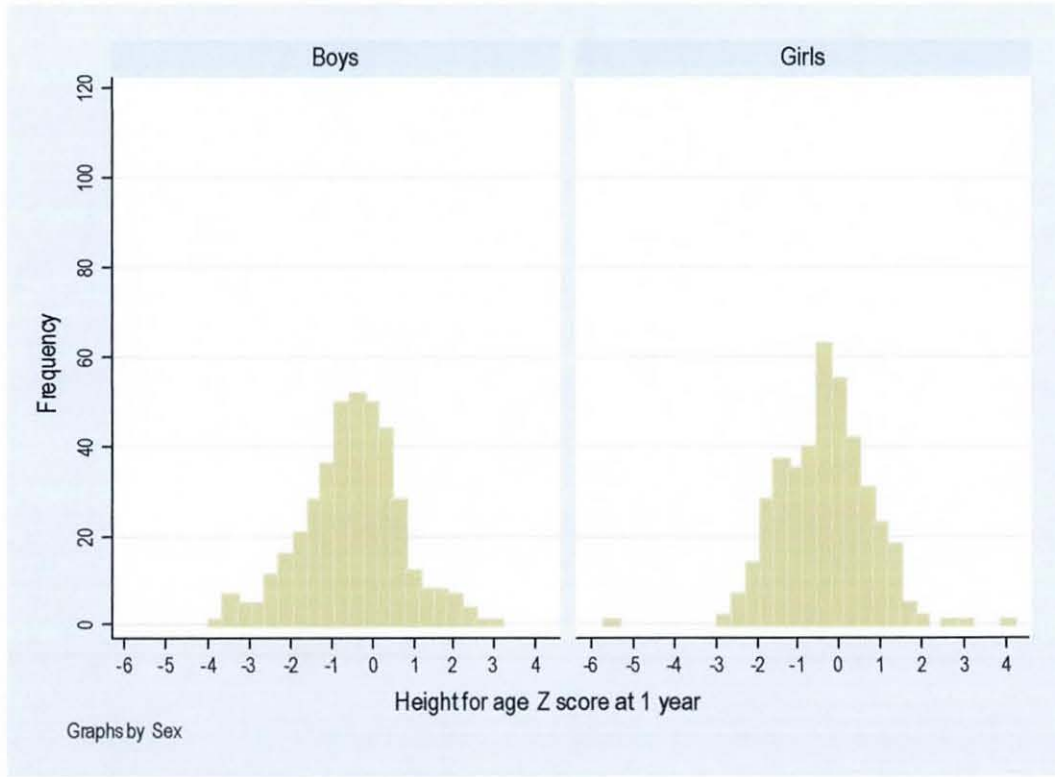
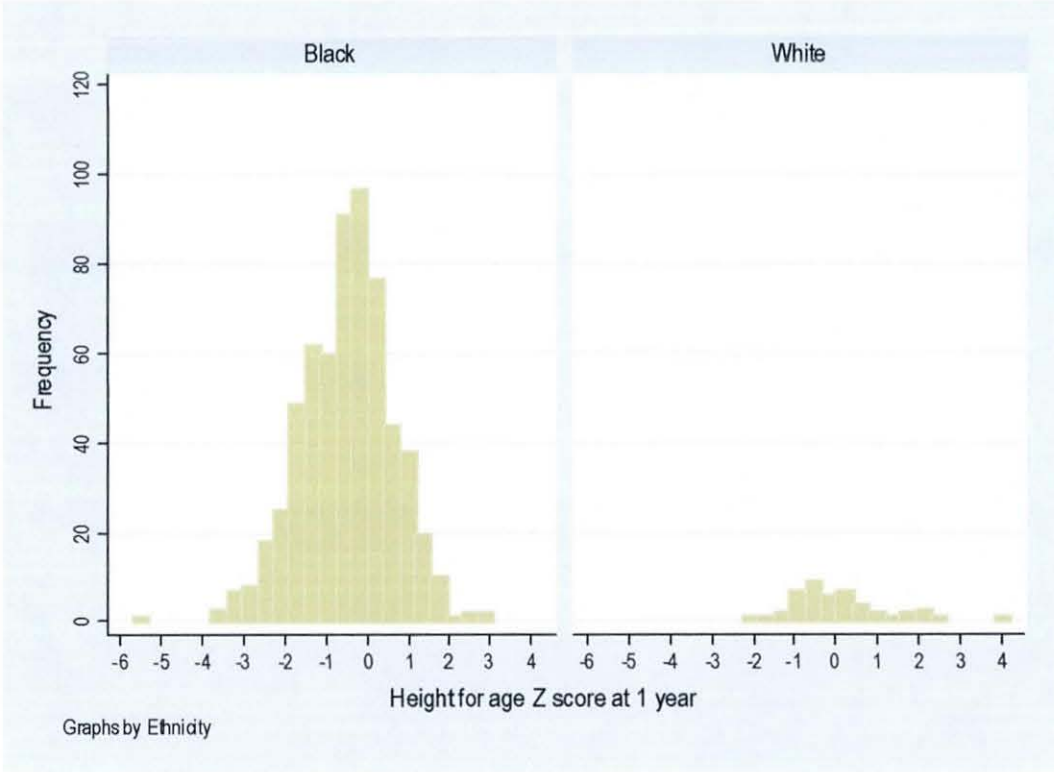


Figure 4.2.3 Distribution of height-for-age z-scores at 1 year by ethnicity



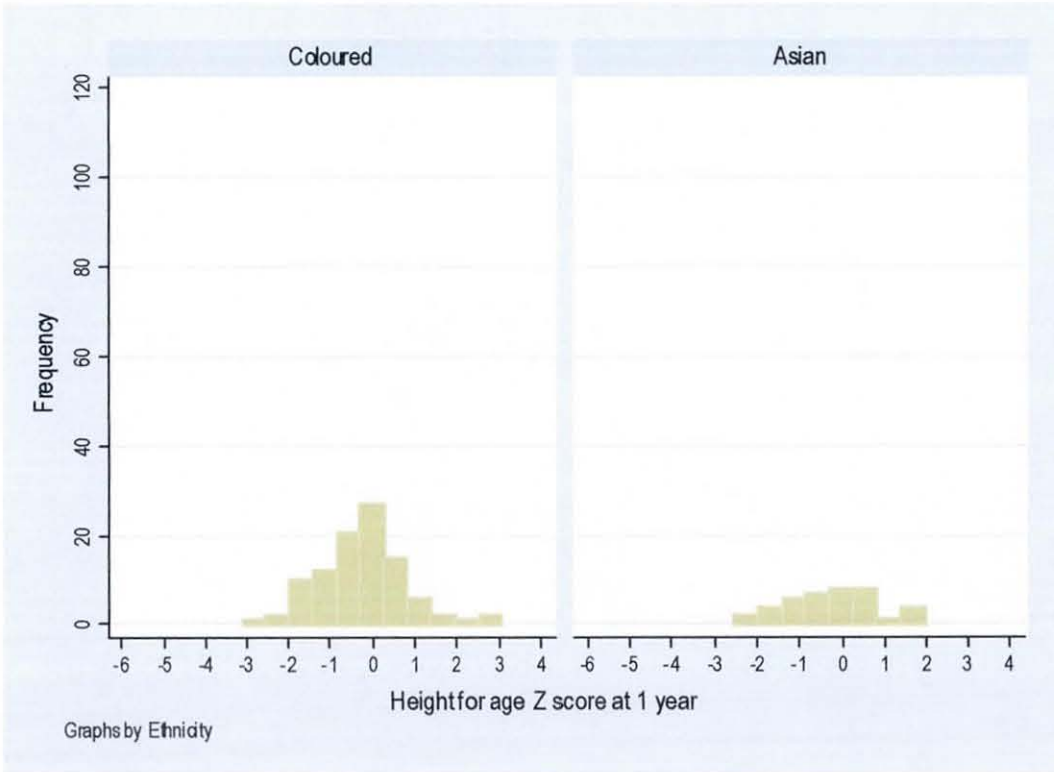
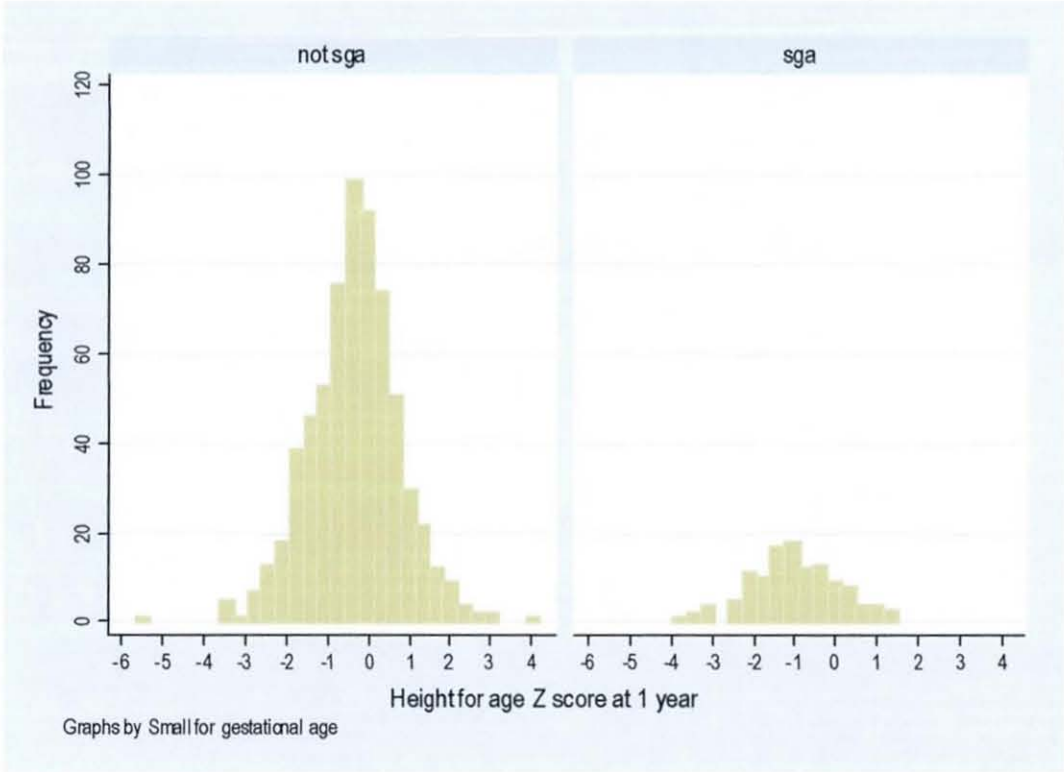


Figure 4.2.4 Distribution of height-for-age z-scores at 1 year by small for gestational age



Stunted at one year of age

Two reference populations were used to define stunting at one year of age (CDC/ WHO 1978 and CDC/ NCHS 2000). Categorisations of stunting at this age were different between the two references ($p< 0.05$). Using the CDC/ WHO 1978 population reference, 63 (7.9%) infants were stunted while this number was smaller at 34 (4.2%) using the CDC/ NCHS 2000 reference, indicating a relatively low prevalence of stunting at this age. A total of 29 infants were classified as stunted under the 1978 population reference, but not stunted under the 2000 reference (table 4.2.2).

Table 4.2.2
Classification of stunting at 1 year using CDC/ WHO 1978 and CDC/ NCHS 2000 reference populations

	CDC/ NCHS 2000	
CDC/ WHO 1978	Not stunted n (%)	Stunted n (%)
Not stunted	738 (96.2)	0 (0.0)
Stunted	29 (3.8)	34 (100.0)

BIVARIATE RESULTS: UNADJUSTED MEASURES OF ASSOCIATION AND EFFECT

Results presented in bivariate and multivariate analyses use stunting defined by the CDC/ NCHS 2000 reference. When these differed to those obtained using the CDC/ WHO 1978 reference, discrepancies are highlighted. Tables 4.2.3 – 4.2.12 show the distribution of proximate, socio-economic and social support exposures in the general study population and stratified by stunting status. These tables also show the unadjusted effect of exposures on stunting at one year of age. Unadjusted results indicate associations with the following variables: sex, SGA, pre-term delivery (table 4.2.3), mother's schooling, grandfather's level of schooling, frequency of partner's pay (table 4.2.4), water facility, toilet facility (table 4.2.5), cooking fuel and ownership of a washing machine, car, fridge and children's toys (table 4.2.7).

PROXIMATE EXPOSURES

Table 4.2.3 shows that the majority of the study sample was Black (76.8%). Over 15% of infants were born SGA, while 8.4% and 9.4% were born LBW and pre-term respectively. The majority were born to multiparous mothers (56.6 %) and to those who reported never having smoked (89.8%). Table 4.2.3 also shows that females were at reduced likelihood of stunting (OR= 0.20; 95%CI 0.08 - 0.48). SGA infants and those born pre-term were at increased likelihood of stunting at one year (OR= 2.76; 95%CI 1.30 - 5.48) and (OR= 3.10; 95%CI 1.34 - 7.15) respectively. No associations below the 0.05 p-value level were seen with maternal age at delivery, parity or maternal smoking behaviour (table 4.2.3). No association with ethnicity was seen using the CDC/ NCHS 2000 population reference (table 4.2.3). This result differed to that using the CDC/ WHO 1978 population reference, where Coloured infants were at reduced likelihood of stunting at one year (OR= 0.30; 95%CI 0.09 – 1.00). The distribution of LBW also did not differ between the stunted and non-stunted group, unlike with stunting defined using the 1978 population reference (OR= 3.29; 95%CI 1.67 – 6.46) (data not shown).

Table 4.2.3 Distribution of proximate exposures by stunting aged 1 year (CDC/ NCHS 2000) and unadjusted OR

Proximate Exposures	Study sample (n=801) N (%)	Stunted (n=34) N (%)	Not Stunted (n=767) N (%)	Crude OR (95 %CI)	p-value
Sex					
Male	395 (49.3)	28 (82.4)	367 (47.8)	1.00	
Female	406 (50.7)	6 (17.6)	400 (52.2)	0.20 (0.08, 0.48)	0.000
Ethnicity					
Black	615 (76.8)	33 (97.1)	582 (75.9)	1.00	
White	47 (5.9)	0 (0.0)	47 (6.1)	Insufficient data	
Coloured	99 (12.4)	1 (2.9)	98 (12.8)	0.18 (0.02, 1.34)	0.059
Indian	40 (4.9)	0 (0.0)	40 (5.2)	Insufficient data	
Small for gestational age					
Not SGA	657 (82.0)	23 (67.6)	634 (82.7)	1.00	
SGA	121 (15.1)	11 (32.4)	110 (14.3)	2.76 (1.30, 5.84)	0.006
Missing	23 (2.9)	0.(0.0)	23 (3.0)	Insufficient data	
Low birth weight					
Not LBW	732 (91.4)	28 (82.3)	704(91.8)	1.00	
LBW < 2500 grams	67 (8.4)	6 (17.7)	61 (7.9)	2.47 (0.98, 6.22)	0.047
Missing	2 (0.2)	0 (0.0)	2 (0.3)	Insufficient data	
Pre-term birth					
Term 37-41 weeks	701 (87.5)	26 (76.5)	675 (88.0)	1.00	
Pre-term < 37 weeks	75 (9.4)	8 (23.5)	67 (8.7)	3.10 (1.34, 7.15)	0.005
Missing	25 (3.1)	0 (0.0)	25 (3.3)	Insufficient data	
Maternal age at delivery					
≤ 19.99 yrs	133 (16.6)	7 (20.6)	126 (16.4)	1.00	
20-24.99 yrs	238 (29.7)	11 (32.4)	227 (29.6)	0.87 (0.33, 2.31)	0.783
25-29.99 yrs	226 (28.2)	9 (26.5)	217 (28.3)	0.75 (0.27, 2.06)	0.571
30-34.99 yrs	142 (17.7)	6 (17.6)	136 (17.7)	0.79 (0.26, 2.43)	0.686
≥ 35 yrs	62 (7.8)	1 (2.9)	61 (8.0)	0.29 (0.03, 2.48)	0.233
Parity					
1 live birth	348 (43.4)	16 (47.1)	332 (43.3)	1.00	
≥ 2 live births	453 (56.6)	18 (52.9)	435 (56.7)	0.86 (0.43, 1.71)	0.664
Mother's smoking behaviour					
Never smoked	719 (89.8)	32 (94.1)	687 (89.6)	1.00	
Ever smoked	72 (9.0)	2 (5.9)	70 (9.1)	0.61 (0.14, 2.62)	0.505
Missing	10 (1.2)	0 (0.0)	10 (1.3)	Insufficient data	

SGA = Small for gestational age
LBW = Low birth weight

EDUCATION AND EMPLOYMENT SES EXPOSURES

Table 4.2.4 shows that the majority of mothers in this sample (70.9%), at the time of data collection, had a level of schooling below matriculation, with very few completing university (2.4%). A larger proportion of partners obtained matriculation (35.3%) although few completed university (4.4%). Around the time of the child's birth, over 38% of mothers reported that they "earn money" and almost 60% of partners were employed (table 4.2.4).

This table also shows that infants of mothers who obtained matriculation were at reduced likelihood of stunting (OR= 0.31; 95%CI 0.11 - 0.91). Table 4.2.4 also shows that, using data from around the time of birth, a higher level of schooling (>Standard 5) obtained by the maternal grandfather was associated with a reduced likelihood of stunting (OR= 0.17; 95%CI 0.04 - 0.68). Again from information collected around the time of birth, table 4.2.4 shows that infants whose father was paid on a less frequent basis (i.e. < monthly) were at increased likelihood of stunting (OR= 3.16; 95%CI 1.20 – 8.32). No other associations below the 0.05 p-value level were seen with stunting using the CDC/ NCHS 2000 population reference (table 4.2.4). However, results using the CDC/ WHO 1978 reference indicated associations between stunting at one year and partner's schooling (OR= 0.44; 95%CI 0.23 – 0.84), partner's employment (OR= 0.52; 95%CI 0.28 – 0.95) and level of grandmother's schooling (OR= 0.40; 95%CI 0.17 – 0.94) reported around the time of the child's birth. Results using CDC/ WHO 1978 reference also indicated that infants whose mothers, near the child's birth, reported "earning money" were at reduced likelihood of stunting (OR= 0.46; 95%CI 0.25 – 0.87).

Table 4.2.4 Distribution of education & employment by stunting aged 1 year (CDC/ NCHS 2000) & unadjusted OR

Education & Employment	Study sample(n=801) N (%)	Stunted (n=34) N (%)	Not Stunted (n=767) N (%)	Crude OR (95 %CI)	p-value
Mother's Schooling					
< Matriculation	568 (70.9)	30 (88.2)	538 (70.2)	1.00	
Matriculation	232 (29.0)	4 (11.8)	288 (29.7)	0.31 (0.11, 0.91)	0.024
Missing	1 (0.1)	0 (0.0)	1 (0.1)	Insufficient data	
Mother's further education					
No further education	568 (70.9)	31 (91.2)	537 (70.0)	1.00	
Course not completed	29 (3.6)	0 (0.0)	29 (3.8)	Insufficient data	
In-service training	29 (3.6)	0 (0.0)	29 (3.8)	Insufficient data	
Technicon & college	60 (7.5)	1 (2.9)	59 (7.7)	Insufficient data	
University	19(2.4)	0 (0.0)	19 (2.5)	0.29 (0.04, 2.20)	0.205
Other	52 (6.5)	0 (0.0)	52 (6.8)	Insufficient data	
Missing	44 (5.5)	2 (5.9)	42 (5.4)	0.82 (0.19, 3.57)	0.797
Partner's Schooling					
< Matriculation	393 (49.1)	20 (58.8)	373 (48.6)	1.00	
Matriculation	283 (35.3)	7 (20.6)	276 (36.0))	0.47 (0.20, 1.14)	0.087
Missing/ system missing	125 (15.6)	7 (20.6)	118 (15.4)	1.11 (0.46, 2.68)	0.823
Partner's further education					
No further education	367 (45.8)	15 (44.1)	352 (45.9)	1.00	
Course not completed	27 (3.4)	0 (0.0)	27 (3.5)	Insufficient data	
In-service training	51 (6.4)	3 (8.8)	48 (6.3)	1.47 (0.41, 5.26)	0.555
Technicon & college	52 (6.5)	3 (8.8)	49 (6.4)	1.44 (0.40, 5.15)	0.576
University	35 (4.4)	0 (0.0)	35 (4.5)	Insufficient data	
Other	53 (6.6)	1 (3.0)	52 (6.8)	0.45 (0.06, 3.50)	0.435
Missing/ system missing	216 (27.0)	12 (35.3)	204 (26.6)	1.38 (0.63, 3.01)	0.416
Maternal grandmother educ.					
< Std 5	149 (18.6)	8 (23.5)	141 (18.4)	1.00	
Std 5 - Matriculation	249 (31.1)	5 (14.7)	244 (31.8)	0.36 (0.11, 1.13)	0.068
Missing/ system missing	403 (50.3)	21 (61.8)	382 (49.8)	0.97 (0.42, 2.24)	0.941
Maternal grandfather educ.					
< Std 5	99 (12.3)	8 (23.5)	91 (11.9)	1.00	
Std 5 - Matriculation	200 (25.0)	3 (8.8)	197 (25.7)	0.17 (0.04, 0.68)	0.005
Missing/ system missing	502 (62.7)	23 (67.7)	479 (62.4)	0.55 (0.24, 1.26)	0.151
Mother's work					
Unemployed	291 (36.3)	17 (50.0)	274 (35.7)	1.00	
Housewife	197 (24.6)	5 (14.7)	192 (25.0)	0.42 (0.15, 1.16)	0.085
Earns money	305 (38.1)	12 (35.3)	293 (38.2)	0.66 (0.31, 1.41)	0.280
Missing	8 (1.0)	0 (0.0)	8 (1.1)	Insufficient data	
Frequency of mother's pay					
Monthly	212 (26.5)	5 (14.7)	207 (27.0)	1.00	
< monthly	91 (11.4)	6 (17.6)	85 (11.1)	2.92 (0.86, 9.92)	0.071
Missing/ system missing	498 (62.1)	23 (67.7)	475 (61.9)	2.00 (0.75, 5.36)	0.157
Partner employed					
Partner employed	480 (59.9)	18 (52.9)	462 (60.2)	1.00	
Partner not working	137 (17.1)	10 (29.4)	127 (16.6)	0.49 (0.22, 1.10)	0.079
Missing/ system missing	184 (23.0)	6 (17.7)	178 (23.2)	0.43 (0.15, 1.21)	0.100
Frequency of partner's pay					
Monthly	294 (36.7)	6 (17.6)	288 (37.6)	1.00	
< monthly	243 (30.3)	15 (44.1)	228 (29.7)	3.16 (1.20, 8.32)	0.014
Missing/ system missing	264 (33.0)	13 (38.3)	251 (32.7)	2.49 (0.93, 6.66)	0.061

HOME CHARACTERISTICS AND CONDITION OF HOME SES EXPOSURES

Using SES data collected around the time of the child's birth, table 4.2.5 shows that the majority of the study sample lived in a house or cottage (74%) and most rented their home from their local authority (38.1%). Over 45% of homes had two rooms that were used for sleeping while over 77% had a separate kitchen that was used only for cooking purposes. Almost 27% of homes did not have ceilings. A total of 33.9% and 38.9% respectively had indoor hot water or an indoor flush toilet. Table 4.2.5 also shows that infants, who around the time of their birth, came from homes with an indoor hot tap or indoor flush toilet were at reduced likelihood of stunting (OR= 0.11; 95%CI 0.03 - 0.48 and OR= 0.14; 95%CI 0.04 - 0.47 respectively). An association with having a separate kitchen was noted when the CDC/ WHO 1978 population reference was used (OR= 0.54; 95%CI 0.31 – 0.96) (data not shown). However, no associations were seen with other home characteristic variables when the 2000 CDC/ NCHS population reference was used (table 4.2.5).

Table 4.2.6 shows that, around the time of the child's birth, the majority of respondents classified the condition of their home as "fair" (40.8%) with most reporting no cracked walls (54.3%), no broken doors (62.3%) or windows (60.4%) and no leaks (58.2%). This table shows that respondents, at this time, did not generally consider their homes to be troubled by pests, although 30.5% and 28.0% did report being troubled by flies or cockroaches respectively. No associations were seen between stunting and SES exposures measuring the condition of the home (Table 4.2.6).

Table 4.2.5 Distribution of home characteristics by stunting aged 1 year (CDC/NCHS 2000) & unadjusted OR

Home characteristics Exposures	Study sample (n=801) N (%)	Stunted (n=34) N (%)	Not Stunted (n=767) N (%)	Crude OR (95 %CI)	p-value
Type of home					
Shack	47 (5.9)	4 (11.8)	43 (5.6)	1.00	
Room or Garage	70 (8.8)	2 (5.9)	68 (9.0)	0.32 (0.05, 1.84)	0.176
Flat	54 (6.7)	0 (0.0)	54 (7.0)	Insufficient data	
House shared with another family	32 (4.0)	1 (2.9)	31 (4.0)	0.35 (0.03, 3.35)	0.338
Cottage or House	593 (74.0)	26 (76.5)	567 (73.9)	0.49 (0.16, 1.48)	0.198
Missing	5 (0.6)	1 (2.9)	4 (0.5)	2.69 (0.23, 31.42)	0.412
Tenureship					
Rented from another person	231 (28.8)	10 (29.4)	221 (28.8)	1.00	
Provided by employer	34 (4.3)	1 (2.9)	33 (4.3)	0.67 (0.08, 5.43)	0.705
Rented from local authority	305 (38.1)	15 (44.1)	290 (37.8)	1.14 (0.50, 2.60)	0.749
Owned	215 (26.8)	7 (20.6)	208 (27.1)	0.74 (0.28, 1.99)	0.555
Missing	16 (2.0)	1 (3.0)	15 (2.0)	1.47 (0.17, 12.35)	0.719
Number of sleeping rooms					
1	188 (23.5)	12 (35.3)	176 (22.9)	1.00	
2	363 (45.3)	14 (41.2)	349 (45.5)	0.59 (0.26, 1.30)	0.185
≥3	241 (30.1)	8 (23.5)	233 (30.4)	0.50 (0.20, 1.26)	0.136
Missing	9 (1.1)	0 (0.0)	9 (1.2)	Insufficient data	
Separate kitchen					
No	174 (21.7)	12 (35.3)	162 (21.1)	1.00	
Yes	620 (77.4)	22 (64.7)	598 (78.0)	0.50 (0.24, 1.03)	0.054
Missing	7 (0.9)	0 (0.0)	7 (0.9)	Insufficient data	
Type of roofing material					
Asbestos	282 (35.2)	10 (29.4)	272 (35.5)	1.00	
Tiles	59 (7.4)	0 (0.0)	59 (7.7)	Insufficient data	
Corrugated metal	138 (17.2)	6 (17.7)	132 (17.2)	1.24 (0.44, 3.48)	0.687
Missing/ system missing	322 (40.2)	18 (52.9)	304 (39.6)	1.61 (0.73, 3.55)	0.234
Home has ceiling					
No	216 (26.9)	10 (29.4)	206 (26.9)	1.00	
Yes	337 (42.1)	10 (29.4)	327 (42.6)	0.63 (0.26, 1.54)	0.307
Missing/ system missing	248 (31.0)	14 (41.2)	234 (30.5)	1.23 (0.53, 2.84)	0.622
Water facility					
Outdoor tap or indoor cold tap	522 (65.2)	32 (94.1)	490 (63.9)	1.00	
Indoor hot tap	272 (33.9)	2 (5.9)	270 (35.2)	0.11 (0.03, 0.48)	0.000
Missing	7 (0.9)	0 (0.0)	7 (0.9)	Insufficient data	
Toilet facility					
Bucket or outdoor flush toilet	480 (50.9)	31 (91.2)	449 (58.5)	1.00	
Indoor flush toilet	312 (38.9)	3 (8.8)	309 (40.3)	0.14 (0.04, 0.47)	0.000
Missing	9 (1.12)	0 (0.0)	9 (1.2)	Insufficient data	

Table 4.2.6 Distribution of Condition of home by stunting aged 1 year (CDC/ NCHS 2000) & unadjusted odds ratio

Condition of home Exposures	Study sample (n=801) N (%)	Stunted (n=34) N (%)	Not Stunted (n=767) N (%)	Crude OR (95 %CI)	p-value
Condition of home					
Good	148 (18.5)	5 (14.7)	143 (18.6)	1.00	
Fair	327 (40.8)	13 (38.2)	314 (40.9)	1.18 (0.41, 3.39)	0.753
Poor	80 (10.0)	2 (5.9)	78 (10.2)	0.73 (0.14, 3.88)	0.714
Missing/ system missing	246 (30.7)	14 (41.2)	232 (30.3)	1.72 (0.61, 4.91)	0.300
Home has cracked walls					
No	435 (54.3)	14 (41.2)	421 (54.9)	1.00	
Yes	111 (13.9)	6 (17.6)	105 (13.7)	1.72 (0.64, 4.59)	0.274
Missing/ system missing	255 (31.8)	14 (41.2)	241 (31.4)	1.75 (0.82, 3.73)	0.145
Home has broken doors					
No	499 (62.3)	18 (52.9)	481 (62.7)	1.00	
Yes	50 (6.2)	2 (5.9)	48 (6.3)	1.11 (0.25, 4.95)	0.888
Missing/ system missing	252 (31.5)	14 (41.2)	238 (31.0)	1.57 (0.77, 3.22)	0.212
Home has broken windows					
No	484 (60.4)	17 (50.0)	467 (60.9)	1.00	
Yes	67 (8.4)	3 (8.8)	64 (8.3)	1.29 (0.37, 4.52)	0.692
Missing	250 (31.2)	14 (41.2)	236 (30.8)	1.63 (0.79, 3.37)	0.183
Home has leaks					
No	466 (58.2)	14 (41.2)	452 (58.9)	1.00	
Yes	87 (10.9)	6 (17.6)	81 (10.6)	2.39 (0.89, 6.43)	0.074
Missing/ system missing	248 (30.9))	14 (41.2)	234 (30.5)	1.93 (0.90, 4.13)	0.084
Home troubled by flies					
No	306 (38.2)	9 (26.5)	297 (38.7)	1.00	
Yes	244 (30.5)	11 (32.3)	233 (30.4)	1.56 (0.63, 3.83)	0.330
Missing/ system missing	251 (31.3)	14 (41.2)	237 (30.9)	1.95 (0.83, 4.59)	0.120
Home troubled by rats					
No	401 (50.1)	16 (47.0)	285 (50.2)	1.00	
Yes	141 (17.6)	4 (11.8)	137 (17.9)	0.70 (0.23, 2.14)	0.532
Missing/ system missing	259 (32.3)	14 (41.2)	245 (31.9)	1.37 (0.66, 2.87)	0.394
Home troubled by bed bugs					
No	492 (61.4)	18 (52.9)	474 (61.8)	1.00	
Yes	48 (6.0)	2 (5.9)	46 (6.0)	1.14 (0.26, 5.10)	0.859
Missing/ system missing	261 (32.6)	14 (41.2)	274 (32.2)	1.49 (0.73, 3.05)	0.270
Home troubled by cockroaches					
No	321 (40.1)	10 (29.4)	311 (40.6)	1.00	
Yes	224 (28.0)	10 (29.4)	214 (27.9)	1.45 (0.59, 3.56)	0.410
Missing/ system missing	256 (31.9)	14 (41.2)	242 (31.5)	1.80 (0.78, 4.13)	0.160

ECONOMIC SES EXPOSURES

Around the time of the child's birth, a large majority of homes had electricity supply (94.8%) and 81.1% used electricity or gas as their main cooking fuel (table 4.2.7). Over 78% and 71% respectively did not employ domestic help or have private medical insurance cover. The majority had a television, radio and fridge in their home (table 4.2.7). However, few had a washing machine (21.1%) or car (34.3%). Infants from homes where, at the time of their birth, certain consumer durables (fridge, washing machine, car and toys) were owned were at reduced likelihood of stunting (table 4.2.7). Table 4.2.7 shows that infants from homes where electricity or gas were the main cooking fuels were at reduced likelihood of stunting (OR= 0.45; 95%CI 0.21 - 0.95). When stunting at one year was defined using the CDC/ WHO 1978 reference population, the association between cooking fuel and stunting was attenuated (OR= 0.57; 95%CI 0.31 – 1.03) (data not shown). No associations were seen between stunting and other economic SES exposures (table 4.2.7).

DEPRIVATION AND HOUSEHOLD COMPOSITION SES EXPOSURES

During the six months prior to the survey (i.e. during early to mid pregnancy), over 17% reported that their family had had too little money for basics (food, clothing, rent etc.) and over 19% reported that there was problematic use of alcohol or drugs in the family (table 4.2.8). The majority had not been separated unwillingly from their children (83.7%) or physically abused by their partner (90.5%). Table 4.2.8 also shows that over 17% of mothers fell pregnant when still at school (table 4.2.8). No associations were found between stunting and deprivation variables. However results using CDC/ WHO 1978 population reference indicated a positive association between problematic alcohol or drug use in the family and stunted at one year of age (OR= 1.96; 95%CI 1.10 – 3.48) (data not shown).

Using data from around the time of the child's birth, table 4.2.9 shows that a very large majority of homes reported that the mother was a usual resident (99.5%). Table 4.2.9 also shows that at the time of survey 21% of homes reported that at least one sibling of the Bt20 child, who was aged under five years, was resident in the home. No associations were seen between stunting at this age and household composition variables (table 4.2.9). However, when stunting was defined using the CDC/ WHO 1978 reference population, a positive association between having a young sibling and stunting was noted (OR= 1.88; 95%CI 1.07 – 3.30) (data not shown).

Table 4.2.7 Distribution of economic SES exposures by stunting aged 1 yr (CDC/ NCHS 2000) & unadjusted OR

Economic Exposures	Study sample (n=801) N (%)	Stunted (n=34) N (%)	Not Stunted (n=767) N (%)	OR (95 %CI)	p-value
Electricity supply					
No	38 (4.7)	2 (5.9)	36 (4.7)	1.00	
Yes	759 (94.8)	32 (94.1)	727 (94.8)	0.79 (0.18, 3.44)	0.755
Missing	4 (0.5)	0 (0.0)	4 (0.5)	Insufficient data	
Cooking fuel used					
Other (coal, paraffin, wood)	147 (18.4)	11 (32.4)	136 (17.7)	1.00	
Electricity/generator or gas	650 (81.1)	23 (67.6)	627 (81.8)	0.45 (0.21, 0.95)	0.033
Missing	4 (0.5)	0 (0.0)	4 (0.5)	Insufficient data	
Employ domestic help					
No	631 (78.8)	31 (91.2)	600 (78.2)	1.00	
Yes	120 (15.0)	1 (2.9)	199 (15.5)	0.16 (0.02, 1.21)	0.043
Missing/ system missing	50 (6.2)	2 (5.9)	48 (6.3)	0.81 (0.19, 3.47)	0.773
Medical aid cover					
No	570 (71.2)	28 (82.3)	542 (70.7)	1.00	
Yes	165 (20.6)	4 (11.8)	161 (21.0)	0.48 (0.16, 1.39)	0.168
Missing/ system missing	66 (8.2)	2 (5.9)	64 (8.3)	0.60 (0.14, 2.60)	0.495
Television in home					
No	211 (26.3)	10 (29.4)	201 (26.2)	1.00	
Yes	582 (72.7)	22 (64.7)	560 (73.0)	0.79 (0.37, 1.70)	0.544
Missing	8 (1.0)	2 (5.9)	6 (0.8)	6.70 (1.16, 38.56)	0.014
Radio in home					
No	130 (16.2)	4 (11.8)	126 (16.4)	1.00	
Yes	664 (82.9)	29 (85.3)	635 (82.8)	1.44 (0.50, 4.17)	0.501
Missing	7 (0.9)	1 (2.9)	6 (0.8)	5.25 (0.49, 56.08)	0.125
Phone in home					
No	337 (42.1)	19 (55.9)	318 (41.5)	1.00	
Yes	455 (56.8)	14 (41.2)	441 (57.5)	0.53 (0.26, 1.08)	0.075
Missing	9 (1.1)	1 (2.9)	8 (1.0)	2.09 (0.25, 17.68)	0.488
Fridge in home					
No	217 (27.1)	16 (47.1)	201 (26.2)	1.00	
Yes	576 (71.9)	17 (50.0)	559 (72.9)	0.38 (0.19, 0.77)	0.006
Missing	8 (1.0)	1 (2.9)	7 (0.9)	1.79 (0.21, 15.60)	0.591
Washing machine in home					
No	621 (77.5)	32 (94.2)	589 (76.8)	1.00	
Yes	169 (21.1)	1 (2.9)	168 (21.9)	0.11 (0.01, 0.81)	0.009
Missing	11 (1.4)	1 (2.9)	10 (1.3)	1.84 (0.23, 14.86)	0.561
Car in home					
No	514 (64.2)	28 (82.3)	486 (63.4)	1.00	
Yes	275 (34.3)	5 (14.7)	270 (35.2)	0.32 (0.12, 0.84)	0.015
Missing	12 (1.5)	1 (3.0)	11 (1.4)	1.58 (0.20, 12.69)	0.665
Children's toys in home					
No	294 (36.7)	20 (58.8)	274 (35.7)	1.00	
Yes	498 (62.2)	13 (38.2)	485 (63.2)	0.37 (0.18, 0.75)	0.004
Missing	9 (1.1)	1 (3.0)	8 (1.1)	1.71 (0.20, 14.44)	0.617

Table 4.2.8 Distribution of deprivation SES exposures by stunting aged 1 yr (CDC/ NCHS 2000) & unadjusted OR

Deprivation Exposures	Study sample (n=801) N (%)	Stunted (n=34) N (%)	Not Stunted (n=767) N (%)	OR (95 %CI)	p-value
Family recently had too little money for basics					
No	643 (80.3)	25 (73.5)	618 (80.6)	1.00	
Yes	140 (17.5)	9 (26.5)	131 (17.1)	1.70 (0.77, 3.73)	0.182
Missing	18 (2.2)	0 (0.0)	18 (2.3)	Insufficient data	
Mother recently separated unwillingly from children					
No	670 (83.7)	29 (85.3)	641 (83.6)	1.00	
Yes	25 (3.1)	1 (2.9)	24 (3.1)	0.92 (0.12, 7.05)	0.937
Missing	106 (13.2)	4 (11.8)	102 (13.3)	0.87 (0.30, 2.52)	0.793
Drug or alcohol problem in family					
No	631 (78.8)	24 (70.6)	607 (79.1)	1.00	
Yes	155 (19.3)	10 (29.4)	145 (18.9)	1.74 (0.81, 3.73)	0.147
Missing	15 (1.9)	0 (0.0)	15 (2.0)	Insufficient data	
Mother recently physically abused by partner					
No	725 (90.5)	30 (88.2)	695 (90.6)	1.00	
Yes	40 (5.0)	3 (8.8)	37 (4.8)	1.88 (0.55, 6.45)	0.309
Missing	36 (4.5)	1 (3.0)	35 (4.6)	0.66 (0.09, 5.00)	0.687
Mother still at school when fell pregnant					
No	414 (51.7)	13 (38.2)	401 (52.3)	1.00	
Yes	137 (17.1)	7 (20.6)	7 (20.6)	1.66 (0.65, 4.26)	0.286
Missing/ system missing	250 (31.2)	14 (41.2)	14 (41.1)	1.83 (0.84, 3.97)	0.120

Table 4.2.9
Distribution of household composition SES exposures by stunting aged 1 yr (CDC/ NCHS 2000) & unadjusted OR

Household composition Exposures	Study sample (n=801) N (%)	Stunted (n=34) N (%)	Not Stunted (n=767) N (%)	OR (95 %CI)	p-value
Mother reported resident					
No mother reported	1 (0.1)	0 (0.0)	1 (0.1)	1.00	
Mother reported	797 (99.5)	34 (100.0)	763 (99.5)	Insufficient data	
Missing	3 (0.4)	0 (0.0)	3 (0.4)	Insufficient data	
Father reported resident					
No father reported	438 (54.7)	21 (61.8)	417 (54.4)	1.00	
Father reported	357 (44.6)	13 (38.2)	344 (44.8)	0.75 (0.37, 1.52)	0.424
Missing	6 (0.7)	0 (0.0)	6 (0.8)	Insufficient data	
Grandfather reported resident					
No grandfather reported	545 (68.0)	27 (79.4)	518 (67.5)	1.00	
Grandfather reported	250 (31.2)	7 (20.6)	243 (31.7)	0.55 (0.24, 1.29)	0.164
Missing	6 (0.8)	0 (0.0)	6 (0.8)	Insufficient data	
Grandma reported resident					
No grandma reported	380 (47.5)	14 (41.2)	366 (47.7)	1.00	
Grandma reported	416 (51.9)	20 (58.8)	396 (51.6)	1.32 (0.66, 2.65)	0.434
Missing	5 (0.6)	0 (0.0)	5 (0.7)	Insufficient data	
At least 1 sibling ≤ 5yrs resident					
No young sibling reported	626 (78.1)	24 (70.6)	602 (78.5)	1.00	
At least 1 young sibling reported	168 (21.0)	10 (29.4)	158 (20.6)	1.59 (0.74, 3.40)	0.229
Missing	7 (0.9)	0 (0.0)	7 (0.9)	Insufficient data	

SOCIAL SUPPORT EXPOSURES

Table 4.2.10 shows that, around the time of the child's birth, the majority of mothers had a number of people they could ask for help (79.5%) and a number of people to talk to about problems (83.7%). The majority also belonged to an organisation e.g. a church (70.8%). Over 50% of infants were cared for during the day by their mother, with only few cared for by a childminder (7.1%). Results show no association between stunting and general social support exposures (table 4.2.10).

Table 4.2.11 shows that, around the time of the child's birth, the majority of mothers surveyed were either unsure or reported that they did not desire their pregnancy (58.4%). However, over 73% felt their family and financial situation was right and ready for the arrival of the child and 83.8% reported that their partner desired the pregnancy. Using data from the six month questionnaire, few mothers (12.5%) were accompanied by anyone other than medical staff during their labour and delivery. No associations between stunting and social support around pregnancy were seen (table 4.2.11).

Table 4.2.12 shows that the majority of mothers were "single" (61.9%) around the time of the child's birth. However, over 82% believed their partner or the child's father would contribute financially to the upbringing of the child and over 46% thought their partner would help with childcare. A total of 62.1% reported that their partner never made things harder for them (table 4.2.11). An association between the missing value category of partner's help and childcare was noted. Excluding these missing values had no effect on the size of effect or strength of association of this variable and as such the missing value category was retained to increase sample size. Results showed no associations between support from a partner and stunting (table 4.2.12). However, an association with partner's help with childcare was noted when stunting was defined using the CDC/ WHO 1978 reference population (OR= 0.55; 95%CI 0.31 – 0.99) (data not shown).

Table 4.2.10 Distribution of social support (general) by stunting aged 1 yr (CDC/ NCHS 2000) & unadjusted OR

Social support Exposures	Study sample (n=801) N (%)	Stunted (n=34) N (%)	Not Stunted (n=767) N (%)	OR (95 %CI)	p-value
Mother has network to request help from					
No-one	81 (10.1)	5 (14.7)	76 (9.9)	1.00	
Unsure/ maybe	76 (9.5)	1 (2.9)	75 (9.8)	0.20 (0.02, 1.82)	0.114
Number of people	637 (79.5)	28 (82.4)	609 (79.4)	0.70 (0.26, 1.86)	0.472
Missing	7 (0.90	0 (0.0)	7 (0.9)	Insufficient data	
Mother can talk to someone about problems					
No-one	70 (8.7)	3 (8.8)	67 (8.7)	1.00	
Unsure/ maybe	52 (6.5)	2 (5.9)	50 (6.5)	0.89 (0.14, 5.59)	0.904
Number of people	670 (83.7)	29 (85.3)	641 (83.6)	1.01 (0.30, 3.41)	0.987
Missing	9 (1.1)	0 (0.0)	9 (1.2)	Insufficient data	
Mother belongs to organisation (e.g. church)					
No	222 (27.7)	7 (20.6)	215 (28.0)	1.00	
Yes	567 (70.8)	26 (76.5)	541 (70.5)	1.48 (0.63, 3.45)	0.366
Missing	12 (1.5)	1 (2.9)	11 (1.5)	2.79 (0.31, 24.95)	0.337
Person who cares for child					
Mother	401 (50.1)	17 (50.0)	384 (50.1)	1.00	
Childminder	57 (7.1)	1 (2.9)	56 (7.3)	0.40 (0.05, 3.10)	0.367
Other family or friend	95 (11.9)	2 (5.9)	93 (12.1)	0.48 (0.11, 2.14)	0.330
Missing/ system missing	248 (30.9)	14 (41.2)	234 (30.5)	1.35 (0.65, 2.79)	0.415

Table 4.2.11 Distribution of social support (pregnancy) by stunting age 1 yr (CDC/ NCHS 2000) & unadjusted OR

Social support around pregnancy Exposures	Study sample (n=801) N (%)	Stunted (n=34) N (%)	Not Stunted (n=767) N (%)	OR (95 %CI)	p-value
Mother desire for pregnancy					
Unsure/ no	486 (58.4)	19 (55.9)	499 (58.5)	1.00	
Yes desires pregnancy	303 (37.8)	14 (41.2)	289 (37.7)	1.14 (0.56, 2.32)	0.707
Missing	30 (3.8)	1 (2.9)	29 (3.8)	0.81 (0.10, 6.31)	0.844
Family & finances ready for preg.					
Unsure/ no	195 (24.3)	11 (32.4)	184 (24.0)	1.00	
Yes	587 (73.3)	23 (67.6)	564 (73.5)	0.68 (0.32, 1.43)	0.307
Missing	19 (2.4)	0 (0.0)	19 (2.5)	Insufficient data	
Partner desire for pregnancy					
Unsure/ no	95 (11.9)	5 (14.7)	90 (11.7)	1.00	
Yes	671 (83.8)	29 (85.3)	642 (83.7)	0.81 (0.31, 2.15)	0.677
Missing	35 (4.3)	0 (0.0)	35 (4.6)	Insufficient data	
Mother accompanied at birth					
No (only medical staff)	452 (56.4)	20 (58.8)	432 (56.3)	1.00	
Yes	100 (12.5)	0 (0.0)	100 (13.0)	Insufficient data	
Missing/ system missing	249 (31.1)	14 (41.2)	235 (30.7)	1.29 (0.64, 2.60)	0.480

Table 4.2.12 Distribution of social support (partner) by stunting aged 1 yr (CDC/ NCHS 2000) & unadjusted OR

Social support from partner Exposures	Study sample (n=801) N (%)	Stunted (n=34) N (%)	Not Stunted (n=767) N (%)	OR (95 %CI)	p-value
Mother's marital status					
Single	496 (61.9)	25 (73.5)	471 (61.4)	1.00	
Previously married	11 (1.4)	0 (0.0)	11 (1.4)	Insufficient data	
Married	288 (36.0)	9 (26.5)	279 (36.4)	0.61 (0.28, 1.32)	0.205
Missing	6 (0.7)	0 (0.0)	6 (0.8)	Insufficient data	
Mother's cohabitation status					
Not living with partner	378 (47.2)	17 (50.0)	361 (47.1)	1.00	
Living with partner	382 (47.7)	12 (35.3)	370 (48.2)	0.69 (0.32, 1.46)	0.330
Missing	41 (5.1)	5 (14.7)	36 (4.7)	2.95 (1.02, 8.52)	0.036
Partner contribute financially to child					
Don't know/ no	90 (11.2)	5 (14.7)	85 (11.1)	1.00	
Yes	663 (82.8)	28 (82.4)	635 (82.8)	0.75 (0.28, 1.99)	0.563
Missing	48 (6.0)	1 (2.9)	47 (6.1)	0.36 (0.04, 3.24)	0.343
Partner helps with childcare					
No	172 (21.5)	12 (35.3)	160 (20.8)	1.00	
Yes	370 (46.2)	15 (44.1)	355 (46.3)	0.56 (0.26, 1.23)	0.146
Missing/ system missing	259 (32.3)	7 (20.6)	252 (32.9)	0.37 (0.14, 0.97)	0.035
Partner helps with housework					
No	309 (38.6)	16 (47.1)	293 (38.2)	1.00	
Yes	296 (36.9)	11 (32.3)	285 (37.2)	0.71 (0.32, 1.55)	0.385
Missing/ system missing	196 (24.5)	7 (20.6)	189 (24.6)	0.68 (0.27, 1.68)	0.399
Things made harder by way partner acts					
Always or Sometimes	267 (33.3)	8 (23.5)	259 (33.8)	1.00	
Never	497 (62.1)	26 (76.5)	471 (61.4)	1.79 (0.80, 4.01)	0.153
Missing	37 (4.6)	0 (0.0)	37 (4.8)	Insufficient data	

MULTIVARIATE RESULTS: ADJUSTED MEAURES OF ASSOCIATION AND EFFECT

INDIVIDUALLY ADJUSTED MEASURES- PROXIMATE AND SES EXPOSURES

Proximate Exposures

When the effects of the proximate variables of sex, SGA and pre-term were simultaneously adjusted for one another, only sex and SGA remained associated with stunting at one year of age (table 4.2.13). Female infants remained less likely to be stunted at one year of age (OR= 0.20; 95%CI 0.08 - 0.49). Those born SGA remained at increased likelihood of stunting (OR= 2.59; 95%CI 1.21 - 5.53). These results concurred with those obtained when stunting was defined using the CDC/ WHO 1978 population reference (data not shown).

Table 4.2.13
Adjusted effect of proximate exposures on stunting aged 1 year (CDC/ NCHS 2000) (n = 778)

Variables	Categories	OR (95 %CI)	p-value
Sex	Male		
	Female	0.20 (0.08, 0.49)	0.000
Small for gestational age	Not SGA		
	SGA	2.59 (1.21, 5.53)	0.014

SGA = Small for gestational age

SES Exposures

A number of SES exposures, collected around the time of the child's birth, that were associated in bivariate analysis with stunting at this age, were also collinear with one another (water and toilet facilities, type of cooking fuel used and ownership of washing machine) [xvii]. These variables were therefore included in principal component analysis to develop an SES index (tertiles) (table 4.2.14). Table 4.2.15 shows the Eigen vector weights that each variable contributed to the index.

Table 4.2.14
SES exposures included in PCA to create SES index for use in logistic regression (CDC/ NCHS 2000)

PCA SES index variables	Categories
Water facility	Outdoor or indoor cold tap only
	Indoor hot tap
Toilet facility	Bucket or outdoor flush toilet only
	Indoor flush toilet
Washing machine in home	No
	Yes
Cooking fuel used	Other (brazier, coal, wood, paraffin)
	Electricity/generator or gas

PCA = Principal component analysis
SES = Socio-economic status

[xvii] The variables used to develop the SES index in the CDC/ WHO 1978 analyses included water and toilet facilities, ownership of washing machine, fridge, separate kitchen and hired domestic help.

Table 4.2.15 Eigen vector weights of SES exposures included in index (CDC/ NCHS 2000)

Variable	Eigenvector
Water facility	0.550
Toilet facility	0.538
Washing machine	0.401
Cooking fuel	0.497

PCA = Principal component analysis
SES = Socio-economic status

Table 4.2.16 shows that, in comparison to infants from homes in the lowest tertile of the SES index, infants from homes in the highest tertiles were at reduced likelihood of stunting at one year of age (OR= 0.17; 95%CI 0.05 – 0.56).

Table 4.2.16
Effect of PCA SES index on stunting aged 1 year (CDC/ NCHS 2000) (unadjusted odds ratios) (n=778)

Variables	Categories	OR (95 %CI)	p-value
Tertiles of SES index	Low tertile	1.00	
	Mid Tertile	0.17 (0.02, 1.24)	0.080
	High Tertile	0.17 (0.04, 0.56)	0.001

SES = Socio-economic status
SES index = water facility, toilet facility, washing machine, cooking fuel

On adjustment for the SES index, the effects of maternal schooling, grandfather's schooling and the frequency of partner's pay on stunting were no longer seen (table 4.2.17). The associations between stunting and ownership of a fridge, car or children's toys were also no longer seen (table 4.2.17). Table 4.2.17 shows that the only SES exposure which remained associated with stunting upon adjustment for other SES exposures, was the SES index.

Table 4.2.17 Adjusted effect of SES exposures on stunting aged 1 year (CDC/ NCHS 2000) (n=778)

Variables	Categories	OR (95 %CI)	p-value
Tertiles of SES index	Low tertile	1.00	
	Mid Tertile	0.16 (0.02, 1.30)	0.086
	High Tertile	0.20 (0.04, 0.90)	0.036
Mother's schooling	< Matriculation	1.00	
	Matriculation	0.64 (0.21, 1.96)	0.432
Maternal grandfather educ.	< Std 5	1.00	
	Std 5 - Matriculation	0.35 (0.09, 1.41)	0.142
	Missing/ system missing	0.68 (0.09, 1.41)	0.383
Frequency of partner's pay	Monthly	1.00	
	< monthly	0.51 (0.19, 1.39)	0.189
	Missing/ system missing	0.87 (0.39, 1.90)	0.72
Fridge in home	No	1.00	
	Yes	0.75 (0.35, 1.62)	0.47
	Missing	1.38 (0.01, 403.60)	0.911
Car in home	No	1.00	
	Yes	0.84 (0.29, 2.41)	0.741
	Missing	3.52 (0.04, 270.77)	0.57
Children's toys in home	No	1.00	
	Yes	0.60 (0.28, 1.28)	0.186
	Missing	4.24 (0.07, 262.68)	0.492

SES = Socio-economic status
SES index = water facility, toilet facility, washing machine, cooking fuel

These results differed somewhat to those using the CDC/ WHO 1978 population reference, where adjusted associations with stunted at one year were seen between the mother's schooling, if a young sibling was resident in the home and problematic alcohol or drug use in the family (table 4.2.18).

Table 4.2.18
Adjusted effect of SES exposures on stunting aged 1 year (CDC/ WHO 1978) (n=794)

Variables	Categories	OR (95 %CI)	p-value
Mother's schooling	< Matriculation	1.00	
	Matriculation	0.33 (0.14, 0.74)	0.007
At least 1 sibling ≤ 5yrs resident	No young sibling reported	1.00	
	At least 1 young sibling reported	2.00 (1.13, 3.55)	0.018
Drug or alcohol problem in family	No	1.00	
	Yes	1.83 (1.02, 3.28)	0.042
	Missing	0.96 (0.12, 7.67)	0.967

SES = Socio-economic status

COMBINED EFFECT ON STUNTING OF PROXIMATE AND SES EXPOSURES

Table 4.2.19 shows that, in comparison to those from the lowest tertile, infants from homes in the highest tertile of the SES index were at reduced likelihood of stunting (OR= 0.16; 95%CI 0.05 -

0.55). Female infants remained at reduced likelihood of stunting at this age (OR= 0.20; 95%CI 0.08 - 0.50). Those infants born SGA remained at increased likelihood of stunting (OR= 2.82; 95%CI 1.30 - 6.11).

Table 4.2.19
Adjusted effect of proximate and SES exposures on stunting aged 1 year (CDC/ NCHS 2000) (n =778)

Variables	Categories	OR (95 %CI)	p-value
Tertiles of SES index	Low tertile	1.00	
	Mid Tertile	0.20 (0.03, 1.52)	0.121
	High Tertile	0.16 (0.05, 0.55)	0.003
Sex	Male	1.00	
	Female	0.20 (0.08, 0.50)	0.001
Small for gestational age	Not SGA	1.00	
	SGA	2.82 (1.30, 6.11)	0.009

SES = Socio-economic status
SES index = water facility, toilet facility, washing machine, cooking fuel
SGA = Small for gestational age

Results shown in this final model differed somewhat to those using the CDC/ WHO 1978 population reference, where adjusted associations were seen between sex and SGA as well as with mother's schooling, if a young sibling was resident in the home and problematic alcohol or drug use in the family (table 4.2.20).

Table 4.2.20
Adjusted effect of proximate and SES exposures on stunting (CDC/ WHO 1978) (n =794)

Variables	Categories	OR (95 %CI)	p-value
Mother's schooling	< Matriculation	1.00	
	Matriculation	0.26 (0.11, 0.63)	0.003
At least 1 sibling ≤ 5yrs resident	No young sibling reported	1.00	
	At least 1 young sibling reported	2.11 (1.17, 3.81)	0.013
Drug or alcohol problem in family	No	1.00	
	Yes	2.16 (1.18, 3.97)	0.012
	Missing	0.92 (0.11, 7.38)	0.935
Sex	Male	1.00	
	Female	0.51 (0.30, 0.90)	0.021
Small for gestational age	Not SGA	1.00	
	SGA	3.28 (1.79, 5.98)	0.000

SES = Socio-economic status
SES index = water facility, toilet facility, separate kitchen, washing machine, fridge & domestic help
SGA = Small for gestational age

As the distal level variable of SES (SES index) remained associated with the stunting in this final model (CDC/ NCHS 2000), the effect of including this variable was investigated using Likelihood Ratio tests. Results (χ^2 = 15.33, p= 0.0001) indicated that the variable of SES index added to the

model, and should be retained. Goodness of fit test ($\chi^2 = 6.95$, $p = 0.1387$) indicated that there was no evidence against the null hypothesis that this final model was a good fit for the data and adequately explained the variation in the data.

4.3 STUNTED AT TWO YEARS OF AGE

Analysis at two years (defined as 1.50 – 2.49 years) was carried out on a total of 621 children who had complete sex, height and age data and at least partially complete demographic, SES and social support data obtained from the antenatal and six month questionnaires. Children included in analyses ranged in age from 1.87 – 2.41 years.

RESULTS OF DESCRIPTIVE ANALYSIS OF OUTCOME VARIABLE

HEIGHT-FOR-AGE AND STUNTED OUTCOME AT TWO YEARS OF AGE

Height-for-age z-scores

Table 4.3.1 shows means and standard deviations of height-for-age z-scores stratified by proximate exposures. The mean height-for-age z-score did not differ between males and females. White children had the highest mean height-for-age z-scores and were taller than Black or Coloured children ($p<0.001$ and $p=0.003$ respectively). The mean height-for-age z-score of Indian children was not different to that of other ethnic groups (see also figure 4.3.3). Children born SGA had a lower mean height-for-age z-scores than AGA births ($p=0.01$) (see also figure 4.3.4). Similarly, children born LBW had lower mean height-for-age z-scores than those weighing over 2.5 kg at delivery ($p=0.02$). Two year olds whose mothers were aged either over 25 years or over 30 years at delivery had higher mean height-for-age z-scores than those whose mothers were under 20 years ($p=0.003$ and $p=0.01$ respectively). Children whose mothers reported having ever smoked also had a lower mean height-for-age z-score ($p=0.036$) (see also figure 4.3.5). The mean height-for-age z-scores of children at two years was not different between those who were born pre-term and those born after 37 weeks gestation or between those born to mothers who were primi or multiparous (table 4.3.1).

Stunted outcome at two years of age

Two reference populations were used to define stunting at two years (CDC/ WHO 1978 and CDC/ NCHS 2000). The categorisation of stunting did not differ significantly between the CDC/ WHO 1978 and CDC/ NCHS 2000 population references ($p >0.01$). Using the CDC/ WHO 1978 reference a total of 100 children (16.1%) were classified as stunted, while 82 children (13.2%) were so classified using the CDC/ NCHS 2000 reference. This prevalence was substantially higher that those seen for stunting at one (4.2%) or five (3.8%) years of age in this study.

Table 4.3.1
Mean height-for-age z-score of children aged 2 years (1.5-2.49 yrs) by proximate exposures

Category	Sample size (n)	Mean Height for age z-scores	SD
Male	325	-0.93	1.24
Female	296	-0.92	1.20
Black	479	-1.04	1.16
White †	52	-0.10	1.37
Coloured *	79	-0.80	1.25
Indian	11	-0.43	1.05
Not SGA	533	-0.86	1.21
SGA *	73	-1.24	1.15
Not LBW	581	-0.89	1.23
LBW < 2500 g *	37	-1.36	1.00
Term 37-41 weeks	554	-0.89	1.20
Pre-term < 37 weeks	52	-1.08	1.30
≤ 19.99 yrs	97	-1.21	1.08
20-24.99 yrs	199	-0.97	1.19
25-29.99 yrs *	167	-0.80	1.10
≥ 30 yrs *	158	-0.80	1.41
1st live birth	276	-0.90	1.15
≥ 2 live births	345	-0.93	1.27
Ever smoked	61	-0.95	1.22
Never smoked *	553	-0.60	1.19

* p-value<0.05
† p-value< 0.001
SGA = Small for gestational age
LBW = Low birth weight

Figure 4.3.1Distribution of height-for-age z-scores at 2 years in study sample

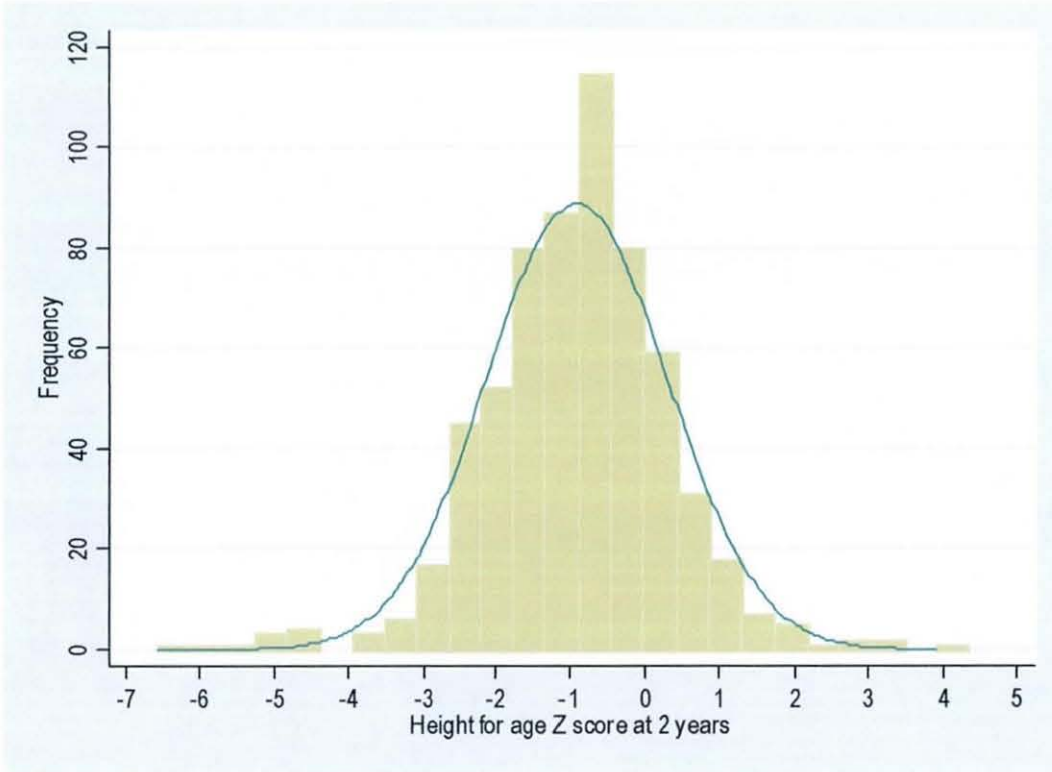


Figure 4.3.2 Distribution of height-for-age z-scores at 2 years by sex

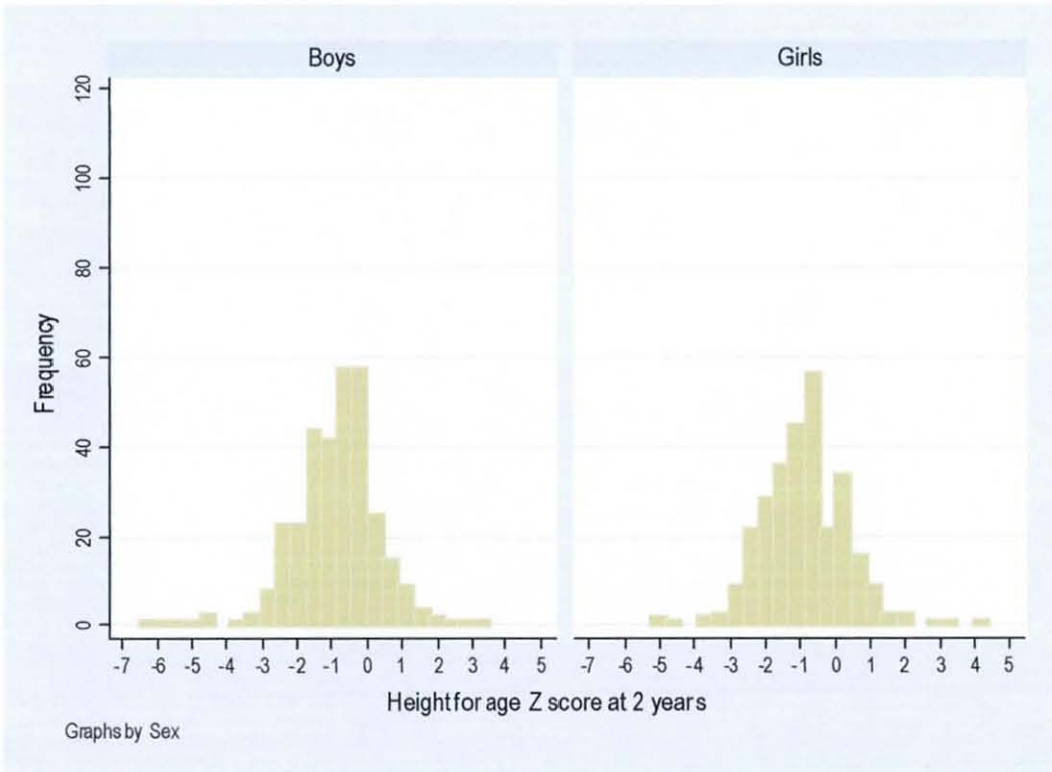
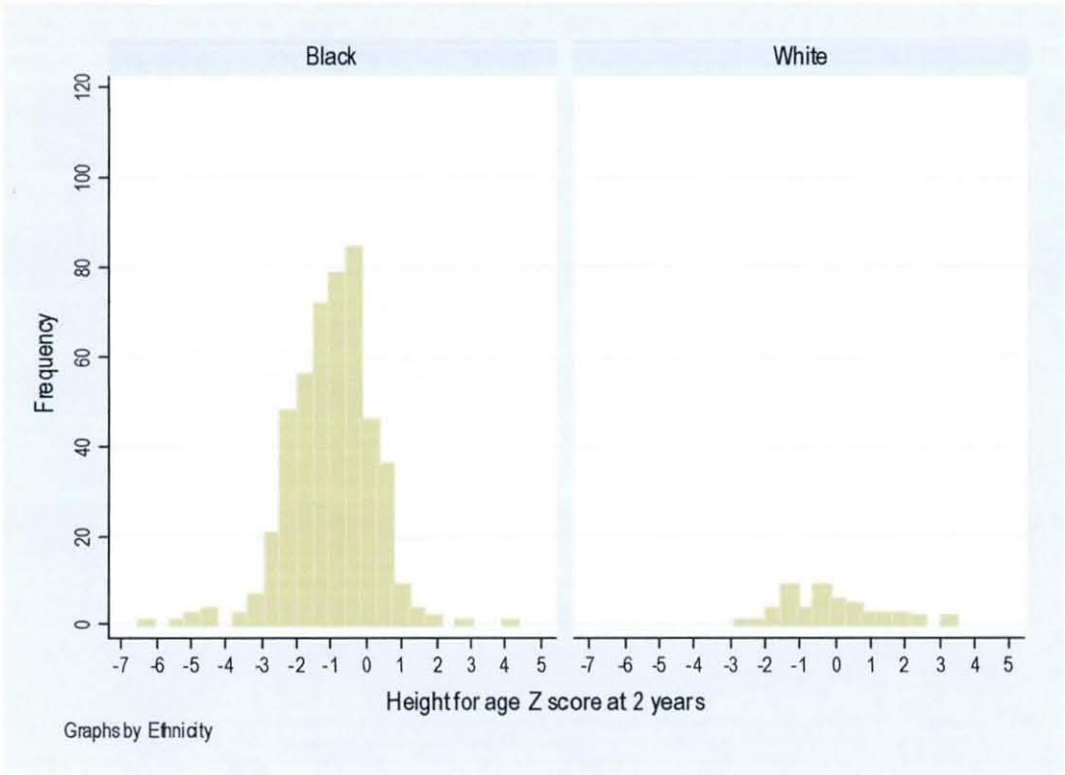


Figure 4.3.3 Distribution of height-for-age z-scores at 2 years by ethnicity



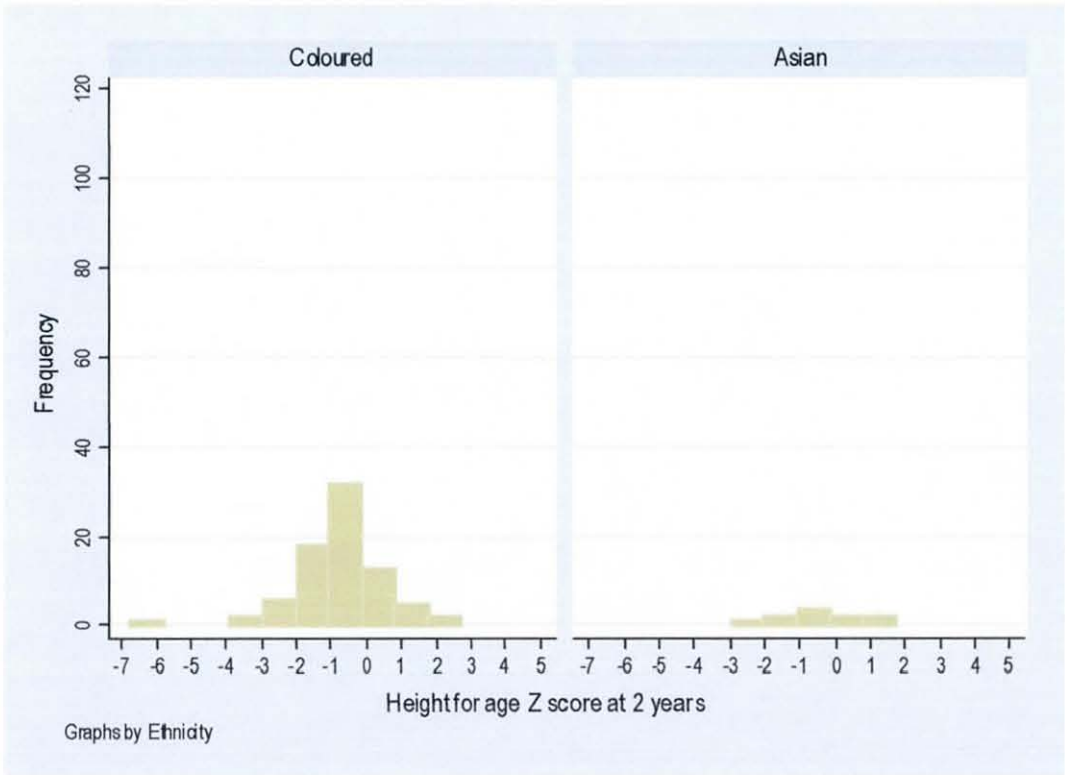


Figure 4.3.4 Distribution of height-for-age z-scores at 2 years by small for gestational age

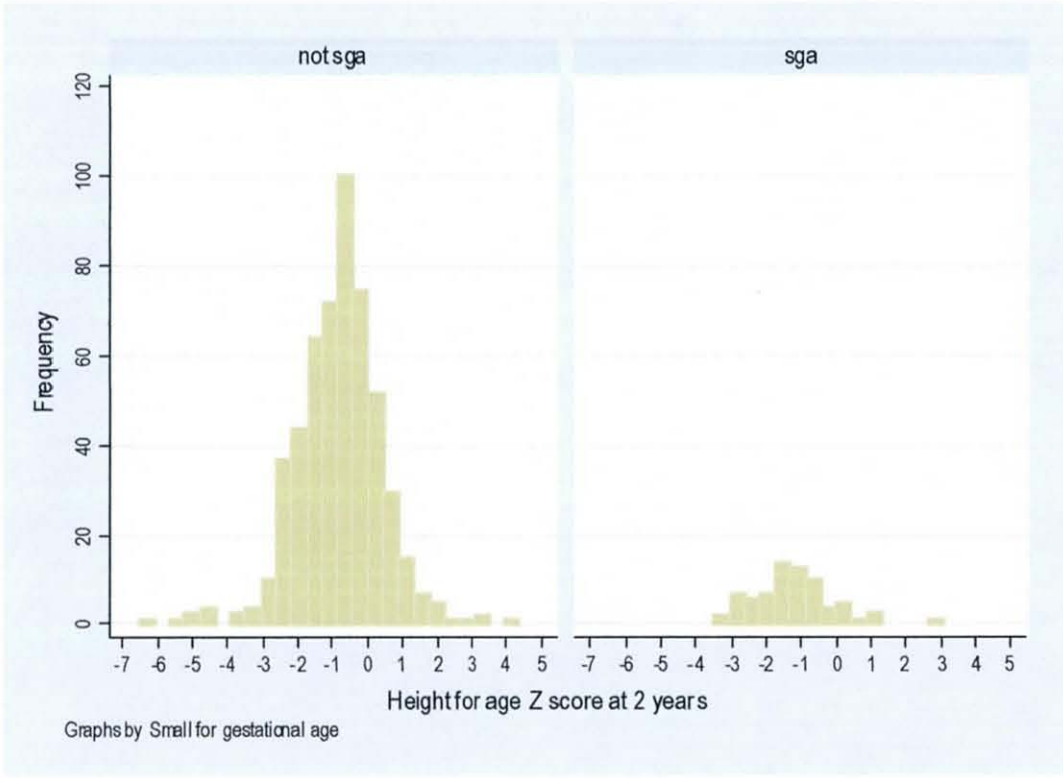
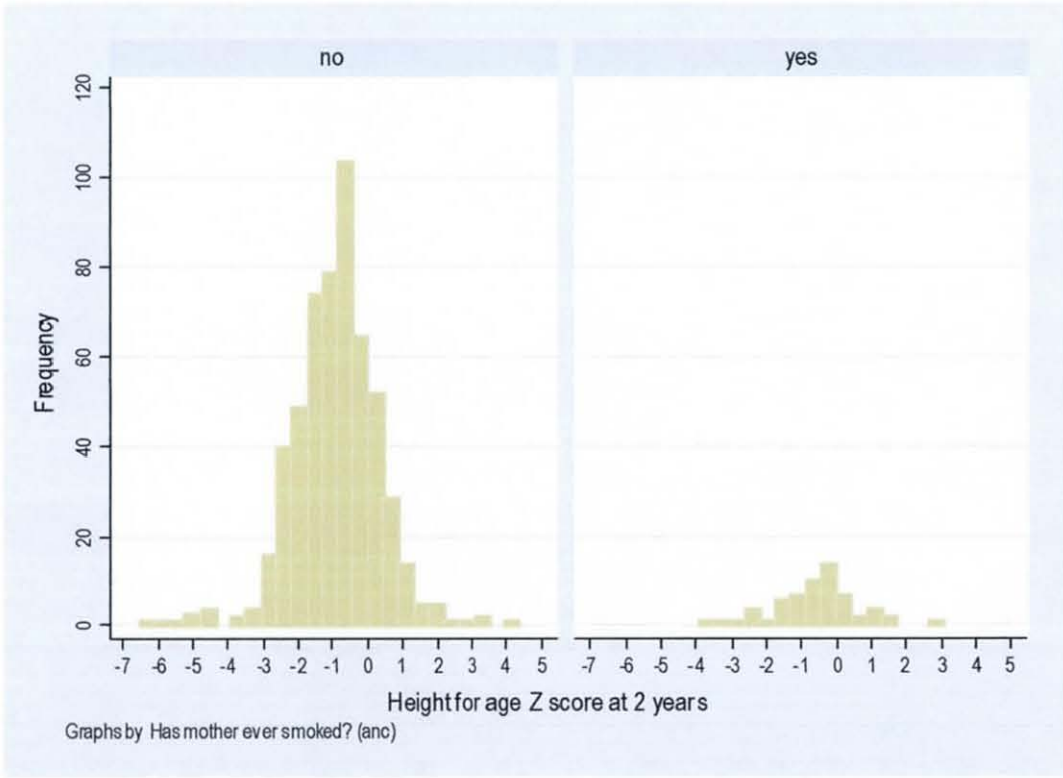


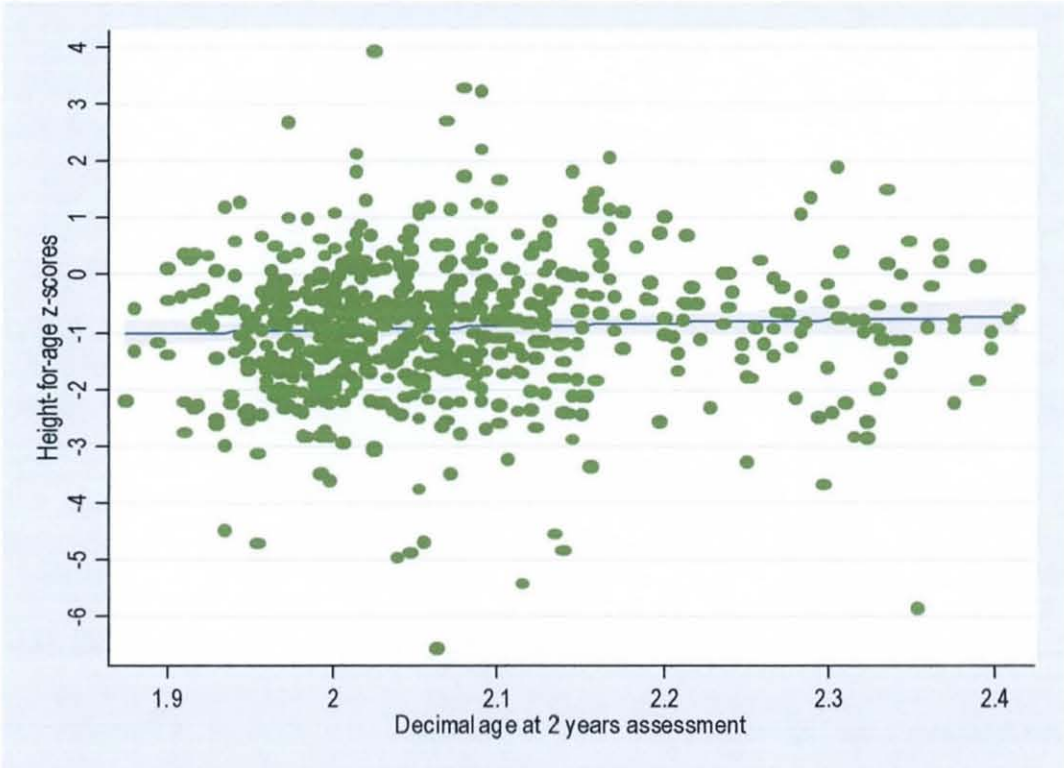
Figure 4.3.5 Distribution of height-for-age z-scores at 2 years by maternal smoking behaviour



Measurement of height at two years of age

As outlined in section 3.1 *Growth and additional data,* during the two year data collection Bt20 staff collected a mix of stature and length data (Norris, 2004). The different techniques were not principally driven by an exact calculation of age but rather by whether or not the child could stand unaided. As height measured by stature is systematically shorter than that measured by length, patterns of height-for-age z-scores typically show a disjunction at two years of age that reflects a change in measurement technique from collecting length to collecting stature data e.g. (Buyken et al., 2005) rather than a real change in stunting prevalence at this age. However, in this data the mean height-for-age was –0.82 z-scores in older children (>2.00 years) in comparison to –1.17 z-scores in younger children (<1.99 years) ($p=0.0013$) and no apparent disjunction in z-scores at two years of age was seen (figure 4.2.6). Figure 4.2.6 also shows the very weak positive correlation between age and height-for-age z-scores in this sample ($r^2=0.0026$). Misclassification resulting in an underestimate of stunting prevalence may have occurred at older ages if a stature reference was used but the child was measured lying down (length). Likewise, overestimation of stunting at younger ages may have arisen if length references were used for children who were measured standing up. Unfortunately it is not possible to assess this type of misclassification in this study, as a record of measurement technique used for each child was not recorded (Norris, 2004).

Figure 4.3.6 Distribution of height-for-age z-scores at 2 years by age



BIVARIATE RESULTS: UNADJUSTED MEASURES OF ASSOCIATION AND EFFECT

Results presented in bivariate and multivariate analyses used stunting defined by the CDC/ NCHS 2000 reference. Differences in results between the references are highlighted where they occurred. Tables 4.3.2 – 4.3.11 show the distribution of exposure and outcome variables. They also show unadjusted odds ratios of effect of proximate, socio-economic and social support exposures on stunting at two years of age. Unadjusted results show associations with the following variables collected during the birth and six month questionnaires; ethnicity (table 4.3.2) mother's schooling, mother's work, frequency of partner's pay (table 4.3.3), number of sleeping rooms (table 4.3.4), condition of the home (table 4.3.5), electricity supply, cooking fuel, hired domestic worker, medical aid coverage, ownership of TV, washing machine, fridge and children's toys (table 4.3.6), problematic drug or alcohol use in the family, mother still at school when fell pregnant (table 4.3.7) and whether the family and finances were ready for the pregnancy (table 4.3.11).

PROXIMATE EXPOSURES

Table 4.3.2 shows that the majority of the sample was classified as Black (77.1%). Almost 12% of two year olds were born SGA, while 6.0% and 8.4% were born LBW and pre-term respectively (table 4.3.2). The majority were born to mothers aged 20-29.99 years at delivery (59.0%) and to those who reported never having smoked (89.1%). In comparison to Black children, White children were at reduced likelihood of stunting (OR= 0.11; 95%CI 0.01 - 0.85). No associations were observed with the other proximate exposures (table 4.3.2). On the whole, results using the CDC/ WHO 1978 reference indicated similar findings. However, the effect of White ethnicity was smaller (OR= 0.18; 95%CI 0.04 – 0.75) (data not shown). Results using this reference also indicated an association with maternal age at delivery, where infants of mothers aged 25.00 - 29.99 years were at reduced likelihood of stunting (OR= 0.35; 95%CI 0.17 – 0.69) (data not shown).

Table 4.3.2 Distribution of proximate exposures by stunting aged 2 years (CDC/ NCHS 2000) and unadjusted OR

Proximate Exposures	Study sample n=621 N (%)	Stunted (n= 82) N (%)	Not Stunted (n= 539) N (%)	Crude OR (95 %CI)	p-value
Sex					
Male	325 (52.3)	47 (57.3)	278 (51.6)	1.00	
Female	296 (47.7)	35 (42.7)	261 (48.4)	0.79 (0.49, 1.27)	0.333
Ethnicity					
Black	479 (77.1)	70 (85.4)	409 (75.9)	1.00	
White	52 (8.4)	1 (1.2)	51 (9.5)	0.11 (0.01, 0.85)	0.011
Coloured	79 (12.7)	11 (13.4)	68 (12.6)	0.94 (0.47, 1.88)	0.872
Indian	11 (1.8)	0 (0.0)	11 (2.0)	Insufficient data	
Small for gestational age					
Not SGA	553 (85.8)	65 (79.3)	486 (86.8)	1.00	
SGA	73 (11.8)	14 (17.1)	59 (11.0)	1.71 (0.90, 3.24)	0.097
Missing	15 (2.4)	3 (3.6)	12 (2.2)	1.80 (0.49, 6.56)	0.366
Low birth weight					
Not LBW	581 (93.5)	76 (92.7)	505 (93.7)	1.00	
LBW < 2500 grams	37 (6.0)	6 (7.3)	31 (5.7)	1.29 (0.52, 3.19)	0.586
Missing	3 (0.5)	0 (0.0)	3 (0.6)	Insufficient data	
Pre-term birth					
Term 37-41 weeks	554 (89.2)	69 (84.1)	485 (90.0)	1.00	
Pre-term < 37 weeks	52 (8.4)	10 (12.2)	42 (7.8)	0.60 (0.29, 1.25)	0.166
Missing	15 (2.4)	3 (3.7)	12 (2.2)	1.05 (0.24, 4.48)	0.948
Maternal age at delivery					
≤ 19.99 yrs	97 (15.6)	18 (22.0)	79 (14.7)	1.00	
20-24.99 yrs	199 (32.1)	25 (30.5)	174 (32.3)	0.63 (0.32, 1.23)	0.170
25-29.99 yrs	167 (26.9)	17 (20.7)	150 (27.8)	0.50 (0.24, 1.02)	0.053
30-34.99 yrs	102 (16.4)	15 (18.3)	87 (16.1)	0.76 (0.36, 1.61)	0.467
≥ 35 yrs	56 (9.0)	7 (8.5)	49 (9.1)	0.63 (0.24, 1.62)	0.331
Parity					
1 live birth	276 (44.4)	33 (40.2)	243 (45.1)	1.00	
≥ 2 live births	345 (55.6)	49 (59.8)	296 (54.9)	1.22 (0.76, 1.96)	0.412
Mother's smoking behaviour					
Never smoked	553 (89.1)	72 (87.8)	481 (89.2)	1.00	
Ever smoked	61 (9.8)	9 (11.0)	52 (9.7)	1.16 (0.54, 2.45)	0.704
Missing	7 (1.1)	1 (1.2)	6 (1.1)	1.11 (0.13, 9.40)	0.921

SGA = Small for gestational age
LBW = Low birth weight

EDUCATION AND EMPLOYMENT SES EXPOSURES

Using data collected around the time of the child's birth, table 4.3.3 shows that 29% of mothers obtained matriculation while 3.5% attended university. Almost 35% of partners obtained matriculation and 5.5% attended university (table 4.3.3). A total of 21.6% of grandfathers completed Standard 5 at school, while almost 30.0% of grandmothers did. Almost 37% of mothers reported that they "earned money" while 59.3% of partners were employed (table 4.3.3). Two year olds born to mothers who obtained matriculation were at reduced likelihood of stunting (OR=0.38; 95%CI 0.20 - 0.72). Children whose mothers reported "earning money" were also at reduced likelihood (OR=0.46; 95%CI 0.26 - 0.81). Those whose fathers were paid on a more frequent basis, rather than on a monthly basis, were at increased likelihood of stunting (OR=2.15; 95%CI 1.19 - 3.91). Using the CDC/ WHO 1978 reference, the effect of mother's level of schooling was larger (OR=0.31; 95%CI 0.17 – 0.59) (data not shown). Results using this reference also indicated that children whose father had matriculated were at reduced likelihood of stunting (OR=0.56; 95%CI 0.34 – 0.94) as were those whose grandfather had attended school beyond Standard 5 (OR=0.43; 95%CI 0.23 – 0.89).

HOME CHARACTERISTICS AND CONDITION OF HOME SES EXPOSURES

Table 4.3.4 shows that, around the time of the child's birth, the majority lived in a house or cottage (80.7%) and most rented their home from the local authority (39.6%). Over 46% of homes had two rooms that were used for sleeping, while over 80% had a separate kitchen (table 4.3.4). Over 27% of homes did not have ceilings, while 33.6% and 36.4% respectively had sole or shared use of an indoor hot water tap or an indoor flush toilet. Children from homes with three or more sleeping rooms were at reduced likelihood of stunting (OR=0.45; 95%CI 0.22 - 0.91). No associations between stunting and other home characteristic exposures were seen (table 4.3.4). Results using the CDC/ WHO 1978 reference showed that children from homes with a ceiling were at reduced likelihood of stunting (OR=0.57; 95%CI 0.34 – 0.97) (data not shown).

Table 4.3.5 shows that almost 38% classified the condition of their home as "fair", with most reporting no cracked walls (49.1%), no broken doors (56.7%) or windows (56.1%) and no leaks (53.0%). Table 4.3.5 also shows that the majority did not generally consider their homes to be troubled by pests, although 29.5% and 24.6% did report being troubled by flies or cockroaches. In comparison to children from homes classified as in "good" condition, those from homes in "fair" condition were more likely to be stunted (OR= 2.33; 95%CI 1.04 - 5.21). No associations between stunting and other SES exposures measuring the condition of the home were seen (table 4.3.5).

Table 4.3.3 Distribution of education & employment by stunting aged 2 yrs (CDC/ NCHS 2000) & unadjusted OR

Education & Employment Exposures	Study sample n=621 N (%)	Stunted (n= 82) N (%)	Not Stunted (n= 539) N (%)	Crude OR (95 %CI)	p-value
Mother's Schooling					
< Matriculation	440 (70.8)	70 (85.4)	370 (68.6)	1.00	
Matriculation	180 (29.0)	12 (14.6)	168 (31.2)	0.38 (0.20, 0.72)	0.002
Missing	1 (0.2)	0 (0.0)	1 (0.2)	Insufficient data	
Mother's further education					
No further education	445 (71.7)	68 (82.9)	337 (69.9)	1.00	
Course not completed	27 (4.3)	1 (1.2)	26 (4.8)	0.21 (0.03, 1.61)	0.099
In-service training	18 (2.9)	2 (2.4)	16 (3.0)	0.69 (0.15, 3.09)	0.629
Technicon & college	42 (6.8)	3 (3.7)	39 (7.2)	0.43 (0.13, 1.42)	0.154
University	22 (3.5)	1 (1.2)	21 (3.9)	0.26 (0.03, 2.01)	0.167
Other	33 (5.3)	4 (4.9)	29 (5.4)	0.76 (0.26, 2.25)	0.625
Missing	34 (5.5)	3 (3.7)	31 (5.8)	0.54 (0.16, 1.81)	0.308
Partner's Schooling					
< Matriculation	292 (47.0)	42 (51.2)	250 (46.4)	1.00	
Matriculation	217 (34.9)	22 (26.8)	195 (36.2)	0.67 (0.39, 1.16)	0.154
Missing/ system missing	112 (18.1)	18 (22.0)	94 (17.4)	1.14 (0.62, 2.08)	0.670
Partner's further education					
No further education	255 (41.0)	37 (45.1)	218 (40.5)	1.00	
Course not completed	19 (3.1)	0 (0.0)	19 (3.5)	Insufficient data	
In-service training	33 (5.3)	6 (7.3)	27 (5.0)	1.31 (0.50, 3.39)	0.578
Technicon & college	51 (8.2)	6 (7.3)	45 (8.4)	0.78 (0.31, 1.97)	0.607
University	34 (5.5)	2 (2.4)	32 (5.9)	0.37 (0.08, 1.61)	0.167
Other	38 (6.1)	3 (3.7)	35 (6.5)	0.50 (0.15, 1.73)	0.269
Missing/ system missing	191 (30.8)	28 (34.2)	163 (30.2)	1.01 (0.59, 1.72)	0.965
Maternal grandmother educ.					
< Std 5	95 (15.3)	14 (17.1)	81 (15.0)	1.00	
Std 5 - Matriculation	184 (29.6)	17 (20.7)	167 (31.0)	0.59 (0.27, 1.26)	0.167
Missing/ system missing	342 (55.1)	51 (62.2)	291 (54.0)	1.01 (0.53, 1.92)	0.966
Maternal grandfather educ.					
< Std 5	74 (11.9)	10 (12.2)	64 (11.9)	1.00	
Std 5 - Matriculation	134 (21.6)	11 (13.4)	123 (22.8)	0.57 (0.23, 1.43)	0.225
Missing/ system missing	413 (66.5)	61 (74.4)	352 (65.3)	1.11 (0.54, 2.28)	0.778
Mother's work					
Unemployed	235 (37.8)	42 (51.2)	193 (35.8)	1.00	
Housewife	154 (24.8)	18 (22.0)	136 (25.2)	0.61 (0.33, 1.10)	0.099
Earns money	229 (36.9)	21 (25.6)	208 (38.6)	0.46 (0.26, 0.81)	0.006
Missing	3 (0.5)	1 (1.2)	2 (0.4)	2.30 (0.20, 26.13)	0.490
Frequency of mother's pay					
Monthly	164 (26.4)	13 (15.9)	151 (28.0)	1.00	
< monthly	67 (10.8)	7 (8.5)	60 (11.1)	1.35 (0.51, 3.57)	0.537
Missing/ system missing	390 (62.8)	62 (75.6)	328 (60.9)	2.19 (1.17, 4.13)	0.012
Partner employed					
Partner not working	105 (16.9)	12 (14.6)	93 (17.3)	1.00	
Partner employed	368 (59.3)	46 (56.1)	322 (59.7)	1.11 (0.56, 2.18)	0.768
Missing/ system missing	148 (23.8)	24 (29.3)	124 (23.0)	1.50 (0.71, 3.16)	0.284
Frequency of partner's pay					
Monthly	224 (36.1)	20 (24.4)	204 (37.8)	1.00	
< monthly	195 (31.4)	34 (41.5)	161 (29.9)	2.15 (1.19, 3.91)	0.010
Missing/ system missing	202 (32.5)	28 (34.1)	174 (32.3)	1.64 (0.89, 3.02)	0.108

Table 4.3.4 Distribution of home characteristics by stunting aged 2 years (CDC/ NCHS 2000) and unadjusted OR

Home characteristics	Study sample n=621	Stunted (n= 82)	Not Stunted (n= 539)	Crude OR	
Exposures	N (%)	N (%)	N (%)	(95 %CI)	p-value
Type of home					
Shack	29 (4.7)	7 (8.5)	22 (4.1)	1.00	
Room or Garage	37 (6.0)	3 (3.7)	34 (6.3)	0.28 (0.06, 1.25)	0.074
Flat	32 (5.1)	5 (6.1)	27 (5.0)	0.58 (0.16, 2.13)	0.407
House shared with another family	17 (2.7)	2 (2.40	15 (2.8)	0.42 (0.07, 2.39)	0.313
Cottage or House	501 (80.7)	64 (78.1)	437 (81.1)	0.46 (0.19, 1.12)	0.081
Missing	5 (0.8)	1 (1.2)	4 (0.7)	0.78 (0.07, 8.55)	0.843
Tenureship					
Rented from another person	168 (27.0)	23 (28.1)	145 (26.9)	1.00	
Provided by employer	16 (2.6)	0 (0.0)	16 (3.0)	Insufficient data	
Rented from local authority	246 (39.6)	40 (48.8)	206 (38.2)	1.22 (0.70, 2.13)	0.475
Owned	178 (28.7)	18 (21.9)	160 (29.70	0.71 (0.37, 1.37)	0.304
Missing	13 (2.1)	1 (1.2)	12 (2.2)	0.52 (0.06, 4.27)	0.540
Number of sleeping rooms					
1	125 (20.1)	20 (24.4)	105 (19.5)	1.00	
2	287 (46.2)	45 (54.9)	242 (44.9)	0.98 (0.55, 1.73)	0.935
≥ 3	202 (32.6)	16 (19.5)	186 (34.5)	0.45 (0.22, 0.91)	0.024
Missing	7 (1.1)	1 (1.2)	6 (1.1)	0.87 (0.10, 7.73)	0.904
Separate kitchen					
No	119 (19.2)	17 (20.7)	102 (18.9)	1.00	
Yes	498 (80.2)	65 (79.3)	433 (80.3)	0.90 (0.51, 1.60)	0.722
Missing	4 (0.6)	0 (0.0)	4 (0.8)	Insufficient data	
Type of roofing material					
Asbestos	205 (33.0)	33 (40.2)	172 (31.9)	1.00	
Tiles	42 (6.8)	2 (2.5)	40 (7.40	0.26 (0.06, 1.15)	0.056
Corrugated metal	99 (15.9)	16 (19.5)	83 (15.4)	1.00 (0.52, 1.93)	0.989
Missing	275 (44.3)	31 (37.8)	244 (45.3)	0.66 (0.39, 1.12)	0.124
Home has ceiling					
No	171 (27.5)	28 (34.1)	143 (26.5)	1.00	
Yes	227 (36.6)	26 (31.8)	201 (37.3)	0.66 (0.37, 1.18)	0.156
Missing/ system missing	223 (35.9)	28 (34.1)	195 (36.2)	0.73 (0.41, 1.29)	0.283
Water facility					
Shared use of outside tap	64 (10.3)	8 (9 .8)	56 (10.4)	1.00	
Sole use of outside tap	193 (31.1)	27 (32.9)	166 (3.8)	1.14 (0.49, 2.65)	0.764
Shared/ sole use inside cold tap	152 (24.5)	23 (28.0)	129 (23.9)	1.25 (0.52, 2.97)	0.615
Shared/ sole use of inside hot tap	209 (33.6)	24 (29.3)	185 (34.3)	0.91 (0.38, 2.14)	0.825
Missing	3 (0.5)	0 (0.0)	3 (0.6)	Insufficient data	
Toilet facility					
Bucket or other source	3 (0.5)	1 (1.2)	2 (0.4)	1.00	
Shared use of outdoor flush toilet	60 (9.7)	9 (11.0)	51 (9.5)	0.35 (0.03, 4.46)	0.400
Sole use of outdoor flush toilet	309 (49.8)	42 (51.2)	267 (49.5)	0.31 (0.03, 3.57)	0.324
Shared use of indoor flush toilet	19 (3.0)	3 (3.7)	16 (3.0)	0.37 (0.02, 6.14)	0.474
Sole use of indoor flush toilet	226 (36.4)	27 (32.9)	199 (36.9)	0.27 (0.02, 3.13)	0.262
Missing	4 (0.6)	0 (0.0)	4 (0.7)	Insufficient data	

Table 4.3.5 Distribution of condition of home by stunting aged 2 years (CDC/ NCHS 2000) and unadjusted OR

Condition of home Exposures	Study sample n=621 N (%)	Stunted (n= 82) N (%)	Not Stunted (n= 539) N (%)	Crude OR (95 %CI)	p-value
Condition of home					
Good	104 (16.8)	8 (9.8)	96 (17.8)	1.00	
Fair	234 (37.7)	38 (46.3)	196 (36.4)	2.33 (1.04, 5.21)	0.035
Poor	58 (9.3)	7 (8.5)	51 (9.4)	1.65 (0.56, 4.83)	0.358
Missing/ system missing	225 (36.2)	29 (35.4)	196 (36.4)	1.77 (0.78, 4.04)	0.166
Home has cracked walls					
No	305 (49.1)	42 (51.2)	263 (48.8)	1.00	
Yes	88 (14.2)	10 (12.2)	78 (14.5)	0.80 (0.38, 1.67)	0.558
Missing/ system missing	228 (36.7)	30 (36.6)	198 (63.7)	0.95 (0.57, 1.57)	0.838
Home has broken doors					
No	352 (56.7)	47 (57.3)	305 (56.6)	1.00	
Yes	42 (6.8)	5 (6.1)	37 (6.9)	0.88 (0.33, 2.45)	0.794
Missing/ system missing	227 (36.5)	30 (36.6)	197 (36.5)	0.99 (0.60, 1.62)	0.962
Home has broken windows					
No	348 (56.1)	47 (57.3)	301 (55.8)	1.00	
Yes	48 (7.7)	6 (7.3)	42 (7.8)	0.91 (0.37, 2.27)	0.848
Missing/ system missing	225 (36.2)	29 (35.4)	196 (36.4)	0.95 (0.58, 1.56)	0.832
Home has leaks					
No	329 (53.0)	44 (53.7)	285 (52.9)	1.00	
Yes	66 (10.6)	9 (11.0)	57 (10.6)	1.02 (0.47, 2.21)	0.954
Missing/ system missing	226 (36.4)	29 (35.3)	197 (36.5)	0.95 (0.58, 1.58)	0.853
Home troubled by flies					
No	209 (33.6)	28 (34.1)	181 (33.6)	1.00	
Yes	183 (29.5)	25 (30.5)	158 (29.3)	1.02 (0.57, 1.83)	0.939
Missing/ system missing	229 (36.9)	29 (35.4)	200 (37.1)	0.94 (0.54, 1.64)	0.820
Home troubled by rats					
No	293 (47.2)	38 (46.3)	255 (47.3)	1.00	
Yes	95 (15.3)	15 (18.30	80 (14.8)	1.26 (0.66, 2.41)	0.487
Missing/ system missing	233 (37.5)	29 (35.4)	204 (37.8)	0.95 (0.57, 1.60)	0.858
Home troubled by bed bugs					
No	357 (57.5)	48 (58.5)	309 (57.3)	1.00	
Yes	31 (5.0)	5 (6.1)	26 (4.8)	1.24 (0.45, 3.38)	0.677
Missing/ system missing	233 (37.5)	29 (35.4)	204 (37.8)	0.91 (0.56, 1.50)	0.725
Home troubled by cockroaches					
No	238 (38.3)	31 (37.8)	207 (38.4)	1.00	
Yes	153 (24.6)	23 (28.1)	130 (24.1)	1.18 (0.66, 2.12)	0.575
Missing/ system missing	230 (37.1)	28 (34.1)	202 (37.5)	0.92 (0.53, 1.60)	0.782

ECONOMIC SES EXPOSURES

Around the time of the child's birth, the majority of homes had electricity supply (96.9%) and 82.0% used electricity or gas as their main cooking fuel (table 4.3.6). Over 79% and 71% respectively did not employ domestic help or have private medical insurance cover (table 4.3.6). Table 4.3.6 also shows that, around the time of the child's birth, the majority had a television, radio and fridge in their home, however, few had a washing machine (20.8%) or car (34.1%). Children from homes with electricity supply were at reduced likelihood of stunting (OR= 0.24; 95%CI 0.08 - 0.69). In comparison to children from homes where other fuels were used (e.g. wood or paraffin), those from homes that used electricity or gas were at reduced likelihood of stunting (OR= 0.49; 95%CI 0.29 - 0.84). Those from homes which employed domestic help and those whose families had private medical insurance cover were at reduced likelihood of stunting (OR= 0.30; 95%CI 0.11 - 0.86 and OR= 0.49; 95%CI 0.25 - 0.97 respectively). Children from homes which owned consumer durables (television, fridge, washing machine and children's toys) were also at reduced likelihood of stunting (table 4.3.6). When stunting was defined using the CDC/ WHO 1978 reference, the variables of medical aid and ownership of children's toys were not significantly associated with stunting. A larger association with electricity supply was also noted when this reference was used (OR= 0.31; 95%CI 0.11 – 0.87) (data not shown).

Table 4.3.6 Distribution of economic exposures by stunting aged 2 years (CDC/ NCHS 2000) and unadjusted OR

Economic Exposures	Study sample n=621 N (%)	Stunted (n= 82) N (%)	Not Stunted (n= 539) N (%)	Crude OR (95 %CI)	p-value
Electricity supply					
No	16 (2.6)	6 (7.3)	10 (1.9)	1.00	
Yes	602 (96.9)	76 (92.7)	526 (97.6)	0.24 (0.08, 0.69)	0.004
Missing	3 (0.5)	0 (0.0)	3 (0.5)	Insufficient data	
Cooking fuel used					
Other (coal, paraffin, wood)	109 (17.5)	23 (28.1)	86 (16.0)	1.00	
Electricity/generator or gas	509 (82.0)	59 (71.9)	450 (83.5)	0.49 (0.29, 0.84)	0.008
Missing	3 (0.5)	0 (0.0)	3 (0.6)	Insufficient data	
Employ domestic help					
No	493 (79.4)	69 (84.1)	424 (78.7)	1.00	
Yes	85 (13.7)	4 (4.9)	81 (15.0)	0.30 (0.11, 0.86)	0.017
Missing/ system missing	43 (6.9)	9 (11.0)	34 (6.3)	1.63 (0.75, 3.55)	0.217
Medical aid cover					
No	443 (71.3)	66 (80.5)	377 (69.9)	1.00	
Yes	138 (22.2)	11 (13.4)	127 (23.6)	0.49 (0.25, 0.97)	0.036
Missing/ system missing	40 (6.5)	5 (6.1)	35 (6.5)	0.82 (0.31, 2.16)	0.682
Television in home					
No	165 (26.6)	30 (36.6)	135 (25.0)	1.00	
Yes	452 (72.8)	51 (62.2)	401 (74.4)	0.57 (0.35, 0.94)	0.025
Missing	4 (0.6)	1 (1.2)	3 (0.6)	1.50 (0.15, 15.04)	0.729
Radio in home					
No	111 (17.9)	17 (20.7)	94 (17.5)	1.00	
Yes	504 (81.1)	64 (78.1)	440 (81.6)	0.80 (0.45, 1.44)	0.461
Missing	6 (1.0)	1 (1.2)	5 (0.9)	1.10 (0.12, 10.16)	0.929
Phone in home					
No	266 (42.8)	41 (50.0)	225 (41.8)	1.00	
Yes	349 (56.2)	40 (48.8)	309 (57.3)	0.71 (0.44, 1.13)	0.151
Missing	6 (1.0)	1 (1.2)	5 (0.9)	1.10 (0.12, 9.68)	0.933
Fridge in home					
No	165 (26.6)	31 (37.8)	134 (24.9)	1.00	
Yes	450 (72.5)	50 (61.0)	400 (74.2)	0.54 (0.33, 0.88)	0.013
Missing	6 (1.0)	1 (1.2)	5 (0.9)	0.86 (0.10, 7.71)	0.896
Washing machine in home					
No	483 (77.8)	73 (89.0)	410 (76.1)	1.00	
Yes	129 (20.8)	8 (9.8)	121 (22.4)	0.37 (0.17, 0.80)	0.008
Missing	9 (1.4)	1 (1.2)	8 (1.5)	0.70 (0.09, 5.71)	0.740
Car in home					
No	401 (64.6)	56 (68.3)	345 (64.0)	1.00	
Yes	212 (34.1)	25 (30.5)	187 (34.7)	0.82 (0.50, 1.36)	0.450
Missing	8 (1.3)	1 (1.2)	7 (1.3)	0.88 (0.10, 7.31)	0.906
Children's toys in home					
No	249 (40.1)	41 (50.0)	208 (38.6)	1.00	
Yes	365 (58.8)	39 (47.6)	326 (60.5)	0.61 (0.38, 0.97)	0.037
Missing	7 (1.1)	2 (2.4)	5 (0.9)	2.03 (0.38, 10.88)	0.399

DEPRIVATION AND HOUSEHOLD COMPOSITION SES EXPOSURES

Table 4.3.7 shows that, around the time of the child's birth, the majority (83.1%) reported that their family had not had too little money for basics (food, clothing, rent etc.). The majority had not been separated unwillingly from their children (82.4%) or physically abused by their partner (90.8%). Over 18% reported problematic use of alcohol or drugs in the family. Almost 17% of mothers fell pregnant when still at school (table 4.3.7). Children from homes that reported problematic use of alcohol or drugs were at increased likelihood of stunting (OR= 1.78; 95%CI 1.03 - 3.05). Two year olds whose mothers were still at school when they fell pregnant were also at increased likelihood of stunting (OR= 2.20; 95%CI 1.20 - 4.01). No associations between stunting and other deprivation exposures were seen (table 4.3.7). When stunting was defined using the CDC/ WHO 1978 reference, the association with problematic drug and alcohol use was not statistically significant (data not shown).

Table 4.3.8 shows that, around the time of the child's birth, the majority of homes reported that the mother was a usual resident (99.4%) in the home. The majority of homes did not report a father or grandfather as usual residents (58.6% and 67.8% respectively). This table also shows that around the time of the child's birth almost 23% of homes reported at least one sibling of the Bt20 child who was aged under five years. No significant associations between stunting and household composition exposures were seen (table 4.3.8). However, when stunting was defined using the CDC/ WHO 1978 population reference children from homes where a father was usually resident were at reduced likelihood of stunting (OR= 0.51; 95%CI 0.32 – 0.82), while those from homes where a grandmother was reported usually resident were at increased likelihood (OR= 1.59; 95%CI 1.02 – 2.48) (data not shown).

Table 4.3.7 Distribution of deprivation exposures by stunting aged 2 years (CDC/ NCHS 2000) & unadjusted OR

Deprivation Exposures	Study sample n=621 N (%)	Stunted (n= 82) N (%)	Not Stunted (n= 539) N (%)	Crude OR (95 %CI)	p-value
Family recently had too little money for basics					
No	516 (83.1)	68 (82.9)	448 (83.1)	1.00	
Yes	98 (15.8)	14 (17.1)	84 (15.6)	1.10 (0.59, 2.04)	0.768
Missing	7 (1.1)	0 (0.0)	7 (1.3)	Insufficient data	
Mother recently separated unwillingly from children					
No	512 (82.4)	66 (80.5)	446 (82.7)	1.00	
Yes	16 (2.6)	1 (1.2)	15 (2.8)	0.45 (0.06, 3.48)	0.432
Missing	93 (15.0)	15 (18.3)	78 (14.5)	1.30 (0.70, 2.39)	0.399
Drug or alcohol problem in family					
No	501 (80.7)	60 (73.2)	441 (81.8)	1.00	
Yes	113 (18.2)	22 (26.8)	91 (16.9)	1.78 (1.03, 3.05)	0.035
Missing/ system missing	7 (1.1)	0 (0.0)	7 (1.3)	Insufficient data	
Mother recently physically abused by partner					
No	564 (90.8)	68 (83.0)	496 (92.0)	1.00	
Yes	30 (4.8)	7 (8.5)	23 (4.3)	2.22 (0.91, 5.39)	0.070
Missing	27 (4.4)	7 (8.5)	20 (3.7)	2.55 (1.04, 6.29)	0.035
Mother still at school when fell pregnant					
No	294 (47.3)	32 (39.0)	262 (48.6)	1.00	
Yes	104 (16.8)	22 (26.8)	82 (15.2)	2.20 (1.20, 4.01)	0.009
Missing/ system missing	223 (35.9)	28 (34.2)	195 (36.2)	1.17 (0.68, 2.02)	0.557

Table 4.3.8 Distribution of household composition by stunting aged 2 yrs (CDC/ NCHS 2000) & unadjusted OR

Household composition Exposures	Study sample n=621 N (%)	Stunted (n= 82) N (%)	Not Stunted (n= 539) N (%)	Crude OR (95 %CI)	p-value
Mother reported resident					
No mother reported	0 (0.0)	82 (100.0)	535 (99.3)	1.00	
Mother reported	617 (99.4)	0 (0.0)	0 (0.0)	Insufficient data	
Missing	4 (0.6)	0 (0.0)	4 (0.7)	Insufficient data	
Father reported resident					
No father reported	364 (58.6)	56 (68.3)	308 (57.1)	1.00	
Father reported	251 (40.4)	26 (31.7)	225 (41.8)	0.63 (0.39, 1.04)	0.072
Missing	6 (1.0)	0 (0.0)	6 (1.1)	Insufficient data	
Grandfather reported resident					
No grandfather reported	421 (67.8)	58 (70.7)	363 (67.4)	1.00	
Grandfather reported	194 (31.2)	24 (29.3)	170 (31.5)	0.88 (0.53, 1.47)	0.634
Missing	6 (1.0)	0 (0.0)	6 (1.1)	Insufficient data	
Grandma reported resident					
No grandma reported	286 (46.0)	32 (39.0)	254 (47.1)	1.00	
Grandma reported	329 (53.0)	50 (61.0)	279 (51.8)	1.42 (0.88, 2.29)	0.145
Missing	6 (1.0)	0 (0.0)	6 (1.1)	Insufficient data	
At least 1 sibling ≤ 5yrs resident					
No young sibling reported	472 (76.0)	60 (73.2)	412 (76.4)	1.00	
At least 1 sibling ≤ 5yrs reported	142 (22.9)	22 (26.8)	120 (22.3)	1.26 (0.74, 2.14)	0.393
Missing	7 (1.1)	0 (0.0)	7 (1.3)	Insufficient data	

GENERAL SOCIAL SUPPORT AND SUPPORT FROM PARTNER EXPOSURES

Table 4.3.9 shows that around the time of the child's birth the majority of mothers had a number of people they could ask for help (81.2%) and a number of people to talk to about problems (85.0%). At this time the majority also belonged to an organisation (72.1%). Over 45% of children were cared for during the day by their mother with only few cared for by a childminder (7.7%). No associations were seen between stunting at two years and general social support exposures (table 4.3.9).

Table 4.3.10 shows that the majority of mothers classified themselves as "single" (64.4%) around the time of the child's birth. However, almost 84% believed their partner or the child's father would contribute financially to the upbringing of the child. When surveyed around the time of the child's birth, over 43% of mothers thought that their partner would help with childcare while almost 60% reported that her partner never made things more difficult for her (table 4.3.10). No associations were seen between stunting and variables measuring social support from a partner (table 4.3.10). When stunting was defined using CDC/ WHO 1978 reference, those whose mothers were married and those whose fathers helped with housework were at reduced likelihood of stunting (OR= 0.54; 95%CI 0.33 – 0.91 and OR= 0.46; 95%CI 0.26 – 0.82 respectively) (data not shown).

SOCIAL SUPPORT DURING PREGNANCY EXPOSURES

Table 4.3.11 shows that around the time of the child's birth the majority of mothers were either unsure or reported that they do not desire their pregnancy (53.9%). Almost 74% of mothers felt their family and financial situation was right and ready for their new baby while almost 85% reported that their partner desired the pregnancy (table 4.3.11). Few mothers (11.6%) were accompanied by anyone other than medical staff during their labour and delivery. Two year olds born to mothers who reported that their families were prepared for the pregnancy were at reduced likelihood of stunting (OR= 0.39; 95%CI 0.24 - 0.65). No associations between stunting and other social support exposures were seen (table 4.3.11). When stunting was defined using CDC/ WHO 1978 reference, children of mothers who reported that they desired their pregnancy were at reduced likelihood of stunting (OR= 0.60; 95%CI 0.38 – 0.96). Those whose mother was accompanied during labour and delivery were also less likely to be stunted at two years, using this reference (OR= 0.31; 95%CI 0.12 – 0.80). The size of the effect of family readiness for pregnancy on stunting was smaller using this reference (OR= 0.47; 95%CI 0.29 – 0.74) (data not shown).

Table 4.3.9 Distribution of social support (general) by stunting aged 2 yrs (CDC/ NCHS 2000) & unadjusted OR

Social support Exposures	Study sample n=621 N (%)	Stunted (n= 82) N (%)	Not Stunted (n= 539) N (%)	Crude OR (95 %CI)	p-value
Mother has network to request help from					
No-one	59 (9.5)	10 (12.2)	49 (9.1)	1.00	
Unsure/ maybe	50 (8.0)	8 (9.8)	42 (7.8)	0.93 (0.33, 2.59)	0.895
Number of people	504 (81.2)	63 (76.8)	441 (81.8)	0.70 (0.34, 1.45)	0.336
Missing	8 (1.3)	1 (1.2)	7 (1.3)	0.70 (0.07, 6.45)	0.752
Mother can talk to someone about problems					
No-one	45 (7.2)	9 (11.0)	36 (6.7)	1.00	
Unsure/ maybe	37 (6.0)	10 (12.2)	27 (5.0)	1.48 (0.52, 4.19)	0.456
Number of people	528 (85.0)	62 (75.6)	466 (86.4)	0.53 (0.24, 1.16)	0.107
Missing	11 (1.8)	1 (1.2)	10 (1.9)	0.40 (0.04, 3.67)	0.401
Mother belongs to organisation (e.g. church)					
No	165 (26.6)	19 (23.2)	146 (27.1)	1.00	
Yes	448 (72.1)	63 (76.8)	385 (71.4)	1.26 (0.73, 2.17)	0.412
Missing	8 (1.3)	0 (0.0)	8 (1.5)	Insufficient data	
Person who cares for child					
Mother	281 (45.3)	43 (52.4)	238 (44.1)	1.00	
Childminder	48 (7.7)	7 (8.5)	41 (7.6)	0.94 (0.40, 2.25)	0.898
Other family or friend	69 (11.1)	4 (4.9)	65 (12.1)	0.34 (0.12, 1.00)	0.038
Missing/ system missing	223 (35.9)	28 (34.2)	195 (36.2)	0.79 (0.47, 1.33)	0.379

Table 4.3.10 Distribution of social support (partner) by stunting aged 2 yrs (CDC/ NCHS 2000) & unadjusted OR

Social support from partner Exposures	Study sample n=621 N (%)	Stunted (n= 82) N (%)	Not Stunted (n= 539) N (%)	Crude OR (95 %CI)	p-value
Mother's marital status					
Single	400 (64.4)	60 (73.2)	340 (63.1)	1.00	
Previously married	14 (2.3)	2 (2.4)	12 (2.2)	0.94 (0.20, 4.33)	0.941
Married	200 (32.2)	20 (24.4)	180 (33.4)	0.63 (0.37, 1.08)	0.090
Missing	7 (1.1)	0 (0.0)	7 (1.3)	Insufficient data	
Mother's cohabitation status					
Not living with partner	315 (50.7)	49 (59.8)	266 (49.4)	1.00	
Living with partner	272 (43.8)	31 (37.8)	241 (44.7)	0.70 (0.43, 1.13)	0.143
Missing	34 (5.5)	2 (2.4)	32 (5.9)	0.34 (0.08, 1.47)	0.130
Partner contribute financially to child					
Don't know/ no	63 (10.1)	4 (4.9)	59 (11.0)	1.00	
Yes	521 (83.9)	72 (87.8)	449 (83.3)	2.36 (0.83, 6.73)	0.096
Missing	37 (6.0)	6 (7.3)	31 (5.7)	2.85 (0.73, 11.14)	0.114
Partner helps with childcare					
No	130 (20.9)	17 (20.7)	113 (21.0)	1.00	
Yes	268 (43.2)	31 (27.8)	237 (44.0)	0.87 (0.46, 1.64)	0.665
Missing/ system missing	223 (35.9)	34 (41.5)	189 (35.0)	1.19 (0.64, 2.24)	0.577
Partner helps with housework					
No	233 (37.5)	31 (37.8)	202 (37.5)	1.00	
Yes	215 (34.6)	21 (25.6)	194 (36.0)	0.70 (0.39, 1.27)	0.243
Missing/ system missing	173 (27.9)	30 (36.6)	143 (26.5)	1.37 (0.79, 2.36)	0.261
Things made harder by way partner acts					
Always or Sometimes	220 (35.4)	34 (41.5)	186 (34.5)	1.00	
Never	371 (59.8)	43 (52.4)	328 (60.9)	0.72 (0.44, 1.16)	0.178
Missing	30 (4.8)	5 (6.1)	25 (4.6)	1.09 (0.39, 3.06)	0.864

Table 4.3.11
Distribution of social support during pregnancy by stunting aged 2 years (CDC/ NCHS 2000) and unadjusted OR

Social support around pregnancy Exposures	Study sample n=621 N (%)	Stunted (n= 82) N (%)	Not Stunted (n= 539) N (%)	Crude OR (95 %CI)	p-value
Mother desire for pregnancy					
Unsure/ no	335 (53.9)	52 (63.4)	283 (52.5)	1.00	
Yes desires pregnancy	260 (41.9)	27 (32.9)	233 (43.2)	0.63 (0.38, 1.04)	0.067
Missing	26 (4.2)	3 (3.7)	23 (4.3)	0.71 (0.20, 2.45)	0.587
Family & finances ready for preg.					
Unsure/ no	152 (24.5)	34 (41.5)	118 (21.9)	1.00	
Yes	459 (73.9)	47 (57.3)	412 (76.4)	0.39 (0.24, 0.65)	0.001
Missing	10 (1.6)	1 (1.2)	9 (1.7)	0.38 (0.05, 3.19)	0.359
Partner desire for pregnancy					
Unsure/ no	76 (12.2)	11 (13.4)	65 (12.1)	1.00	
Yes	527 (84.9)	67 (81.7)	460 (85.3)	0.86 (0.43, 1.71)	0.669
Missing	18 (2.9)	4 (4.9)	14 (2.6)	1.69 (0.46, 6.15)	0.422
Mother accompanied at birth					
No (only medical staff)	322 (51.8)	48 (58.5)	274 (50.9)	1.00	
Yes	72 (11.6)	5 (6.1)	67 (12.4)	0.42 (0.16, 1.12)	0.074
Missing/ system missing	227 (36.6)	29 (35.4)	198 (36.7)	0.84 (0.51, 1.37)	0.479

MULTIVARIATE RESULTS: ADJUSTED MEAURES OF ASSOCIATION AND EFFECT

INDIVIDUALLY ADJUSTED MEASURES- PROXIMATE SES & SOCIAL SUPPORT EXPOSURES

Proximate Exposures

Table 4.3.2 shows that ethnicity was the only proximate exposure associated with stunting at two years of age. In comparison to Black two year olds, White children were at reduced likelihood of stunting (OR=0.11; 95%CI 0.01 – 0.85) (table 4.3.2). These results differed slightly to those seen using the CDC/ WHO 1978 population reference, where White children and those born to mothers aged 25 – 29.9 years were at reduced likelihood of stunting (OR= 0.20; 95%CI 0.47 – 0.85 and OR= 0.39; 95%CI 0.20 – 0.77 respectively) (table 4.3.12).

Table 4.3.12 Adjusted effect of proximate exposures on stunting aged 2 years (CDC/ WHO 1978) (n = 620)

Variables	Categories	OR (95 %CI)	p-value
Ethnicity	Black	1.00	
	White	0.20 (0.47, 0.85)	0.030
	Coloured	0.60 (0.29, 1.25)	0.274
	Indian	0.48 (0.06, 3.87)	0.493
Maternal age at delivery	≤ 19.99 yrs	1.00	
	20-24.99 yrs	0.59 (0.32, 1.07)	0.082
	25-29.99 yrs	0.39 (0.20, 0.77)	0.007
	30-34.99 yrs	0.63 (0.31, 1.29)	0.210
	≥ 35 yrs	0.67 (0.28, 1.57)	0.356

SES Exposures

As a number of significant SES predictors of stunting were also collinear with one another, principal component analysis (PCA) was used and an SES index was created (tertiles). Variables included in PCA are shown in table 4.3.13. Table 4.3.14 shows the Eigen vector weights that each variable contributed to the index. Table 4.3.15 shows that, in comparison to those from homes in the lowest tertile, children from homes in the mid or highest tertiles were at reduced likelihood of stunting (OR= 0.54; 95%CI 0.31 - 0.93 and OR= 0.43; 95%CI 0.23 - 0.81 respectively).

Table 4.3.13
SES exposures included in PCA to create SES index for use in logistic regression (CDC/ NCHS 2000)

PCA SES index variables	Categories
Electricity supply	No
	Yes
Number of sleeping rooms	1
	2
	≥ 3
Employ domestic help	No
	Yes
Medical aid cover	No
	Yes
Cooking fuel used	Other (brazier, coal, wood, paraffin)
	Electricity/generator or gas
Ownership of washing machine	No
	Yes
Ownership of fridge	No
	Yes
Ownership of television	No
	Yes

PCA = Principal component analysis
SES = Socio-economic status

Table 4.3.14 Eigen vector weights of SES exposures included in index (CDC/ NCHS 2000)

Variable	Eigenvector
Electricity supply	0.436
Number of rooms	0.259
Domestic worker	0.127
Medical aid insurance	0.119
Cooking fuel	0.358
Washing machine	0.423
Fridge	0.463
Television	0.436

PCA = Principal component analysis
SES = Socio-economic status

Table 4.3.15
Effect of PCA SES index on stunting aged 2 years (CDC/ NCHS 2000) (unadjusted odds ratios) (n=609)

Variables	Categories	OR (95 %CI)	p-value
Tertiles of SES index	Low tertile	1.00	
	Mid tertile	0.54 (0.31, 0.93)	0.027
	High tertile	0.43 (0.23, 0.81)	0.009

PCA = Principal component analysis
SES index = electricity supply, # rooms, domestic help, medical aid, cooking fuel, fridge, washing machine & TV
SES = Socio-economic status

Once adjusted for mother's schooling and family readiness for pregnancy, the associations between stunting and SES index, condition of the home, problematic alcohol or drug use and ownership of children's toys were no longer seen. The effects of frequency of partner's pay and whether the mother was still at school when she fell pregnant, were also no longer seen following adjustment for mother's work. Table 4.3.16 shows that children from families that, around the time of the child's birth, reported that they were ready for the pregnancy remained at reduced likelihood of stunting (OR= 0.45; 95%CI 0.27 - 0.74). Two year olds whose mothers had, by the time of the child's birth, obtained matriculation and those whose mothers "earn money" remained at reduced likelihood of stunting (OR= 0.48; 95%CI 0.25 - 0.91 and OR= 0.56; 95%CI 0.32 - 0.99 respectively). When stunting was defined using CDC/ WHO 1978 population reference, the SES-adjusted effect of mother's work did not differ substantially (<10%), that of family readiness was smaller (OR= 0.45; 95%CI 0.27 – 0.74), while the SES-adjusted effect of mother's schooling was larger (OR= 0.48; 95%CI 0.25 – 0.91) (data not shown).

Table 4.3.16 Adjusted effect of SES exposures on stunting aged 2 years (CDC/ NCHS 2000) (n=609)

Variables	Categories	OR (95 %CI)	p-value
Family & finances ready for pregnancy	Unsure/ no	1.00	
	Yes	0.45 (0.27, 0.74)	0.002
	Missing	0.48 (0.06, 4.05)	0.499
Mother's schooling	< Matriculation	1.00	
	Matriculation	0.48 (0.25, 0.91)	0.026
Mother's work	Unemployed	1.00	
	Housewife	0.72 (0.39, 1.32)	0.288
	Earns money	0.56 (0.32, 0.99)	0.047
	Missing	3.63 (0.21, 62.71)	0.375

SES = Socio-economic status

COMBINED EFFECT ON STUNTING OF PROXIMATE, SES & SOCIAL SUPPORT EXPOSURES

Table 4.3.17 shows the fully adjusted effects of SES and proximate exposures, collected around the time of the child's birth, on stunting at two years of age. Children from those families who reported that they and their financial situation were ready for the pregnancy, remained at reduced likelihood of stunting (OR= 0.45; 95%CI 0.27 - 0.75). However, on adjustment for ethnicity, the effects of mother's schooling and mother's work were attenuated to (OR= 0.57; 95%CI 0.29 - 1.13) and (OR= 0.59; 95%CI 0.33 - 1.07) respectively. In turn, when adjusted for mother's schooling, the effect of ethnicity on stunting at this age was no longer seen.

When stunting was defined by the CDC/ WHO 1978 reference similar results were obtained. The SES-adjusted effects of maternal age and ethnicity were no longer seen. The effect of mother's

work was also no longer seen on adjustment for ethnicity and maternal age. In comparison to the CDC/ NCHS 2000 reference results, the adjusted effect of family readiness was substantially smaller (OR= 0.56; 95%CI 0.35 – 0.91). Using this categorisation of stunting, a reduced likelihood of stunting in two year olds whose mothers reported matriculation remained (OR= 0.45; 95%CI 0.24 – 0.88) (data not shown).

Table 4.3.17 Adjusted effect of proximate & SES exposures on stunting aged 2 yrs (CDC/ NCHS 2000) (n =609)

Variables	Categories	OR (95 %CI)	p-value
Family & finances ready for pregnancy	Unsure/ no	1.00	
	Yes	0.45 (0.27, 0.75)	0.002
	Missing	0.48 (0.06, 4.05)	0.498
Mother's schooling	< Matriculation	1.00	
	Matriculation	0.57 (0.29, 1.13)	0.107
Mother's work	Unemployed	1.00	
	Housewife	0.74 (0.40, 1.37)	0.342
	Earns money	0.59 (0.33, 1.07)	0.082
	Missing	3.72 (0.21, 64.28)	0.366
Ethnicity	Black	1.00	
	White	0.22 (0.03, 1.77)	0.156
	Coloured	1.11 (0.54, 2.28)	0.783
	Indian	Insufficient data	

SES = Socio-economic status

Ethnicity, mother's schooling and mother's work were closely associated ($p<0.001$) and in this sample it was not possible to estimate the adjusted effect of ethnicity, mother's schooling or mother's work on stunting at two years of age due to issues of co-linearity. Table 4.3.16 shows that the 95% confidence intervals of the SES adjusted effects of mother's schooling and work were approaching one, indicating that the study may be underpowered in terms of investigating the effect of these exposures (95%CI 0.25 - 0.91 and 0.32 - 0.99 respectively). Results from likelihood ratio tests, however, suggest that the effect of ethnicity on stunting may be mediated through mother's work and mother's schooling (i.e. these variables lie on the causal pathway). For example, removal of ethnicity exposure changed the model little and results from likelihood ratio tests indicated that this variable did not significantly add to the model ($\chi^2 = 3.26$, $p= 0.1963$). However, removal of mother's schooling and work exposures significantly affected the model, suggesting that inclusion of these variables was important ($\chi^2 = 15.83$, $p= 0.0147$). Results of a goodness of fit test indicate that the model excluding ethnicity was a reasonable fit of the data ($\chi^2 = 31.15$, $p= 0.3585$).

4.4 STUNTED AT FIVE YEARS OF AGE RESULTS

Of the 3,275 participants in the cohort study, data from a total of 600 children seen at the five year data collection point (4.50 – 5.49 years) were used in this analysis. Those included had complete sex, height and age data at five years and at least partially complete demographic, SES and social support data, obtained from the antenatal and six month questionnaires. Children included ranged in age from 4.62 – 5.48 years.

RESULTS OF DESCRIPTIVE ANALYSIS OF OUTCOME VARIABLE

HEIGHT-FOR-AGE Z-SCORES AND STUNTED OUTCOME AT FIVE YEARS OF AGE

Height-for-age z-scores

Table 4.4.1 shows means and standard deviations of height-for-age z-scores, stratified by proximate exposures. Females had a higher mean height-for-age z-score than males (p=0.03) (see also figure 4.4.2). White children had the highest mean height-for-age z-score at five years and were taller than Coloured (p=0.01) or Black children (p <0.0001). Black children had a higher mean height-for-age z-score than Coloured children but lower mean height-for-age z-score than Indian children (p<0.001) (see also figure 4.4.3). Children born SGA had a lower mean height-for-age z-score than AGA children (p <0.0001) (see also figure 4.4.4). Similarly, children born LBW had lower mean height-for-age z-score than those weighing over 2.5 kg at delivery (p=0.0009). The mean height-for-age z-score of children in this sample did not differ between those children born pre-term or born later than 37 weeks gestation (table 4.4.1). Neither was there any difference in mean height-for-age z-scores of children whose mothers were different ages at delivery, who reported having ever or never smoked or who were primi or multiparous (table 4.4.1).

Stunted outcome at five years of age

Two reference populations were used to define stunting at this age (CDC/WHO 1978 and CDC/NCHS 2000). Categorisation of stunting at five years was not significantly different between these two references (p >0.01) and at this age a very low prevalence of stunting was seen using either classification. Using the CDC/ WHO 1978 reference a small number of children, 32 (5.3%), were classified as stunted, while an even smaller number, 23 children (3.8%), were classified as stunted using the CDC/ NCHS 2000 population reference.

Table 4.4.1
Mean height-for-age z-score for children aged 5 years (4.5 – 5.49 yrs) by proximate exposures

Proximate exposure Category	Sample size (n)	Mean Height for age z-scores	SD
Male	304	-0.54	0.92
Female *	296	-0.37	0.99
Black	508	-0.45	0.96
White	8	0.26	0.85
Coloured	69	-0.65	0.96
Indian †	15	-0.20	0.56
Not SGA	501	-0.38	0.96
SGA †	88	-0.86	0.92
Not LBW	546	-0.42	0.96
LBW < 2500 g †	52	-0.88	0.85
Term 37-41 weeks	527	-0.44	0.96
Pre-term < 37 weeks	61	-0.58	0.98
≤ 19.99 yrs	113	-0.48	1.03
20-24.99 yrs	204	-0.51	0.96
25-29.99 yrs	147	-0.49	0.89
≥ 30 yrs	136	-0.31	0.97
1st live birth	279	-0.47	0.95
≥ 2 live births	321	-0.45	0.97
Never smoked	549	-0.45	0.95
Ever smoked	44	-0.55	1.11

* p-value< 0.05
† p-value< 0.001
SGA = Small for gestational age
LBW = Low birth weight

Figure 4.4.1 Distribution of mean height-for-age z-score at 5 years in study sample

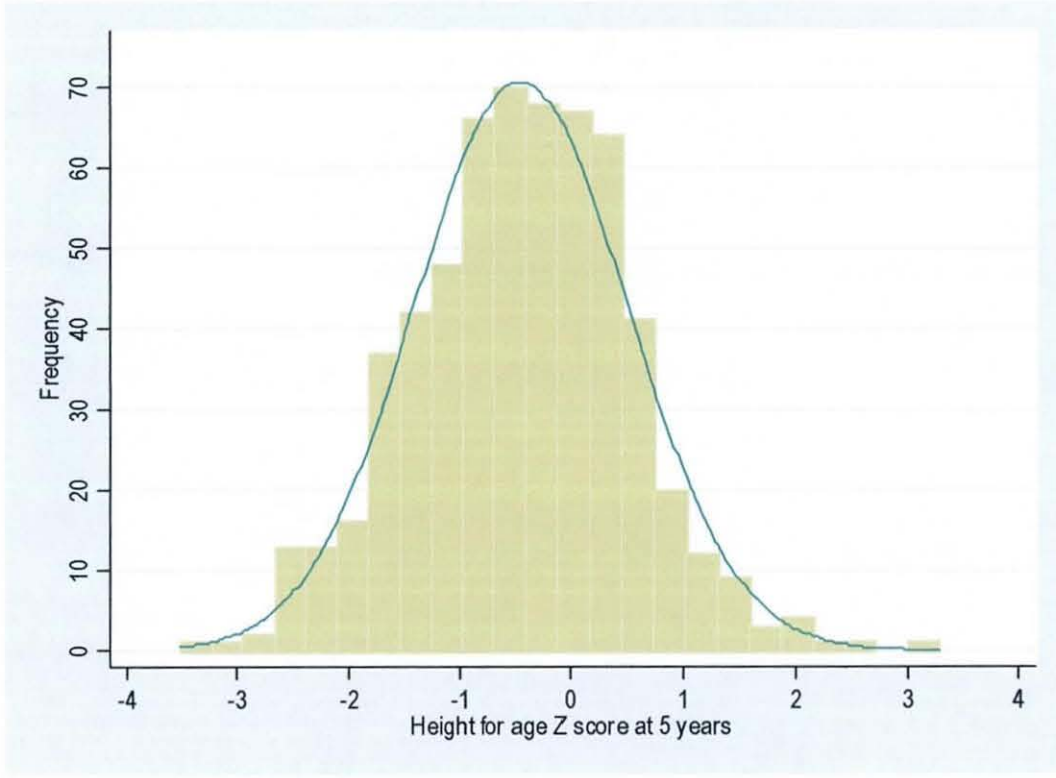


Figure 4.4.2 Distribution of mean height-for-age z-score at 5 years by sex

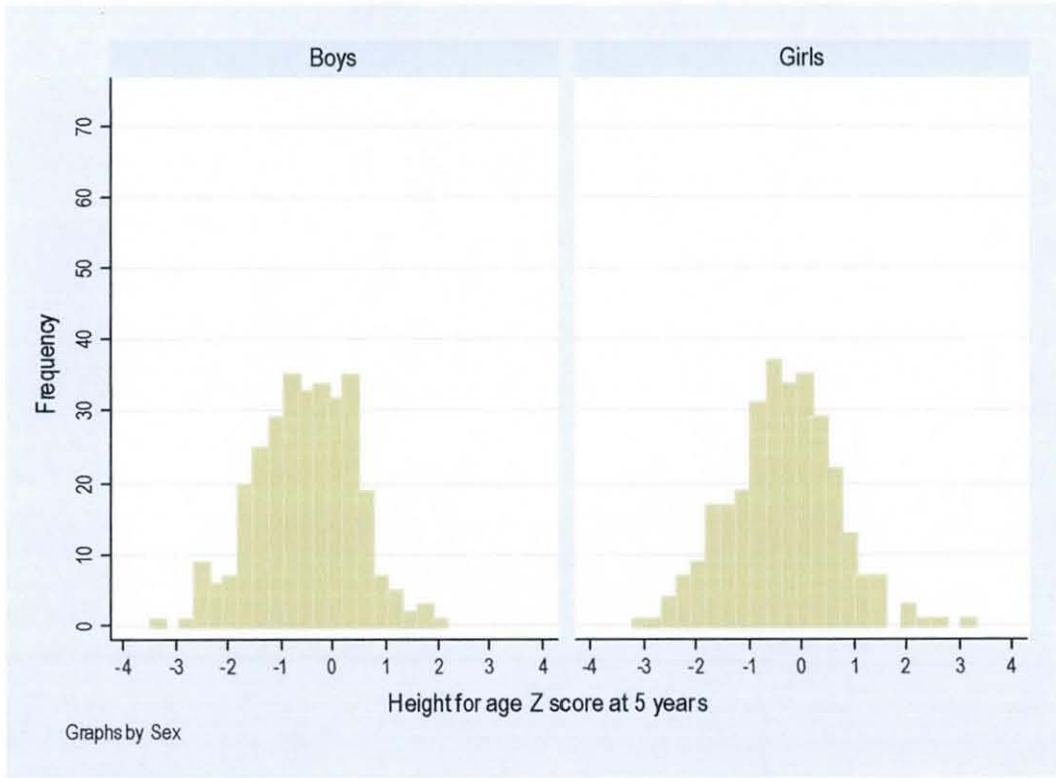
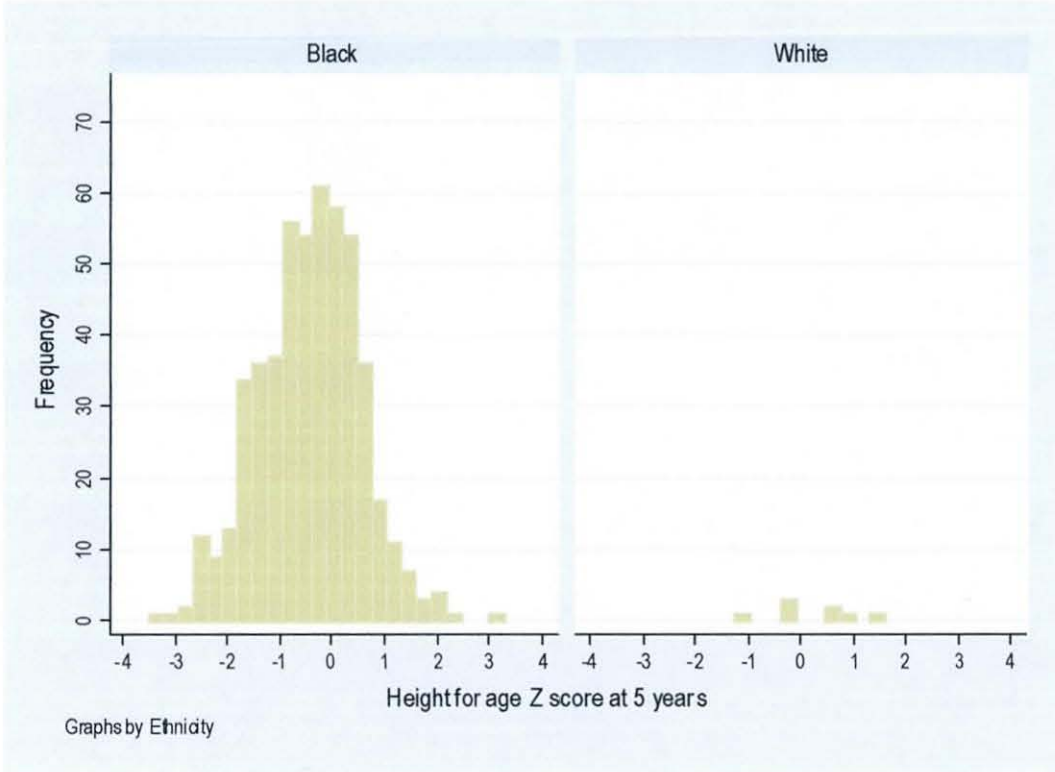


Figure 4.4.3 Distribution of mean height-for-age z-score at 5 years by ethnicity



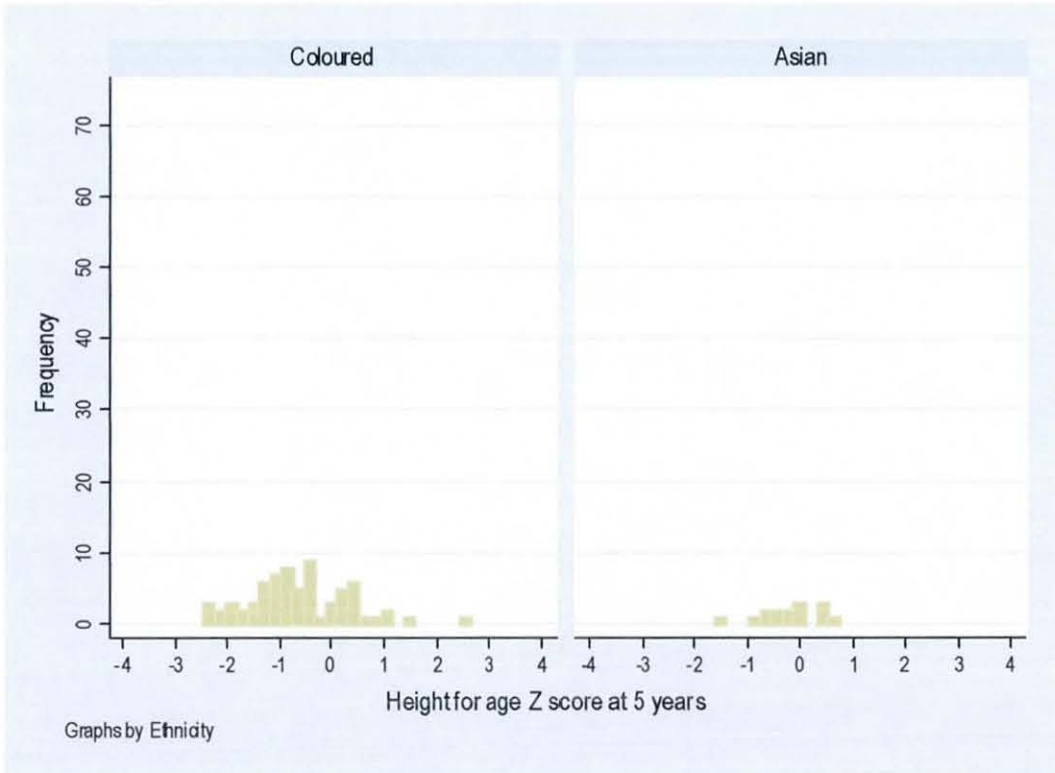
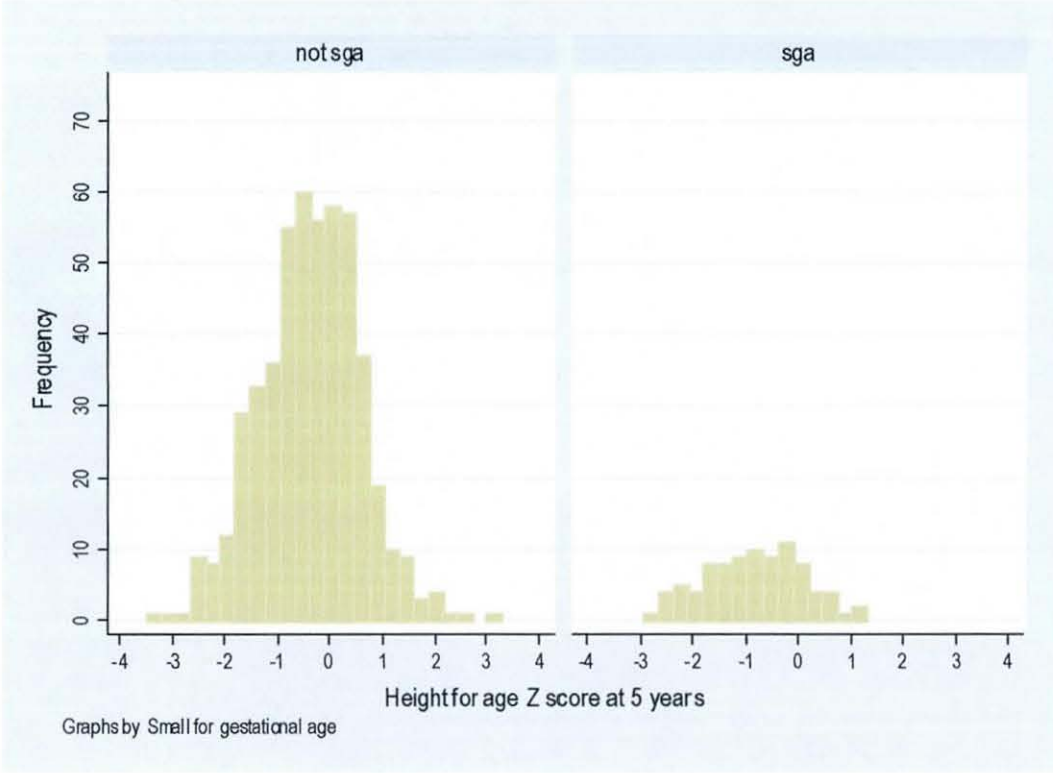


Figure 4.4.4 Distribution of mean height-for-age z-score at 5 years by small for gestational age



BIVARIATE RESULTS: UNADJUSTED MEASURES OF ASSOCIATION AND EFFECT

Results presented in bivariate and multivariate analyses used stunting defined by the CDC/ NCHS 2000 reference. However, where these differed to results obtained using the CDC/ WHO 1978, differences are highlighted. Tables 4.4.2 – 4.4.11 show the distribution of exposures and outcomes as well as the unadjusted odds ratios of exposures on stunting at five years of age. Unadjusted results show associations with the following variables; SGA (table 4.4.2), grandfather's level of schooling, mother's work (table 4.4.3), cracked walls, broken door, leaks and home troubled by bed bugs (table 4.4.5).

PROXIMATE EXPOSURES

Table 4.4.2 shows that the majority of the sample was classified as Black (84.7%). Almost 15% of children were born SGA, while 8.7% and 10.2% were born LBW and pre-term respectively (table 4.4.2). The majority were born to mothers aged 20-30 years at delivery (58.5%) and to those who reported never having smoked (91.5%). Children born SGA were at increased likelihood of stunting at five years (OR= 3.96; 95%CI 1.66 – 9.46). No other associations between proximate exposures and stunting were seen (table 4.4.2). Results using the CDC/ WHO 1978 reference indicated a smaller, association between SGA and stunting (OR= 2.79; 95%CI 1.27 – 6.15) (data not shown). Results using this reference also indicated that five year olds born LBW were at increased likelihood of stunting (OR= 2.61; 95%CI 1.02 – 6.69) (data not shown).

Table 4.4.2 Distribution of proximate exposures by stunting aged 5 years (CDC/ NCHS 2000) and unadjusted OR

Proximate Exposures	Study sample n=600 N (%)	Stunted (n=23) N (%)	Not Stunted (n=577) N (%)	Crude OR (95 %CI)	p-value
Sex					
Male	304 (50.7)	12 (52.2)	292 (50.6)	1.00	
Female	296 (49.3)	11 (47.8)	285 (49.4)	0.94 (0.41, 2.16)	0.883
Ethnicity					
Black	508 (84.7)	21 (91.3)	487 (84.4)	1.00	
White	8 (1.3)	0 (0.0)	8 (1.4)	Insufficient data	
Coloured	69 (11.5)	2 (8.7)	67 (11.6)	0.69 (0.16, 3.02)	0.624
Indian	15 (2.5)	0 (0.0)	15 (2.6)	Insufficient data	
Small for gestational age					
Not SGA	501 (83.5)	14 (60.9)	487 (84.4)	1.00	
SGA	88 (14.7)	9 (39.1)	79 (13.7)	3.96 (1.66, 9.46)	0.002
Missing	11 (1.8)	0 (0.0)	11 (1.9)	Insufficient data	
Low birth weight					
Not LBW	546 (91.0)	19 (82.6)	527 (91.3)	1.00	
LBW < 2500 grams	52 (8.7)	4 (17.4)	48 (8.3)	2.31 (0.75, 7.07)	0.142
Missing	2 (0.3)	0 (0.0)	2 (0.4)	Insufficient data	
Pre-term birth					
Term 37-41 weeks	527 (87.8)	19 (82.6)	508 (88.0)	1.00	
Pre-term < 37 weeks	61 (10.2)	4 (17.4)	57 (9.9)	1.87 (0.62, 5.71)	0.268
Missing	12 (2.0)	0 (0.0)	12 (2.1)	Insufficient data	
Maternal age at delivery					
≤ 19.99 yrs	113 (18.8)	5 (21.7)	108 (18.7)	1.00	
20-24.99 yrs	204 (34.0)	9 (39.1)	195 (33.8)	1.00 (0.33, 3.05)	0.996
25-29.99 yrs	147 (24.5)	2 (8.7)	145 (25.1)	0.30 (0.06, 1.56)	0.152
30-34.99 yrs	91 (15.2)	5 (21.8)	86 (14.9)	1.25 (0.36, 4.48)	0.726
≥ 35 yrs	45 (7.5)	2 (8.7)	43 (7.5)	1.00 (0.19, 5.38)	0.996
Parity					
1 live birth	279 (46.5)	11 (47.8)	268 (46.4)	1.00	
≥ 2 live births	321 (53.5)	12 (52.2)	309 (53.6)	0.95 (0.41, 2.18)	0.897
Mother's smoking behaviour					
Never smoked	549 (91.5)	20 (87.0)	529 (91.7)	1.00	
Ever smoked	44 (7.3)	3 (13.0)	41 (7.1)	1.93 (0.55, 6.78)	0.302
Missing	7 (1.2)	0 (0.0)	7 (1.2)	Insufficient data	

SGA = Small for gestational age
LBW = Low birth weight

EDUCATION AND EMPLOYMENT SES EXPOSURES

Table 4.4.3 shows that, around the time of the child's birth, 24% of mothers in the sample obtained matriculation, but fewer than 1% attended university. A total of 49.2% of partners obtained matriculation although few attended university (2.2%). Around the time of the child's birth, over 33% of mothers reported that they "earn money", while 57.8% of partners were employed (table 4.4.3). Five year olds whose mother reported "earning money" were at reduced likelihood of stunting in comparison to those whose mothers were unemployed (OR = 0.26; 95%CI 0.07 – 0.91), however very few of the stunted sample had a mother who earned money (n = 3). Children whose maternal grandfather completed at least Standard 5 at school were also at reduced likelihood of stunting at five years (OR = 0.17; 95%CI 0.03 - 0.86). However, very few of the stunted sample had a grandfather with this level of schooling (n = 2). No associations were seen between other education and employment exposures and stunting (table 4.4.3). On the whole, results obtained using the CDC/ WHO 1978 reference did not differ except for a smaller protective effect of maternal employment on stunting at this age (OR = 0.31; 95%CI 0.11 – 0.86) (data not shown).

Table 4.4.3 Distribution of education & employment by stunting aged 5 yrs (CDC/ NCHS 2000) & unadjusted OR

Education & Employment Exposures	Study sample n=600 N (%)	Stunted (n=23) N (%)	Not Stunted (n=577) N (%)	Crude OR (95 %CI)	p-value
Mother's Schooling					
< Matriculation	455 (75.8)	20 (87.0)	435 (75.4)	1.00	
Matriculation	144 (24.0)	3 (13.0)	141 (24.4)	0.46 (0.14, 1.58)	0.219
Missing	1 (0.2)	0 (0.0)	1 (0.2)	Insufficient data	
Mother's further education					
No further education	450 (75.0)	21 (91.3)	429 (74.3)	1.00	
Course not completed	20 (3.3)	0 (0.0)	20 (3.5)	Insufficient data	
In-service training	23 (3.8)	0 (0.0)	23 (4.0)	Insufficient data	
Technicon & college	22 (3.7)	0 (0.0)	22 (3.8)	Insufficient data	
University	5 (0.9)	0 (0.0)	5 (0.9)	Insufficient data	
Other	45 (7.5)	2 (8.7)	43 (7.4)	0.95 (0.21, 4.19)	0.946
Missing	35 (5.8)	0 (0.0)	35 (6.1)	Insufficient data	
Partner's Schooling					
< Matriculation	295 (49.2)	12 (52.2)	283 (49.0)	1.00	
Matriculation	193 (32.1)	4 (17.4)	189 (32.8)	0.50 (0.16, 1.57)	0.235
Missing/ system missing	112 (18.7)	7 (30.4)	105 (18.2)	1.57 (0.61, 4.10)	0.355
Partner's further education					
No further education	285 (47.5)	13 (56.5)	272 (47.1)	1.00	
Course not completed	12 (2.0)	0 (0.0)	12 (2.1)	Insufficient data	
In-service training	36 (6.0)	2 (8.7)	34 (5.9)	1.23 (0.27, 5.69)	0.790
Technicon & college	36 (6.0)	0 (0.0)	36 (6.2)	Insufficient data	
University	13 (2.2)	0 (0.0)	13 (2.3)	Insufficient data	
Other	41 (6.8)	1 (4.4)	40 (6.9)	0.52 (0.07, 4.11)	0.538
Missing/ system missing	177 (29.5)	7 (30.4)	170 (29.5)	0.86 (0.34, 2.20)	0.756
Maternal grandmother educ.					
< Std 5	102 (17.0)	6 (26.1)	96 (16.6)	1.00	
Std 5 - Matriculation	167 (27.8)	5 (21.7)	162 (28.1)	0.50 (0.15, 1.66)	0.254
Missing/ system missing	331 (55.2)	12 (52.2)	319 (55.3)	0.61 (0.23, 1.64)	0.323
Maternal grandfather educ.					
< Std 5	68 (11.3)	6 (26.1)	62 (10.8)	1.00	
Std 5 - Matriculation	124 (20.7)	2 (8.7)	122 (21.1)	0.17 (0.03, 0.86)	0.033
Missing/ system missing	408 (68.0)	15 (65.2)	393 (68.1)	0.40 (0.15, 1.05)	0.064
Mother's work					
Unemployed	250 (41.7)	14 (60.9)	236 (40.9)	1.00	
Housewife	145 (24.2)	6 (26.1)	139 (24.1)	0.73 (0.27, 1.94)	0.524
Earns money	200 (33.3)	3 (13.0)	197 (34.1)	0.26 (0.07, 0.91)	0.035
Missing	5 (0.8)	0 (0.0)	5 (0.9)	Insufficient data	
Frequency of mother's pay					
Monthly	132 (22.0)	1 (4.3)	131 (22.7)	1.00	
< monthly	69 (11.5)	2 (8.7)	67 (11.6)	3.91 (0.35, 43.91)	0.269
Missing/ system missing	399 (66.5)	20 (87.0)	379 (65.7)	6.91 (0.92, 50.02)	0.060
Partner employed					
Partner not working	122 (20.4)	2 (8.7)	120 (20.8)	1.00	
Partner employed	347 (57.8)	16 (69.6)	331 (57.4)	2.90 (0.66, 12.80)	0.160
Missing/ system missing	131 (21.8)	5 (21.7)	126 (21.8)	2.38 (0.45, 12.51)	0.305
Frequency of partner's pay					
Monthly	203 (33.8)	10 (43.5)	193 (33.5)	1.00	
< monthly	187 (31.2)	8 (34.8)	179 (31.0)	0.86 (0.33, 2.23)	0.761
Missing/ system missing	210 (35.0)	5 (21.7)	205 (35.5)	0.47 (0.16, 1.40)	0.176

HOME CHARACTERISTICS AND CONDITION OF HOME SES EXPOSURES

Table 4.4.4 shows that around the time of the child's birth the majority of the sample lived in a house or cottage (84.0%). Most rented their home from their local authority (47.3%). Almost 50% of homes had two rooms that were used for sleeping, while 84.0% had a separate kitchen used exclusively for cooking purposes (table 4.4.4). Over 27% of homes in the sample did not have ceilings, while 26.2% and 32.2% respectively had sole or shared use of an indoor hot water tap or an indoor flush toilet (table 4.4.4). No significant associations were seen between home characteristics (antenatal measure) and stunting at five years of age (table 4.4.4). When stunting was defined using the CDC/ WHO 1978 reference, five year olds whose childhood home (antenatal measure) had a ceiling were at decreased likelihood of stunting (OR = 0.35; 95%CI 0.14 – 0.91). Those from homes (antenatal measure) which had access to an indoor hot tap were also at reduced likelihood of stunting (OR = 0.18; 95%CI 0.04 – 0.78) (data not shown).

Table 4.4.5 shows that, around the time of the child's birth, 41.0% of respondents classify the condition of their home as "fair". Table 4.4.5 also shows that at this time most reported no cracked walls (50.4%), broken doors (58.0%) or broken windows (56.5%) and no leaks (53.7%). Five year olds whose childhood home (antenatal measure) had cracked walls were at increased likelihood of stunting (OR = 3.34; 95%CI 1.25 – 8.94). Children from homes with broken doors (antenatal measure) were also at increased likelihood (OR = 3.89; 95%CI 1.30 - 11.66) as were those from homes with leaks (OR = 3.17; 95%CI 1.11 - 9.06). Table 4.4.5 also shows that five year olds whose childhood home (antenatal measure) was troubled by bed bugs were at increased likelihood of stunting (OR = 4.54; 95%CI 1.49 – 13.88). However, it must be noted that the confidence intervals for all these results are wide (table 4.4.5). No associations between stunting and other SES exposures measuring the condition of the home were seen (table 4.4.5). Results obtained using the CDC/ WHO 1978 classification of stunting showed a smaller effect of a home having cracked walls (OR = 2.82; 95%CI 1.14 – 7.00), while the association with bed bugs showed a larger effect (OR = 5.70; 95%CI 2.07 – 15.66) (data not shown). Using this reference, children from homes in poor condition (antenatal measure) were at increased likelihood of stunting at five years (OR = 9.17; 95%CI 1.04 – 80.86). Confidence intervals for these results were very wide.

Table 4.4.4 Distribution of home characteristics by stunting aged 5 years (CDC/NCHS 2000) & unadjusted OR

Home characteristics	Study sample n=600	Stunted (n=23)	Not Stunted (n=577)	Crude OR	
Exposures	N (%)	N (%)	N (%)	(95 %CI)	p-value
Type of home					
Shack	23 (3.8)	1 (4.3)	22 (3.8)	1.00	
Room or Garage	28 (4.7)	0 (0.0)	28 (4.8)	Insufficient data	
Flat	25 (4.2)	2 (8.7)	23 (4.0)	1.91 (0.16, 22.63)	0.607
House shared with another family	16 (2.7)	1 (4.3)	15 (2.6)	1.47 (0.08, 25.81)	0.792
Cottage or House	504 (84.0)	19 (82.7)	485 (84.1)	0.86 (0.11, 6.73)	0.887
Missing	4 (0.6)	0 (0.0)	4 (0.7)	Insufficient data	
Tenureship					
Rented from another person	144 (24.0)	2 (8.7)	142 (24.6)	1.00	
Provided by employer	3 (0.5)	0 (0.0)	3 (0.5)	Insufficient data	
Rented from local authority	284 (47.3)	16 (69.6)	268 (46.5)	4.24 (0.96, 18.69)	0.056
Owned	157 (26.2)	5 (21.7)	152 (26.3)	2.33 (0.45, 12.23)	0.315
Missing	12 (2.0)	0 (0.0)	12 (2.1)	Insufficient data	
Number of sleeping rooms					
1	102 (17.0)	3 (13.1)	99 (17.1)	1.00	
2	299 (49.8)	15 (65.2)	284 (49.2)	1.74 (0.49, 6.15)	0.388
≥ 3	194 (32.4)	5 (21.7)	189 (32.8)	0.87 (0.20, 3.73)	0.855
Missing	5 (0.8)	0 (0.0)	5 (0.9)	Insufficient data	
Separate kitchen					
No	93 (15.5)	3 (13.0)	90 (15.6)	1.00	
Yes	504 (84.0)	20 (87.0)	484 (83.9)	1.24 (0.36, 4.26)	0.733
Missing	3 (0.5)	0 (0.0)	3 (0.5)	Insufficient data	
Type of roofing material					
Asbestos	228 (38.0)	15 (65.2)	213 (36.9)	1.00	
Tiles	26 (4.3)	0 (0.0)	26 (4.5)	Insufficient data	
Corrugated metal	97 (16.2)	2 (8.7)	95 (16.5)	0.30 (0.07, 1.33)	0.113
Missing/ system missing	249 (41.5)	6 (26.1)	243 (42.1)	0.35 (0.13, 0.92)	0.033
Home has ceiling					
No	166 (27.7)	11 (47.8)	155 (26.9)	1.00	
Yes	221 (36.8)	6 (26.1)	215 (37.2)	0.39 (0.14, 1.09)	0.072
Missing/ system missing	213 (35.5)	6 (26.1)	207 (35.9)	0.41 (0.15, 1.13)	0.084
Water facility					
Outdoor tap or indoor cold tap	438 (73.0)	20 (87.0)	418 (72.4)	1.00	
Indoor hot tap	157 (26.2)	2 (8.7)	155 (26.9)	0.27 (0.06, 1.17)	0.080
Missing	5 (0.8)	1 (4.3)	4 (0.7)	5.22 (0.56, 48.92)	0.147
Toilet facility					
Bucket or outdoor flush toilet	401 (66.8)	17 (73.9)	384 (66.5)	1.00	
Indoor flush toilet	193 (32.2)	5 (21.7)	188 (32.6)	0.60 (0.22, 1.65)	0.324
Missing	6 (1.0)	1 (4.4)	5 (0.9)	4.52 (0.50, 40.82)	0.179

Table 4.4.5 Distribution of Condition of home by stunting aged 5 years (CDC/ NCHS 2000) and unadjusted OR

Condition of home Exposures	Study sample n=600 N (%)	Stunted (n=23) N (%)	Not Stunted (n=577) N (%)	Crude OR (95 %CI)	p-value
Condition of home					
Good	77 (12.9)	1 (4.3)	76 (13.2)	1.00	
Fair	246 (41.0)	12 (52.2)	234 (40.5)	3.89 (0.50, 30.46)	0.195
Poor	65 (10.8)	4 (17.4)	61 (10.6)	4.98 (0.54, 45.75)	0.156
Missing/ system missing	212 (35.3)	6 (26.1)	206 (35.7)	2.21 (0.26, 18.69)	0.465
Home has cracked walls					
No	302 (50.4)	9 (39.1)	293 (50.8)	1.00	
Yes	86 (14.3)	8 (34.8)	78 (13.5)	3.34 (1.25, 8.94)	0.016
Missing/ system missing	212 (35.3)	6 (26.1)	206 (35.7)	0.95 (0.33, 2.70)	0.921
Home has broken doors					
No	348 (58.0)	12 (52.2)	336 (58.2)	1.00	
Yes	41 (6.8)	5 (21.7)	36 (6.2)	3.89 (1.30, 11.66)	0.015
Missing/ system missing	211 (35.2)	6 (26.1)	205 (35.5)	0.82 (0.30, 2.22)	0.695
Home has broken windows					
No	339 (56.5)	14 (60.9)	325 (56.3)	1.00	
Yes	51 (8.5)	3 (13.0)	48 (8.3)	1.45 (0.40, 5.23)	0.570
Missing/ system missing	210 (35.0)	6 (26.1)	204 (35.4)	0.68 (0.26, 1.80)	0.442
Home has leaks					
No	322 (53.7)	10 (43.5)	312 (54.1)	1.00	
Yes	65 (10.8)	6 (26.1)	59 (10.2)	3.17 (1.11, 9.06)	0.031
Missing/ system missing	213 (35.5)	7 (30.4)	206 (35.1)	1.06 (0.40, 2.82)	0.907
Home troubled by flies					
No	183 (30.5)	5 (21.8)	178 (30.9)	1.00	
Yes	201 (33.5)	11 (47.8)	190 (32.9)	2.06 (0.70, 6.05)	0.188
Missing/ system missing	216 (36.0)	7 (30.4)	209 (36.2)	1.19 (0.37, 13.82)	0.767
Home troubled by rats					
No	281 (46.8)	14 (60.9)	267 (46.3)	1.00	
Yes	100 (16.7)	2 (8.7)	98 (17.0)	0.39 (0.87, 1.74)	0.217
Missing/ system missing	219 (36.5)	7 (30.4)	212 (36.7)	0.63 (0.25, 1.59)	0.327
Home troubled by bed bugs					
No	341 (56.8)	11 (47.8)	330 (57.2)	1.00	
Yes	38 (6.4)	5 (21.8)	33 (5.7)	4.54 (1.49, 13.88)	0.008
Missing/ system missing	221 (36.8)	7 (30.4)	214 (37.1)	0.98 (0.37, 2.57)	0.969
Home troubled by cockroaches					
No	202 (33.7)	6 (26.1)	196 (34.0)	1.00	
Yes	180 (30.0)	11 (47.8)	169 (29.3)	2.13 (0.77, 5.87)	0.146
Missing/ system missing	218 (36.3)	6 (26.1)	212 (36.7)	0.92 (0.29, 2.97)	0.893

ECONOMIC SES EXPOSURES

Table 4.4.6 shows that around the time of the child's birth a large majority of homes had electricity supply (96.7%). Over 81% used electricity or gas as their main cooking fuel (table 4.4.6). Table 4.4.6 also shows that at this time over 84% of the sample did not employ domestic help and 78.5% did not have private medical insurance cover. The majority had a television, radio and fridge in their home, however, few had a washing machine (15.2%) or a car (29.5%) (table 4.4.6). No associations were seen between antenatally-collected economic SES exposures and stunting (table 4.4.6).

DEPRIVATION AND HOUSEHOLD COMPOSITION SES EXPOSURES

Table 4.4.7 shows that, around the time of the child's birth, the majority (80.4%) of participants reported that their family had not had too little money for basics (food, clothing, rent etc.). It also shows that the majority had not been separated unwillingly from their children (79.8%) or physically abused by their partner (90.0%). A total of 20.0% reported that there was problematic use of alcohol or drugs in the family (antenatal measure), while over 18% of mothers fell pregnant when still at school (table 4.4.7). No associations between deprivation exposures (antenatal measure) and stunting at five years were seen (table 4.4.7).

Table 4.4.8 shows that the majority (99.3%) of homes reported that the mother was a usual resident (antenatal measure). Around the time of birth of the five year old child, the majority of homes in the sample did not report a father or grandfather as a usual resident (64.4% for fathers and 61.7% for grandfathers). Table 4.4.8 also shows that 19.5% of homes reported as resident at least one sibling aged under five years at the time of Bt20 child's birth. No associations were seen between household composition exposures (antenatal measure) and stunting at this age (table 4.4.8).

Table 4.4.6 Distribution of economic SES exposures by stunting aged 5 yrs (CDC/ NCHS 2000) & unadjusted OR

Economic Exposures	Study sample n=600 N (%)	Stunted (n=23) N (%)	Not Stunted (n=577) N (%)	Crude OR (95 %CI)	p-value
Electricity supply					
No	17 (2.8)	2 (8.7)	15 (2.6)	1.00	
Yes	580 (96.7)	21 (91.3)	559 (96.9)	0.28 (0.06, 1.31)	0.107
Missing	3 (0.5)	0 (0.0)	3 (0.5)	Insufficient data	
Cooking fuel used					
Other (coal, paraffin, wood)	112 (18.6)	7 (30.4)	105 (18.2)	1.00	
Electricity/generator or gas	487 (81.2)	16 (69.6)	471 (81.6)	0.51 (0.20, 1.27)	0.148
Missing	1 (0.2)	0 (0.0)	1 (0.2)	Insufficient data	
Employ domestic help					
No	506 (84.3)	20 (87.0)	486 (84.2)	1.00	
Yes	57 (9.5)	0 (0.0)	57 (9.9)	Insufficient data	
Missing/ system missing	37 (6.2)	3 (13.0)	34 (5.9)	2.14 (0.61, 7.58)	0.236
Medical aid cover					
No	471 (78.5)	18 (78.3)	453 (78.5)	1.00	
Yes	84 (14.0)	3 (13.0)	81 (14.0)	0.93 (0.27, 3.24)	0.912
Missing/ system missing	45 (7.5)	2 (8.7)	43 (7.5)	1.17 (0.26, 5.21)	0.836
Television in home					
No	149 (24.8)	7 (30.4)	142 (24.6)	1.00	
Yes	446 (74.4)	15 (65.2)	431 (74.7)	0.70 (0.28, 1.77)	0.457
Missing	5 (0.8)	1 (4.4)	4 (0.7)	5.07 (0.50, 51.55)	0.170
Radio in home					
No	100 (16.7)	3 (13.0)	97 (16.8)	1.00	
Yes	497 (82.8)	19 (82.6)	478 (82.8)	1.28 (0.37, 4.43)	0.691
Missing	3 (0.5)	1 (4.4)	2 (0.4)	16.17 (1.13, 231.41)	0.040
Phone in home					
No	247 (41.2)	11 (47.8)	236 (40.9)	1.00	
Yes	348 (58.0)	11 (47.8)	337 (58.4)	0.70 (0.30, 1.64)	0.413
Missing	5 (0.8)	1 (4.4)	4 (0.7)	5.36 (0.55, 52.08)	0.148
Fridge in home					
No	139 (23.2)	6 (26.1)	133 (23.0)	1.00	
Yes	456 (76.0)	16 (69.6)	440 (76.3)	0.81 (0.31, 2.10)	0.659
Missing	5 (0.8)	1 (4.3)	4 (0.7)	5.54 (0.53, 57.47)	0.151
Washing machine in home					
No	503 (83.8)	20 (87.0)	483 (83.7)	1.00	
Yes	91 (15.2)	2 (8.7)	89 (15.4)	0.54 (0.12, 2.36)	0.415
Missing	6 (1.0)	1 (4.3)	5 (0.9)	4.83 (0.54, 43.29)	0.159
Car in home					
No	416 (69.3)	18 (78.3)	398 (69.0)	1.00	
Yes	177 (29.5)	4 (17.4)	173 (30.0)	0.51 (0.17, 1.53)	0.231
Missing	7 (1.2)	1 (4.3)	6 (1.0)	3.68 (0.42, 32.24)	0.239
Children's toys in home					
No	239 (39.8)	8 (34.8)	231 (40.0)	1.00	
Yes	354 (59.0)	13 (56.5)	341 (59.1)	1.10 (0.45, 2.70)	0.834
Missing	7 (1.2)	2 (8.7)	5 (0.9)	11.55 (1.94, 68.82)	0.007

Table 4.4.7 Distribution of deprivation exposures by stunting aged 5 yrs (CDC/ NCHS 2000) & unadjusted OR

Deprivation Exposures	Study sample n=600 N (%)	Stunted (n=23) N (%)	Not Stunted (n=577) N (%)	Crude OR (95 %CI)	p-value
Family recently had too little money for basics					
No	482 (80.4)	17 (73.9)	465 (80.6)	1.00	
Yes	107 (17.8)	6 (26.1)	101 (177.5)	1.62 (0.62, 4.22)	0.319
Missing	11 (1.8)	0 (0.0)	11 (1.9)	Insufficient data	
Mother recently separated unwillingly from children	479 (79.8)	18 (78.3)	461 (79.9)	1.00	
Yes	16 (2.7)	1 (4.3)	15 (2.6)	1.71 (0.21, 13.64)	0.614
Missing	105 (17.5)	4 (17.4)	101 (17.5)	1.01 (0.34, 3.06)	0.980
Drug or alcohol problem in family					
No	471 (78.5)	19 (82.6)	452 (78.3)	1.00	
Yes	120 (20.0)	4 (17.4)	116 (20.1)	0.82 (0.27, 2.46)	0.724
Missing	9 (1.5)	0 (0.0)	9 (1.6)	Insufficient data	
Mother recently physically abused by partner					
No	540 (90.0)	19 (82.6)	521 (90.3)	1.00	
Yes	36 (6.0)	2 (8.7)	34 (5.9)	1.61 (0.36, 7.21)	0.532
Missing	24 (4.0)	2 (8.7)	22 (3.8)	2.49 (0.55, 11.38)	0.238
Mother still at school when fell pregnant					
No	277 (46.2)	11 (47.8)	266 (46.1)	1.00	
Yes	110 (18.3)	6 (26.1)	104 (18.0)	1.39 (0.50, 3.87)	0.522
Missing/ system missing	213 (35.5)	6 (26.1)	207 (35.9)	0.70 (0.25, 1.93)	0.491

Table 4.4.8 Distribution of household composition by stunting aged 5 years (CDC/ NCHS 2000) & unadjusted OR

Household composition Exposures	Study sample n=600 N (%)	Stunted (n=23) N (%)	Not Stunted (n=577) N (%)	Crude OR (95 %CI)	p-value
Mother reported resident					
No mother reported	1 (0.2)	0 (0.0)	1 (0.2)	1.00	
Mother reported	596 (99.3)	23 (100.0)	573 (99.3)	Insufficient data	
Missing	3 (0.5)	0 (0.0)	3 (0.5)	Insufficient data	
Father reported resident					
No father reported	386 (64.4)	12 (52.2)	374 (64.8)	1.00	
Father reported	209 (34.8)	11 (47.8)	198 (34.3)	1.73 (0.75, 3.99)	0.198
Missing	5 (0.8)	0 (0.0)	5 (0.9)	Insufficient data	
Grandfather reported resident					
No grandfather reported	370 (61.7)	15 (65.2)	355 (61.5)	1.00	
Grandfather reported	224 (37.3)	8 (34.8)	216 (37.5)	0.88 (0.36, 2.10)	0.768
Missing	6 (1.0)	0 (0.0)	6 (1.0)	Insufficient data	
Grandma reported resident					
No grandma reported	209 (34.8)	11 (47.8)	198 (34.3)	1.00	
Grandma reported	385 (64.2)	12 (52.2)	373 (64.7)	0.58 (0.25, 1.34)	0.200
Missing	6 (1.0)	0 (0.0)	6 (1.0)	Insufficient data	
At least 1 sibling <5yrs resident					
No young sibling reported	477 (79.5)	18 (78.3)	459 (79.6)	1.00	
At least 1 young sibling reported	117 (19.5)	5 (21.7)	112 (19.4)	1.14 (0.41, 3.13)	0.802
Missing	6 (1.0)	0 (0.0)	6 (1.0)	Insufficient data	

SOCIAL SUPPORT EXPOSURES

Table 4.4.9 shows that around the time of the child's birth the majority of mothers had a network of people from whom they could ask for help (81.7%). Around the time of birth the majority also had a number of people to talk to about problems (85.8%). Table 4.4.9 shows that, around the time of the child's birth, the majority belonged to an organisation such as a church (73.2%). Almost 48% of children in the sample were cared for around the time of birth by their mother, with only few (5.7%) cared for by a childminder (table 4.4.9). No associations were seen between stunting at this age and measures of general social support (table 4.4.9)

Table 4.4.10 shows that around the time of the child's birth the majority of mothers surveyed were either unsure or reported that they did not desire their pregnancy (56.8%). Table 4.4.10 shows that, around the time of birth, over 73% of mothers in this sample felt their family and financial situation was right and ready for their new baby. Over 84% of mothers reported that their partner desired the pregnancy. Few mothers (8.3%) were accompanied by anyone other than medical staff during their labour and delivery. No associations were seen between exposures measuring social support in pregnancy and stunting at five years (table 4.4.10).

The majority of mothers surveyed around the time of birth classified themselves as "single" (70.0%) (table 4.4.11). Over 82% believed their partner would contribute financially to upbringing of the child (table 4.4.11). Over 36% thought their partner would help with childcare. A total of 60.2% reported that her partner never made things more difficult for her (table 4.4.11). No associations were seen between stunting and social support from the mother's partner around the time of the five year old's birth (table 4.4.11).

Table 4.4.9 Distribution of social support (general) by stunting aged 5 yrs (CDC/ NCHS 2000) & unadjusted OR

Social support Exposures	Study sample n=600 N (%)	Stunted (n=23) N (%)	Not Stunted (n=577) N (%)	Crude OR (95 %CI)	p-value
Mother has network to request help from					
No-one	56 (9.3)	1 (4.3)	55 (9.5)	1.00	
Unsure/ maybe	48 (8.0)	4 (17.4)	44 (7.6)	5.00 (0.54, 46.35)	0.157
Number of people	490 (81.7)	17 (74.0)	473 (82.0)	1.98 (0.26, 15.14)	0.512
Missing	6 (1.0)	1 (4.3)	5 (0.9)	11.00 (0.60, 203.76)	0.107
Mother can talk to someone about problems					
No-one	50 (8.3)	1 (4.3)	49 (8.5)	1.00	
Unsure/ maybe	27 (4.5)	3 (13.1)	24 (4.2)	6.12 (0.60, 62.03)	0.125
Number of people	515 (85.8)	18 (78.3)	497 (86.1)	1.77 (0.23, 13.58)	0.581
Missing	8 (1.4)	1 (4.3)	7 (1.2)	7.00 (0.39, 125.03)	0.186
Mother belongs to organisation (e.g. church)					
No	149 (24.8)	7 (30.4)	142 (24.6)	1.00	
Yes	439 (73.2)	16 (69.6)	423 (73.3)	0.77 (0.31, 1.90)	0.568
Missing	12 (2.0)	0 (0.0)	12 (2.1)	Insufficient data	
Person who cares for child					
Mother	287 (47.8)	17 (73.9)	270 (46.8)	1.00	
Childminder	34 (5.7)	0 (0.0)	34 (5.9)	Insufficient data	
Other family or friend	68 (11.3)	0 (0.0)	68 (11.8)	Insufficient data	
Missing/ system missing	211 (35.2)	6 (26.1)	205 (35.5)	0.46 (0.18, 1.20)	0.113

Table 4.4.10
Distribution of social support (pregnancy) by stunting aged 5 yrs (CDC/ NCHS 2000) and unadjusted odds ratios

Social support around pregnancy Exposures	Study sample n=600 N (%)	Stunted (n=23) N (%)	Not Stunted (n=577) N (%)	Crude OR (95 %CI)	p-value
Mother desire for pregnancy					
Unsure/ no	341 (56.8)	14 (60.9)	327 (56.7)	1.00	
Yes desires pregnancy	245 (40.8)	9 (39.1)	236 (40.9)	0.89 (0.38, 2.09)	0.791
Missing	14 (2.4)	0 (0.0)	14 (2.4)	Insufficient data	
Family & finances ready for preg.					
Unsure/ no	155 (25.8)	7 (30.4)	148 (25.7)	1.00	
Yes	439 (73.2)	16 (69.6)	423 (73.3)	0.80 (0.32, 1.98)	0.629
Missing	6 (1.0)	0 (0.0)	6 (1.0)	Insufficient data	
Partner desire for pregnancy					
Unsure/ no	72 (12.0)	4 (17.4)	68 (11.8)	1.00	
Yes	505 (84.2)	18 (78.3)	487 (84.4)	0.62 (0.21, 1.91)	0.413
Missing	23 (3.8)	1 (4.3)	22 (3.8)	0.77 (0.08, 7.28)	0.822
Mother accompanied at birth					
No (only medical staff)	331 (55.2)	14 (60.9)	317 (54.9)	1.00	
Yes	50 (8.3)	3 (13.0)	47 (8.2)	1.44 (0.40, 5.22)	0.574
Missing/system missing	219 (36.5)	6 (26.1)	213 (36.9)	0.64 (0.24, 1.68)	0.316

Table 4.4.11 Distribution of social support (partner) by stunting aged 5 yrs (CDC/ NCHS 2000) & unadjusted OR

Social support from partner Exposures	Study sample n=600 N (%)	Stunted (n=23) N (%)	Not Stunted (n=577) N (%)	Crude OR (95 %CI)	p-value
Mother's marital status					
Single	420 (70.0)	17 (73.9)	403 (69.9)	1.00	
Previously married	8 (1.3)	0 (0.0)	8 (1.4)	Insufficient data	
Married	166 (27.7)	6 (26.1)	160 (27.7)	0.89 (0.34, 2.29)	0.808
Missing	6 (1.0)	0 (0.0)	6 (1.0)	Insufficient data	
Mother's cohabitation status					
Not living with partner	348 (58.0)	13 (56.5)	335 (58.1)	1.00	
Living with partner	221 (36.8)	9 (39.1)	212 (36.7)	1.09 (0.46, 2.60)	0.839
Missing	31 (5.2)	1 (4.4)	30 (5.2)	0.86 (0.11, 6.79)	0.885
Partner contribute financially to child					
Don't know/ no	75 (12.5)	4 (17.4)	71 (12.3)	1.00	
Yes	494 (82.3)	18 (78.3)	476 (82.5)	0.67 (0.22, 2.09)	0.482
Missing	31 (5.2)	1 (4.3)	30 (5.2)	0.60 (0.06, 5.52)	0.645
Partner helps with childcare					
No	147 (24.5)	7 (30.4)	140 (24.3)	1.00	
Yes	221 (36.8)	7 (30.4)	214 (37.1)	0.65 (0.22, 1.90)	0.437
Missing/ system missing	232 (38.7)	9 (39.2)	223 (38.6)	0.81 (0.30, 2.18)	0.678
Partner helps with housework					
No	237 (39.5)	13 (56.5)	224 (38.8)	1.00	
Yes	185 (30.8)	3 (3.1)	182 (31.6)	0.28 (0.08, 1.01)	0.052
Missing/ system missing	178 (29.7)	7 (30.4)	171 (29.6)	0.71 (0.27, 1.80)	0.467
Things made harder by way partner acts					
Always or Sometimes	213 (35.5)	9 (39.1)	204 (35.4)	1.00	
Never	361 (60.2)	13 (56.5)	348 (60.3)	0.85 (0.35, 2.01)	0.707
Missing	26 (4.3)	1 (4.4)	25 (4.3)	0.91 (0.11, 7.46)	0.927

MULTIVARIATE RESULTS: ADJUSTED MEAURES OF ASSOCIATION AND EFFECT

INDIVIDUALLY ADJUSTED MEASURES- PROXIMATE AND SES EXPOSURES

Proximate Exposures

Table 4.4.2 shows that small for gestational age was the only proximate exposure variable associated with stunting at five years of age. Five year olds born SGA were at increased likelihood of stunting (OR= 3.96; 95%CI 1.66 – 9.46).

SES Exposures

The effect on stunting at five years of age of the SES variables of grandfather's level of schooling, mother's employment, whether the home had cracked walls and whether the home had leaks were no longer seen on adjustment for the variable measuring whether the home had broken doors. Table 4.4.13 shows the effects of the remaining SES exposures on stunting at five years, simultaneously adjusted for one another. Five year olds from homes with broken doors remained at increased likelihood for stunting (OR = 3.16; 95%CI 1.02 – 9.79). Those children who came from homes troubled by bed bugs (antenatal measure) also remained at increased likelihood of stunting (OR = 3.82; 95%CI 1.22 – 11.98). It is important to note however, that the confidence intervals for these results are very wide (table 4.4.12) and the sample sizes small (table 4.4.5). These results differed slightly to those seen using the CDC/ WHO 1978 population reference, where adjusted associations were seen only with the variable measuring if the home was troubled by bed bugs (OR= 5.61; 95%CI 2.08 – 15.10) (data not shown).

Table 4.4.12
Adjusted effect of SES exposures on stunting outcome (CDC/ NCHS 2000) (n=589)

Variables	Categories	OR (95 %CI)	p-value
Home has broken doors	No	1.00	
	Yes	3.16 (1.02, 9.79)	0.046
	Missing/ system missing	0.40 (0.04, 3.66)	0.415
Home troubled by bed bugs	No	1.00	
	Yes	3.82 (1.22, 11.98)	0.022
	Missing/ system missing	2.66 (0.32, 22.29)	0.367

SES = Socio-economic status

COMBINED EFFECT ON STUNTING OF PROXIMATE AND SES EXPOSURES

Table 4.4.13 shows the effects of SES and proximate exposures on stunting at five years of age (CDC/ NCHS 2000). The adjusted effect of SGA on stunting at five years showed an increased likelihood and its effect was not mediated through the SES exposures (table 4.4.13). The adjusted effects of being from a home (birth measures) with broken doors or which was troubled by bed

bugs also showed increased likelihoods of stunting in these exposure groups (table 4.4.13) and these effects were also not mediated through SGA. Results seen using the CDC/ WHO 1978 reference showed that the adjusted effect of SGA birth and whether the home was troubled by bed bugs remained associated with stunting at five years of age (OR= 3.02; 95%CI 1.35 – 6.76 and OR= 6.08; 95%CI 2.22 – 16.64 respectively) (data not shown).

Table 4.4.13
Adjusted effect of proximate and SES exposures on stunting (CDC/ NCHS 2000) (n =589)

Variables	Categories	OR (95 %CI)	p-value
Small for gestational age	Not SGA	1.00	
	SGA	4.98 (1.97, 12.57)	0.001
Home has broken doors	No	1.00	
	Yes	4.18 (1.30, 13.38)	0.016
	Missing/ system missing	0.60 (0.06, 5.56)	0.656
Home troubled by bed bugs	No	1.00	
	Yes	4.34 (1.35, 13.94)	0.014
	Missing/ system missing	1.72 (0.20, 14.60)	0.620

SES = Socio-economic status

As distal level variables of SES (broken door and home troubled by bed bugs) remained associated with the stunting in this final model (CDC/ NCHS 2000), the effect of including these variables in the models was investigated using Likelihood Ratio tests. Results (χ^2 = 12.37, p= 0.0148) indicated that these SES variables added significantly to the model, and should be retained. Goodness of fit test (χ^2 = 2.87, p= 0.897) indicated that there was no evidence against the null hypothesis that this final model was a good fit for the data and adequately explained the variation in the data.

5. QUALITATIVE RESULTS

Qualitative analysis was carried out using thematic coding. Sub-themes which emerged are presented under the main codes of water, toilet, cooking fuel, medical aid, social support in pregnancy, childcare, mother's employment, mother's schooling, electricity supply, type of home, tenureship, condition of the home, type of roofing material, drugs and alcohol, marital status and ownership of consumer durables (section 5.1). The opinions of participants (community informants and mothers) of if and how these measures of socio-economic status and social support may influence child growth, via diet, illness and stress, are summarised. Measures which participants identified as markers of advantage or disadvantage are also presented (section 5.4). In this setting these included electricity supply, water facility, the condition of the home and ownership of consumer durables. Finally, participants' opinions on the ranking order of a number of categorical SES variables are also summarised (section 5.6).

Community informants (nurses, teachers and church leaders) mentioned that diet may be influenced by social support during pregnancy, mother's employment, childcare, mother's schooling and use of alcohol or drugs (section 5.2). They mentioned that illness may be influenced by water facilities, toilet facilities, medical aid, mother's employment, childcare and mother's schooling (section 5.3). In their opinion stress may be influenced by social support during pregnancy, type of home, tenureship and condition of the home (section 5.4). Mothers mentioned that diet may be influenced by mother's employment as well as by ownership of a fridge. Those consulted mentioned that illness may be influenced by water facilities, toilet facilities, mother's employment, mother's schooling and ownership of consumer durables. Finally during discussion groups, mothers mentioned that stress may be influenced by mother's employment status (section 5.5).

5.1 RESULTS FROM OPEN CODING

THEMES FROM OPEN CODING

Qualitative analysis of this study addressed three aims.

1. To investigate how local residents perceived the association between certain measures of SES/ social support and infant/ child growth and health.
2. To investigate whether these perceptions varied by mother's SES status.
3. To obtain ranking orders for a number of categorical SES measures.

Table 5.1.2 shows a summary of the main and sub-themes created during open coding of transcripts. Sixteen main themes were developed from the focus group and interview guides, while sub-themes were developed from reading the transcripts.

Perceptions of community informants (healthcare nurses, teachers and church leaders) are summarised in sections 5.2 – 5.4. The way community informants perceived or did not perceive certain variables to be related to infant and child growth or health, sub-themes are grouped under three headings: diet (of pregnant woman and of child), illness and stress (in pregnant woman and in child). These summary topics were chosen for their biological pathways to growth and health (Kramer, 1987; Waterlow, 1990; Palton, 1962). During data analysis it also became apparent that participants viewed certain variables to be important to child growth and health but did not specifically perceive their effect to be mediated through diet, illness or stress. Participants' views of these variables were summarised under a generic heading of markers of disadvantage and poverty.

Community informants perceived that diet of the pregnant woman may be influenced by her desire for the pregnancy. They mentioned that the following socio-economic and social support measures may influence a child's diet: mother's desire for the pregnancy, mother's employment, child care, mother's level of schooling and problematic alcohol or drug use in the family. Community informants also identified a number of measures influencing childhood illness, which included water facilities, toilet facilities, medical aid (private medical insurance), mother's employment, child care and mother's level of schooling. Finally, healthcare nurses responded that social support in pregnancy may influence levels of stress experienced by the pregnant woman. Community informants responded that mother's employment as well as SES measures of house characteristics may influence the level of stress experienced by a child.

Opinions expressed by mothers during focus group discussions are summarised in section 5.5. This section also includes comparison of mother's perceptions, stratified by SES status (low, medium, high). As with community informants, perceptions of mothers collected during focus group discussions, were summarised under the headings of diet, illness and stress. Mothers responded that they believed mother's employment, mother's schooling and ownership of a fridge had an effect on diet. Mothers interviewed responded that toilet and water facilities as well as mother's employment, mother's schooling and ownership of a number of consumer durables had an effect on illness. During FGDs mothers also noted the influence that mother's employment status may

have on levels of stress experienced by the child. Finally the results of participants' opinions of how to rank categorical SES measures are summarised in section 5.6 variables investigated included: water facility, toilet facility, childcare, the type of home, tenureship and roofing material.

CHARACTERISTICS OF PARTICIPANTS

A total of seventy-two participants took part in focus group discussions and in-depth interviews (table 5.1.1). Twenty-five interviews were held with key community informants. All twelve healthcare nurses were female. Ten were African South African while two were Caucasian British South African. The eight school teachers who participated in interviews were also female. Seven were African South African and one was Caucasian Portuguese South African. All of the five church leaders were male. Three of these were African South African, one Caucasian British South African and one Caucasian British. Seven focus group discussions were held with forty-seven mothers. All mothers who participated were African South African Zulu or Sotho speakers, except one African South African mother who was English-speaking (this discussion was held in English).

Table 5.1.1 Demographic characteristics of study participants

Category of Participant	Sample size	Sex	Low SES	Mid SES	High SES
Health care nurses *	12	Female	3	6	3
Primary school teachers	8	Female	3	3	2
Church leaders	5	Male	2	2	1
Mothers	47	Female	22	11	14

* SES of healthcare nurses included public clinics, public hospitals & private clinics

All healthcare nurses and community respondents (teachers and church leaders) who enrolled participated in interviews. Of the 55 mothers who enrolled and agreed to participate in focus group discussions, 85.4% (n = 47) attended the focus groups. All seven mothers who did not attend had been classified as low SES.

Table 5.1.2 Main and sub theme codes from qualitative analysis

Main theme code	Sub theme label	Explanation
1. Water * †		hot indoor, cold indoor, outside tap, shared/sole access
1.1	Sterility	sterility of water, tap, area around tap, water container
1.2	Health	illness, infection, disease
1.3	Hygiene	washing, bathing of child
1.4	Accidents	scalding from boiling water
1.5	Safety	safety of children outside home e.g. when fetching water
1.6	Accessibility	access to taps, control of access, upkeep, responsibility
1.7	Convenience	fetching (time, travel) & heating, boiling
1.8	Poverty	lack of water facility due to income
2. Toilet * †		indoor flush, outdoor flush, pit latrine, shared/sole access
2.1	Health	illness, infection, flies
2.2.	Hygiene	washing hands
2.3	Unpleasant	smell, waste (urine, faeces)
2.4	Upkeep	cleaning of toilet, access/ control of toilet
2.5	Sharing	access/ control, different standards
2.6	Accidents	children falling in toilets
3. Cooking fuel †		electricity, gas, paraffin, coal, wood
3.1	Accidents	burns
3.2	Safety	electrocuted, explosions, poisoning
3.3	Respiratory	ventilations, inhalation, smell
3.4	Convenience	food preparation, food storage
4. Medical aid †		private medical insurance
4.1	Queues	time waiting
4.2	Drugs	generic, expensive, shortages
4.3	Staff numbers	staff patient ratio
4.4	Specialist care	referrals, all tests
4.5	Extra services	food, assistance e.g. to toilet
4.6	Cost	expense
4.7	Poverty	disadvantage, poor, unable to afford
5. Social support in pregnancy †		mother desires pregnancy, financially and emotionally ready
5.1	Psychological	neglect, anger, interest, communication
5.2	Managing against odds	mother makes do even if not prepared for pregnancy
5.3	Physical care	
5.3.1	Physical care Mum	nutrition, sleep, stress
5.3.2	Physical care Child	nutrition, health, breastfeeding
6. Childcare †		alternative to mother caring for child during the day
6.1	Diet	balanced, cheap food, lack of variety, child's specific likes
6.2	Illness	exposure, taking child to clinic, noticing child is sick
6.3	Attention to child	ratio of carers/ children, individual attention
6.4	Quality of care provider	training, registered, supervision, not siblings
6.5	Cost	expense
6.6	Development	socialised, many different carers

* Theme addressed to mothers
† Theme addressed to healthcare nurses
§ Theme addressed to school teachers & church leaders

Table 5.1.2 continued Main and sub theme codes from qualitative analysis

Main theme code	Sub theme label	Explanation
7. Mother's employment * † §		employed vs. unemployed
7.1	Income	food, education, health
7.2	Diet	type of food, time for food preparation
7.3	Illness	noticing, delay in treatment, supervise medicines
7.4	Psychological	miss each other, bonding, supervision
7.5	Tiredness	no time, interest, diet
7.6	Job security	time conflicts, permission time off
7.7	Supervision	miss school, homework, chores
7.8	Single parent	no other parent to provide income
7.9	Child's insight	child aware of parent's situation (poverty etc.)
8. Mother's schooling * † §		little/no schooling vs. complete secondary school
8.1	Sources of knowledge	where else apart from school learn to care for child
8.2	Diet	type of food
8.3	Illness	hygiene, identify if sick, administer medicines
8.4	Reading	illiteracy, magazines, pick up information easily
8.5	Child's education	encourage own children to get education
9. Electricity §		
9.1	Convenience	save time, meals
9.2	Hygiene	bathing
9.3	Poverty	lack of income, live in shacks
10. Type of home §		House, cottage, flat, room, garage, shack
10.1	Privacy	child own room, share with parents
10.2	Space/crowding	overcrowded, cramped
10.3	Facilities	water, sanitation
10.4	Unpleasant	hot, cold, not comfortable
10.5	Independence	your rules, own boss
10.6	Psychology	outside influences
10.7	Income	unemployment
11. Tenureship §		Owned, local authority, rented employer, private landlord
11.1	Loss of home	eviction
11.2	Decision making	someone else's rules
11.3	Landlord tenant relationship	whims, orders, chores, potential to make complaints
11.4	Psychology	sense identity
11.5	Quality of property	
12. Condition of home §		broken windows or doors, leaks
12.1	Psychology	spirit down, worry, fights
12.2	Income/ disadvantage	cost, old area, pensioners, unemployed
12.3	Security	break-ins
12.5	Health	diet, leaks, cold

* Theme addressed to mothers
† Theme addressed to healthcare nurses
§ Theme addressed to school teachers & church leaders

Table 5.1.2 continued Main and sub theme codes from qualitative analysis

Main theme code	Sub theme label	Explanation
13. Roofing material §		tiles, corrugated metal, asbestos, masonite
13.1	Income/ expense	cost of material
13.2	Leaks	leaking roof
13.3	Security	break-ins
13.4	Temperature control	keeping house warm or cool
13.5	Health	disease
13.6	Repair/ maintenance	frequency of replacement, durability
14. Drugs & Alcohol §		problematic use in home
14.1	Crime	stealing etc.
14.2	Dealing drugs	children used as dealers
14.3	Diet	child not properly fed at home
14.4	Unemployment	can't hold down jobs
14.5	Neglect	child not properly cared for
14.6	Psychology/ values	think it is normal if parents/ household does it
15. Marital status *		married, living with partner, single
15.1	Father figure	discipline in school, learn from both parents, role models
15.2	Hard work	single parenting difficult
15.3	Mum only OK	sometimes better if single, manage ok
15.4	Love	child feels loved, secure, peace, communication
16. Consumer durables *		TV, fridge, washing machine, phone, radio, car & toys
16.1	Expense	financially demanding, electricity, infrastructure, buying in bulk
16.2	Not necessary	can do without, money on other things
16.3	Psychology	fit in with peers, updated, social interaction
16.4	Safety	children not playing out on streets
16.5	Food	store goods in fridge
16.6	Illness	communication in emergencies, get to hospital, store meds
16.7	Communication	talking on phone, keep in touch
16.8	Convenience	saves time and energy, arthritis for older people, useful
16.9	Independence	don't have to ask to borrow, troublesome to use other peoples
16.10	Education/ development	TV & radio programmes, homework from school

* Theme addressed to mothers
† Theme addressed to healthcare nurses
§ Theme addressed to school teachers & church leaders

5.2 COMMUNITY INFORMANTS- EFFECT ON DIET

DIET DURING PREGNANCY

The social support variable of mother's desire for pregnancy was identified, by healthcare nurses, as an influence on the pregnant woman's diet (see table 5.1.2 code 5.3). Only healthcare nurses were asked questions about the effect of social support in pregnancy. Responses on the effect of social support in pregnancy on diet were prompted through specific questions on mother's desire for pregnancy and the family's emotional and financial readiness for the pregnancy.

DIET DURING PREGNANCY AND MOTHER'S DESIRE FOR PREGNANCY

Many thought that women who did not want their pregnancy or who were unprepared for their pregnancy (e.g. unplanned pregnancy) may not take as good care of themselves during their pregnancy and that this may affect their unborn infants. In particular, issues of nutrition, sleep and following positive health behaviours (e.g. not smoking or drinking alcohol) were raised.

Healthcare nurse (6):

INTERVIEWER: Do you think that if a mother is pregnant and she wants to be pregnant at that time, do you think that may have an impact on the health and the growth of her child?

SISTER: Definitely.

INTERVIEWER: Why are you saying that?

SISTER: Because she'd look after herself, she'd take care, she'd eat properly, she'd try and avoid smoking, avoid drinking, all this kind of thing.

DIET OF INFANT OR CHILD

Socio-economic and social support measures discussed in relation to diet of the infant or child included the effect of a mother's desire for the pregnancy, mother's employment, child care, mother's level of schooling and problematic alcohol or drug use in the family (see table 5.1.2 codes 6, 7, 8 and 14). Questions addressing the effect on a child's diet of mother's employment and mother's level of schooling were addressed to all categories of community informant. Those addressing the effect of mother's desire for pregnancy and childcare were exclusively addressed to healthcare nurses. Questions on the effect of problematic alcohol and drug use in the family were addressed to school teachers and church leaders, but not to healthcare nurses.

CHILD'S DIET AND MOTHER'S DESIRE FOR PREGNANCY

Regarding whether or not the mother desired her pregnancy, nurses mentioned that infants born from wanted pregnancies were generally loved, well looked after and well fed while those from unwanted pregnancies may be neglected.

Healthcare nurse (2):

INTERVIEWER: And what about if the mother feels that she wants the pregnancy, compared to a mother who doesn't feel that way? Do you think there is a difference in the growth of the baby?

SISTER: Yes. The child is loved, the child is fed. And when the child grows, the child loves the parent. You can see the child is well nourished, the child is well looked after, you know. There is a big difference.

Healthcare nurse (5):

INTERVIEWER: What happens if a mum feels that she wants her pregnancy, compared to a mother who doesn't feel that; do you think that there would be any difference in the way a child ...(interrupted by respondent).

SISTER: They will be different.

INTERVIEWER: And why would you think that?

SISTER: The one that's not prepared; even when the baby is born, she is going to neglect the baby. I've seen some of the mothers; you find that the child is sick, and even when the baby is crying; she doesn't even pick up the baby. It's feeding time; she doesn't want to feed the baby. She neglects the child. The child is wet; she doesn't want to change the nappy.

However, a relatively few nurses also mentioned that even babies from unwanted or unplanned pregnancies could grow well.

Healthcare nurse (8):

INTERVIEWER: You think that has an effect on the health of the baby?

SISTER: Not really because they do grow you know unwanted babies, not unless the mummy decides to abandon the baby. Sometimes you find that she is stuck with the baby, and that baby must grow.

CHILD'S DIET AND MOTHER'S EMPLOYMENT

A number of varying opinions were raised with reference to the influence of mother's employment (employed vs. unemployed) on the diet of infants or children. A number of respondents suggested that the diet of a child whose mother works may be better due to increased income, while due to financial constraints an unemployed mother may not be able to feed her child as well.

Healthcare nurse (8):

INTERVIEWER: What about the diet, would that be different?

SISTER: Yeah, that is different because if [she is] unemployed some of the things she can't afford.

Healthcare nurse (6):

SISTER: And also your availability of income and the power of buying food, what nourishing food, if you only buy bread and mealy meal, you can't give the child a high protein diet.

However, relatively few participants also maintained that the children of working mothers may have a poorer diet as these mothers may be too tired or stressed to cook nutritious meals.

School teacher (3):

INTERVIEWER: Do you think that the diet of a child would be different in a home where the mother worked compared to where she did not?

TEACHER: Yeah, that would be different, especially if there wasn't a domestic worker, the mother might come home and just make quick meals that aren't healthy or eat take-away meals.

Healthcare nurse (5):

INTERVIEWER: And do you think that in the way that a child eats, like a child's diet; do you think that there would be a difference between a mother who is working and a mother who is not working in her child's diet?

SISTER: Like what? Like preparing ... maybe you lack time to prepare a well balanced diet, if you are working.

Church leader (3):

CHURCH LEADER: I would hazard a guess that I think the temptation of a person who is working is to say well, I haven't got time to cook; let me go and buy something quickly, and so they'll have this sort of ready made foods. That... that would be my guess. That's what I would do.

CHILD'S DIET AND CHILDCARE

A number of healthcare nurses maintained that the diet of children who are looked after at home by their mother is superior to that received by children who are cared for by a child minder in the home or by staff at a crèche. Reasons mentioned included the care practices of the care giver, the expense of food and staff to child ratio in childcare facilities (e.g. crèches).

Healthcare nurse (4):

SISTER: Yes, there is a difference. I once visited one crèche, I didn't like that, the food was not good; like they were giving children sour porridge without milk, and it's not good for the children. And then some crèches the

children they eat with their hands, and you'll wonder if they wash their hands before they eat. And in some of the crèches the diet is not up to the standard.

Healthcare nurse (1):

INTERVIEWER: And do you think the diet of the child who stays at home with mom would be different from the diet of a child who stays in crèche?

SISTER: Yes it would be different because since birth the mother knows the correct thing, how to prepare the menu for the child. What does my child eat, doesn't, us there at the crèche we do supplements, we don't give what mothers give, we don't have quality foods because we are providing a lot of people and they want profit so they go for the cheapest.

Healthcare nurse (6):

SISTER: Crèches have got lots of problems, because they have a lot of babies to look after, and they don't get any individual attention like at home, if you have a dedicated person at home, I think it's better for the child that way.

However, nurses also acknowledged that this will depend on who, apart from the mother, is caring for the child and the quality of the crèche used.

Healthcare nurse (7):

SISTER: I would say the best child is the one who stays with mummy, second one with the crèche and third because this could be any member of the family- if it is your mother or your sister it will be fine, but sometimes you find it is other siblings. When a baby cries it doesn't say maybe the baby is hungry, if one has to think the baby is hungry the wrong thing will be given because it will be bottle, bottle all the time even at an age where the child has to be cooked for.

SISTER: When I go to crèches, besides what I see on the wall, I sometimes want to see what is being given to these children because there can be a beautiful menu and yet it is different. Sometimes when you visit you tactfully want to go through and see how[they are] preparing [the food]. And basically now it is not every person who starts a crèche by going through the necessary training.

Fewer nurses described the diet children receive in crèche as superior to that given at home.

Healthcare nurse (2):

INTERVIEWER: And would you say there is a difference in the diet of the children, you know that's in a crèche and a child that stays at home with mum?

SISTER: Yes there is a difference. In the day care you are sure that the child is going to get better cooked food that is right for that child. At home you may find that there is nothing. Maybe you give the child bread, or give a

child... something that is available at that time. But in the day care, you find that they have organized spinach, eh vegetables, eh lunch you know, milk, you know, and all those things.

CHILD'S DIET AND MOTHER'S SCHOOLING

Most participants thought that the diet of a child may vary with the mother's level of schooling. In particular, issues of nutrients, food groups, balanced diets and ways of cooking were raised.

Church leader (1):

INTERVIEWER: Do you think that the way a mother feeds a child, the diet, do you think that will be different to a mother who has lots of schooling and the one who hasn't been to school?

CHURCH LEADER: Yes, because a mother who has been to school knows exactly what and how to feed her baby but the mother who hasn't been to school only knows that her baby's tummy should be full, and wouldn't mind about the diet, no matter as long as the tummy is full- they will be feeding the child with starch all day.

The majority of participants, although viewing education as important, also mentioned that education and knowledge may be gained from sources outside of school, for example from mothers and parents through role-modelling and from healthcare clinics.

School teacher (3):

INTERVIEWER: If we had a mother who has had a lot of schooling and a mother who hasn't had schooling, do you think the way they feed the child or diet of the child is different?

TEACHER: I would say yes especially if mothers are taught about proper diet and healthcare and that sort of thing but I still think a lot of it comes from role-modelling.

Healthcare nurse (10):

INTERVIEWER: And do you think the mother's schooling affects the diet of the child?

SISTER: Definitely. If you are not educated or have very little education you won't know about different food groups. But at sometime with ones that are not educated if you give education from healthcare workers then it helps them even if they haven't had schooling.

Some raised the issue of illiteracy as a restriction in gathering information about diet from other sources.

Healthcare nurse (11):

INTERVIEWER: Ok, ok and do you think that the, the how learned a mother is affects her child's diet?

SISTER: Yes, yes, because if, if um, you didn't go to school, there are some magazines that teach mothers how to cook. The TV, you know, the media, you know, even if, like I said to, or wherever we do recipes,

we know about the cholesterols, we know about you know how to prepare the baby's milk and whatever. It becomes difficult for them to understand those things. So education of the mother has got an influence on the baby's growth.

CHILD'S DIET AND ALCOHOL & DRUG ABUSE

A few participants in the interviews, school teachers in particular, mentioned that problematic use of drugs or alcohol by parents may negatively affect the way a child is cared for and their diet.

School teacher (4):

TEACHER: You know the most negative thing here in Orlando East is alcoholism, our kids are most affected by alcohol and drunkenness in their homes most of their parents they drink some of them they drink to such an extent that they are unable to take care of their kids and those kids feel the pressure.

School teacher (5):

TEACHER: The community, this area is very poor, the family unemployment, poverty and children come to school without food, they told me that they sleep without food they wake up with nothing but at the school we have the school nutrition program we can give them food at the school, most of the families they don't work and they are alcoholic they are not even, they are not engaged in the education...

5.3 COMMUNITY INFORMANTS- EFFECT ON ILLNESS

Participants responded that they believed a number of socio-economic measures had an effect on childhood illness. These included water facilities, toilet facilities, medical aid (private medical insurance), mother's employment, child care and mother's level of schooling (see table 5.1.2 codes 1, 2, 4, 6, 7 and 8). Questions on the effect of water and toilet facilities, medical aid and childcare on illness were addressed to healthcare nurses only. Questions addressing the effect of mother's employment and level of schooling were put to all categories of community informant.

ILLNESS AND WATER FACILITIES

Nurses mentioned that infants and children from homes which had to share an outdoor tap are more likely to experience more gastro-intestinal related illness than those from homes who had sole access to either an outdoor tap or indoor tap.

Healthcare nurse (7):

SISTER: These (outdoor) would differ from these (indoor). Because to me this child would be having illness, shall I say, to me this child (outdoor) is exposed to illnesses that would interfere with the gastrointestinal tract mostly, compared to this child (indoor). But we are not excluding this (indoor). This would be if I were to say 1/100 I would find this, but with this (outdoor) I would find a 50-50 situation.

Issues raised around sharing an outdoor tap included lack of upkeep of the tap and contact with infected individuals and infection through use of a shared tap.

Healthcare nurse (12):

SISTER: Well of course they are going to be going out and drinking from the outdoor taps, um little kids are notorious for putting their mouths to the taps, ok so you could have spread of infection that way right. Um, ja and I think it's, it's still very dependent on the parent and how careful and um, ah, what's the word, conscientious they are about keeping up cleanliness and so on.

Healthcare nurse (6):

SISTER: People in these places where they don't have indoor running water, they don't have indoor toilets, they have to use pit latrine and they don't wash their hands, because they don't have water out there. They touch their bloody noses, touch the taps and the next person come and opens and closes the tap and spreads all those germs and diseases around and children obviously suffer because their immune system isn't so well developed that they pick up anything that's going.

Healthcare nurses interviewed also responded that illness was more common in children from homes with an outdoor tap than an indoor tap due to the use of non-sterile or dirty containers to store water.

Healthcare nurse (11):

SISTER: Plastic buckets or whatever buckets so this buckets, I'm let me say let me make an example, it's, it's what is happening I'm telling you it's, it's a real, it's happening. I can use this bucket to pass urine in it and I can use it, I'm telling you, you know, I don't have things to, to you know sterilise the bucket, you don't have those things. They are too expensive, you just wash it with water and soap and then you go, fetch water and then you going to use that water to cook and do everything.

INTERVIEWER: Ok, ja, ja so it's, it can be very dangerous.

SISTER: Yes.

Healthcare nurse (10):

SISTER: Also having water from a tap you can never be sure if it [is] not contaminated even though it is from a tap because it is transported and stored in a bucket before it is consumed, so this child is more at risk.

Nurses also noted that infants and children from homes without access to an indoor hot tap have hot water less readily available and they mentioned that this may have a negative influence on hygiene, particularly in terms of bathing. The inconvenience of fetching water and time consuming nature of heating water were the main issues raised in relation to this.

Healthcare nurse (10):

SISTER: ... water I'ts not readily available, you have to go and fetch the water so you can't use plenty of water like for bathing, you must just wipe because you must not waste water.

ILLNESS AND TOILET FACILITES

Results of interviews with nurses also raised the issue of toilet facilities. It was thought that children from homes with a pit latrine experienced more illness than those from homes with flush toilets.

Healthcare nurse (7):

INTERVIEWER: And do you think the growth of a baby would be different?

SISTER: Very. Like I am saying this child (pit latrine) will have all the gastrointestinal problems will be found in this baby as compared to this (indoor flush toilet).

The unsanitary nature of pit latrines, flies, lack of running water facilities to wash hands in the case of both children and adults and difficulty in upkeep of this type of toilet were mentioned as important reasons for increased illness.

Healthcare nurse (2):

SISTER: With this one, well it is better than going outside and going and do it from the bush, but faeces and everything are there, and the flies they attract the flies. Sometimes you find the flies just loitering around and coming in and out, taking all the germs and taking them to other areas, you know and it's a health problem.

Healthcare nurse (6):

SISTER: I think there's an increased risk because the child doesn't have a tap to wash her/his hands straight away and they always forget. A child being a child will use the toilet, probably not wipe properly, not be supervised, not wash their hands either, so perhaps, they always put their hands in their mouths and they're infected and afterwards they have growth problems due to the infection.

Healthcare nurse (7):

INTERVIEWER: And a pit latrine?

SISTER: (Sigh) this in the absence of these two (indoor and outdoor flush), this has to be used. Um I am looking at this to say after toilet use where do you go to wash your hands. I am looking at it. I know people will be saying we will provide water outside which will stand there for the whole day. To me doesn't serve the purpose of washing because it stays there for the whole day you are rather getting yourself dirty, more the idea of saying I am washing my hands.

Healthcare nurse (9):

INTERVIEWER: Indoor flush toilet?

SISTER: This is the best because the minute whatever has happened in there they use the toilet to flush it over and it is clean. And in most cases you find that it is with this porcelain and it is easily cleaned. So you can clean it and it remains clean all the time. And with these types of toilet you can even add ordinary jik just to kill bacteria in it, so this is safe, the most safe.

Nurses interviewed also mentioned that children tended to pick up infection more easily and experience more illness if they lived in homes with shared access to an outdoor flush toilet than those with sole use of indoor flush toilets. The main issues raised surrounding this included poor upkeep due to diminished individual responsibility for cleaning and maintenance and unhygienic use of shared toilet facilities.

Healthcare nurse (3):

SISTER: Indoor flush toilet, because it's inside your house; it's yours; you control it. And this one outdoor flush toilet, anybody can come there from outside, even ... let's say you are inside the house; you don't see that person. So she can come and do whatever pass stools and leave them as they are, you know. So this one is even too dirty.

ILLNESS AND MEDICAL AID

The majority of nurses interviewed mentioned that the experience of illness by children from families who had medical aid was better, mainly due to faster access to medical attention, superior quality of medical attention received and better medicines and drugs.

Healthcare nurse (9):

INTERVIEWER: In your opinion what kind of difference does it make to [the] health of a child if [the] family has medical aid?

SISTER: You know what I can say is once parent has medical aid it is quicker for her child to be seen. Say in an emergency you come to a private clinic you are immediately attended because there are not those big numbers of patients that are waiting there. You come to a provincial hospital, as you come to the door the casualty is choka block full. And then these others they don't want even to give you way because they want to be treated as well as they have been long in hospital. So by the time reach the doctor maybe it is detrimental to your child. So that is why it is best to have medical aid then you can go to a place where it is not too full, you are attended immediately and your child's life might be saved.

Healthcare nurse (9):

SISTER: We see more because we see up to 54 babies in one day, which is a lot.

INTERVIEWER: How many sisters?

SISTER: Four.

INTERVIEWER: That is a lot for you.

SISTER: Yes we are very much understaffed. We have just finished now working. As you came in the last three ladies went out with their babies. We work tirelessly from 8-4:30, sometimes we don't take tea.

Healthcare nurse (1):

SISTER: You know with medical aid now, you are able to get, you go to the private clinic where you can get the best service as quick as possible than waiting in a queue in a provincial not being attended and not getting the right, the good treatment.

Healthcare nurse (2):

INTERVIEWER: Mostly no; okay and in your opinion, what kind of difference does it make to the health and growth of the child if the family has medical aid or not?

SISTER: Yes, there is a difference to the growth of the child because those children with a private medical aid they are at an advantage. They go to the best private hospitals; they're given all the tests. You know, they ... here [public hospital] we are sometimes having a shortage of everything. They [private] have abundance.

Healthcare nurse (12):

INTERVIEWER: And do you think also not only in access to treatment but in the actual treatment that people receive. Do you think there's a difference between those that have medical cover and not?

SISTER: I think so definitely without a doubt.

INTERVIEWER: Ok, and in what ways?

SISTER: Well um very often the clinics and even hospitals run out of medicines, medications uh they just don't have the medications to give the people. I know it's notorious for going to the regional clinics, um, the child or even the adult goes along, is not well, and they give Panado, and maybe if they lucky they'll get cough mixture but there is no antibiotics to give them if they need it, you know and this sort of thing.

However, relatively few nurses maintained that, apart from waiting times to receive medical attention, there was no difference between children whose families had medical aid and those who did not. In particular they maintained that the quality of medicines provided were equally good.

Healthcare nurse (7):

INTERVIEWER: Do you think a family having medical aid or not having medical aid, do you think it makes a difference to their child's health?

SISTER: Not basically. The difference is the waiting times. But my thinking is that whatever can be given in the private hospitals is available here, even if it is generic medicines. Paracetemol will be paracetemol from wherever to here.

ILLNESS AND MOTHER'S EMPLOYMENT

A variety of opinions were expressed by participants on the role and influence that mother's employment status (employed vs. unemployed) may have on a child's experience of illness. School teachers in particular mentioned that in families where mothers were employed, more income was available to take children to private healthcare centres when ill. As described above, access to medical attention and treatment is accelerated by using private medical facilities.

School teacher (3):

INTERVIEWER: Do you think they will go to different types of healthcare?

TEACHER: I think they would be able to afford different types of healthcare provider, because [of]... the job that they have.

However a large number of participants, especially healthcare nurses, also mentioned that working mothers may have difficulties due to delays in treatment seeking behaviour and difficulty caring for sick children because of work. The main issues raised in relation to this difficulty included noticing the development of symptoms, taking time off work to care for a sick child and job security.

Healthcare nurse (11):

INTERVIEWER: Ok, so you don't see the signs...

SISTER: You don't see, yes, you don't see those symptoms, you don't, you cannot assess you know, you don't give uh, uh, uh time for the baby, you know. You don't wash your baby. You, you know, you send someone, please go wash the baby. So you don't check you know, you don't ja you don't check everything. Because this mother who is not working, she's got time for the child.

Church leader (3):

INTERVIEWER: And would she do something in the same time frame if she was working and not working?

CHURCH LEADER: Well, ... she might, she might ask for time off to take the child to a clinic; or she might say 'well, I can't', because some employers are not very accommodating. So she might have to ask somebody else to take the child to a clinic. Eh, but I think she would, the mother would.

Healthcare nurse (10):

INTERVIEWER: And what do you think happens to families without medical aid, what is the process that they have to go through?

SISTER: They have to start here at the clinic you can't just go to hospital for any illness, you have to follow a queue and be send and referred to a hospital. You find most of them employed where benefits are not good, if you don't go to work- no work no pay, so they don't go to the clinic but just hope that the child is going to get better. So by the time the child goes to the hospital it is much worse.

Healthcare nurse (7):

SISTER: But most people opt for another member of the family to stay behind because if [she] has a job she really has to cling to that job.

ILLNESS AND CHILDCARE

The majority of nurses interviewed reported that infant and childhood illness was linked to different forms of child care. Most mentioned that infants and children were exposed to more infection when cared for by someone other than the mother. Increased exposure to illness was particularly mentioned for children cared for in crèche, due to the poor hygiene and care practices that may be found in some crèches.

Healthcare nurse (5):

INTERVIEWER: ... you know a child that stays in crèche and a child that stays at home with her mum; do you think there would be a difference in how often those children get sick?

SISTER: Umm ... Yes, it's a difficult one (laughing). That's a difficult one. Because I think in the crèche those children are exposed to any kind of infection, because there are many children. So, if there are measles outbreak there, they can be affected than a child that stays at home with her mother only.

Healthcare nurse (6):

INTERVIEWER: And what about the health of children, do you think that there's difference in the health of the children who attends crèches and those who are looked after at home?

SISTER: Definitely they are more susceptible to infections at crèches than children who are at home, because they are sharing toys, everybody is riding on the bicycle and blowing it's nose and putting the toys in the mouth and the next person takes that, especially the younger babies, and they don't wash them, I don't think they have the facilities to wash the toys in between the children. The children pick up infection more easily.

Some nurses also mentioned that caregivers other than mothers did not notice the development of symptoms or seek treatment as quickly as mothers themselves.

Healthcare nurse (3):

INTERVIEWER: And what about the way that ... how often a child is sick ... the child that stays at crèche and the child that stays at home with the mother; is there any difference?

SISTER: Yes, because if a mother stays with the child at home, it's very easy to see your baby that this baby is sick. She'll be reluctant to feed, crying, always crying. And in crèche there are many children; sometimes they don't see that a child of yours, that this child is sick.

ILLNESS AND MOTHER'S SCHOOLING

A variety of participants interviewed, including school teachers, church leaders and nurses reported that they thought differences in infant and childhood illness would exist between children whose mothers had a high level of schooling and those whose mothers had little or no schooling. These differences included how quickly a child would be taken to a health centre, the type of health service provider that would be used (Western versus Traditional) as well as the way mother's level of schooling would affect the administration of medicines.

School teacher (3):

INTERVIEWER: And if a child is sick, do you think a mother depending on her level of schooling will treat the child differently?

TEACHER: Yes, because the mother who has been to school will be able to pick up if there is something wrong with a child. She would read the signs differently or pick up symptoms faster.

Church leader (1):

INTERVIEWER: If a child was sick do you think there will be a difference in the way they use healthcare services?

CHURCH LEADER: Yes, because I believe somebody who have been to school knows that a child needs to be taken to doctor or a clinic and the mother who hasn't been to school might take a baby to a herbalist whereas that may not be healthy.

Healthcare nurse (5):

INTERVIEWER: And do you think as well that in the treatments that they are given from the clinic, like the medications that they are given; do you think that the level of schooling of the mum ... (interrupted by respondent).

SISTER: Yes, yes. Even here you find it difficult to explain to mothers who didn't go to school.

However, most community informants interviewed responded that the level of schooling a mother had received would not influence her child's health and illness experiences. These participants mentioned that there would be no differences in health seeking or treatment seeking behaviour, nor in the way medicines were administered.

School teacher (8):

INTERVIEWER: Do you think there is a difference between mothers who had lot of schooling compared to mothers with less schooling in the way they treat a sick child?

TEACHER: No if they are sick they do take care of them and take them to the clinic.

Healthcare nurse (6):

INTERVIEWER: And do you think that your mother's level of schooling would influence how she, not necessarily, how she gets to get healthcare but what she does with [medicines]...?

SISTER: No, you can teach anybody to make rehydration solutions, saline nose drops, you can demonstrate it, they can do it, you can repeat it, you can give them hand outs on it. No, I've seen some very primitive people from far [out in the] sticks, uneducated people that are good mothers. No, I don't think I can go with that. The level of education, look, it must be a factor but I don't think, I don't think it makes a huge difference.

5.4 COMMUNITY INFORMANTS- EFFECT ON STRESS AND MEASURES OF DISADVANTAGE

STRESS IN THE PREGNANT WOMAN & MOTHER

Healthcare nurses responded that social support in pregnancy may influence levels of stress experienced by the pregnant woman (see table 5.1.2 code 5). Questions of the effect of social support in pregnancy on stress in the pregnant woman and mother were addressed to healthcare nurses only.

STRESS IN THE PREGNANT WOMAN AND SOCIAL SUPPORT IN PREGNANCY

Nurses responded during interviews that support in pregnancy, in particular whether the mother desired the pregnancy and whether she and her family were emotionally and financially prepared for a new child, may influence stress. Nurses reported that lack of this type of social support may effect the growth of the baby during pregnancy through stress and by the pregnant woman not taking good care of herself.

Healthcare nurse (11):

INTERVIEWER: Do you think that if a mother is pregnant and she wants to be pregnant at that time, do you think that may have an impact on the health and the growth of her child?

SISTER: The exercise, she won't do the exercises, you know, you know. She will be depressed and you know all the stresses of depressed mother, you see.

Healthcare nurse (1):

INTERVIEWER: And then if you have a mother who feels happy about her pregnancy and she wants her pregnancy compared to a mother who is not ready for her pregnancy, do you think that would influence the health of her baby?

SISTER: Yes, will influence the health of the baby, the one who doesn't want the pregnancy because wont eat properly, you will always so distressed about this thing and then you know stress also affects your level of appetite, you don't eat well, you don't sleep well,

STRESS IN THE INFANT & CHILD

Participants responded that mother's employment as well as SES measures of house characteristics may influence the level of stress experienced by a child (see table 5.1.2 codes 7, 10, 11 and 12). Questions of mother's employment (employed vs. unemployed) and its effect on stress in the infant and child were addressed to all categories of community informant. Questions addressing the effect of type of home, condition of the home and tenureship on stress in the infant and child were directed to school teachers and church leaders.

STRESS IN THE INFANT & CHILD AND MOTHER'S EMPLOYMENT

Participants reported that children may experience elevated levels of stress because of the stressful environment that may exist in a home where the mother is employed. In particular, issues of mother's expressing their stress and frustration at home were raised.

Healthcare nurse (6):

SISTER: Oh, yes. I think that would be even worse especially when the mother is coming home being stressed but maybe take it out on the child if the child got on your nerves and the child would be affected emotionally.

STRESS IN THE INFANT & CHILD AND TYPE OF HOME, CONDITION OF HOME AND TENURESHIP

During interviews, participants reported that families, including children, may experience stress or depression due to their living circumstances. Indeed participants raised that children were not only aware of their situations, but would like to improve these to experience better circumstances.

Church leader (3):

CHURCH LEADER: I think it is, certainly is because I think even children are very much aware of their surroundings, especially in our society. Today one sees it by the way children like to dress. There is a sense of wanting, nice is a horrible word to use, but nice things in a child's mind.

School teacher (5):

TEACHER: It means kids living in this type of a place (shack) will have this type of idea that our parents cannot afford and this is why we are living like this and will tend to try and do something to come to the rescue of their parents. The very same kids as these who are from the shacks because here in the shacks there is abuse, there is alcoholism, thugerism, there is this type of attitude which I cannot explain. It is an irresponsible attitude basically. Because the kids here (shack) most of them are not well cared for, and you will find that the appearance of the shack one (child) is filthy. If as a person I am this type of a person who like to be clean, I will only clean my shack but I won't be able to clean the streets and everything. So the kids living have this congested mind set which is not good for education, they won't be having this freedom of open minded thinking.

During discussions about types of homes (home, cottage, flat, room, garage, shack), participants emphasised the social and psychological stress placed on individuals living in rooms, garages and shacks.

School teacher (5):

TEACHER: ... the garage it gives an impression that you live in the garage as if you are a car I remember I had a friend who lived in the garage with her family her kids usually asked their mom, mom why do we have to live here like cars, because they did not even have this private door they used this big garage door so they have to go under that door in and out so it was a problem for them.

Participants, especially school teachers, also mentioned that children from homes which were in bad disrepair experienced more problems of depression and low spirits.

Church leader (1):

INTERVIEWER: Do you think a child that stays in a home that needs a lot of repairs, that influences the way they grow and their health compared to a child that stays in a home that is in good condition?
CHURCH LEADER: I think so because the tendency that a child has is always competing with their peers and a child won't understand why he/she is living in such conditions whereas his peers are living in better conditions. And I think that affects the child maybe not health wise but mentally the child gets pressure. Sometimes you will see a child being reserved, he can't mix well with other children and when you check that it has nothing to do with the child per se, but a lot to do with the conditions she comes from.

School teacher (2):

TEACHER: Yes, the one who is from the house which eh... with some repairing and from the home which is good; there is a difference. And then the one who's... who will be affected is the one who is from the home, which needs eh, repairing.
INTERVIEWER: And why would they be affected?
TEACHER: They would be affected eh, emotionally, and sometimes eh, spiritually. You find that their spirit are... is down.

During discussions about tenureship (owned, rented from local authority, provided by employer, rented from someone else) participants reported that individuals from homes which were rented from someone else or provided by the employer may experience more stress. They raised the issue that these individuals may be affected by lack of power and decision-making ability.

School teacher (5):

TEACHER: This one is provided by the employer, I can also not do anything if the employer does not allow me to do it, and if the employer say my job is, I am no longer employed then it means I am also going to lose this one so without one I won't be securely free to say, I own this house. The rented from someone else have a problem because with these rented homes you will find that there are restrictions if I have got kids maybe the owner of the house does not want a person with kids and I have got always to keep my kid within the limits there

are certain boundaries which are not accessible to my kids and the are certain duties that as a ....what as a tenant I have to clean this, sweep the yard and do some things that maybe I won't be doing if it was a home that is owned by me. Iya-(yes), that's it.

Participants also raised the issue of uncertainty attached to these types of tenancy, whereby families may be evicted without warning or recourse.

School teacher (6):

TEACHER: It's more ... yes, it's ... at least it's controllable. It's controlled; they don't just... they inform you before they act on anything. This one they don't; if maybe they are having their own problems, then it, it also falls on you. You are kicked at the middle of the night with the children. Just think of the children; it's raining at night; you are supposed to look for a place, for a shelter during the night. Emm, provided by employer; this one is nearly like the one where you are renting from someone. Like what is happening now; they are just kicked and out of the farm, and ... look, they are not provided with any place where they can get the shelter.

Church leader (3):

CHURCH LEADER: Eh, this, I'm putting the one provided by employer last, because that would depend on the conditions of the tenant of, you know, if I know that I have this house as long as I have this job; I've always got the fear that I might eh, lose it. And I think that's one of the problems of accommodation tied to a job. That, that could be a worry for the people, for the parents.

DISADVANTAGE AND POVERTY

In addition to addressing the specific aims of the project, the focus group discussions and in-depth interviews improved the author's familiarisation with the meaning of SES and social support measures in the Soweto and Johannesburg context. Issues regarding markers of poverty were raised during general discussion in the focus groups and interviews, as well as in response to introductory questions on neighbourhood access to certain SES and social support variables. Therefore, although not specifically prompted, information from participants' comments were included to inform quantitative analysis through identifying variables that stand apart as markers of extreme advantage or disadvantage. Variables identified by participants as markers of poverty or advantage included electricity supply to the home, hot water facilities, unemployment, medical aid, type of home, condition of the home and ownership of a number of consumer durables (see table 5.1.2 codes 1, 4, 7, 9, 10, 12 and 16).

DISADVANTAGE, POVERTY AND ELECTRICITY SUPPLY

Questions about the effect of electricity supply in the home on child growth and health were addressed to school teachers and church leaders. As a means of introducing the topic, teachers and church leaders were asked to discuss the extent of the electricity supply in the neighbourhood they worked in. During these discussions many participants commented that homes that lacked electricity supply were part of a disadvantaged sector of society.

School teacher (2):

INTERVIEWER: Okay, would you say that families that use the school; would you say most of their homes have electricity?

TEACHER: No, because you find that most of the learners they are from the, the, the shacks; they are from the shacks and they don't have electricity.

DISADVANTAGE, POVERTY AND WATER FACILITIES

Questions on the effect of water facilities on child growth and health were addressed to mothers and healthcare nurses. During discussions a large number of nurses and fewer mothers mentioned that access to indoor hot water was a marker of advantage. Nurses included the cost of heating water and the infrastructure (e.g. geyser, electricity) required for such a facility.

Mother (Medium SES):

MOTHER: These ones [indoor hot tap] you find in homes where they can afford and these ones [outdoor tap] are the ones that most people use.

Healthcare nurse (10):

SISTER: Usually [the] majority of the people who live in areas with outdoor taps are poor and the accessibility of water is not easy.

Healthcare nurse (1):

SISTER: We do need both hot tap and cold water tap indoor all at once but we cannot afford all of us because we have to get a geyser and a geyser is so expensive.

DISADVANTAGE, POVERTY AND UNEMPLOYMENT

Questions on the effect of mother's work on child growth and health were addressed to all categories of informant in both interviews and focus group discussions. During discussions mothers mentioned that circumstances are particularly hard where both parents are unemployed or where the mother is a single parent without work. Mothers also mentioned that parental unemployment may precipitate a continued cycle of deprivation.

Mother (High SES):

MOTHER: It depends if the mother is the sole bread winner and you know, she is not working, there is no one to provide for the child, those two children will grow differently, yes.

Mother (Low SES):

MOTHER: The father of my children, who passed away in 2000, used to look after us well. So now that he is gone we are struggling and I am trying all that I can, even though I do not have a job, to close that gap. My eldest is always saying 'if my father was here' and that hurts.

Mother (High SES):

MOTHER: Umm, there is a big difference. The difference is that the child of the mother who's working, he gets everything. The child whose mother is not working, just because the child grows up with suffering he will probably become a criminal when he is old because he is different from other children. There will be a difference between that child and others.

DISADVANTAGE, POVERTY AND MEDICAL AID

Questions on medical aid were addressed to healthcare nurses. During interviews nurses were asked introductory questions about the extent of medical aid coverage in the neighbourhood they worked in. Nurses reported that families with medical aid were advantaged in comparison to those without. They also emphasised that this advantage would have been even more marked in 1991, prior to the period when employers started subsidising the cost of medical aid insurance schemes.

Healthcare nurse (8):

INTERVIEWER: Do many of the families who use "location name" clinic [low SES] have medical aid?
SISTER: No, it is 1/1000 because most of these people who live around here are not working. How can they afford medical aid if they are not working. It is 1/1000.

Healthcare nurse (3):

INTERVIEWER: We also have some questions about medical aid. Do you think that most of the families that use this ward [Baragwanath Hospital] have medical aid?
SISTER: No, as I told you that the others are from the shacks. They are poor.

Healthcare nurse (9):

INTERVIEWER: Can I ask you to think in [the] time of 1990. Do you think the difference between a family having or not having medical aid was different then?
SISTER: 1990 there were very few people who had medical aid then because government was still providing this sort of free treatment to everybody. So majority of people were flocking to government hospital and then very few families who came in here [private clinic]. And for medical aid then it was for those privileged, we would say those that were a bit rich, we would say those who can afford to pay medical aid before it started to be your bosses pay a certain amount and you pay a certain amount. So it was not affordable, so most people were not having medical aid. But now that medical aid is affordable you pay ½ or a ¼ your boss pays ¾ to make whole then it is affordable so that is why majority of us now we do come to private sector with your medical aid.

DISADVANTAGE, POVERTY AND TYPE AND CONDITION OF HOME

Questions concerning the effect of type of home and condition (disrepair) of the home on child growth and health were addressed to school teachers and church leaders. During responses to introductory questions as well as during discussions specific to the effect of these variables on child growth and health, teachers identified families whose home is a shack as severely disadvantaged.

School teacher (10):

INTERVIEWER: Okay, okay. And then, do you think between say like a house and a shack; the way that a child grows and the health of a child in a shack; do you think it's different to the health of a child in a house?
TEACHER: Very ... much different. Far much different, because most of the people who live in the shacks, they are poor; they are not working. That is why they're even there in the shacks, because if maybe they are ... they could afford, they could go and live in the house. Far much different.

School teacher (2):

INTERVIEWER: Okay. And do you think; thinking about the growth and the health of a child that is living for example in a house and a child living in a shack; do you think there could be any difference in the growth?

TEACHER: Yes, there can be a difference; there will be a different. The difference is that eh... this, the child who's living in a house has got the advantages, and then this one is disadvantaged.

During discussions, following introductory questions on the extent of disrepair of homes in the neighbourhood participants worked in, church leaders identified families living in homes which required a lot of repairs and were in poor condition as disadvantaged.

Church leader (1):

INTERVIEWER: And why do you think they are not repaired?

CHURCH LEADER: Because people do not have money to do that and if that wasn't the case they would love to live in better houses, but they cannot afford.

Church leader (2):

INTERVIEWER: OK. Thank you. And do you think that a lot of the homes in the area of your parish [low SES] are in need of repairs? Do they have broken doors, leaking roofs?

CHURCH LEADER: Certainly. There are quite a number of things that are not in order. Some of the people you can see that they can't even put a ceiling on their houses. It means that they cannot afford to do that so because ceilings play a major role it protects the heat and even the temperature or the weather. And some of the gates are collapsing, they don't have their walls so they've got a number of repairs. Some of the taps are leaking. It shows that because that's the responsibility of the people who are living there, it's not the responsibility of the government so you can see these people they can't even afford to call a plumber to fix the leaking tap.

Church leader (5):

INTERVIEWER: Do you think a lot of the homes here in Zola [low SES] need to be repaired, like with broken windows, doors and leaking roofs?

CHURCH LEADER: Yes, I think so because in the old days the Municipality Housing Department had maintenance groups that were taking care of our homes because we got our homes from them. But now we need to repair the houses ourselves and the houses need not only to be repaired but extended as well, as families are growing. There are those who are not working and can't afford to repair the house- to put your own fence and your own gates.

DISADVANTAGE, POVERTY AND OWNDERSHIP OF CONSUMER DURABLES

Questions on ownership of a number of consumer durables were addressed to mothers during focus group discussions. As a means of introducing the topic, mothers were asked questions about the extent of ownership of consumer durables in their neighbourhood. This was carried out using pile sorting of photo cards of items into those most people in that neighbourhood would have and those very few people would have. Mothers' homes which owned cars and washing machines were

labelled as advantaged, while they identified those without televisions as a more disadvantaged group.

Mother (High SES):

INTERVIEWER: And what do you think is the most important, like the thing, the most influential thing in owning a car? (long silence) Why would people not own a car? Is it because they don't need it?

MOTHER: No (corporate answer)

MOTHER: Money

MOTHER: It's money

INTERVIEWER: It's money?

MOTHER: Money (laughter all talking)

INTERVIEWER: Ok, ok.

Mother (High SES):

MOTHER: Well no, I was talking about the car thing. It's because of most of the time it's because of unemployment. Most of the people are unemployed and we are single parents so we can't afford to have a car.

Mother (Low SES):

MOTHER: I would love to have a washing machine, I just don't have the money or the space where I can use it. There is a house where I used to work and their laundry was done with a washing machine. ...It depends where you live, like if I had a nice place where I could put the machine, I'm sure I would have one... I live in a shack. I don't have a tap to connect it to, and you can't drag it outside every time you want to wash. Where I used to work, it was fully connected, all you had to do was open the tap and start it.

INTERVIEWER: But in the areas where we live, it's maybe also hard because there's not the connections. So, do we think that there are any other reasons in the communities that we live, that not a lot of people might have a washing machine?

MOTHER: Yes, like people who live in the RDP houses, they have to buy their electricity. So if you are going to plug in a machine as well, it is going to use up too much electricity. And so people cannot afford that.

Mother (High SES):

MOTHER: I'm poor, I've got no money to buy TV, that is why I am buying radio, it is because of money.

Mother (High SES):

MOTHER: I think it may not be very important but it means something, you know we as people, we are poor, we always don't want to expose ourselves at least. So for us, we buy these things, you find that very poor people, they have a TV just to maintain a status of some sort and they're trying to protect their children.

5.5 MOTHERS

As with community informants, perceptions of mothers collected during focus group discussions, were summarised under the headings of diet, illness and stress. However, as the second aim of this qualitative project was to investigate if these perceptions varied by SES category, a matrix approach to analysis within each of the three SES groups was undertaken. In this project two focus group discussions were held with mothers of a relatively high SES category, two with those of medium level SES and three with those of a low SES category. Comparisons were made between issues raised during discussions in groups of each of the three SES categories and results are summarised in tables 5.5.1 - 5.5.9.

DIET

DIET AND MOTHER'S EMPLOYMENT

Mothers of all three SES categories were asked questions on the effect that mother's employment (employed vs. unemployed) may have on a child's diet (table 5.1.2 code 7). Mothers in the low SES category responded that maternal employment may have some positive effect on diet, particularly due to increased levels of income and the ability to afford better or "luxury" foods. However, this group of mothers also stated that even unemployed mothers would make sure that their child was fed and that some unemployed mothers may compensate for their lack of income by growing their own vegetables. Fewer mothers from the medium SES category mentioned that mother's employment status may affect a child's diet. High SES category mothers responded that unemployed mothers would not be able to afford to feed their children a balanced diet (table 5.5.1).

DIET AND MOTHER'S SCHOOLING

Mother's level of schooling and employment status were very linked in the discussions of mothers in the low SES category, whereby more education was connected with a better employment status (table 5.1.2 code 8). Mothers in the low SES category mentioned that educated mothers may have higher incomes to spend on food than unschooled mothers. These mothers also discussed that educated mothers may not have as much time to prepare food as uneducated ones. Very few mothers in this category mentioned that unschooled mothers would not know how to prepare a balanced meal (e.g. due to illiteracy and incapacity to read recipe books). Rather the majority mentioned that mothers don't need schooling to learn about feeding or raising a child. They stated that this was learned from parents mostly, not from school. Similarly, mothers in the medium SES category also mentioned that mother's level of schooling would not affect diet, but emphasised that this type of information was learned from parents. Although mothers in the high SES category

groups mentioned that schooling wasn't necessary to learn how to be a mother, they also mentioned that uneducated mothers wouldn't have knowledge about food groups and nutrition and that this would affect how they fed their children (table 5.5.2).

Table 5.5.1 Effect of mother's employment on diet, by SES category

Low SES	Medium SES	High SES
Income *They all eat expensive food and you who is uneducated, with no money will eat lower than them. When you don't have money you can't afford to feed your children fancy things, but when you have money you will make sure that they have enough.* Make do/ grow own vegetables *But if she is around she can just try to get bread or some milk, but she is trying as I have said, each and every time, the mothers that are not working, they make sure that their children, even that they don't afford they get something.* *You'll find that one unemployed mother will decide to plant veggies in her garden, so that there will at least be something healthy to eat.*	Income *Like when you are earning a little, you can't buy pizzas, you buy according to your salary, you buy cheaper foods.*	Income *I think sometimes maybe even mothers who are not working, children will have less to eat because now she is not able to provide and there's nothing to buy food [with].*

Table 5.5.2 Effect of mother's schooling on diet, by SES category

Low SES	Medium SES	High SES
Income *I think the mother that's educated is getting enough money, and the one who is not educated, she can't afford. Children are going to eat Kellogg's and for the one who is uneducated, they will eat soft porridge, so I think there will be some differences. The educated one will go to Checkers or Pick & Pay and I won't go to Checkers to buy food, I get the brands that have no names.* Time to cook *On the other hand, an educated mother may not have enough time to cook.*		
Balanced diet *An educated mother will know what is right for the child, the foods that she must feed him and how they should be cooked.* *And an uneducated mother will not be able to even read the recipe book.*		Balanced diet *Because of the educational background, I know that my children must get a lot of protein and I know that proteins are good. So the parent with less education is not exposed to that type of information.*
Schooling not essential to be mother *It doesn't make a difference whether you are educated or not. You raise your child as best you can.*	Schooling not essential to be mother *Yes, it's true that we raise children through our own experiences and of those around us. You raise them according to what you think is good for them. You also take a guide from how your parents raised you.*	Schooling not essential to be mother *You don't have to go to school to be a mother. I think you learn it from your mother who understood her family, loved the children, gave the children a good treatment. You go to school but you don't know how to keep your child.*

DIET AND OWNERSHIP OF A FRIDGE

Some mothers in the low SES categories responded that owning a fridge may influence a child's diet by affecting food storage as well as food buying patterns (bulk buying at end of month when salaries are paid) (table 5.1.2 code 16). Mothers in this category also raised the difficulty of sharing this type of consumer durable with other households. Relatively few mothers from medium SES categories mentioned that ownership of a fridge may influence a child's diet. However, ownership of a fridge was considered a necessity by mothers in high SES categories in order to preserve food and feed children well (table 5.5.3).

Table 5.5.3 Effect of ownership of a fridge on diet, by SES category

Low SES	Medium SES	High SES
Storage *The house that has a fridge may have more food and healthier food because they are able to store it. Unlike in a house that doesn't have one, there might not be as much food.*	Storage *The family without a fridge it is going to be difficult for children because sometimes you buy something and because you don't have a fridge you will put it somewhere and the food goes off.*	Storage *I think a fridge is a necessity.* *I think to have a fridge at home is a good idea, because food is the best when you put it in the fridge.*
Buying patterns *But do you understand, if you don't have a fridge you must buy meat every day because you don't have a place to store it.*		
Inconvenient to share *Not having a fridge is not right, because what will you do with the food that you buy. Using someone else's fridge is troublesome because they will get irritated.*		

ILLNESS

ILLNESS AND TOILET FACILITIES

During focus group discussions, mothers from each SES category were asked to discuss if they believed the growth and health of a child or infant would vary between homes with different toilet facilities (indoor flush toilet, outdoor flush toilet and pit latrine). Mothers in the low SES category responded that infection status and health of a child may be negatively affected by living in a home with a non-flush toilet (table 5.1.2 code 2). They mentioned that a child's health status was particularly influenced by the unclean nature of pit latrines, the difficulty in upkeeping (cleaning) this type of toilet facility and the associated problem of flies. In comparison, flush toilets were described by mothers in the low SES category as cleaner and easier to upkeep. Mothers in this category also responded that sharing toilet facilities with people outside the home unit could negatively influence illness by increasing the risk of picking up infections. Mothers in the medium SES category also responded that childhood illness may be affected by shared or sole access to a toilet facility, although these opinions were less widespread and elaborately illustrated than in the low SES category. Mothers in the high SES group discussions also highlighted the importance of toilet facilities for child health. Pit latrines were described as unclean and produced an environment in which disease could be contracted. Flush toilets, and in particular indoor flush toilets, were considered cleaner and more sanitary as they were easier to clean and offered the opportunity to wash hands (table 5.5.4).

ILLNESS AND WATER FACILITIES

Mothers were asked whether they believed the growth and health of infants and children differed between homes that had different types of water facility (indoor hot and cold tap, indoor cold tap, outdoor tap) and different access to water facilities (shared or sole access) (table 5.1.2 code 1). Mothers in both the medium and high SES categories responded that the water facilities may influence a child's health, however, no mothers in the low SES category mentioned this. Many mothers of medium SES responded that access to water facilities, and in particular sharing an outdoor tap with other households, could negatively influence child health. Fewer mentioned that not having an indoor hot tap may negatively affect bathing habits. Mothers in the high SES category also responded that sharing an outdoor tap with people outside the household may negatively influence child health. They mentioned that children who use this type of water facility usually experience more disease, picked up from other tap users and the unsanitary condition of the shared tap (table 5.5.5).

Table 5.5.4 Effect of type of toilet on illness, by SES category

Low SES	Medium SES	High SES
Cleanliness *I like this one (indoor flush) because it is inside the house and is clean. It is also safer for children in terms of cleanliness and health.*		Cleanliness *I think there is a big difference if the toilet does not flush. Maybe I have a kind of Diarrhoea and I sit on that toilet, remember that that toilet is not flushing. A young girl comes after me, they're going to catch this disease you know.*
Upkeep *You can't really clean that one (pit)*		Upkeep *No, it (pit latrine) is totally wrong because first if you sit there, nobody can flush you know. If you sit there and you have diarrhoea, I have something else, we have to sit on the same toilet, and the children come and sit here too. They have to touch and nobody can wash the toilet you know.*
Sharing *Because with the one outside, everybody goes there and some people are not very clean. Others spit on the toilet seat. So there are a lot of germs*	Sharing *You're going to have a problem there (sharing) because if it is in the street because they don't clean, anyone who goes in there can mess it and leave a mess there and when you come you find a mess.*	
Flies *I don't like this toilet (pit) for anyone because it is unhealthy. Flies will go in there after you've been, then they come and sit on your food.*		Washing hands *Like this indoor flush, na, there's always a tap to wash your hands.*

Table 5.5.5 Effect of type of water facility on illness, by SES category

Low SES	Medium SES	High SES
	Sharing *I prefer the indoor cold tap, because the indoor cold tap is in the home, you know each of you who uses it. You're careful about your tap. But the outdoor one, anyone comes and uses it. So in the yard you can set some rules, and you can teach your children not to drink with mouths, they must take cups.* Bathing habits *This one (outdoor tap) is not nice because you have to go and get water from the tap then come back and boil the water. It is too much work. So at times like when it is raining you won't bathe because you have to go out there to get the water.*	Sharing *I think... the tap in the street is for everybody and they are going to touch it, I mean we don't always keep out hands clean. You are going to touch, I'm going to touch that tap with my dirty hands and then maybe the child comes and touches the same tap and then you know children like, you know, eating their hands...*

ILLNESS AND MOTHER'S EMPLOYMENT

Mothers in each SES category were asked to discuss if, in their opinion, mother's employment status (employed vs. unemployed) influenced illness. Mothers of low SES responded that there may be a difference in health seeking behaviour between unemployed and employed mothers due to the availability of income and funds for healthcare (table 5.1.2 code 7). These mothers responded that employed mothers may, due to income, access private healthcare services and as such access treatment more quickly. However, these mothers emphasised that even those without means could receive treatment and medical attention from clinics.

Mothers in the medium SES categories also responded that employed mothers may have more income to access private healthcare services and allow their child to receive more timely diagnosis and treatment. These mothers also mentioned that mothers at work would differ to mothers at home in how fast symptoms of a child's illness were noticed. A few mothers in the medium SES category mentioned that there were differences in care of a sick child of a mother who worked as this child had to be left with someone else during the day and this may influence the administration of medicines.

Mothers in the high SES category also mentioned that working mothers would have more income than unemployed mothers and could afford to use private, and more speedy, healthcare services, although a few mothers in this category still noted that unemployed mothers may take a child to the clinic. These mothers emphasised that noticing symptoms in a sick child was more difficult for working mothers who were not around their children as often as unemployed mothers. However mothers in this category believed that, although challenging, a working mother could adequately care for a sick child either by taking time off work or by organising for someone else to care for the child (table 5.5.6).

Table 5.5.6 Effect of mother's employment on illness, by SES category

Low SES	Medium SES	High SES
	Fund/ private healthcare *I think the important thing is when the mother's working and the child is ill, she can afford to go to the doctor (private doctor).*	Fund/ private healthcare *But the mother who is working will take the child to the doctor... a private doctor while the one who is not working they can be taking her to the clinic. So that is the difference.*
Use of public healthcare services *The medication that they get on medical aid is the same [as from the public sector] so the only difference is that they went to the doctor who examined the child.*		Use of public healthcare services *I think that if you are working or not, and if you've got a sick child, we can still take out child to the clinic or wherever we can get her*
	Speed of noticing symptoms *There is a difference. Because when you work maybe you leave for work very early, you do not get to see the child before you leave. Then the next thing you get a call saying that the child is ill. But when you are at home you can see when the child wakes up whether they are ok or not.*	Speed of noticing symptoms *Whereas when now I'm working at home if she is sick I can see immediately in the morning and I can give her Panado just to carry her through the afternoon. In the afternoon she can come and have a rest.*
	Care of sick child *When you are at home you can give their treatment according to the doctor's instructions. When you aren't there (i.e. at work), you need someone else to do it and they might not do it properly.*	Care of sick child *I think maybe if she's working she can ask somebody else to look after the child and then to give the treatment, the same treatment to the child. Or maybe she can take days off from work or to come and look after the child because they do get those privileges of looking after your children when they are sick.*

ILLNESS AND MOTHER'S SCHOOLING

Questions on the influence of maternal level of schooling on illness were put to mothers of all SES categories. Views of mothers in low SES categories on schooling were closely related to those of employment status. Mothers of low SES reported that those mothers with more schooling had more means and could therefore afford to use private, and more speedy, healthcare services (table 5.1.2 code 8). A few mothers in this category mentioned that mothers with little or no schooling may use alternative or traditional (non-Western) practitioners. A number of mothers in the medium SES category responded that illiteracy may affect the administration of medicines in the unschooled group. A few mothers in the high SES category responded that mother's level of schooling may influence how fast symptoms are noticed. A minority of mothers in this category mentioned that a mother's level of schooling may influence the type of practitioner used (table 5.5.7).

Table 5.5.7 Effect of mother's schooling on illness, by SES category

Low SES	Medium SES	High SES
Funds/ private healthcare services *Yes because the educated mother will take the child to the private doctor or hospital whereas the uneducated will just take the child to the clinic and at the clinic they [the clinic] will give Panados, that's all.*	Administration of medicines *Because if you are a woman and your child is sick, and the doctor gave you some medicine I can't even read this thing...*	Speed of noticing symptoms *A parent for instance who is educated is well informed on the symptoms for instance how soon, what to look for in a child so you can decide how soon you must take a child to the hospital. You're aware of things, you know, and that is the difference between the parents who are not educated.*
Use of alternative medicine *The educated mothers won't give their children something like the spuit because they fear it will kill their child. I on the other hand, if my child is feverish will try that first. They would rather take the child straight to the doctor.*		Use of alternative medicine *I think the one that the parents are generally more educated will go to the doctors and the one with the less education will always be concerned with the traditional ways.*

ILLNESS AND OWNERSHIP OF CONSUMER DURABLES

Mothers were asked to discuss if there were any differences in the growth and health of infants and children between homes that owned and did not own a number of consumer durables, including a telephone, fridge and car. Mothers in the low SES category responded that ownership or access to a telephone, fridge or car may affect access to healthcare by allowing rapid access to services in an emergency (table 5.1.2 code 16). One participant in this category also mentioned that access to

a fridge may influence the storage of medicines. One mother in the high SES category mentioned that ownership of a telephone may affect access to emergency services, including ambulances. However, on the whole the effect of owning consumer durables on health or illness was not mentioned by mothers in either the medium or high SES categories (table 5.5.8).

Table 5.5.8 Effect of ownership of a car, phone and fridge on illness, by SES category

Low SES	Medium SES	High SES
Access to healthcare/ emergency services *A car is very useful like maybe when someone is sick and it is late at night you can't go and wake a neighbour and the ambulance takes a long time to come then you can just start your car and go.* *The phone is an absolute necessity because if you are in trouble you call the police quickly. Also if the child is sick or you are sick and there is nobody else, you can use it to call for help.* Storage of medicines *Sometimes they give you medicines in the clinic and say you must keep them in the fridge.*		Access to healthcare/ emergency services *There is a difference, when they want to get help for example when the child gets burnt by the boiling water they cannot go to the public phone to call the hospital to come and fetch them. Maybe me I am sick, my child dials the number to the hospital and they come and fetch me.*

STRESS

STRESS AND MOTHER'S EMPLOYMENT

Mothers from all SES categories, were asked to discuss the positive and negative effects of maternal employment on the child (table 5.1.2 code 7). As such, responses were not specifically prompted, but phrased in the manner of positive and negative influences. Mothers in the low SES category mentioned that lack of income due to unemployment affected children in a negative way, particularly with relation to peer pressure, fitting in and teasing. Conversely, mothers of medium and high SES emphasised the negative effect of mother's employment on children, especially in terms of mothers taking out their stress on children (table 5.5.9).

Table 5.5.9 Effect mother's employment on stress, by SES category

Low SES	Medium SES	High SES
Peer pressure and teasing *You see you compete with these children whose parents (are rich) only to find out that your child is lonely... only to find out that Jo who doesn't have these "All star" shoes is left out...* *I have a problem with my child. If you don't give her bread with eggs, she doesn't want to go to school. If I give her pap, she refuses.* *(other mother) It is because the other children tease her...*	Stress taken out on children *Sometimes you'll find that I have to help them with homework, I can't help them because I am tired. I have to cook, I have to do this and that. I get stressed. That is a negative thing.*	Stress taken out on children *Like for example, it might be that when the mother comes home from work, she comes being stressed and when she gets home she releases her stress on the children and they too become confused.*

5.6 RANKING ORDERS OF CATEGORICAL VARIABLES

The third aim of this qualitative project was to inform quantitative analysis by obtaining local opinions on ranking orders for a number of categorical variables that were collected in the Bt20 cohort. These variables included water facility, toilet facility, childcare, the type of home, tenureship and roofing material. Participants in focus group discussions and interviews were asked to rank the categories of these variables, either through listing the order (childcare, tenureship and roofing material) or by pile sorting of photo cards (water, toilet, type of home). Table 5.6.1 shows the sub-themes from open coding used to summarise participant's explanations for ranking orders.

Table 5.6.1 Main and sub-themes used for ranking of categorical variables

Main theme code	Sub theme label	Explanation
1. Water * †		hot indoor, cold indoor, outside tap, shared/sole access
1.3	Hygiene	washing, bathing of child
1.6	Accessibility	access to taps, control of access, upkeep, responsibility
1.7	Convenience	fetching (time, travel) & heating, boiling
2. Toilet * †		indoor flush toilet, outdoor flush, pit latrine, shared/sole access
2.2.	Hygiene	washing hands
2.3	Unpleasant	smell, waste (urine, faeces)
2.4	Upkeep	cleaning, access/ control
2.5	Sharing	access/ control, different standards
6. Childcare †		alternative to mother caring for child during the day
6.1	Diet	balanced, cheap food, lack of variety, child's specific likes
6.2	Illness	exposure, taking child to clinic, noticing child is sick
6.3	Attention to child	ratio of carers/ children, individual attention
6.4	Quality of care provider	training, registered, supervision, not siblings
6.5	Cost	expense
6.6	Development	socialised, many different carers
10. Type of home §		House, cottage, flat, room, garage, shack
10.1	Privacy	child own room, share with parents
10.2	Space/crowding	overcrowded, cramped
10.3	Facilities	water, sanitation
10.4	Unpleasant	hot, cold, not comfortable
10.6	Psychology	outside influences
11. Tenureship §		Owned, rented local authority, provided by employer, private landlord
11.1	Loss of home	eviction
11.2	Decision making	someone else's rules
11.3	Landlord tenant relationship	whims, orders, chores, potential to make complaints
11.4	Psychology	sense identity
11.5	Quality of property	
12. Condition of home §		broken windows or doors, leaks
12.2	Income/ disadvantage	cost, old area, pensioners, unemployed
12.3	Security	break-ins
12.4	Health	diet, leaks, cold
13. Roofing material §		tiles, corrugated metal, asbestos, masonite
13.1	Income/ expense	cost of material
13.2	Leaks	leaking roof
13.3	Security	break-ins
13.4	Temperature control	keeping house warm or cool
13.5	Health	disease
13.6	Repair/ maintenance	frequency of replacement, durability

RANKING OF WATER FACILITES

Healthcare nurses and mothers were asked to rank categories of water facility (indoor hot and cold tap, indoor cold tap only, outdoor tap). Nurses and mothers interviewed, unanimously ranked water facilities in the following manner:

1. access to an indoor hot and cold tap
2. access to an indoor cold tap only
3. access to an outdoor cold tap

Participants specifically raised two aspects of convenience; fetching water and boiling or heating water. In terms of convenience of fetching water, a distinction was made between having an indoor and outdoor tap. In terms of convenience of boiling or heating water, a distinction was made between access to a hot water tap and a cold tap only.

Mother (Low SES):

MOTHER: There is a difference because the first one [outdoor cold tap] takes up a lot of time getting the water and boiling it. This one [indoor hot and cold tap] makes life a lot easier because both hot and cold are available to you immediately.

Healthcare nurse (10):

SISTER: I would say here it's easier if you have both, hot and cold water because that makes it easier for the mother for example: bathing, as it is time consuming to warm up water and if people don't have electricity they cannot afford to warm up water for bathing. With a cold tap it is better than nothing and it is easily accessible because it is inside the house, so it is better than this one, outside tap. Indoor cold tap is more accessible than outside but it is still expensive to warm up the water not only for bathing but to prepare the feeds as well. And here, outside tap, there is a lot of work involved.

Participants raised an additional distinction between outdoor taps that were located within someone's yard and exclusively for use by the family, and taps shared with others in the community. Again unanimously, participants rated the sole access outdoor tap as superior to the shared outdoor tap.

Healthcare nurse (8):

INTERVIEWER: If you did have tap in the street, do you think the difference between being in the street and shared and in yard only (interrupted by participant)...

SISTER: Yes there is a vast difference, because if there is a tap serving the whole row of houses is a hassle, have to go put tin there and wait for your turn so it means spend more time queuing for water. When in yard don't have to queue.

RANKING OF TOILET FACILITIES

Ranking of toilet facilities was carried out by healthcare nurses and mothers. Nurses and mothers also unanimously ranked toilet facilities in the following order:

1. indoor flush toilet
2. outdoor flush toilet
3. pit latrine

The main reasons raised by participants for this ordering included the ability to flush away waste, cleanliness and the relative ease of cleaning/ up-keeping the facility.

Mother (low SES):

MOTHER: I like this one [indoor flush toilet] because you are able to close it, flush it and clean it, unlike the other ones.

Healthcare nurse (8):

SISTER: The pit latrine is a disaster.

INTERVIEWER: How come?

SISTER: You know it is not flushable, everything remains there. It is a danger to little ones they can even fall inside. It is unhygienic if don't know how to care for it, like buying lime to put in to stop the smell which comes. It is terrible, it is uncomfortable.

Nurses, in particular, were emphatic in their opinion that a toilet should not be shared by more than one family due to problems of cleanliness.

Healthcare nurse (1):

SISTER: I'm preferring it [indoor toilet] because it is only used by that family, not many families with different diseases where you can catch diseases like when you are going in public toilet there in the supermarket. You don't feel happy. You're afraid even to sit.

Mother (Medium SES):

MOTHER: Lots of people sharing, yes within the yard.

MOTHER: Including the squatters?

MOTHER: Yes.

MOTHER: No it's not right because some people are very filthy.

MOTHER: Sometimes you come and it's awful.

MOTHER: Some people pee on the rim and others don't flush after them.

RANKING OF CHILDCARE SERVICES

Healthcare nurses were asked to discuss the childcare options available to mothers if they couldn't care for their child themselves during the day. Nurses were then asked to rank the types of childcare service they mentioned. The opinion of the majority of nurses interviewed was that the first and ideal choice of caregiver for a child was the mother.

Healthcare nurse (1):

SISTER: The best child will be the child that stays with the mother because she knows what is best for baby.

Other feasible options mentioned included crèche (where a child is cared for at a centre), childminders (care for the child in the home), grandmothers of the child and other relatives e.g. siblings of the child. Nurses mentioned that the relative order of these types of childcare depended on the quality of the childcare option. Registered crèches were considered superior to unregistered crèches.

Healthcare nurse (3):

INTERVIEWER: What about crèches? Do women use crèches?

SISTER: The crèches? Crèches, I think, crèches are all right, but I think the crèches are all right when the child is from six months. Yes, crèches are all right. But you must look for a crèche which is registered, because there are those mbombayi crèches like I can just take my house and say it is a crèche, and when you come there ... when the people come there, that place is dirty. There are those crèches.

Crèches where each carer had fewer, rather than more, children to take care of were also preferred.

Healthcare nurse (6):

SISTER: Crèches have got lots of problems, because they have a lot of babies to look after, and they don't get any individual attention like at home, if you have a dedicated person at home, I think it's better for the child that way.

A grandmother or suitable adult family member was considered by many nurses to be a good choice, and usually a cost-effective option.

Healthcare nurse (9):

INTERVIEWER: If a mother during the day she can't be at home to take care of her child, what are her choices?

SISTER: Her choices is she must just try and have a substitute mother who will give love to this child or whatever. In most cases we tend to like grannies to be with us when you have that child because your mum is going to give love to your child and then that child will grow up with love. When mum comes back from work she gets that love from the mother whereas she is getting it from granny as well.

Healthcare nurse (4):

SISTER: With us Blacks the extended family, they come in handy; our grannies they look after the children if you can't afford to take it to a crèche.

However, not all family members were considered a good option, in particular being cared for by a sibling was considered a poor choice of caregiver.

Healthcare nurse (7):

SISTER: I would say the best child is the one who stays with mummy, second one with the crèche and third because this could be any member of the family- if it is your mother or your sister it will be fine, but sometimes you find it is other siblings ... With my mum or sister I would say that is relevant, but if it is other siblings, oh, I am having a problem- but these are the things you see around our communities.

The capability of a childminder, as well as the clarity of instructions left to follow, were also considered important.

Healthcare nurse (10):

INTERVIEWER: If the mother can't stay at home to take care of the child what's the next best option?

SISTER: I think is to have someone like a nanny. It doesn't have to be a professional nanny as long as you are going to train her and make sure everything is there and instruct her on how to do things.

RANKING OF TYPES OF HOME

Questions on the ranking of types of home were addressed to school teachers and church leaders. The majority of participants interviewed ranked the types of home in the following order:

1. house
2. cottage
3. flat
4. room
5. garage
6. shack

Issues surrounding space and over-crowding were important and were frequently mentioned during discussions and interviews.

Church leader (2):

CHURCH LEADER: To add on that the other thing that doesn't sustain the growth of a child, you know some of these children they are growing up in the families where there are six children that are staying in a three roomed house, you can imagine its over crowded and the attention that a child needs it doesn't get the attention.

School teacher (3):

TEACHER: There is lots of people living in the same room in a shack. whereas in a house there is more space and a number of rooms where each child can have a room and there is no sharing, and in a shack there is no garden to play where the kids can stretch their legs.

Issues of privacy between parents and children in particular were also central.

School teacher (7):

TEACHER: For instance, we have children who stays at the shacks out there at Protea South. You know, you can hear them by talking their behaviour that the type of environment they come from is not the environment that we see outside here. Why, because both the family and the children share one room, where the father would be sleeping with the mother on the bed, and the children sleeping on the floor. At times, a child is not in the mood of sleeping in that very night; and unfortunately, the father would take it that all the children are fast asleep, only to find that some are not. And you know, you know what happens with adults when they are two.

Church leader (4):

INTERVIEWER: Do you think the health and growth of young children would be affected by the type of home they are living in?

CHURCH LEADER: They definitely are, purely from the point of view that in a shack the whole family is sleeping together so there is very little privacy, children hear everything that goes on in and if there are problems in the family with alcohol and drugs they can experience the real awfulness of broken families.

The lack of facilities in a room, garage or shack as well as the unpleasant nature of these types of home, were also issues frequently raised by participants, and church leaders in particular.

Church leader (1):

CHURCH LEADER: I think so because in the shacks most of that time they don't have water or electricity and that will impact negatively on the upbringing of the child than the child who is growing in a proper house who will normally have everything they need to bring up a child, so there would be a difference.

RANKING OF TYPES OF TENURESHIP

School teachers and church leaders were asked to rank types of tenureship. Participants interviewed agreed on the following order for types of tenureship:

1. owned
2. rented from local authority
3. provided by/rented from employer
4. rented from someone else

The main issues raised concerning the ranking of types of tenureship were issues of power between the landlord and tenant, in particular complying with rules made by the landlord and the threat of being evicted.

School teacher (4):

TEACHER: This one [rented from someone else] is worse because they will tell you that they have rules. The rules maybe the owner told you that every morning you must sweep the floor and clean the yard and the toilet. Because you don't have a place to stay you have to abide to the rules from the owner.

Church leader (2):

INTERVIEWER: We have some types of tenureship. Could you put them in order for us? So rented from someone else you think is the worst, why is that?

CHURCH LEADER: Well you don't know what he thinks he might think of a night that he needs his house and you will be out in the street. So for me it is the least that I would go for.

INTERVIEWER: And renting from the local authority?

CHURCH LEADER: That is better but at the same time you have no ownership but at least you will have some kind of contact with the owner because the local authority can't just get you out of the house overnight, they will give you some time to make some other arrangements. For example if you fail to pay your rent they will give you some time and make some other arrangements with you.

RANKING OF ROOFING MATERIALS

School teachers and church leaders were asked to rank types of roofing material (tiles, corrugated metal, asbestos, asbestos and zinc, concrete and masonite). Participants agreed that tiles were the best material for constructing a roof while masonite was the worst. Tiles were identified as the roofing material of choice as they were strong and durable, able to withstand extreme weather conditions and required little maintenance and infrequent replacing. On the other hand, masonite was described as easily broken and offering little protection against the elements.

School teacher (2):

TEACHER: Yes. This one a tile, I mean, really I think is a nice thing, very expensive one, although it's not expensive but is a long-lasting thing.

Church leader (2):

INTERVIEWER: So why do you think the tiles, why do you choose these first?

CHURCH LEADER: Tiles you don't have a problem with tiles that much, tiles stand for different kinds of weather, it makes the house look beautiful.

School teacher (3):

TEACHER: Masonite is used in the shacks- it doesn't shelter well from the rain.

Church leader (1):

INTERVIEWER: And we have a child staying in a home where the roof is made of masonite compared to a child staying in a home were the roof is made of tiles, do you think that will make a difference to health and growth?

CHURCH LEADER: Yes, I think so because staying in a house with tiles you are more settled and staying in a house with masonite anything can happen, heavy winds and heavy rains will come and you won't be secured and that makes a difference.

However, there was not agreement between participants on the ranking of materials between the two extremes of tiles and masonite. Corrugated metal roofing was described by some participants as an alternative to tiles, if tiles were too expensive. Problems with corrugated metal roofing highlighted during interviews included leaks, maintenance and temperature control.

Church leader (2):

CHURCH LEADER: I think it's OK. If you cannot afford tiles you can use corrugated metal.

School teacher (8):

TEACHER: Corrugated metals do leak, especially where you put the nails.

Church leader (1):

INTERVIEWER: Corrugated metals?

CHURCH LEADER: Sometimes they rust and you have to change them, so they don't last

School teacher (6):

TEACHER: The only thing, they [houses with corrugated metal roofs] need a ceiling, because if there is no ceiling, when it's cold, in the morning, usually in the morning, the water drops from the... the metal to the, to the people or anything inside the house.

INTERVIEWER: And does it get hot?

TEACHER: Yes, it gets hot; when it's hot, it gets hot. Sometimes you can even think that the rain outside is drizzling, whereas there is nothing [noise of metal expanding]. Yes, they are affected by the weather.

Few participants commented on the use of concrete as a roofing material, some were not aware of its use for this purpose. A few mentioned that concrete roofing would have problems of temperature control.

School teacher (1):

TEACHER: Yes, yes. I prefer tile, asbestos, yes, yes; concrete, this I don't know them.

Church leader (2):

CHURCH LEADER: Before we carry on you see the concrete it does give a problem, and then wintertime is cold and summertime when it's hot it's very hot. It doesn't help in the maintenance of the weather, to help the people who are living there it affects them.

A number of participants recalled asbestos as a material used for roofing in townships and mentioned that it had problems of damage which required replacing as holes etc. could not be repaired in this material. A few also mentioned health problems associated with the use of asbestos as a roofing material.

Church leader (4):

CHURCH LEADER: Hmm masonite, concrete, asbestos and zinc I think were all, and asbestos especially, used in the past and for inexpensive housing especially before I think asbestos was known to cause the problems that it can, and it was a very popular material.

School teacher (8):

TEACHER: Asbestos and zinc is not that good especially when it is heavily raining as there can become holes in the roof.

School teacher (5):

TEACHER: Well what I have discovered with asbestos is that is is not healthy, iya-(yes), for people to be, for the houses to be roofed with asbestos.

School teacher (6):

TEACHER: You see, I don't like asbestos because so many people are getting sick because of it.

6. DISCUSSION

Results of this study have indicated that a number of proximate, socio-economic and social support exposures showed associations with infant and child growth in this urban South African context. Factors influencing SGA delivery which are discussed, include ethnicity, parity, maternal smoking behaviour and social support. The lack of any association between SGA delivery and socio-economic factors in this sample is also discussed. Proximate factors influencing child stunting which are discussed include age, sex of the child and SGA delivery. Socio-economic factors reviewed include water and sanitation, mother's education, mother's work as well as measures of household wealth and markers of disadvantage. The effect of social support on stunting is also discussed. Finally some strengths and limitations of this study are outlined. Relevant areas include: data availability; methods of data management; analysis techniques and the qualitative research project (strengths) as well as statistical methods, power and interpretation of results; characteristics of the cohort and study sample; mixed longitudinal cohort and loss to follow up; exposure data and outcome data (limitations).

6.1 SMALL FOR GESTATIONAL AGE

Small size at birth represents a considerable public health issue in many developing countries. It has been estimated that 11% of newborns delivered in developing countries are low birth weight (<2500 grams), while almost 24% are born below the 10th percentile for gestational age-specific birth weight (i.e. SGA) (de Onis et al., 1998). Prevalence of SGA is lowest in Latin America where 5% of the developing world's total number of SGA infants are born (de Onis et al., 1998). Developing countries in Asia, and South Central Asia in particular, have the highest prevalence of SGA at 20.9%. Due to the large population density in this region of the world, this in fact represents 75% of infants born SGA in the developing world (de Onis et al., 1998). Prevalence is lower in Africa than in Asia, with 11.4% for West Africa and almost 15% reported for mid Africa, although these infants make up a considerable proportion (20%) of the developing country SGA prevalence total (de Onis et al., 1998). WHO estimates from the World Health Report 2006 indicate that the prevalence of low birth weight in Southern African countries (2000 estimate) ranged from 10% to 16% (Botswana 10%; Kenya and Zimbabwe 11%; Mozambique, Namibia and Lesotho 14%; South Africa 15%; Malawi 16%). These results are similar to the prevalence of SGA delivery found in this study (14.8%).

SUMMARY OF RESULTS

Unadjusted results from this study showed that increased likelihood of SGA was associated with Indian and Coloured ethnicity, primi-parity and maternal smoking. Unadjusted results also showed that one measure of social support (mother's desire for pregnancy) was positively associated with SGA. However, no economic measures of household SES were associated with the outcome.

The adjusted effect of mother's desire for pregnancy was strongly attenuated due to confounding by ethnicity, where Indian and Coloured mothers were less likely than Black mothers to report that they were prepared for the pregnancy. The adjusted effect of Coloured ethnicity on SGA was also attenuated due to the close association between smoking and ethnicity. Similarly, the close association between ethnicity and maternal smoking behaviour, also caused the ethnicity-adjusted effect of maternal smoking on SGA to be attenuated. Final adjusted results indicated, therefore, that in this sample the categories of Indian ethnicity and primi-parity showed increased likelihood of SGA delivery.

FACTORS INFLUENCING SGA DELIVERY IN URBAN SOUTH AFRICA

ETHNICITY

Black and White Ethnicity

In contrast to findings from US studies in particular, no difference in the likelihood of SGA delivery was noted between Black and White infants (Shiono et al., 1997; Alexander et al., 1999; Ananth et al., 2004). These results also contrasted to another South African study in which Coloured and Black infants had lower birth weight than White infants (Bachmann et al., 1996).

The lack of association of heavier birth weight or lower prevalence of SGA in White infants in this sample was contrary to expectations, particularly when the social, economic and psycho-social circumstances to which Black South Africans were exposed throughout Apartheid are considered (Price, 1991). However, the lack of Black ethnic associations with low birth weight is this study may be influenced by the lack of the Black ethnicity-maternal smoking behaviour pattern which is found elsewhere, e.g. USA. Unlike in the USA and other developed countries, Black women in South Africa show very low prevalence of smoking, and this behaviour is concentrated in the White, and particularly in the Coloured, populations (see section 6.1 *Parity and Maternal Smoking Behaviour*).

In addition, the lack of and association between White ethnicity and birth weight or SGA in this sample may have been due to the fact that the sample size for White infants in this study was small

(n=89), and the study may have been insufficiently powered to investigate this association. Furthermore, the White participants who agreed to enrol and partake in the study may not have been representative of the White South African population at the time and may have been of lower SES than those who declined to participate, although available data from this study does not suggest this (see section 6.3 *Strengths and Limitations- Cohort and Study Sample*).

Asian Ethnicity

Final adjusted results of this analysis did, however, show an increased likelihood of SGA in the Indian ethnic group. Indian newborns in this analysis had the lightest mean birth weight and were lighter than newborns from all other ethnic groups. They were also at increased likelihood of SGA, in comparison to Black newborns. However, it is important to note that unlike many other studies referenced, this study was not able to adjust for either maternal size (height or weight) or weight gain during pregnancy. Measures of maternal size and weight gain during pregnancy show associations with SGA delivery (Fourn et al., 1999; Strauss and Dietz, 1999; Verhoeff et al., 2001). Adjustment for these factors is particularly important when investigating the effect of Asian ethnicity, as Asian mothers tend to be shorter and lighter than White mothers and also tend to gain significantly less weight during pregnancy e.g. (Moller et al., 1989). As such, final adjusted results from this study are unable to rule out the possibility that the Indian ethnicity effect reported is mediated through maternal size and pregnancy weight gain.

Previous studies have consistently reported that infants of Indian and South Asian descent have lower mean birth weights (Dawson and Jonas, 1982; Kramer, 1987) and increased likelihood of SGA (Doombos et al., 1991; Thompson et al., 2001), despite adjustment for maternal size. In developed countries, this is a trend which persists even in infants born to subsequent generations of migrant Indian or South Asian parents (Doornbos et al., 1991; Harding et al., 2004). Apart from factors of maternal size (height and weight), studies from the UK in particular suggest a number of pathways through which Asian ethnicity may influence size at birth. Potential pathways of influence relevant in a UK setting include low, inadequate or untimely use of ANC (Aspinall and Jacobsen, 2004) which is in turn associated with SGA delivery (Brabin et al., 1998; Fourn et al., 1999; Letamo and Majelantle, 2001; Feresu et al., 2004). However, studies of ANC use by Indian South Africans are lacking.

Other means of influence relevant in the UK are related to SES measures including low income, high levels of unemployment (Berthoud, 1998) and low levels of maternal education (Mohood and

Berthoud, 1997). These factors may in turn influence low, inadequate or untimely use of ANC services (Barros et al., 1996; Burgard, 2004; Goldani et al., 2004) and maternal smoking during pregnancy (Shohaimin et al., 2003; Moshin and Bauman, 2005). Unfortunately research on these questions is lacking from the South African context, in which Asians are much less deprived than in the UK. In fact, at the time of this study (1990 – 1995) Indian groups showed SES characteristics more similar to White groups than other non-White groups (Richter et al., 2004) (see also section 2.1 *South African Context and Measurement of Socio-economic status – Apartheid*). However, differences between the unadjusted and smoking-adjusted ethnic effects on SGA in this analysis suggest a role for maternal smoking behaviour. Indeed results indicate that all of the Coloured ethnic effect and some of the Indian ethnic effect were mediated through maternal smoking behaviour.

In summary, the Indian ethnic effect reported in this study would be elucidated by inclusion of measures of maternal size and weight gain during pregnancy. Although collection of retrospective measures of maternal pre-pregnancy weight and weight gain during pregnancy is not feasible, measures of maternal height may be collected. This is already underway for a sub-section of the Bt20 cohort (Bone Health study), however, availability of maternal height for as many of the participants as possible would be very useful for investigating infant and child growth outcomes in the Bt20 cohort.

PARITY AND MATERNAL SMOKING BEHAVIOUR

In keeping with results from previous studies e.g. (Thompson et al., 2001; Verhoeff et al., 2001), results from this sample indicated that primi-parity was associated with increased likelihood of SGA delivery. However, the biological mechanism of how parity may influence size at birth is not clear (Shoham-Vardi et al., 1994). Furthermore, as noted by Kramer, despite the high population attributable fraction of primi-parity (due to high incidence of first births), this factor is not amenable to intervention (Kramer, 1987).

Previous research has established maternal smoking during pregnancy as a risk factor for SGA delivery (Lieberman et al., 1994; Horta et al., 1997; Chiolero et al., 2005), even in contexts of low smoking prevalence, such as Benin (Fourn et al., 1999) or South Africa (Steyn et al., 2006). In unadjusted analysis maternal smoking behaviour was associated with increased likelihood of SGA delivery. However, on adjustment for ethnicity, this effect was attenuated due to the close association between these variables, whereby Coloured and Indian women were more likely to

have smoked than Black women. These results suggest that the unadjusted effect of Coloured ethnicity on SGA is mediated through maternal smoking behaviour.

Smoking prevalence in South African women is relatively low e.g. 11% in 1998 (SADHS, 1998). Lower prevalence of smoking is reported in Black South Africans, in comparison to other ethnic groups (Peltzer, 2002). For example, in comparison to Black women, the likelihood of light smoking (1 – 14 cigarettes/ day) is significantly higher in Indian women (OR= 3.20; 95%CI 1.68 – 6.11), Coloured women (OR=18.34; 95%CI 13.34 – 25.22) and White women (OR=12.95; 95%CI 7.55 – 22.24)(SADHS, 1998). The likelihood of heavy smoking (≥15 cigarettes/ day) is also much higher in Coloured and in White women, than Black women (OR= 49.32; 95%CI 21.59 – 112.67 and OR=161.46; 95%CI 62.82 – 414.96 respectively) (SADHS, 1998).The low prevalence seen in Black South African women may be related to smoking taboos for pre-menopausal Black women (Steyn et al., 2006). Smoking during pregnancy shows similar trends. In a study of five public health sector hospitals in Cape Town, Everett *et al.* reported that rates of smoking during pregnancy were exceptionally high in Coloured women (47%), in comparison to rates of 4% in Black and 3% in Indian pregnant women (Everett et al., 2005).

As early as 1993, in an effort to curb the increasing trend of cigarette smoking, South Africa introduced very strong tobacco control legislation (e.g. Tobacco Products Control Act) as well as anti-tobacco educational programmes. Legislation has resulted in strong control and prohibition of sales to persons under the age of 16 years, high taxes on tobacco products, bans on smoking in places of employment including restaurants and bars, as well as bans on advertisement and sponsorship by the tobacco industry. However results from studies suggest that such intervention has not benefited all sections of the South African population equally, and the Coloured population remain particularly at risk (SADHS, 1998).

Additionally, educational programs, including ANC interventions to provide advice and encourage quitting of smoking during pregnancy, appear to have had considerably less impact than legislative interventions (Everett et al., 2005). For example, ANC centres provide pamphlets on the effects of alcohol use during pregnancy with details of responsibilities for women, partners, teachers, health care workers and the community. However, similar information on the effects of smoking during pregnancy, and recommendations for giving up are not available [xviii]. In the same study from Cape

[xviii] http://www.doh.gov.za/docs/index.html (Pamphlets- Alcohol free pregnancy parts 1 and 2).

Town, Everett *et al.* also reported that as well as high rates of smoking during pregnancy, quitting rates in pregnant Coloured women were also low (Everett et al., 2005). Everett *et al.* particularly highlight two key areas in which programmes could be improved: the poor training of ANC centre staff to deliver smoking cessation messages to pregnant women; and the non-patient orientated approach used by ANC staff and doctors when providing advice (Everett et al., 2005). These researchers advocate the use of "motivational interviewing" as well as the "five A" approach by ANC centre staff [xix].

1. *Ask - ask the patient whether she smokes. If she stopped before or when she found out she was pregnant, congratulate her and again stress the benefits of not smoking. If she's still smoking, proceed to ...*
2. *Advise - advise the patient to quit in a strong, personalised manner. Discuss the risk of smoking to the unborn baby and stress the benefits of quitting.*
3. *Assess - assess the willingness of the woman to quit within the next 30 days. If she is ready to quit, proceed to the next step. If not, give information to build motivation and confidence to make a quit attempt in future.*
4. *Assist - assist the patient by offering practical advice on quitting strategies, prompt her to seek support within her social circle (especially from her partner) and provide self-help materials.*
5. *Arrange - arrange for a follow-up contact where smoking status is reassessed and further support is given.*

Results form this study suggest and important role of smoking behaviour in infant growth and size at birth measured by SGA. Additional work in three areas is recommended. Firstly, further research on reasons for low smoking prevalence in Black South Africans would be useful, particularly if these proved transferable to other ethnic groups within South Africa. Similarly, identifying correlates of or preferably reasons for smoking behaviour during pregnancy in non-Black ethnic groups may also aid in reducing smoking prevalence. Finally, building on the work of Everett *et al.*, further examination of smoking prevention and cessation programs targeted at pregnant women in South Africa would also be useful in order to improve and ameliorate their content and/or delivery to further reduce the prevalence of smoking during pregnancy in South Africa, and consequently reduce the incidence of SGA deliveries.

[xix] www.sahealthinfo.org/motivational/smoking.htm

HOUSEHOLD SOCIO-ECONOMIC STATUS

Previous work has reported that SGA delivery shows associations with unemployment, low household income and occupational class (Finch, 2003; Zambonato et al., 2004; Torres-Arreola et al., 2005), low maternal education e.g. (Luo et al., 2006) and single marital status (Gorman, 1999; Pickett et al., 2005). Despite the inclusion of similar measures of SES in this study, namely maternal and paternal unemployment, maternal education and maternal marital status, no such associations were seen in this sample. It has been suggested that the effects of these SES factors on SGA delivery may be mediated through maternal smoking behaviour during pregnancy (Kleinman and Madans, 1985; Najman et al., 1998; Phung et al., 2003; Shohaimi et al., 2003; Burgard, 2004; Mohsin and Bauman, 2005; Kiernan and Pickett, 2006) as well as through ANC use (Katz et al., 1994; Nwakoby, 1994; Barros et al., 1996; Burgard, 2004; Goldani et al., 2004; Onah et al., 2006).

Results from the 1998 Demographic Health Survey for South Africa indicate a significant negative trend in light smoking (1-14 cigarettes/ day) from poorest to richest quintiles of household wealth (SADHS, 1998). However, no significant differences in heavy smoking behaviour (≥15 cigarettes/ day) were seen between wealth quintiles (SADHS, 1998), which is unsurprising considering the highest prevalence of heavy smoking (1998 measure) was found in the White population, which was also the most socio-economically advantaged group in South Africa at this time. Furthermore, the highest prevalence of light smoking in women (SADHS, 1998) and of smoking during pregnancy (Everett et al., 2005) were found in the Coloured ethnic group, which was not the most socio-economically deprived ethnic group in South Africa. Although further research is necessary, it is possible that the smoking behaviour pathway through which SES may affect SGA delivery in other settings may not be as relevant in the South African context.

Health seeking behaviour, including ANC use, has been extensively studied in developing countries (Hill et al., 2003; Kofoed et al., 2004; Taffa and Chepngeno, 2005). Research has suggested that factors influencing ANC use include income and household wealth e.g. (Hjortsberg, 2003) as well as maternal education e.g. (Onah et al., 2006). However, in South Africa additional issues also play a large role in influencing health seeking behaviour. These include many measures which are not available in this study, such as accessibility of healthcare centres (e.g. transport, availability of alternative childcare), interaction with staff (e.g. politeness, access to expert/specialist care), waiting times, success of previous visits, perceived value for money (e.g. were a variety or large amount of medications provided/ prescription), the patient's own explanatory model of illness

causation e.g. (Kauchali et al., 2004; Habbani et al., 2006; Spark-du Preez, 2006) as well as the patient's perceived need for the service, which in the case of ANC may be influenced by experiences of previous pregnancies e.g. (Ndyomugyenyi et al., 1998).

The two issues discussed above concerning maternal smoking behaviour and ANC use suggest that the lack of associations seen in this sample between available measures of SES and SGA delivery may be due to the particularities of the South African context and that, in effect, the finding of no association with the available SES measures is an accurate reflection of the investigated association in this setting. However, it is important to consider the possibility that this negative finding is not an accurate reflection, but rather the result of two data issues. The first: characteristics of the SES environment in Johannesburg and Soweto during the Apartheid era and the second: sampling issues in both the Bt20 cohort study and this particular study. Due to political, educational, economic and social policies of Apartheid, variability in social and economic profiles of non-White, and particularly Black, groups was constrained in South Africa at the time of this study (1990) (see section 2.1 *South African context and Measurement of Socio-economic status-Apartheid*). For example, in 1991 35% of Black men were unemployed and only 10% of Black households owned a car (Pillay, 1996). This restricted variability in exposure may have influenced the ability to detect significant SES effects within and between non-White ethnic groups in this setting. This issue may be particularly relevant to this analysis due to the small representation of Whites (n=89) to which non-White ethnic groups may be compared.

The ability to detect significant SES associations in this study may also have been reduced due to enrolment in both the larger Bt20 cohort study and participation in this particular analysis. It has previously been recognised that Indian and White ethnic groups were under-represented in the Bt20 cohort (Richter et al., 2004). Participants included in this analysis (n=1,544) were also less likely than those excluded (n=549) to be Indian. As South African Whites and Indians in 1990 were of higher SES profiles, a reduction in their representation would have reduced the range of SES exposures and consequently the power to detect significant SES effects. The SES of White participants who enrolled and remained in this study may also have been lower than those who declined to participate or were lost to follow-up (Richter et al., 2004), although rates of maternal and partner's employment in this study show similar prevalence to other studies (e.g. 69.7% White mothers employed in this study versus 60% in (Pillay, 1996); 89.9% White partners (fathers) employed in this study versus 82% in (Pillay, 1996)).

SOCIAL SUPPORT

Unadjusted results indicated that only one measure of social support was associated with SGA in this sample. Mothers who reported being ready for their pregnancy were at reduced likelihood of an SGA delivery, when compared to mothers who reported that they were unsure or not ready. However, this effect was attenuated on adjustment for ethnicity. Associations between undesired or unplanned pregnancy and size at birth have been previously reported (Bustan and Coker, 1994; Eggleston et al., 2001). Studies of other aspects of social support during pregnancy have also reported associations with low birth weight (Collins et al., 1993; Feldman et al., 2000) and SGA delivery (Dejin-Karlsson et al., 2000). It is suggested that social support may influence levels of stress experienced during pregnancy (Cohen and Wills, 1985; Collins et al., 1993; Seguin et al., 1995; Hoffman and Hatch, 1996; Kazi et al., 2006), as well as health behaviours such as smoking (Graham, 1995) and ANC use (Collins et al., 1993; Burgard, 2004). Associations between levels of stress experienced during pregnancy also show associations with size at birth (Rothberg et al., 1991; Lobel et al., 2000; Rondo et al., 2003) that may be mediated through health behaviours. In addition to influencing health behaviours, studies suggest that stress may influence size at birth through hormonal factors including catecholamine, that may reduce blood flow and restrict transport of oxygen and nutrients to the foetus (Paarlberg et al., 1995; Hoffman and Hatch, 1996).

Although some research in this area has been carried out in developed countries, particularly in the USA, information is lacking from the developing world, in particular from South Africa where few studies have addressed the issue (Rothberg et al., 1991; Burgard, 2004). It is essential to investigate and identify the particular aspects of pregnancy commitment and social support during pregnancy which may affect size at birth in this context, so that these may be incorporated into, and addressed by, ante-natal care and social services policy in South Africa. Despite the paucity of investigative research, results from the qualitative project carried out within this study indicated that both a mother's desire for the pregnancy as well as her family's readiness for the pregnancy were perceived by health care nurses in Soweto and Johannesburg to influence the care a mother affords herself during pregnancy. During interviews nurses particularly highlighted that the diet, sleep patterns and health behaviours (smoking and alcohol consumption) of pregnant mothers may be influenced by her desire or readiness for the pregnancy and whether or not the pregnancy was planned.

In this study the effect of mother's desire for pregnancy on SGA delivery was attenuated on adjustment for ethnicity. This social support variable showed a close association with ethnicity,

where, in comparison to Black women, Coloured (OR=0.23; 95%CI 0.17 – 0.44), Indian (OR=0.11; (95%CI 0.05 – 0.24) and White women (OR=0.52; 95%CI 0.33 – 0.82) were less likely to report that they desired their pregnancy. In fact, as well as higher prevalence of support during pregnancy, Black women in this study also reported higher prevalence of general social supportk measured by having a number of people to seek help from and to talk to about problems as well as being a member of an organisation such as a church. Further detailed investigation of the extent and type of social support available to pregnant women from different ethnic groups living in Johannesburg/ Soweto is desirable, with particular emphasis on potentially unique characteristics of Black South African groups.

6.2 STUNTED AT AGES 1, 2 AND 5 YEARS

Although no longer a health issue in developed countries, stunting represents a considerable public health challenge in developing country settings. Prevalence of stunting in children under 5 years of age in developing countries has been estimated at almost 43% (de Onis et al., 1993). Prevalence is highest in Asia, particularly South Asia, at 47.1%, followed by Africa at 38.6% and lower in Latin America at 22.2% (de Onis et al., 1993). However, population distribution means that the majority (80%) of stunted children are found in Asia, while 15% and 5% respectively are found in Africa and Latin America (de Onis et al., 1993). Recent estimates of stunting in southern African countries from DHS data (2000) indicated that the prevalence of stunting in children under 3 years of age ranged from 27.2 % to 44.9% (Fotso and Kuate-Defo, 2006). Lower prevalence was reported for Zimbabwe (27.2%), Kenya (30.7%) while higher prevalence was found in Mozambique (36.8%), Tanzania (38.7%), Malawi (44.7%) and Zambia (44.9%) (Fotso and Kuate-Defo, 2006).

The South African Department of Health reports lower prevalence of stunting in children under the age of 3 years in South Africa (25.5%), although prevalence between provinces varies (e.g. Western Cape 14.2%, Free State 39.8%) (Labadarios, 1999). The prevalence of stunting from this study is substantially lower than these estimates at 4.2% (1 year), 13.2% (2 years) and 3.8% (5 years). However it is important to note that in developing countries, including South Africa, high prevalence of stunting is particularly found in rural areas whereas this study represents an urban sample.

SUMMARY OF RESULTS

STUNTED AT AGE 1 YEAR

Unadjusted analyses indicated that male infants, those born SGA, and those born pre-term were at increased likelihood of stunting at one year. Unadjusted associations were also seen between stunting aged 1 year and the following socio-economic exposures, which were measured during the antenatal period: mother's education; grandfather's education; frequency of pay received by the father/mother's partner; water facilities; toilet facilities; type of cooking fuel used and ownership of a number of consumer durables (car, washing machine, fridge and toys).

As a number of these socio-economic measures were collinear (water facilities, toilet facilities, type of cooking fuel used and ownership of a washing machine), an SES index was created using Principal Component Analysis. On adjustment for this SES index, the association of stunting with the other socio-economic measures was attenuated. On adjustment for the effect of SGA delivery,

the association between pre-term delivery and stunting aged 1 year was also attenuated. As such, final adjusted results indicated associations between stunting at 1 year and sex of the infant, SGA delivery and the SES index (water facilities, toilet facilities, type of cooking fuel used and ownership of a washing machine). However, no associations between social support factors or parity and stunting at this age were seen.

STUNTED AT AGE 2 YEARS

Only one proximate variable, ethnicity, showed an association with stunting at 2 years in unadjusted analyses, where White children were less likely to be stunted than Black children. However, a large number of socio-economic variables (antenatal) showed unadjusted associations with stunting at 2 years of age (mother's education, mother's work, frequency of father's pay, number of sleeping rooms, electricity supply, type of cooking fuel used, hired domestic help, medical aid coverage, condition of the home, problematic alcohol or drug use in the family, mother still at school when fell pregnant as well as ownership of a TV, washing machine, fridge and toys). Unadjusted results indicated that only one social support variable was associated with stunting at 2 years (family readiness for pregnancy).

When all of the associated SES factors from the bivariate analysis were entered into the multivariate model, three measures remained associated with stunting at this age; mother's education, mother's work and family readiness for the pregnancy. In the final fully-adjusted model, the effect of ethnicity was attenuated due to its close association with mother's education and mother's work. The fully-adjusted effects of mother's education and work were also attenuated. However, results from likelihood ratio tests indicated that these socio-economic variables added to the final model, while ethnicity did not. Final results showed that only the family's readiness for the pregnancy remained associated with stunting at this age, where those who reported their family was unsure or not ready for the arrival of the new baby were at increased likelihood of stunting. No associations were seen between stunting at this age and measures of parity, sex of the child, SGA delivery or water and sanitation facilities.

STUNTED AT AGE 5 YEARS

Unadjusted results indicated that few variables were associated with stunting at 5 years of age. Children born SGA were at increased likelihood of stunting at this age. Those whose grandfather had completed a higher level of education were at reduced likelihood, as were those whose mothers "earned money". Stunting at aged 5 years also showed associations with a number of

variables summarising the condition of the home. These included having cracked walls, broken doors, leaks and being troubled by bed bugs.

On adjustment for the effect of living in a home with broken doors, the effects of mother's work and grandfather's level of schooling were attenuated. The effects of living in a home with cracked walls or leaks were also attenuated on adjustment for this variable. Final adjusted results, therefore, indicated a positive association between SGA delivery and stunting at 5 years, as well as a positive association between stunting at this age and homes with broken doors or those troubled by bed bugs (antenatal measures). No associations were seen between stunting at this age and measures of parity, sex of the child, water and sanitation services or social support.

FACTORS INFLUENCING STUNTING IN URBAN SOUTH AFRICA

AGE, SEX AND SGA DELIVERY

Prevalence of stunting in this study is 4.2% aged 1 year, 13.2% aged 2 years and 3.8% aged 5 years. Although analyses in this study are cross sectional and participants represent a mixed longitudinal sample, the patterns of prevalence of stunting show the usual variation with age (Hernandez-Diaz et al., 1999; Padmadas et al., 2002; Ojofeitimi et al., 2003; Shah et al., 2003; Bloss et al., 2004). The cross sectional nature of the sample and analyses may over-represent the prevalence of long-duration stunting in comparison to short-duration stunting.

The positive association between male infants and stunting aged 1 year seen in this sample is similar to a number of previous studies from African countries e.g. (Shrimpton et al., 2001) and may be due to increased male susceptibility to environmental insults (Stinson, 1985). The lack of association between male sex and stunting at older ages differs somewhat to findings from other studies. For example, in a study of stunting in children under 3 years of age Griffiths *et al.* reported sex associations in a number of African countries (Ghana, Malawi, Nigeria, Tanzania, Zambia and Zimbabwe) (Griffiths et al., 2004). However one study, based on work from the Cebu cohort in the Philippines, did report similar findings to this study (Adair and Guilkey, 1997). In children under 1 year of age, an increased likelihood of stunting was noted in males, however this association had reversed in older children where females were at increased likelihood (Adair and Guilkey, 1997). Adair *et al.* suggested that differences in behavioural factors surrounding infant feeding may contribute to the increased prevalence of stunting in males aged 1 year, where males received larger quantities and earlier introduction of complementary feeds (Adair and Guilkey, 1997). This issue has not been investigated in South Africa.

The finding of increased likelihood of stunting at both 1 and 5 years of age in those born SGA is also in keeping with previous research. Studies from developing countries (Adair and Guilkey, 1997; Saleemi et al., 2001; Marins and Almeida, 2002; Aerts et al., 2004) including South Africa (Chopra, 2003), have reported associations between low birth weight delivery and stunting in childhood. This association may be due to the fact that patterns of linear growth tend to show tracking or canalisation from one age to another along similar percentiles or centile bands (Tanner, 1966). The lack of association between size at birth and stunting at 2 years of age may be due to the lack of power to investigate this association in this sample. For example, odds ratios of the effect of SGA delivery on stunting at 2 years of age are in a positive direction and the confidence intervals only just cross the null value (OR=1.71; 95%CI 0.90 – 3.24).

HOUSEHOLD SOCIO-ECONOMIC STATUS

Sanitation – Water and Toilet facilities

In this sample, stunting aged 1 year was negatively associated with improved socio-economic status, as summarised by the SES index. This index included measures of sanitation (water and toilet facilities) as well as type of cooking fuel used and ownership of a washing machine. In this sample, sanitation services were not associated with stunting at 2 or 5 years of age.

The association between stunting and sanitation facilities in a household has been extensively researched in developing countries (Daniels et al., 1991; Merchant et al., 2003; Checkley et al., 2004; Pongou et al., 2004). The influence of sanitation facilities is mediated, for the most part, through infectious disease morbidity (Esrey et al., 1991; Esrey, 1996; Abate et al., 2001; Fewtrell et al., 2005). Diarrhoeal morbidity in particular is related to access to clean drinking water (Fewtrell et al., 2005), safe disposal of excrement (Esrey, 1996), hygiene and hand washing behaviours as well as safe feeding practices including hand washing prior to feeding, use of clean utensils and safe food storage (Huttly et al., 1997). In turn, toilet facilities influence excrement disposal while water facilities influence personal and domestic hygiene- particularly hand washing behaviours (Huttly et al., 1997).

The effect of infectious disease morbidity on height is usually transient and compensatory growth occurs with sufficient disease-free time (Briend, 1998). However, the effect of sub clinical infection resulting in intestinal damage may be much more prevalent and long lasting, having a larger and less transient effect on stunting (Menzies et al., 1999; Lunn, 2000). Hygiene behaviours and safe food preparation may also impact on levels of these sub clinical infections experienced by children

in developing country settings (Menzies et al., 1999; Lunn, 2000) potentially influencing prevalence of more long-lasting stunting.

Results from qualitative research carried out in this study indicated that Johannesburg and Soweto residents themselves recognised the influence that toilet and water facilities may have on child health. Findings corroborated those established in intervention studies and risk factor investigation studies carried out in other developing countries (Huttly et al., 1997; Fewtrell et al., 2005). With reference to toilet facilities, those consulted commented that indoor flush toilets were more sanitary and clean and additionally offered the opportunity to wash hands after toilet use. Participants also mentioned that access to an indoor flush toilet may prevent children picking up infections that may be present in badly-maintained, unsanitary communal toilets. Participants consulted mentioned that access to an indoor tap, whose use was exclusively reserved for household members, reduced childhood illness. On the other hand, participants commented that the use of an outdoor shared tap increased the risk of cross contamination and infection acquired from tap users with less rigorous levels of hygiene behaviour. Participants also highlighted the advantage of access to an indoor tap, as this removed the issue of unsanitary storage of water in containers that may have been used for other purposes- including urination. Those consulted also mentioned that access to an indoor hot tap may influence personal hygiene behaviours, including frequency of bathing for infants and children.

The lack of association between sanitation services and stunting at 2 years of age may be due to the fact that these variables are not important predictors of stunting at this age. However, the fact that the relationship between infectious disease morbidity and stunting tends to be transient, fluxing between periods of stunting and periods when compensatory growth that can occur given sufficiently long periods of disease-free time (Briend, 1998), indicates the need for concurrent measures of growth and sanitation facilities to investigate their association. In addition, the influence of sanitation services at 2 years (1.50 – 2.49 years), would be expected to still play a role in child morbidity as this is both a period when their immune system is still maturing and a period of increased mobility of the child resulting in increased contact with their wider environment (i.e. increased exposure to infectious disease). It is more likely, therefore, that the status of households in terms of supply of sanitation services may have altered between the antenatal period and age 2 years, with the result that the antenatal measure of sanitation services does not reflect current exposure at age 2 years. Indeed, from 1994 one of the key policies of the RDP was the provision of

water and sanitation infrastructure, and the provision of piped water was particularly successful (le Roux, 1996).

On the other hand, the lack of association with sanitation services and stunting at 5 years of age may indeed be due to the fact that sanitation facilities are less important predictors of stunting at 5 years than at younger ages. As outlined above, the association between sanitation facilities and stunting is mediated through infectious disease morbidity and therefore dependent on experiencing morbidity at the age investigated. If 5 year olds in this sample have lower prevalence of stunting due to having experienced less infectious disease morbidity, then the lack of influence of sanitation facilities may be an accurate reflection of the association at this age. Unfortunately, measures of morbidity are not available in this study to investigate this.

Mother's education

Although fully adjusted results of stunting at 2 years of age indicated that the effect of maternal education was attenuated due to its close association with ethnicity, three issues demand that the effect of mother's education should be included in this discussion. Firstly in the analysis of stunting at 2 years of age, logistic regression tests indicated that, although not associated at a 0.05 level, mother's education contributed significantly to the final model and should be retained. Secondly, as highlighted below (section 6.3 *Strengths and Limitations- Outcome data, Population growth references*), when the CDC/ WHO 1978 population reference was used to define stunting at 1 year of age, fully adjusted results indicated that mother's education was association with decreased likelihood of stunting at this age. Finally, when stunting at this age was defined using the CDC/ WHO 1978 population reference (less stringent cut off for stunting i.e. increased sample size for "stunted" category), the fully adjusted effect of maternal education remained association with stunting at 2 years of age.

The association between mother's education and stunting has been extensively researched in developing countries, including South Africa (Chopra, 2003). Most studies report a negative association, whereby children whose mothers have a higher level of schooling are at reduced likelihood of stunting. Maternal education may impact stunting through caretaking, particularly feeding and hygiene behaviours e.g. (Armar-Klemesu et al., 2000) and health seeking behaviours e.g. (Levine et al., 1991), which in turn impact nutrition status and infectious disease morbidity. Suggested mechanisms by which maternal education may impact stunting include improved economic prospects (Cleland and Vanginneken, 1988; Shaw et al., 1999); enhanced cognitive and

language abilities which may facilitate access to health and nutrition information from external sources such as the media (Cleland and van Ginneken, 1988; Cleland and Vanginneken, 1988; Thomas et al., 1990; Stuebing, 1997); establishment of contacts and networks that may help to promote health and wellbeing (Cleland and van Ginneken, 1988; Cleland and Vanginneken, 1988; Lindenbaum et al., 1988) as well as increased autonomy in household decision-making, particularly in relation to ways in which income is utilised (Cleland and Vanginneken, 1988; Ross and VanWilligen, 1997; Begin et al., 1998).

Residents of Johannesburg and Soweto who participated in qualitative research in this study also highlighted the role that mother's education may play in promoting child health in this setting. Participants consulted mentioned that the level of mother's schooling may influence childhood morbidity in a number of ways. These included timeliness of access to health care services, the type of health care provider used and the implementation of health care workers' instructions (e.g. administration of medication). Participants also commented that mother's level of schooling may be related to employment and income, which in turn influences whether or not private health care providers may be consulted. Similar suggestions have been made in the literature investigating how mother's education may influence health seeking behaviour in developing countries (Cleland and Vanginneken, 1988; Shaw et al., 1999).

With reference to children's diets, participants in the qualitative study mentioned that mother's education may influence knowledge of food groups and understanding of a healthy balanced diet. The quality of a child's diet (e.g. inclusion of protein and dairy products) shows associations with stunting in the developing world (Allen et al., 1992; Neumann and Harrison, 1994; Umeta et al., 2002). Again participants also mentioned that mother's education may influence employment and income, which may in turn allow access to higher quality diets. However, participants consulted also emphasised that a woman's ability to be a good caretaker was not solely dependent on information obtained from schooling i.e. curriculum content. They highlighted that other sources, particularly women's own mothers, healthcare workers and the media were important. Such findings are also in agreement with literature in the area (Cleland and Vanginneken, 1988; Thomas et al., 1990; Stuebing, 1997).

Although level of maternal education showed some association with stunting at 1 and 2 years of age, no association, using either of the population growth references, was seen between this measure and stunting at 5 years of age. This lack of association may be due to a number of socio-

political changes in South Africa which were implemented following the 1994 elections, specifically child feeding programs for children at pre-schools and primary schools and provision of free medical and healthcare services to children under the age of 6 years. However, it is more likely that it is due to changes in the household's general economic status between the period of 1990 to 1995 or a lack of power to detect such an association due to the very low prevalence of stunting (3.8%) and small sample size of stunted children at this age (n=23). Improved economic conditions may have permitted access to improved nutrition, reduced morbidity and increased capacity to pay for medical treatment for children once they were sick.

Mother's work

Fully adjusted results from the analyses of stunting at 2 years of age showed that the effect of mother's work was attenuated on adjustment for ethnicity. However, as with the effect of mother's education, logistic regression tests indicated that this variable contributed significantly to the model, while ethnicity did not. The study was underpowered to investigate the effect of frequency of pay (an indication of grade and stability of employment) on stunting at 1 year (mother's and partner's) and 2 years of age (partner's only).

The negative association, in unadjusted analyses, between stunting at 2 years of age and mothers "earning money" is similar to that found in a number of developing countries e.g. (Engle, 1991). This association may be mediated through increased income (Shaw et al., 1999). It has also been suggested from research in Guatemala that income from mother's work may differ to income from father's work in its preferential allocation to children's needs (Engle, 1993). Results from the qualitative research carried out in this study also suggest that mother's work may influence child diet and morbidity. Participants consulted mentioned that income constraints may negatively impact on an unemployed mother's ability to adequately feed her children. Participants also commented that increased income from employment may permit more rapid treatment for illness in this setting, by enabling access to private health care services. Similar findings have been reported in the literature (Cleland and Vanginneken, 1988; Shaw et al., 1999).

Although results obtained in this analysis are in keeping with some findings, they also contrast to others, in which positive associations between employed status (maternal) and stunting were reported (Padmadas et al., 2002; Ukwuani and Suchindran, 2003). When investigating the association between mother's work and childhood stunting, nutrition or morbidity in a developing country setting, the particularities of maternal employment are important (Joekes, 1989; Ukwuani

and Suchindran, 2003). The location of the workplace relative to the home, hours worked, types of tasks required and whether the child may be taken along to work all play a key role in influencing the direction of the association. This is primarily because they influence caretaking behaviours, including health seeking behaviours and child feeding practices, especially breastfeeding (Joekes, 1989). Another important issue in the study of the effects of maternal employment on child stunting, nutrition and morbidity, is the availability of alternatives for childcare or child supervision. Previous research has indicated that crèche care (Victora et al., 1994; Fonseca et al., 1996; Piertersen et al., 2002) and peer childcare (Engle, 1991; Lamontagne et al., 1998; Nakahara et al., 2006) may have negative effects on child nutrition, morbidity and growth.

Results from the qualitative research also provide some insight into these issues. Some participants commented that work away from the home may negatively impact on a child's diet and nutrition, despite additional income, due to working mothers' limited time to prepare nutritious meals. Some of those consulted also mentioned that children of mothers who work away from home may experience delayed medical treatment due to mothers not noticing symptoms early on in the disease episode and difficulty in obtaining time off work to take their child to a healthcare practitioner. When interviewed about the influence of alternatives to maternal childcare, participants consulted commented that the mother was the preferred choice of caregiver. They noted in particular that peer care by young teenagers or other older child siblings was problematic, specifically in terms of inappropriate care (e.g. mistiming of feeds) and poor health seeking behaviour. Those consulted noted that the diet of a child cared for by the mother was often superior to those cared for by alternative carers, including crèches. Participants particularly emphasised the negative impact crèche childcare may have on morbidity incidence, due to cross infection between children attending crèche centres. Such conclusions are similar to those suggested in the literature e.g. (Piertersen et al., 2002; Nakahara et al., 2006).

Household Wealth and Markers of Disadvantage

In this sample, stunting aged 1 year was negatively associated with improved socio-economic status, as summarised by the SES index which included the type of cooking fuel used and ownership of a washing machine. Stunting at 5 years of age was positively associated with children whose home had broken doors or was troubled by bed bugs. The lack of association between any measures of household wealth (e.g. dwelling conditions or ownership of consumer durables) and stunting at 2 years of age and the very small number of associated measures of household wealth at 5 years of age may be due to the lack of importance in this setting of these variables as stunting

exposures. However, it may also represent changes in household SES between the antenatal period, when these exposures were measured, and ages 2 and 5 years such that the available measures of SES are not contemporary indications of the household's SES profile. The persistence of an association at 5 years of age between stunting and variables measuring the condition of the home may be due to the fact that the location and condition of participants' homes in this setting vary less extensively over time than some other measures of household wealth.

Numerous previous studies investigating stunting in developing country settings have reported associations with measures of household wealth (Wamani et al., 2004; Fotso and Kuate-Defo, 2005; Mahmud Khan et al., 2006). Variables making up such indices of household wealth frequently include ownership of consumer durables and possessions (e.g. washing machine) as well as characteristics of the dwelling (e.g. flooring material), although variables measuring the state of repair of the home and difficulty with pests are not frequently collected. Measures of household wealth are used in research in developing country settings due to the difficulty with collecting accurate income or expenditure data (Bradshaw and Steyn, 2001). These measures are promoted as suitable proxy measures for income and wealth (Wagstaff and Watanabe, 2000) and are suggested to influence childhood stunting through increased purchasing power to access health promoting goods and services (Boyle et al., 2006).

For example, it is likely that these socio-economic measures (cooking fuel, ownership of a washing machine and living in a home with broken doors or troubled by pests) represent markers of disadvantage within this community and that their effect on stunting is indirect and influenced by factors such as a household's access to health promoting goods and services (e.g. nutrition and medical treatment). Findings from qualitative research in this study support this suggestion. For example, when ranking types of cooking fuel, participants commented that using electricity and gas as the main source of cooking fuel was costly and required connections to mains supplies, while use of other cooking fuels was accessible to even the most poor. The prevalence of other sources of cooking fuel (wood, coal, paraffin) in the Bt20 cohort also provides some support for this view. Around the time of the child's birth, only 20.5% of the cohort used other fuels as their primary source of cooking fuel- none of the White or Indian population in the cohort used other sources of fuel, while 22.9% of the Black population in the cohort did.

During qualitative discussions participants also highlighted that they considered ownership of a washing machine to be an exclusive luxury good, whose ownership was restricted to an

advantaged group. The prevalence of ownership of a washing machine in the Bt20 cohort around the time of the child's birth also supports this, where 80.7% of households in the study do not own this consumer durable, 92.9% of Black households and 7.7% of White households in the cohort did not. Additionally, those consulted during the qualitative study identified poor condition of the home, as well as residence in a home which was in need of repair, as markers for disadvantage in this setting. Again around the time of the child's birth, a total of 13.4% in the Bt20 cohort classified their home as in good condition while 8.2% considered it in poor condition. However, 68.8% and 0.0% of White homes were in good and poor condition respectively, in comparison to 9.7% and 13.3% of Black homes.

However in addition to this indirect effect, additional direct mechanisms of influence on child morbidity may be estimated by the type of cooking fuel used. The type of cooking fuel used in the home may feasibly influence respiratory disease morbidity through smoke inhalation. Although no measures of morbidity are available in this sample, this potential direct effect is not supported by the data, as no association was seen between stunting and having a separate kitchen used only for cooking (i.e. reducing smoke exposure, particularly when sleeping). The type of cooking fuel used may have influenced food preparation and through this have a direct effect on stunting. Due to the convenience of cooking with electricity or gas, versus cooking with other fuels (e.g. wood or coal), food preparation in these households may occur several times a day, which may in turn influence child morbidity from diarrhoea (Abate et al., 2001). However, food preparation practices in relation to type of cooking fuel available to the household have not, to date, been investigated in the South African setting.

Family readiness for the pregnancy

Final results from the 2 year analyses indicated that the family's readiness for the pregnancy was associated with stunting at this age, despite adjustment for mother's education, mother's work and ethnicity. This result was similar to the association seen between maternal desire for the pregnancy and small for gestational age delivery.

Although the association between this particular psycho-social measure and stunting has not been frequently investigated, studies indicate that low pregnancy commitment, low levels of social support and mistimed pregnancy all show associations with maternal mental well-being and depression (Bustan and Coker, 1994; Kost et al., 1998). In turn, a number of previous studies have reported positive associations between poor levels of mother-infant or mother-child interaction and

failure to thrive and stunting (Roche and Sun, 2003). In particular maternal depression has shown associations with stunting (Murray et al., 1996; Patel et al., 2003; Rahman et al., 2004; Harpham et al., 2005). Research has suggested that maternal depression may influence child growth by influencing the emotional quality of maternal-child interactions, including mother-child engagement (Cooper et al., 1995), interest and caring attitude (de Villiers and Senekal, 2002), stimulation (Bettes, 1988) as well as response to infant or child needs (Livingood et al., 1983). A small number of comments collected from participants consulted during qualitative research in this study suggested that the mother's desire for the pregnancy may influence caring behaviour and mother-child interactions (e.g. feeding, carrying when crying and nappy changing). However, additional research to investigate the mechanisms through which family readiness for the pregnancy may influence stunting in the context of Johannesburg and Soweto is required, especially given that similar measures were also associated with SGA delivery in this setting (see section 4.1 *Small for gestational age results*).

As maternal depression shows associations with social support, in particular intimate partner support (Collins et al., 1993; Seguin et al., 1995; Kazi et al., 2006), data from the Bt20 cohort data was used to investigate correlations between family readiness for the pregnancy and measures of social support. Social support measures highly correlated with family readiness for the pregnancy included mother's and father's desire for the pregnancy and if the pregnancy was unplanned/ mistimed; marital status of the future mother and support from her partner (financial support, help with childcare or housework and ability to talk to partner about problems) as well as the financial stability of the family, including whether the future mother has networks from which she can draw support and financial assistance. Therefore although stunting did not show direct associations with measures of intimate partner social support or social networks, the close correlation of family readiness for the pregnancy with such measures of support suggest that further research using additional, more varied and more detailed measures of social support and social networks may prove interesting.

The association of this social support measure with stunting at 2 years of age but not at 1 year is surprising, as it might be expected that the effect of mother-offspring interactions may have more influence for those aged 1 year (0.5 – 1.5 years) in this study than older toddlers (1.5 – 2.5 years). Additional research is required to investigate the specific aspects of family readiness that may affect stunting as well as the particular mechanisms through which family readiness for the pregnancy may influence stunting in the Johannesburg and Soweto context.

6.3 STRENGTHS AND LIMITATIONS

STRENGTHS

DATA AVAILABILITY FROM THE BT20 COHORT

Use of the Bt20 cohort for analyses carried out in this study provided a considerable advantage in terms of SES data availability. The range of SES exposures available enabled detailed investigation of associations with child growth in this setting. The cohort study collected a wide range of economic measures on the mother, father (or mother's partner) and household. These included measures of:

- education
- employment including frequency of pay
- household wealth including dwelling characteristics such as type of home, tenureship, number of sleeping rooms, whether the home has a separate kitchen, type of roofing material, whether the home has a ceiling and ownership of consumer durables such as TV, radio, fridge, telephone, washing machine, car and children's toys.
- type of cooking fuel
- water and sanitation services
- electricity supply
- medical aid coverage
- family has hired domestic help (e.g. housekeeper)
- condition of the home (repairs, leaks, damage to home, pests)

More uncommonly, the cohort also collected a range of social SES measures. These included deprivation measures (e.g. too little money for basics), drug or alcohol abuse in the home and physical abuse of the mother by her partner. A number of measures of social support were also available including those estimating general social support and networks, intimate partner support and support during pregnancy. General measures of social support recorded membership of organisations as well as perceived networks of support from people who could be approached to discuss problems or provide help. Intimate partner support included measures of marital and cohabitation status as well as partner's participation in child rearing and care for the home. Estimates of social support during pregnancy included whether the mother was still at school when she fell pregnant, whether she and her partner wanted the pregnancy, whether she felt family and financial conditions were ready for the pregnancy and whether she was accompanied by persons other than medical staff during labour.

DATA MANAGEMENT AND ANALYSIS METHODS

Robust data management techniques and analyses methods were also strengths of this study. The growth data used in this study had previously been used for analysis and did not require much data cleaning. However, the SES data required and underwent extensive data cleaning on site in Johannesburg. SES data cleaning processes included random checks on 5% or 10% of cohort samples, populating missing variables and consistency checks.

Analysis methods were consistently applied to all four outcomes in this study. Associations were investigated first in bivariate analysis, followed by use of Mantel-Haenszel methods to investigate one-way adjusted results. Logistic regression modelling was then used to investigate multivariate adjusted results. A forward-fitting procedure was used for model building and the construction of models was based on a conceptual framework whereby proximate associations were investigated first and more distal level variables were then added to the models. The use of such a conceptual framework enabled suggestions for mediation pathways between distal level exposures and growth outcomes.

Methods used in these risk factor analyses also retained as much detail in exposure variables as possible. SES indices were only used when collinearity of significant exposures made it necessary. In this way as much detail about the SES exposures as possible was retained. Furthermore, SES indices included contained only variables which were significantly associated with the growth outcome. In addition, analyses from earlier stages indicated the direction and strength of association between the measures included in the SES index and the growth outcome. In this way the results from analyses using these indices remain useful for informing policy because many of the shortcomings of using indices for socio-economic risk factor analyses were avoided. Specifically, it was possible to ensure that the components of the index were significantly associated with the outcome and determine what the direction of association was (Bollen et al., 1999; Bradshaw and Steyn, 2001; Geyer et al., 2006).

QUALITATIVE RESEARCH

A final key strength of this study was the incorporation of a qualitative research project. The recruitment and methodology of this study, however, contained three key limitations; participant sampling, data collection and time difference between qualitative and quantitative data collection. Sampling was based on ease of accessibility to participants through telephone recruitment and did not represent as closely as planned the SES distribution in the Bt20 cohort (quantitative data). The

SES categorisation of mothers for recruitment and allocation to focus group was based on a combination of SES index (based on 1991) data and categorisation of residential area (2004) as suggested by South African Bt20 staff (all long-standing Johannesburg and Soweto residents). Unfortunately this system of classification and allocation did not work especially well and focus groups consisted of a mix of SES mothers. The sampling of mothers for focus groups was also unsuccessful at recruiting ethnic groups apart from Black South Africans, as such the views of Coloured, Asian or White mothers were not accessed.

The methodology of data collection also contained limitations as data was not collected until saturation point, but was limited rather by availability of funding and time constraints. Ideally, ideas raised in first round focus groups and interviews would have served to inform data collection in subsequent groups and interviews, until no additional key ideas and concepts were raised. Finally, it would have been preferable to have carried out this type of qualitative work during the same time frame as when the quantitative data was collected. This time lag may have especially influenced discussions of medical aid, mother's employment, prevalence of electricity supply and consumer durables within society. Interviews with healthcare nurses surrounding medical insurance cover may have been influenced, as these policies were rare in the early 1990's but are more common now, as employers contribute to the schemes of their employees. Discussions on maternal employment, which were addressed to all participants, may also have been effected as patterns of maternal employment in South Africa have varied over time with an increase in maternal employment as well as an increase in single parent (mostly mother) households, which lends issues of maternal employment further importance still. Prevalence of electricity supply to homes, which was discussed with school teachers and church leaders, as well as prevalence and ownership of consumer durables, which was discussed with mothers, will also have varied substantially between the early 1990's and 2004.

Despite these shortcomings however, the qualitative project contributed to this study in three major ways. As mentioned, the qualitative work assisted ordering of categorical variables. Discussions and interviews with local Johannesburg and Soweto residents also enabled identification of markers of disadvantage. However, perhaps the main contribution of the qualitative project was obtaining a local perspective on the role socio-economic and social support measures available in the Bt20 cohort may play in infant and child growth. These local insights aided interpretation of quantitative findings and provided sign posts for future research relevant to policy.

LIMITATIONS

STATISTICAL METHODS, POWER AND INTERPRETATION OF RESULTS

One of the aims of statistical methods in epidemiology is to investigate the contribution of chance in statistical associations. The role of chance when examining the association of over sixty exposures may be high (up to three in sixty, even when a p value level of 0.05 is seen). Therefore, careful interpretation of associations in this study is essential. The study design of stepwise analysis, to investigate the potential mediation of distal exposures through proximate ones, assists in reducing the influence of chance in this study. By examining associations at a variety of stages, crude, adjusted for other distal exposures and adjusted for distal and proximate exposures, the effect of chance acting on the same exposure variable at each stage is reduced. Nonetheless, it is necessary to apply conservative interpretation of results and highlight awareness of the limitations of examining associations in subset data, i.e. datasets where associations examined were not necessarily the principal hypotheses or aims of the study when data collection occurred (Sterne and Davey Smith, 2001).

Loss of sample size over time in cohort studies is a persistent problem. This attrition may be more problematic in developing world cohorts due to practical difficulties in attending follow up (e.g. cost, poor transportation, mobility and relocation), difficulties in remaining in contact with participants (e.g. poor communications, lack of telephone, lack of permanent address, illiteracy), and lack of motivation to remain involved in intensive follow up which may not be perceived to have a personal or societal benefit (Richter, 2005). Small sample sizes and resulting poor power, due to low prevalence of stunting during childhood, are a large limitation in this study. For example, sample sizes of stunting is low at 1 year (n=34/801), 2 years (n=82/621) and especially at 5 years (n=23/600). Prevalence of stunting in this study is lower than national South African estimates, and although urban samples tend to show lower prevalence of stunting than rural or national samples, much of this difference is expected to be due to loss to follow up over time. Interpretation of associations from small sample sizes must be conservative and the use of confidence intervals as estimates of precision and variability is even more important than when interpreting associations from large sample sizes.

This study aimed specifically to examine stunting, due to its associations with later life health and disease outcomes. However, alternative methods of dealing with the small sample sizes and low stunting prevalence include investigating trends in exposure variables, rather than binary or categorical classifications, as well as investigating height-for-age z-scores as a continuous variable,

rather than stunting. Alternatively, data from the different time points may have been pooled to investigate the association between birth measures of SES and social support and stunting at any point between ages 1 – 5 years. This approach would require censoring of children at later ages that appeared as stunted at earlier ages, or specialised statistical techniques to analyse clustered data. Finally, this South African urban study could have been combined with other stunting studies, for meta-analysis. Selection of other studies with which data from the Bt20 cohort would be pooled should preferably be from urban cohorts in Sub-Saharan Africa that used similar study designs, recruitment and measurement techniques.

The use of significance testing and p-value cut offs in epidemiology has been strongly criticised (Rothman and Greenland, 1998). Reliance on p-value cut offs, in particular, is influenced by sample size and such binary division of "significant/ not significant" may mask details of the data. Use of measures of effect and interpretation of size of effect and, crucially, spread and precision of confidence intervals is to be recommended instead (Rothman and Greenland, 1998). A wide range of 95% of 90% confidence intervals indicates low precision usually resulting due to small sample size. Range of confidence intervals, i.e. their proximity to the null value, may also suggest an association even if intervals narrowly cross the null value and p-value levels are "not significant". Interpretation of change in effect size on adjustment for additional variables is also to be recommended, instead of a focus on change in "significance" of the association (Rothman and Greenland, 1998). These guidelines for interpretation of statistical results are especially important when interpreting the results from the stunting analyses of this study, as associations reported showed low precision and other associations between exposures and growth outcomes may not have been detected due to small sample sizes.

COHORT AND STUDY SAMPLE

Time frame of cohort study

Although the associations investigated in this study have not been previously carried out for this sample (Bt20 cohort), the SES exposure data and growth outcome data come from the early and mid 1990's. Changes over time in exposures and outcomes may influence the relevancy of these findings. With reference to changes in outcome prevalence over time, the prevalence estimates of stunting from this sample were substantially lower than those reported from more recent South African statistics. For example, the prevalence of stunting at 2 years of age from 1993 (13.2%) was lower than that in children under 3 years of age in South Africa from 1999 (25.5%) (Labadarios, 1999). On the other hand, relatively recent estimates of outcomes indicate that for small size at

birth (LBW or SGA) the prevalence from this sample in 1991 (14.8%) was similar to that reported nationally in 2000 (15%) (WHO Health Report, 2006).

However, with reference to differences in SES exposures over time, the differences since 1991 are expected to be substantial, particularly in relation to the creation and growth of a Black South African middle class and elite. Despite this change in SES exposures over time, however, many of the associations described (e.g. sanitation facilities; mother's employment and education) continue to be reported in contemporary growth research from other developing countries (Checkley et al., 2004; Marins and Almeida, 2002; Engle, 1991; Padmadas et al., 2002; Pongou, 2006) as well as South Africa (Chopra, 2003; Zere and McIntyre, 2003; Chopra, 2003). Furthermore, although South African social policy has addressed some of the important issues identified by this research, shortcomings in a number of key areas remain (water and sanitation facilities in areas of informal housing, education and skills training, unemployment, family planning services for adolescents) and the findings of this study in relation to these issues remain relevant.

Sampling framework for participant recruitment

During the third trimester of gestation, pregnant mothers were recruited into the Bt20 cohort study through public ANC centres in Johannesburg and Soweto (Yach et al., 1991). Use of this sampling framework excluded certain groups from enrolment into the cohort. These exclusions affected recruitment of women who did not attend ANC as well as women using private ANC services.

The sampling framework of this cohort may have introduced some selection bias that excluded women who did not attend ANC centres. Women who did not attend ANC centres may have shown a higher risk profile for small for gestational age delivery e.g. poverty, smoking (Burgard, 2004; Goldani et al., 2004; Onah et al., 2006). On the other hand, such women (non-attendees) may have shown a lower risk profile. Research indicates that use of ANC services is influenced by the patient's perceived need and their experience of previous pregnancies (Ndyomugyenyi et al., 1998). As such, non-attendees may have increased experience of pregnancy and have acquired skills of preventing, detecting and responding to pregnancy complications. In addition, frequent attendance for ANC is also associated with pregnancy complications (Barros et al., 1996; Misra and Guyer, 1998; Phung et al., 2003) which are in turn risk factors for SGA delivery e.g. (Mohsin et al., 2003). It is therefore feasible that the sampling framework for recruitment into the Bt20 cohort may have excluded women both at increased and decreased risk of SGA delivery.

In 1990 the SES profile of both White and Indian South Africans was higher than that of Coloured or Black South Africans (Richter et al., 2004). Partly because of their ability to pay to access this more expensive service, women of both White and Indian ethnicity were more likely to use private than public ANC and healthcare centres at the time of recruitment into the Bt20 cohort. As such, sampling exclusively from public ANC centres may have resulted in the exclusion of higher SES profile participants (Richter et al., 2004) with the result that fewer White participants were included in the study. The prevalence of White participants (5.76%) in this study (1991) was substantially lower than that of the Johannesburg and Gauteng general population at 18.6% (1996) (StatsSA, 1996). Additionally, inclusion of Indian participants in this study was also lower than that of other ethnic groups. Such a reduction in SES variability, due both to recruitment into the Bt20 cohort and this study, may have reduced the ability to detect associations between study outcomes and ethnic group or SES exposures. It may also have reduced the size of effect of impacts which were "mainly attributable to SES status" (Richter et al., 1995).

The sampling framework used may also have resulted in the possibility that those White participants included may be of lower SES than those who did not participate. However, the limited number of comparisons available between this study and 1996 figures from the rest of South Africa, do not suggest this, and indicate rather that levels of female and male employment, car ownership and medical aid coverage are higher in the White groups included in the study than in the national population (StatsSA, 1996).

MIXED LONGITUDINAL COHORT & LOSS TO FOLLOW UP

Although the data used in this study are drawn from a cohort study, the sample used represents a mixed longitudinal sample rather than a pure cohort. Specifically, loss to follow up occurred between the time points, and not all of the same individuals are included at each time point between birth and five years of age. Furthermore, some time points have additional participants not included at other ages. This loss of participants during follow up affected issues of power, as previously outlined, and may have introduced bias, if those lost differed by outcome or exposure status to those retained. This issue is particularly relevant to the interpretation of results from stunting analyses. Although results from stunting analyses at different time points (1, 2 and 5 years) follow an age-related trend of prevalence reported by many other studies e.g. (Falkner and Tanner, 1986), it is feasible that this is not a reflection of child age but of study sample make-up. Similarly, interpretations of associations seen between proximate and SES exposures and stunting at

different ages may also not be due to different influences being important at different ages, but again to the make-up of the study sample and the particularities of participants included.

This issue was partially investigated through the comparison of prevalence of a number of important exposures between the baseline cohort and the four time points used in this study (birth and years 1, 2 and 5). Exposures investigated included ethnicity, LBW, preterm delivery, sex of the child, maternal age at delivery, parity, maternal smoking behaviour, mother's and father's education and employment status, mother's marital status, mother's desire for the pregnancy, water facilities, toilet facilities, electricity supply as well as household ownership of a washing machine or car.

In comparison to the baseline cohort (n=1793 maximum), no differences were found for: LBW, sex, maternal age at delivery, parity, maternal smoking behaviour, partner's education, mother's employment, mother's desire for the pregnancy or household ownership of a car or washing machine. Differences were principally found between the baseline cohort and the 5 year analysis group, although some differences with the other three time points were also noted. The 5 year group had a lower prevalence of preterm births ($p<0.05$), higher prevalence of Black participants ($p<0.001$), lower prevalence of partners in employment ($p<0.05$), higher prevalence of married women ($p<0.001$), lower prevalence of hot water and flushing toilets inside the home ($p<0.001$ both) and higher prevalence of electricity supply to the home ($p<0.001$), in comparison to the baseline cohort.

The 1 year analysis group also had lower prevalence of preterm births ($p<0.05$), higher prevalence of high mother's education (matriculation) and higher prevalence of electricity supply ($p<0.001$) than the baseline cohort. In comparison to the baseline cohort, the 2 year analysis group also had increased prevalence of mothers achieving matriculation ($p<0.05$) and increased prevalence of electricity supplied to the home ($p<0.001$). The only difference between the SGA analysis group and the baseline cohort was a higher prevalence of electricity supply to the home ($p<0.001$). These results suggest that as loss to follow up occurred over time, the earlier analysis groups (SGA, 1 and 2 years of age) showed higher SES profiles on the whole than the baseline cohort group, while the later analysis group (5 years) shows a lower SES profile than the baseline cohort.

Comparison of the prevalence of these same exposures between the four time points used in this study was also investigated. No differences in proportion were found for the following exposures: LBW, preterm delivery, sex of the child, maternal age at delivery, parity, maternal smoking

behaviour, mother's and father's education and employment status, water or toilet facilities, mother's desire for the pregnancy or household ownership of a car. The 2 and 5 year age group had higher prevalence of electricity, in comparison to the SGA analysis group ($p<0.001$ and $p<0.05$ respectively). The five year age group had higher prevalence of Black participants than groups at all other time points ($p< 0.05$). It also had higher prevalence of single mothers than the SGA or 1 year group, as well as higher prevalence of ownership of a washing machine than the 1 or 2 year groups ($p< 0.05$).

These investigations suggest that, for the majority of important exposures reviewed, the make-up of the samples did not differ between different analysis time points. However, the make-up of the 2 year group did differ to the SGA analysis group on one measure (electricity supply to the home). The 5 year group differed to the other analysis time points on four of the nineteen exposures investigated, suggesting that the make up of this group may differ to that of earlier time points. However, any bias in SES exposure did not show a clear trend towards decreasing or increasing SES profile. Differences may be due to loss to follow up, however, the differences in martial status, electricity supply to the home and ownership of a washing machine may be due to actual trends over time, such as break up of marriages during the first few years of the study, rather than the inclusion of different types of participant at different time points.

EXPOSURE DATA

The Bt20 cohort collected only household level SES measures and as such no information was available from the community level [xx]. Community level socio-economic measures that would have proved useful include:

- services and infrastructure (e.g. water, sewerage, electricity and roads)
- area resources (e.g. schools, medical centres, parks, playgrounds, food retail outlets, alcohol retail outlets, banks and police stations)
- public transportation
- proportion unemployed
- overcrowding
- residential segregation (e.g. proportion ethnic groups)
- social cohesion and social capital (e.g. civic participation, reciprocity and trust)

[xx] Current work (2006), led by Dr. P Griffiths, is collecting community level data of this sort.

The investigation of the association between socio-economic and social support exposures and infant and child growth in this setting was constrained by the availability of data available from the Bt20 cohort. Although many measures of household socio-economic status and social support were available for use in this study, these exclusively represented data collected during the period surrounding the birth of the child (antenatal and 6 months postnatal). Socio-economic and social support exposure data from later time points in the Bt20 cohort were unavailable for use in this study due to the time constraints of the extensive data cleaning that all socio-economic and social support data required. The impact of using SES and social support exposures from the birth period on outcomes of early time points e.g. SGA and 1 year (0.5 – 1.5 years) is likely to be slight. However, as SES status may change over time, the impact is expected to be greater at later time points e.g. 2 and 5 years. It is important to bear in mind the possibility that lack of significant SES associations at later time points may not simply reflect a lack of importance of the measured SES exposures in this setting, but rather a lack of importance of *early life* measures of such exposures.

Issues of data availability in the Bt20 cohort may also have impacted on the investigations carried out in this research. The lack of data or measures on maternal size (height and weight) and maternal weight gain during pregnancy constrained the ability of this study to draw firm conclusions about the Indian ethnicity findings reported from SGA analyses. Adjustment for these variables would have elucidated if the Indian ethnic effect reported was accounted for by factors of maternal size and weight gain. Availability of measures of maternal weight gain during pregnancy would also have allowed comparison of this factor between ethnic groups. Lack of data on child morbidity, breastfeeding, weaning behaviour and nutritional intake also influenced the interpretation of findings from stunted analyses. Inclusion of this type of data would have proved useful in elucidating the pathways through which socio-economic and social support exposures may have influenced stunting at 1, 2 and 5 years of age.

Finally, particularities of two exposure variables, maternal smoking behaviour and mother's employment, may have influenced investigations carried out in this study. Information on maternal smoking behaviour was obtained from the antenatal questionnaire and reflected, not smoking during pregnancy exclusively, but whether or not the mother had ever smoked. The strong associations seen in this study between maternal smoking and SGA delivery suggest that not all of those mothers who ever smoked ceased to do so during pregnancy. Nonetheless, the prevalence of mothers who reported having ever smoked is expected to be higher than those who smoked

during pregnancy. As such, results from this study may reflect an underestimation of the true effect between maternal smoking during pregnancy and SGA delivery in this setting.

In this study, the variable measuring mother's employment showed a significant positive unadjusted association with stunting at 2 years of age. However, this socio-economic exposure was problematic in a number of ways. The question of mother's work included categories of "unemployed", "housewife" and "earns money". It was clear from examination of original questionnaires and annotations from interviewers that this question was poorly answered. Rather than choosing one of these categories, participants' answers were recorded for two, or sometimes several categories. Data entry of these responses did not appear to systematically prioritise one response over another (i.e. when both housewife and "earns money" were checked on the paper questionnaire, electronic versions of the data did not exclusively report one or the other, but varied in which was entered). Discussions with mothers during qualitative research highlighted further the difficulty of allocating mother's economic activities into these categories. Mothers consulted commented that classification of "unemployed" or "housewife" were not necessarily inconsistent with "earning money". Conversations with mothers who participated in qualitative research also indicated that no consensus existed as to the prioritisation of which classification ("housewife", "earns money" or "unemployed") would be reported.

As with most socio-economic and social support data used in this study, information on mother's work was collected during the antenatal period. Many, although not all, of the interviewers and participants recorded mother's employment during pregnancy. As employment patterns for women, particularly during late pregnancy, differ substantially to those seen during pregnancy-free periods, this may have influenced investigations carried out in this study. Finally, no information was available on hours worked, whether work was part time or full time, location of the workplace relative to the home and whether children were taken along to the mother's place of work. These are all issues that may influence the direction of association between mother's work and stunting in developing country settings (Joekes, 1989).

OUTCOME DATA

Continuous vs. categorical outcomes

Outcomes investigated in this study included small for gestational age and stunted. These outcomes were selected for their relationship to current and future health status and were defined as categorical rather than continuous variables (see section 2.2 *Intrauterine growth and Small for*

gestational age- Implications of small size at birth and section 2.3 *Infant and child growth and Stunting- Implications of stunting*). Using categorical outcomes of birth weight and height conveyed the advantage of comparability with other studies. The influences of the specific characteristics of the cohort's distribution of birth weight and height on investigation results were also avoided by using outcomes that represented categories of recognised risk. Finally the use of a categorical outcome, particularly in the case of birth weight, was also considered favourable as the risk of negative outcomes is not distributed linearly throughout the range of birth weight- i.e. the influence on mortality of 100 grams increase in birth weight does not have the same effect at the bottom of the birth weight distribution as it does at the top e.g. (Aucott et al., 2004).

In spite of these stated advantages, the use of categorical rather than continuous outcomes carried with it limitations. In particular, neither the threshold cut off for small for gestational age ($<10^{th}$ percentile) or that for stunted ($\leq$ -2 z-scores), captured in-utero or postnatal growth restriction perfectly. For example, the SGA category may have included infants who were born to short but healthy mothers while the AGA category may have included infants born to tall mothers who smoked (de Onis et al., 1998). Furthermore, although these classifications represent categories of increased risk, neither is ideal for identifying groups at any risk of negative outcomes, as risk is spread throughout the distribution rather than exclusively contained within these categories.

Population Growth References

The use of a categorical outcome also required the specification of a threshold cut off obtained from a population growth reference. As no South African-specific growth references for birth weight or height currently exist, alternative references had to be used. Small for gestational age was defined using a nationwide reference from the USA (1991) (Alexander et al., 1996). The time period and American origin of this population growth reference may have resulted in an overestimation of SGA infants in this South African study, if the American infants sampled were substantially heavier than those in the South African population. However, despite being based on an American population, this reference was considered appropriate because it was drawn from a large, multi-ethnic population, was age and sex specific, and importantly used the same method for estimating gestational age (LMP) as that used in the Bt20 cohort (Alexander, 1996).

Stunted outcomes at ages 1, 2 and 5 years were defined using both the CDC/ WHO 1978 and CDC/ NCHS 2000 population growth references. The CDC/ WHO 1978 reference used US nationally representative data for height from 3 – 18 years (NHES II 1963 – 1965; NHES III 1966 –

1970; NHANES I 1971 – 1974) (CDC, 2002). The CDC/ NCHS 2000 population growth reference used similar and updated data (NHANES II 1976 – 1978; NHANES III 1988 – 1994) for child growth charts (2 – 18 years). Additionally, information from US nationally representative data (NHANES I – III) was also principally used for infants growth charts (0 – 24 months) (CDC, 2002). However, in contrast, the CDC/ WHO 1978 reference used length measures drawn from the Fels Longitudinal Study (1929 – 1975) for length data from 0 – 36 months (CDC, 2002). This cohort study consisted of primarily bottle-fed infants drawn from White, middle class families in South-Western Ohio (Roche and Guo, 1992).

Both the population growth references used to define stunting are based on American data and, as with the SGA population reference used, this choice of population growth references may have over-estimated the prevalence of stunting in this South African context. Unfortunately at the time of data management and analysis the international growth references for the WHO multicentre study were not available (WHO, 2006), and given the particularities of the two CDC growth charts available the 2000 reference was considered most appropriate. Future research on child growth in the Bt20 cohort, including stunting and malnutrition, should use the WHO mulitcentre population references. Where stunting is concerned, it is anticipated that use of this reference, in comparison to the CDC/ NCHS 2000 reference, would result in an increased prevalence of stunting in children under the age of 5 years (i.e. height cut offs for the WHO mulitcentre are higher) (WHO, 2006).

The particularities of the data used to construct these various growth charts would suggest that the CDC/ WHO 1978 reference would overestimate stunting at young ages (< 2 years) while showing little difference at older ages. In this study, this is exactly what was found. The prevalence of stunting at 1 year of age was significantly different between the references- a higher prevalence was seen with the CDC/ WHO 1978 reference. However, the prevalence of stunting between the two population references at older ages was not significantly different. The less stringent cut off for stunting in the CDC/ WHO 1978 reference, influenced by the make up of the Fels Cohort, resulted in a significantly higher prevalence of stunting at 1 year of age. This increased prevalence of infants in the "diseased" outcome category in fact altered results in stunting analyses, in that increased numbers of SES variables were found to be associated with stunting at 1 year of age, when this outcome was defined using the CDC/ WHO 1978 reference.

In addition to associations with sex of the child and small for gestational age delivery, fully-adjusted results indicated that stunting at 1 year of age also showed negative associations with mother's

education. Positive associations between stunting at this age and residence of at least one sibling aged under 5 years in the household and whether any family members had problems with alcohol or drug consumption were also seen. The importance and influence of mother's education has been previously outlined (see section 6.2 *Stunted at ages 1, 2 & 5 years*). Previous research has also highlighted the influence on child stunting of parity and sibship (Aerts, 2004; Ukuwani, 2003) as well as neglectful caretaking behaviours that may result from alcohol or drug abuse (de Villers, 2002; Livingood, 1983).

7. CONCLUSIONS, POLICY IMPLICATIONS AND FUTURE RESEARCH

CONCLUSIONS

Although drawn from cross-sectional analyses and as such not causative, results of this study have indicated that a number of demographic, behavioural, economic and social support factors show associations with infant and child growth in this urban South African setting. Asian ethnicity, parity and maternal smoking behaviour showed associations with growth in utero, as summarised by small for gestational age delivery. In turn, SGA delivery showed associations with growth and stunting in childhood. Male sex of the child also showed associations with growth and stunting during infancy. Social support measures, including mother's desire for the pregnancy and whether the family and economic conditions were right and ready for the pregnancy, influenced both growth in utero, as summarised by SGA delivery, and growth during early childhood. Socio-economic measures of household status including water and sanitation services, mother's education, mother's work and measures of household wealth also showed associations with growth during childhood.

The impact of growth during early life on later growth was apparent in this study. Results from both SGA delivery and stunting analyses highlighted that the prevention of growth retardation during early life may have an impact on growth retardation at older ages. As such, policies to reduce child growth retardation at older ages must also address the causes of growth retardation at earlier ages. Results from socio-economic and social support analyses indicated that a number of similar measures were associated with growth retardation at different time points, suggesting that the effect of improving the relevant socio-economic and social support conditions may influence growth at more than one time point.

POLICY IMPLICATIONS OF EFFECTS OF SOCIO-ECONOMIC STATUS ON CHILD GROWTH IN URBAN SOUTH AFRICA AND AREAS FOR FURTHER RESEARCH

The prevention of poor infant and child growth and promotion of good nutrition were included as key public health priorities for South Africa in the Department of Health's Strategic priorities for the National Health System 2004 – 2009 [xxi]. As such, policy recommendations that arise out of the identification of significant economic and social SES factors associated with infant and child growth in this study are timely. Results of this study indicate that the principal economic and social SES factors associated with infant and child growth in urban South Africa include mother's education,

[xxi] http://www.doh.gov.za/docs/strat-f.html

mother's employment, supply of water and sanitation services as well as mother's desire for the pregnancy and family's emotional and financial readiness for the pregnancy.

Although, many of the policy recommendations concerning education, employment and water and sanitation service provision are already in place in South Africa (see chapter 2.1 *South African context- Reconstruction and Development Programme*), results of this study suggest the need for further policy recommendations in the following areas: adult education; reduction of unemployment; provision of both water and sanitation services to informal settlements as well as family planning services.

EDUCATION

Mothers in this study (born 1946-1976) began their schooling between approximately 1951 and 1981, although the majority (76.9%) did so between 1961 and 1971. As significant educational reforms for the schooling of non-White South Africans were not introduced until the 1970s, the extent and quality of schooling received by the majority of mothers in this study would have been very low (Price, 1991). Since 1994 the extent and quality of education has improved substantially. For example, nationwide estimates of the proportion of people aged over 20 years who have received no schooling have fallen from 19.3% in 1996 (StatsSA, 1996) to 10.3% in 2001 (StatsSA, 2001). Estimates of these census statistics for Gauteng province indicate a fall from 9.5% to 3.9%, between 1996 and 2001 respectively (Stats SA, 1996; Status SA, 2001).

However despite substantial increases in enrolment, reductions in teacher student ratios and large increases in funding, a number of difficulties remain with provision of schooling in South Africa- both to the current generation of school children and to the adult population (Torres et al., 2000). Difficulties in adequate service provision to current students include: classroom overcrowding and understaffing; low levels of teacher qualifications; poor quality of teaching as indicated by high exam failure and year repeat rates (Torres et al., 2000). High student drop-out rates are also problematic in some areas, where families can not afford to pay for uniforms, books, transport or "improvement fees" [xxii] (Torres et al., 2000).

Under the RDP (1994) the South African government pledged its commitment to life-long learning and adult education. Rates of adult literacy, however, indicate that education service provision to

[xxii] Although schooling is free in all state-run schools, schools may charge a fee (usually small) for "improvement" of school services.

adults is very restricted. Estimates from the United Nations' Human Development Index (HDI) (South Africa UNHD Report 2003) show that rates of literacy in those aged over 15 years have not changed from 1996 (86.0%) to 2002 (85.9%) [xxiii]. Surveys indicate that there are few community-based education services, apart from those delivered in health clinics, and few distance-based learning courses available from higher education centres (Torres et al., 2000).

Bearing in mind the significant association between mother's education and stunting seen in this study, the promotion of adult education in South Africa is an important policy recommendation to reduce this poor growth outcome. Continuation and expansion of information provision and education from healthcare workers (particularly nurses) on issues of nutrition, hygiene, safe food preparation and storage, sanitation and management of childhood illness is essential (e.g. safe food preparation pamphlets [xxiv]). Indeed, participants in the qualitative component of this study recognised the benefits of such health based education programmes to improvements in child growth and development for uneducated mothers. Information provision and education from community-based organisations and social services on nutrition and eligibility for social assistance and relief grants is also necessary. Finally, considering the amount of public health and nutrition messages which are delivered with a component of written material, improvements in adult literacy are also desirable.

UNEMPLOYMENT

Despite the range of policies implemented by the RDP to address unemployment in South Africa, rates of unemployment and under-employment (where people are employed below their skills level or work fewer hours than they would like) remain excessively high (May, 2000; Torres et al., 2000). Indeed, participants in the qualitative research project unanimously mentioned two issues in response to the question "what do you think is the worst thing about this community"- crime and unemployment- and other surveys report similar sentiments e.g. South African Participatory Poverty Assessment, 1997 (Torres et al., 2000).

Recent figures from 2004 and 2005 estimate the rates of unemployment (official definition, which does not include long-term unemployed or those who are no longer searching for employment) in South Africa as 27.8% (Labour Force Survey, 2004) and 26.7% respectively (Labour Force Survey,

[xxiii] (http://www.undp.org.za/NHDR2003.htm

[xxiv] http://www.doh.gov.za/docs/index.html (Pamphlets- Five keys to safer food).

2005) [xxv]. Rates for Gauteng province are estimated at 28.2% and 22.8% for 2004 and 2005 respectively. Although unemployment is high for men, rates for women are even higher (Pillay, 1996). Furthermore, female participation in the formal sector is very low (Torres et al., 2000). Indeed the majority of employees in the informal sector are female and aged either under 25 years of age or between 35-44 years of age (i.e. childrearing years) (Torres et al., 2000).

Furthermore, despite the abolishment of institutionalised racial discrimination, unemployment rates show strong ethnic gradients. For example, in 2005 31.5% of African South Africans and 22.4% of Coloured South Africans were unemployed (official definition) in comparison to 15.8% of Asian and 5.0% of White South Africans. There is also marked ethnic patterning in levels of participation in formal employment. Approximately 11% of the employed work force are estimated to be self-employed and engaged in informal employment (Pillay, 1996). Estimates from the 1995 October Household Survey indicate that approximately 86% of those self-employed are African South Africans, while less than 8% are Coloured, less than 5% are Asian and approximately 2% are White (Torres et al., 2000).

Given the significant association between mother's employment and stunting in this study, employment policies, and particularly policies for the informal sector, remain key areas of intervention in the improvement of child growth in South Africa. Continuation of the Public Works Programmes is necessary, although jobs created under these schemes are not usually widespread or long-lasting (May, 2000). Expansion of actual support, both non-financial and financial, for micro-enterprises is also essential. In particular, facilitating access to funding and capital for the transformation of micro and small enterprises from survivalist to entrepreneurial modes is desirable (Ginsberg, 1998; May, 2000). However again, long-lasting unemployment solutions will not be obtained by policies which focus solely on small, medium or micro enterprises (SMME), as the majority of these will remain survivalist despite support and investment (le Roux, 1996; May, 2000).

Longer-lasting solutions for the unemployment crisis in South Africa may come from skills training and education. For example, the promotion in secondary and tertiary education of vocational training for technicians and artisans may enable young South Africans entering the workforce to have the necessary skills to find employment (Torres et al., 2000). The development of industry-sponsored apprentice schemes as an alternative to higher education for some school students may

[xxv] http://www.statssa.gov.za/publications/statsdownload.asp?PPN=P0210&SCH=3563

also increase employment opportunities (Ginsberg, 1998). A substantial increase in investment by formal sector employers in employee skills development and training may also prove crucial to increase social mobility of current employees and consequent employment of new junior level staff (Torres et al., 2000).

In addition to these measures, the provision of social service assistance in skills development, training and job seeking is required to enable those capable of working of finding gainful employment. The provision of suitable replacement childcare services is also necessary to promote female employment without compromising child caretaking. The Department of Education has a policy on Early Child Development and the provision of education services for children under 6 years of age, however, due to funding constraints progress on its implementation has stalled (May, 2000). Finally, social security support and safety nets for those who remain unemployed and unemployable is necessary until these individuals may also be assimilated into the workforce (Budlender, 2000; Torres et al., 2000).

WATER AND SANITATION SERVICES

Improvement and delivery of key infrastructures (housing, electricity, water and sanitation) was one of the key principles of the RDP established in 1994 (le Roux, 1996). The provision of water to the majority of urban areas has improved substantially since this time. For example, estimates from the 2001 census indicate that 84.5% of households in South Africa and 97.5% of those in Gauteng province have access to piped water within 200 meters of their home (StatsSA, 2001). An estimated total of 32.2% of households in South Africa and 47.2% of those in Gauteng province have access to piped water within their home (StatsSA, 2001). However, the provision of improved sanitation services has progressed more slowly. For example, Census estimates from 1996 and 2001 indicate that the proportion of households with no toilet of any kind decreased from 13.6% to 12.4% in South Africa generally, and from 3.6% to 2.5% in Gauteng province (StatsSA, 1996; StatsSA, 2001). Estimates from the United Nations Development Programme (UNDP) Millennium Development Goals indicate that the provision of "improved" sanitation services (i.e. including flush to piped sewer system, flush to septic tank, flush/pour flush to pit, flush/pour flush to elsewhere) in urban areas of South Africa has improved very little between 1990 and 2002, from 85% to 86% of the population [xxvi].

[xxvi] http://www.undg.org/content.cfm?id=79&page=16&num=10&sort=country&view=basic&archives=0

Despite RDP policies to increase ownership of formal homes, for example through grants and building projects, many poor families are housed in informal settlements, living in shelters such as shacks (le Roux, 1996). Indeed, the 2001 Census indicated that 16.4% of homes in South Africa and 23.9% of those in Gauteng province were informal (StatsSA, 2001). Furthermore, when these statistics are stratified by ethnic group, the African South African group is shown to be particularly at risk. Over 20% of African South Africans are housed in informal housing in comparison to 7.4% of Coloured, 1.1% of Asian and 0.5% of White South Africans (StatsSA, 2001). The population of informal settlements remains large because many poor families can not afford to pay the cost of formal housing, even with grant support (May, 2000), and informal settlements are also substantially populated by foreign immigrants (Solomon, 1996). The provision of key infrastructure services such as water and sanitation to homes in informal settlements falls well behind rates for formal housing areas. Implementing the RDP policies in informal housing settlements has been particularly challenged by contractors' unwillingness to connect insecure tenures to services (May, 2000; Stavrou, 2000). Given the strong association between sanitation and water services and stunting in this urban sample, the wider provision of improved sanitation services, as well as the provision of both water and sanitation services to informal housing areas, are essential and urgent policy recommendations to reduce the prevalence of stunting in this urban South African setting.

FAMILY PLANNING SERVICES

Given the significant associations seen in this study between mother's desire for the pregnancy and family's emotional and financial readiness for the pregnancy with both SGA delivery and stunting in early childhood, the provision and use of effective family planning services is a central policy recommendation of this research. Indeed this is something that the South African government itself is currently concerned with. The reduction in teenage pregnancy, reduction of school girl drop-out rates due to pregnancy and empowerment of women to control their reproductive decisions are all highlighted as key priorities in "Strategic priorities for the National Health system 2004 – 2009" [xxvii].

Although unwanted or unplanned pregnancies are certainly not restricted to teenage women, in this study those aged over twenty years were more likely both to report that they desired their pregnancy (OR = 2.77; 95%CI 1.99 – 3.87) and that their family was ready for the pregnancy (OR = 1.59; 95%CI 1.18 – 2.15). The prevalence of teenage pregnancy is currently very high in South Africa, particularly within the Black and Coloured groups. For example, SADHS estimates for 1998

[xxvii] http://www.doh.gov.za/docs/strat-f.html

indicate that the proportion of females aged 15 – 19 years that have ever been pregnant was 16.4% for the whole of South Africa and 9.5% in Gauteng province (SADHS, 1998). The proportion of ever-pregnant Black and Coloured female teenagers aged 15 – 19 years was 17.8% and 19.3% respectively, compared to 4.3% of Asians and 2.2% of Whites (SADHS, 1998).

Family planning services are available free of charge on the South African National Health system. Services include advice and counselling and free contraceptives, including emergency contraceptives (Mfono, 1998; Ehlers, 2003). Furthermore, since 1996 termination of pregnancy (TOP) services for pregnancies up to 12 weeks gestation have been legal and free under the health service (Ehlers, 2003). However, teenage pregnancy prevalence indicates that these services are used sub-optimally at best and may not be well designed for use by this age group. A study of family planning centres by the Planned Parenthood Association of South Africa in Gauteng province indicated that young parents using the service only initiated contact with family planning services after one year of onset of sexual relations (Mfono, 1998). Barriers to use included inadequate information and knowledge about service providers and fear of societal and parental disapproval.

The lack of awareness of services by teenagers was also highlighted by another small, but South Africa-wide, study (Ehlers, 2003). Of a total of 250 mothers aged 17 – 19 years, 34% did not know about contraception when they became pregnant and a very large majority, 75.6% did not know about emergency contraception (Ehlers, 2003). Teenagers in these studies indicated that the majority of their contraceptive knowledge came from peers, or their mothers, or sisters (Mfono, 1998; Ehlers, 2003). Very few obtained information from teachers/ school or from the media (Mfono, 1998; Ehlers, 2003). As such, improvements in information dissemination through mediums of the media (TV, radio, magazines, newspapers, pamphlets) and schools is essential as these mediums reach large numbers of children at risk of teenage pregnancy. In particular, earlier introduction of sexual education into the school curriculum is recommended, as many of South Africa's teenagers have already experienced sexual intercourse and pregnancy by the age of 16 years.

Further policy recommendations to improve access to and use of family planning services, which may impact on infant and child growth outcomes, include improvement in the delivery of family planning services. Studies have indicated that separate service centres for adolescents are preferred by teenagers, to avoid contact with community adults that may disapprove of the young

age of initiation of sexual intercourse e.g.(Mmari and Magnani, 2003). More appropriate opening times to school-aged adolescents, including weekend access, were also mentioned by participants in Mfono's study as barriers to use of family planning services (Mfono, 1998). Finally, improved attitude of staff at family planning centres and health service staff who work in family planning related services is also desirable. For example, attitudes of family planning nurses was highlighted in both Mfono's and Ehlers' studies as barriers to service usage (Mfono, 1998; Ehlers, 2003) and attitudes of pharmacists to providing emergency contraception have also been reported as barriers to contraceptive use in South Africa (Harris, 1999).

In summary, four areas of policy recommendations and issues for future research stem from this study- education, employment, water and sanitation services, and family planning services. In particular, outcomes of child growth would benefit from the: provision of adult education programmes including those for literacy, nutrition, child illness management, hygiene behaviours, sanitation and food preparation/ storage; implementation of programmes for training and skills provision for school-aged children, current workers, those employed in the informal sector and the many unemployed individuals in South African society; as well as from the provision of both water and sanitation services to informal housing areas. The outcome of size at birth measured by SGA would benefit from implementation of family planning services which are appropriately designed for use by South African women from all ethnic groups and by all age groups, including young women and adolescents.

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SUBJECT INFORMATION SHEET:

i my name is Barbara, I am doing a study on child growth as part of the Birth to Twenty project which is the largest ıd longest running study of child health and development in Africa. This research study that I would like to tell you ɔout aims to find out more about the relationship between a child's environment and the way a child grows. ubjects may contact Birth to Twenty study team with any questions or to withdraw from the study, on 0800-131818.

/hy have you been asked to take part in this study?

ou have been asked to take part in this study because you are a community member of an area in which the Birth › Twenty participants are living in 2004.

/hat is this study about?

ıis study aims to find out more about what parts of a child's environment influence the way in which that child grows ıysically. It aims to collect information from participants, including community members, on how they think certain ɜpects of a child's environment may be important to child growth.

ow will the study findings be used?

ıe information collected in this study will be used by the research team to better understand the living environments ' children, and how they might influence growth. The study will provide information to programs aiming to produce ɜalthier living environments for children growing up in Soweto and Johannesburg areas in the future.

/hat will be done in the study?

ıe study will be in the form of a one-to-one interview where you will be asked to discuss your opinions on the area here you work, and how you think this affects a child's growth.

ıe interview will also be attended by two or three Birth to Twenty researchers, whose jobs it will be to ask questions ıd take notes.

ıe interview may be conducted at your place of work or at the Birth to Twenty centre in either the Baragwanath or ɔhannesburg Hospitals, whichever you prefer.

ıe study will only need one visit, that will last about one hour in total.

ermission will be asked to tape-record the interviews, to help with analysis of the results.

/hat if you do not want to participate?

ıis study is completely voluntary. You do not have to participate unless you want to. At any time- before, during or ter the interview- you can decide that you do not want to participate and there will be no consequences.

uring the interview you should feel free not to answer any questions that you feel uncomfortable about.

fter the interview you can call the Birth to Twenty study team on 0800-131818 to withdraw from the study if you do ɔt want to participate, and your information that you have given will be withdrawn from the study.

re there any benefits?

ıere are no financial benefits for taking part in this study. However, this research is being carried out to better ıderstand child growth and child health in the communities of Soweto and Johannesburg, and it has the potential to ed into policy that might help to improve the growth and health of future generations of children growing up in the udy areas.

re there any risks?

ıere are no known risks to participating in this research.

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ubjects may contact Birth to Twenty study team with any questions or to withdraw from the study, on 0800-131818.

re there any costs?

ıere are no costs to participate. Drinks and snacks will be provided during the group discussion session.
ck & Pay vouchers will be provided to show our appreciation and to contribute to your out of pocket expenses that
sult from taking part in the study.

onfidentiality?

very effort will be taken to protect the identity of participants in the study.
l your information will be kept in a locked research office and no one except the main project researchers will have
ɔcess to it.
'e will use an identification number to record and store your information, rather than using your name.
ɔur name will not be identified on any report or publication of this study or its results.

'ho can you contact to answer questions about the study?

you have any questions, you may phone the Birth to Twenty study at the University of Witwatersrand Medical
chool on
300-131818.

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hy have you been asked to take part in this study?

ou have been asked to take part in this study because you are a healthcare nurse in an area in which the Birth Twenty participants are living in 2004.

hat is this study about?

his study aims to find out more about what parts of a child's environment influence the way in which that child ows physically. It aims to collect information from participants, including healthcare nurses, on how they think ertain aspects of a child's environment may be important to child growth.

ow will the study findings be used?

he information collected in this study will be used by the research team to better understand the living vironments of children, and how they might influence growth. The study will to provide information to programs ming to produce healthier living environments for children growing up in Soweto and Johannesburg areas in the ture.

hat will be done in the study?

he study will be in the form of a one-to-one interview where you will be asked to discuss your opinions on the ea where you work, and how you think this affects a child's growth.

he study will only need one visit, that will last about one hour in total. The interview can take place at your place work or at the Birth to Twenty centre in either the Baragwanath or Johannesburg Hospitals- whichever you efer.

he interview will also be attended by two or three Birth to Twenty researchers, whose jobs it will be to ask uestions and take notes.

ermission will be asked to tape-record the interviews, to help with analysis of the results.

hat if you do not want to participate?

his study is completely voluntary. You do not have to participate unless you want to. At any time- before, during after the interview- you can decide that you do not want to participate and there will be no consequences. uring the discussion group you should feel free not to answer any questions that you feel uncomfortable about. fter the interview you can call the Birth to Twenty study team on 0800-131818 to withdraw from the study if you not want to participate, and your information that you have given will be withdrawn from the study.

e there any benefits?

here are no financial benefits for taking part in this study. However, this research is being carried out to better derstand child growth and child health in the communities of Soweto and Johannesburg, and it has the potential feed into policy that might help to improve the growth and health of future generations of children growing up in e study areas.

SUBJECT INFORMATION SHEET:

i my name is Barbara, I am doing a study on child growth as part of the Birth to Twenty project which is the rgest and longest running study of child health and development in Africa. This research study that I would like tell you about aims to find out more about the relationship between a child's environment and the way a child ows.

ubjects may contact Birth to Twenty study team with any questions or to withdraw from the study, on 0800-31818.

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re there any risks?

here are no known risks to participating in this research.

re there any costs?

here are no costs to participate.

ck & Pay vouchers will be provided to show our appreciation and to contribute to your out of pocket expenses at result from taking part in the study.

onfidentiality?

very effort will be taken to protect the identity of participants in the study.

l your information will be kept in a locked research office and no one except the main project researchers will ave access to it.

'e will use an identification number to record and store your information, rather than using your name.

our name will not be identified on any report or publication of this study or its results.

'ho can you contact to answer questions about the study?

you have any questions, you may phone the Birth to Twenty study at the University of Witwatersrand Medical chool on

800-131818.

SUBJECT INFORMATION SHEET:

i my name is Barbara, I am doing a study on child growth as part of the Birth to Twenty project which is the largest ıd longest running study of child health and development in Africa. This research study that I would like to tell you ɔout aims to find out more about the relationship between a child's environment and the way a child grows. ubjects may contact Birth to Twenty study team with any questions or to withdraw from the study, on 0800-131818.

'hy have you been asked to take part in this study?

ɔu have been asked to take part in this study because you are a caregiver of a child enrolled in the Birth to Twenty oject.

hat is this study about?

ıis study aims to find out more about what parts of a child's world influence the way in which that child grows ıysically. It aims to collect information from caregivers on how they think certain aspects of a child's world may be portant to child growth.

ɔw will the study findings be used?

ıe information collected in this study will be used by the research team to better understand the living environments children, and how they might influence growth. The study will provide information to programs aiming to produce althier living environments for children growing up in Soweto and Johannesburg areas in the future.

ıat will be done in the study?

e study will be in the form of a group discussion where you will be asked to discuss your opinions with other group ɜmbers on the area where you live and your home, and how you think these affect your child's growth.

e group will include between six and ten caregivers of children involved in the Birth to Twenty study.

e group discussion will also be attended by two or three Birth to Twenty researchers, whose jobs it will be to ask estions and take notes.

u will be asked to come along to the Birth to Twenty centre in either the Baragwanath or Johannesburg Hospitals.

e study will only need one visit, that will last about two hours.

rmission will be asked to tape-record the discussions, to help with analysis of the results.

ıat if you do not want to participate?

s study is completely voluntary. You do not have to participate unless you want to.

ɜny time- before, during or after the interview- you can decide that you do not want to participate and there will be consequences.

ring the discussion group you should feel free not to answer any questions that you feel uncomfortable about.

ɜr the interview you can call the Birth to Twenty study team on 0800-131818 to withdraw from the study if you do want to participate, and your information that you have given will be withdrawn from the study.

hdrawal from this study will in no way affect the participation of your child or your family in the larger Birth to ɜnty project.

there any benefits?

ɜre are no financial benefits for taking part in this study. However, this research is being carried out to better 'erstand child growth and child health in the communities of Soweto and Johannesburg, and it has the potential to ɪ into policy that might help to improve the growth and health of future generations of children growing up in the ly areas.

SUBJECT INFORMATION SHEET:

i my name is Barbara, I am doing a study on child growth as part of the Birth to Twenty project which is the largest ıd longest running study of child health and development in Africa. This research study that I would like to tell you ɔout aims to find out more about the relationship between a child's environment and the way a child grows.

ubjects may contact Birth to Twenty study team with any questions or to withdraw from the study, on 0800-131818.

'e there any risks?

ıere are no known risks to participating in this research.

'e there any costs?

ıere are no costs to participate. Drinks and snacks will be provided during the group discussion session.

ck & Pay vouchers will be provided to show our appreciation and to contribute to your out of pocket expenses that sult from taking part in the study.

ɔnfidentiality?

'ery effort will be taken to protect the identity of participants in the study. All your information will be kept in a locked ɜearch office and no one except the main project researchers will have access to it. We will use an identification mber to record and store your information, rather than using your name. Your name will not be identified on any ɔort or publication of this study or its results.

ɜ would also ask that the participants in the group keep private what has been discussed, and respect the nfidentiality of ideas and opinions that other participants have shared with the group.

ıo can you contact to answer questions about the study?

'ou have any questions, you may phone the Birth to Twenty study at the University of Witwatersrand Medical hool on

)0-131818.

In-depth Interview Topic Guide

Participants: Community Representatives

PhD Qualitative Project, BT20, Johannesburg, South Africa

Welcome and Introduction:

A. Greeting-

Hello, how are you?

Thank you for agreeing to participate in the study.

B. Appreciation of their participation, admission that researcher there to learn from them-

It is so great for us that you could find the time to do this interview, because what you have to say is important and useful to our work.

The information and opinions that you have can be helpful to us because they give us more information and teach help to teach us about people's ideas on the subject.

C. Research agenda, problem to be solved-

We have asked you to come along today because we are doing a study with children in the Birth To Twenty project.

Have you heard of Birth to Twenty?

(If not, share a little information on the cohort project with them).

Our study is very interested in how urban South African children grow.

Scientists know that the local environment that children grow up in can affect how they grow.

So in this work, we want to find out more about two things:

1. more information about the world in which children, from the communities that you work in, grow up.
2. how you think that characteristics of a child's world and environment might affect how children grow physically.

Also, it would be most helpful for this project if you could talk specifically about children from the communities that you work in.

D. Confidentiality & Tape Recording

Before we begin, I would just like to assure you that what you share with us and the opinions you express in this interview will be treated with complete confidentiality. You will not be able to be personally identified from the results and you are also free to not answer any questions that you do not feel comfortable with, you may also withdraw from the study at any time without any consequences.

I would also like to ask your permission to tape record the interview and take notes, because this really helps us in our analysis. Is this ok?

Do you have any questions before we begin?

Interview Topics:

E. Opening

To start with I wondered if you could tell me a little bit about yourself and the community you work in.

1. How would you describe the job you do?
2. How long have you been doing this type of work?
3. How long have you worked in this community?
4. You work in this community but do you also live here?
5. How would you describe the community you work in?
   - Do you think the neighbourhoods in this area tend to be similar to one another?
   - If not could you tell me how they are different?

As you know, our study is on child growth...

1. I was wondering what things about this community you think impact the way children from the area grow physically?

(Prompts)

- What in this community do you think is positive for the physical growth of children?
- What do you think is negative for the physical growth of children?

2. Do you know of any programmes in your community to improve child growth?

(Prompts)

- Can you tell me about these?
- What age of children are targeted in these programmes?

F. Themes

Well all the information you have provided me with so far is very useful and I would like now to ask you some more specific questions on how you think certain things about a child's environment influence their growth.

Electricity-

1. Can you tell me about the electricity supply in your community?

(Prompts)

- What is the extent of homes in this community that would have electricity supply?
- How reliable do you think the supply is in this area, e.g. are power cuts common?

2. How, if at all, do you think that electricity supply might be important in child health or growth?

(Prompts)

- Could you give me an example, could you give me more detail?

Type of home-

1. Could you put these types of home in order from best to worst?

(Types of homes include shack, garage, room, cottage, flat and house).

(Prompts)

- Why do you think that this is the "best, second best...worst" (for each different photo of type of home)

2. (For each type of home) Could you tell me if you think this type of home would have an effect on the health and growth of children who live in the home?

(Prompts)

- What kind of an effect?
- How do you think that it would have that effect?

House ownership-

1. In your community can you rank residents living under the following living arrangements?

(Types of living arrangements include owned, renting from the local authority, renting from someone else, provided by an employer.)

2. As far as you know would this be the case in all communities in (region in which interview is taking place)?

Home repairs-

1. Would you think many of the houses in this community are in need of repair, for example have badly leaking roofs or broken doors and windows?

2. Do you think many of the homes in this community are troubled by rats?

3. Could you put the following types of roofing material in order for me from least good to best?

(masonite, corrugated metal, asbestos, asbestos and zinc, concrete cement, tiles).

4. How, if at all, do you think the condition of the house of a family in this community, for example if the house needs a lot of repairs, may influence how children in that home grow physically?

5. How, if at all, do you think the growth and health of children in houses with (upper and lower extremes of roofing material) roofs are different to one another?

6. How, if at all, do you think the health and growth of children living in homes that are troubled by rats is different to those not troubled by rats.

Mother's education & partner's education-

1. How do women learn how to bring up children well?

2. How, if at all, might the level of schooling of a mother influence how she brings up her children?
3. How many years of school education do you think a woman needs to know about bringing children up well?

(Prompts)

- Why do you think this level is important?

4. How, if at all, might the level of schooling of a mother influence her child's growth and development?

(Prompts)

- How, if at all, would her level of schooling affect a child's diet?
- How you think her level of schooling is important in how she cares for a sick child?
- How, if at all, might her level of schooling affect the way she uses health care services?

5. What effect, if any, does a partner's level of education have on a child's growth?
6. In what ways, if at all, are the level of mother's and partner's schooling of different importance to child growth?

(Prompts)

- Do you think one more important than the other?
- In what ways, if at all, is one more/ or not more important than the other?

Now I would like you to think back to around 13 years ago, around the time of 1990/1991.

1. How do you think mother's level of schooling at that time would influence the way she would take care of young children or babies?
2. How, at that time, do you think her level of schooling affected how she would care for a sick child?
3. At that time, how, if at all, do you think that her level of schooling might affect the way she would use health services?

4. Do you think the effect of a partner's level of education on the growth of a small child or baby would have been different at that time?

Job

1. How would you describe the term unemployed?

(Prompts)

- What happens to people who are unemployed?
- Do they get help from government?
- Is the help enough to survive on?
- If not who gives help?

2. How would you describe the term informal sector?

Mother's job:

3. In your opinion, what impact does it have on a community when lots of mothers are working compared to communities where they do not work?

4. How do you think the job a mother does might be important to her child's growth?

(Prompts)

- How, if at all, do you think a mother working might be good for a child?
- How, if at all, do you think a mother working might be bad for a child?

- How, if at all, does the job a mother does influence how a child is looked after?
- How, if at all, does the job a mother does affect how a child eats?
- In your opinion, how, if at all, does the job a mother does affect a child's health?
- How, if at all, might a mother working affect how a child's illness is treated?

Partner's job:

5. In your opinion, is a child's growth affected differently by a mother's job than by a partner's job?

(Prompts)

- How does the job a partner does influence a child's growth?

Again I would like you to think back to the time of 1990/1991...

1. Do you think that the impact on the community when lots of mothers are working would have been different at that time to now?

(Prompts)

- In what ways do you think it may have been different?

2. Do you think the way a mother's job might influence how a child is looked after would have been different at that time?
3. Do you think the way a mother's job might influence how a child eats would have been different at that time?
4. Do you think the way a mother's job might influence a child's health would have been different at that time?
5. Do you think the way a mother's job might influence how a child illness is treated would have been different at that time?

6. Do you think the way a partner's job might influence a child's growth would have been different at that time than now?

Drugs

1. In the communities you work in, do you think it is a common occurrence for people to take drugs?
2. Do you think taking drugs would have been a common occurrence in this community 12-13 years ago?
3. Do you think that the community you work in, would consider drug taking to be a problem?
4. How, if at all, do you think that children from homes in which people take drugs are impacted?

G. Ending-

1. What in your opinion has the most influence on child growth in your communities?

2. What are you most proud of in the community you work in?
3. What is the best service provided in your community that you think helps improve child growth?

4. What are you least proud of in the community you work in?
5. What do you think are the biggest barriers to improving child growth in your community?

6. Have we missed anything important?
7. Do you have any questions for me?

Thank you for talking the time to answer these questions, your answers will be most useful to our research.

Please feel free to contact us about the study on the Birth to Twenty project phone number 0800-131818, if you have any questions or comments, or if you would like to withdraw from the study.

In-depth Interview Topic Guide

Participants: South African healthcare nurses

PhD Qualitative Project, BT20, Johannesburg, South Africa

Welcome and Introduction:

A. Greeting-

Hello, how are you?

Thank you for agreeing to participate in the study.

B. Appreciation of their participation, admission that researcher there to learn from them-

It is so great for us that you could find the time to do this interview, because what you have to say is important and useful to our work.

The information and opinions that you have can be helpful to us because they give us more information and help to teach us about different people's ideas on the subject.

C. Research agenda-

We have asked you to come along today because we are doing a study with children in the Birth To Twenty project.

Have you heard of Birth to Twenty?

(If no, share a little information on the cohort project with them)

Our study is very interested in how urban South African children grow.

Scientists know that the local environment that children grow up in can affect how they grow.

So in this work, we want to find out more about two things:

1. more information about the environment in which children, from the communities that you work in, grow up.
2. how you, as a healthcare nurse, think that characteristics of a child's environment might affect how that child grow physically.

So although I know that you will know a lot about child health and growth in general, it would be most helpful for this study if you could talk specifically about children from the communities that you work in.

D. Confidentiality & Tape Recording

Before we begin, I would just like to assure you that what you share with us and the opinions you express in this interview will be treated with complete confidentiality. You will not be able to be personally identified from the results and you are also free to not answer any questions that you do not feel comfortable with, and can withdraw from the study at any time without any consequences.

I would also like to ask your permission to tape record the interview and take notes, because this really helps us in our analysis. Is this ok?

Do you have any questions before we begin?

Interview Topics:

E. Opening

So first I would like to get a little bit of an idea about you and the work you do here.

1. Could you tell me what type of a healthcare nurse you are?
2. And about how many years you have been a nurse?
3. What kind of patients do you usually see?
    - What age children do you see?
    - Have you always worked with children?
4. Have you always worked in this hospital or clinic?

(Prompts)

- How long have you worked here?
- How does it feel working in this hospital?

5. Could you give me a brief idea of the type of services offered at your clinic?
    a. What do you tend to do most often?
    b. Does tracking children's growth come into your work, and if so how much?
    c. Until what age do you usually track a child's growth at this clinic?
6. How accessible are the tracking services in your clinic?
    a. Could tell me what you think makes it easy for mothers or caregivers to access the services that your clinic offers?
    b. Now could you tell me what you think makes it difficult for this to happen?

7. How do you see the way children grow in this community as a health issue?
8. In your opinion is the growth of their child something that mothers are aware of or worried about?

    (Prompts)

    - What makes you think that?
    - Do mothers ask how their children are growing in comparison to other children?

- Do mothers ask you to track their child's growth?

b. If the clinic were to identify children who are not growing well, what is the procedure that follows?

(Prompts)

- Could you tell me what type of advice, if any, is given to mothers if their child is not growing well?

9. Could you also tell me a little bit about the community you work in?
10. What would you say are the features that defines this community from others in the area?
    a. How would you describe people who come to this clinic?
    b. Do people from other areas come to use this clinic?
    c. Where do they come from?
    d. What do you think the reasons might be that they are coming to this clinic?
    e. How do those other communities compare to this one?

F. Themes

All the information you have provided me with so far is very useful and I would now like to ask you some more specific questions on how you think certain things about a child's environment influence their growth.

Water & toilet facilities

1. Can you think of any ways the type of water source a household has, for example an indoor tap versus a shared outdoor tap, might influence the growth of the children in that household?
2. How, if at all, might sharing source of water with other families make a difference to a child's growth?
3. How, if at all, would the impact of the water source on growth vary with a child's age?
    - What would be the influence in very young children or babies?
    - What would be the influence in young children between about 2- 5 years?
    - What would be the influence in older children between about 6- 8 years?

4. Can you think of any ways the toilet facilities, for example a flush toilet indoors versus a shared pit latrine outdoors, might influence the growth of children in that household?
5. How, if at all, would the impact of the type of toilet facility on growth vary with a child's age?

- What would be the influence in very young children or babies?
- What would be the influence in young children between about 2- 5 years?
- What would be the influence in older children between about 6- 8 years?

Cooking fuel and heating fuel

1. In your opinion, do certain cooking fuels have an influence on a child's health and growth?
2. How might they have such an influence?

Medical aid

1. Do many people in the community you work in have MedicalAid?
2. In your opinion, what kind of difference does having MedicalAid make to a child?
3. What happens to children living in families without MedicalAid?

Now I would like you to think back a little bit for me, to what type difference there was between people who had and did not have MedicalAid a number of years ago and the effect this would have had on them.

4. What kind of difference, if any, do you think it made to children's health in 1990/1991 around the time that Mandela was released from prison?
6. What kind of difference, if any, do you think it made to children's health a few years later in about 1994 around the time of the first elections?
7. What kind of difference, if any, do you think it made to children's health in 1997 about the time that Mandela's presidency was coming to an end?

Social support around pregnancy

1. In what ways, if at all, do you think the growth and health of a baby is affected by whether or not the mother wants to be pregnant at that time?
2. In what ways, if at all, do you think the growth and health of a baby is affected by whether or not the mother feels the family is financially ready for a baby at that time?
3. In what ways, if at all, do you think the growth and health of a baby is affected by whether or not the mother feels the family emotional conditions are right and ready for a baby at that time?

Childcare

1. Do women in the community which you work in use childcare?
2. What types of childcare are offered in this community?

(Write these down as they are said...)

3. Can you rank the different types of childcare from best to worst in terms of the influence you think they have on a child's health and growth?

(Prompts)

- Why did you choose that order?

4. How, if at all, do you think that these types of childcare influence the health of children?
5. How, if at all, do you think that these types of childcare influence their nutrition?
6. How, if at all, do you think that these types of childcare influence their growth?

Job

1. How would you describe the term unemployed?

(Prompts)

- What happens to people who are unemployed?
- Do they get help from government?
- Is the help enough to survive on?
- If not who gives help?

2. How would you describe the term informal sector?

Mother's job:

3. In your opinion, what impact does it have on a community when lots of mothers are working compared to communities where they do not work?

4. How do you think the type of job a mother is doing might be important to her child's growth?

(Prompts)

- How, if at all, do you think a mother working might be good for a child?
- How, if at all, do you think a mother working might be bad for a child?

- How, if at all, does the job a mother does influence how a child is looked after?
- How, if at all, does the job a mother does affect how a child eats?
- In your opinion, how, if at all, does the job a mother does affect a child's health?

- How, if at all, might a mother working affect how a child's illness is treated?

Partner's job:

5. In your opinion, is a child's growth affected differently by a mother's job than by a partner's job?

(Prompts)

- How does the job a partner does influence a child's growth?

Mother's education & partner's education-

1. How do women learn how to bring up children well?

2. How, if at all, might the level of schooling of a mother influence how she brings up her children?

   - If it does, how many years of school education do you think a mother needs to know about bringing children up well?

   (Prompts)

   - Why do you think this level is important?
   - If it doesn't, what are the requirements to know how to bring up children well?

3. How, if at all, might the level of schooling of a mother influence her child's growth and development?

(Prompts)

- How, if at all, would her level of schooling affect a child's diet?
- How you think her level of schooling is important in how she cares for a sick child?
- How, if at all, might her level of schooling affect the way she uses health care services?

4. What effect, if any, does a partner's level of education have on a child's growth?
5. In what ways, if at all, are the level of mother's and partner's schooling of different importance to child growth?

(Prompts)

- Do you think one more important than the other?
- In what ways, if at all, is one more/ or not more important than the other?

Now I would like you to think back to around 13 years ago, around the time of 1990/1991.

4. How do you think mother's level of schooling at that time would influence the way she would take care of young children or babies?
5. How, at that time, do you think her level of schooling affected how she would care for a sick child?
6. At that time, how, if at all, do you think that her level of schooling might affect the way she would use health services?

7. Do you think the effect of a partner's level of education on the growth of a small child or baby would have been different at that time?

G. Ending-

- What in your opinion is the thing that has the most positive influence, whether or not it is something that we have talked about, on child growth in the community you work in ?
- What do you think has the most negative influence?

- Have we missed anything important to child growth?
- Do you have any questions for me?

Thank you for taking the time to answer these questions, your answers will be most useful to our research.

Please feel free to contact us about the study on the Birth to Twenty project phone number 0800-131818, if you have any questions or comments, or if you would like to withdraw from the study.

Welcome and Introduction:

A. Greeting-

Hello, how are you?

Thank you for coming, hope everyone managed to get here without too much trouble.

B. Appreciation of their participation, admission that researcher there to learn from them-

It is so great for us that you could come, because what you have to say is important and useful to our work.

The information and opinions that you have can be helpful to us because they give us more information and teach us about people's ideas on the subject.

C. Research agenda-

We have asked you to come along today because we are doing a study with children in the Birth To Twenty project.

Our study is very interested in how children grow and scientists know that the local world that children grow up in can affect how they grow physically.

So in this work, we want to find out more about two things:

1. more information about the world that children in your communities grow up in and
2. how you, as mothers and caregivers, think that parts of that world might affect how children in your communities grow physically.

D. Confidentiality & Tape Recording

Before we begin, I would just like to assure you that what you share with us and the opinions you express in this interview will be treated with complete confidentiality.

You will not be able to be personally identified from the results.

You are also free to not answer any questions that you do not feel comfortable with.

You may also withdraw from the study at any time without any consequences.

However, due to the nature of talking in a group, what you say will be shared with each other. So we would ask you to respect each other's privacy and not express or share, with people outside the group, the opinions of your fellow group members that you hear from each other this afternoon.

Thank you.

I would also like to ask your permission to tape record the interview and take notes, because this really helps us in our analysis.

Is this ok, do you agree to the discussion being tape-recorded?

E. Ground rules-

So before we start talking about this, there are just a few ground rules that will help to make the discussion more successful.

We would like that

- only 1 person talks at a time

so that we can hear what each person has to say on the tape, and don't miss comments that may be very important and useful.

We would like to ask that everybody gets a chance to talk.

There are no right or wrong answers to the issues we are talking about and everybody's opinions are important to us.

Do you have any questions before we begin?

Discussion Topics:

F. Opening-

i. So, maybe if we start by just getting to know one another a little bit... you are all mothers or caregivers of a BT20 child, right?

ii. Do you think we could go round in a circle and tell one another our first name, the first name of our child that is in the BT20 study?
I'll start, my name is ...

iii. Great, now can we do the same thing, but tell each other what you personally like about your child being in BT20?

iv. Great, thank you.

G. Introductory-

1. I was wondering whether you think some children grow differently from other children of the same age?

(Prompts)

- So, do all children of the same age grow the same?

- Why do you think this might be?

2. Could you tell me in what ways, if at all, do you think that some children grow better or worse than others?

3. As mothers, how do know how your child is growing?

(Prompts)

- How do you know which children are growing better or worse?
- You are aware that your child who is in the BT20 study has their growth measured every year, for example their height.
  But I was wondering if other women in your community worry about how their children grow and how they decide if their child is growing well?
- Do they use nurses or clinic visits to ask about their child growth?

2. What age does a child have to be when you can stop worrying about his/her growth?

3. In what ways do you think your child's growth pattern can influence his/her life ?

(Prompts)

- Why, if at all, does it matter if a child is tall?
- Why, if at all, does it matter if a child is small?
- In what ways, if at all, might how a child grows influence their lives?
- If a child is tall, how, if at all, does it influence their life?
- If a child is small, how, if at all, does it influence their life?
- How do you think how a child grows might be important to their health, if at all?

H. Transition-

4. What things do you think are important for a child to grow properly?

(Prompts)

- Why do you think these are important?

5. How do you think a child's local community is important to their growth?
6. How do you think a child's home world is important to their growth?

I. Key-

So you have pointed out some of the ways that a child's world might be important to how they grow.

Now I would like to ask you some more questions about specific things in a child's world and your opinions or ideas on how these influence growth will be really helpful to our work.

Consumer durables

1. Can you put each one of these photos into one of these two piles?

(Photos to include television, car, radio, fridge, washing machine, telephone, toys.)

The first pile is for things you think that most households your area would have and the second pile is for things that only a very few households in your area would have.

(Prompts)

- Would you all agree with this ordering?
- Why not?
- Why do more people in your area own these type of things (items in first pile)?
- Why do few people in your area own these type of things (items in second pile)?

Now I would like you to think back for me a little bit to the time when your child who is in BT20 was born...

a. Can you again put the photos in piles of those that most households would have had and only a very few households would have had, in 1991, just after your child was born.

You can choose to leave some of the photos out if you wish.

(Prompts)

- Would you all agree with this ordering?
- Why not?
- Why do more people in your area own these type of things (items in first pile)?
- Why do few people in your area own these type of things (items in second pile)?

b. What about when your child who is in BT20 started to go to school, around the time after the general elections... could you do the same thing please?

(Prompts)

- Would you all agree with this ordering?

- Why not?
- Why do more people in your area own these type of things (items in first pile)?
- Why do few people in your area own these type of things (items in second pile)?

c. And finally, could you do the same thing but when your child who is in BT20 was about 7 years old, about the end of Mandela's presidency, how would the items in the piles have been arranged then?

(Prompts)

- Would you all agree with this ordering?
- Why not?
- Why do more people in your area own these type of things (items in first pile)? Why do few people in your area own these type of things (items in second pile)?

2. Can you think of any ways that the growth of children in households that have "an item" may be different to the growth of children in households that do not have this item?

(Use of photos as visual cues here again).
Items to question include- tv, car, radio, fridge, washing machine, telephone or toys.
(Prompts)

- At what age would each of these things (of those that the mothers state are important) be most important for a child's growth?
- Why would they be most important for child's growth at that time?

Water & toilet facilities

1. Can you think of how, if at all, the type of water source a household might influence the growth of the very young children and babies in that household?
(Use photos as visual aids. Photos will include outdoor tap, indoor cold tap, indoor hot and cold tap.)
(Prompts)

- What about ways, if any, that it might influence the growth of children aged 3 or 4 years?
- What about ways, if any, that it might influence the growth of older children aged about 6 or 7 years?

2. How, if at all, would sharing sources of water with other families make a difference?

3. Can you put these photos of different types of toilet facilities in order for me, from worst to best?
   (Photos will include a pit latrine, an outdoor flush toilet, and an indoor flush toilet.)
   (Prompts)
   - Do you all agree with this order?

4. Can you think of any ways the type of toilet in a house might influence the growth of very young children and babies?
5. Can you think of any ways the type of toilet in a house might influence the growth of children aged 3 to 4 years in that household?
6. Can you think of any ways the type of toilet in a house might influence the growth of older children, e.g. 7 year olds in that household?

Employment

1. What do you think being a housewife means?
   (Prompts)
   - In your opinion, is being a housewife a job?
   - Would you say that women who are housewives could be described as "having a job"?
   - Can women who have other jobs, also be housewives?

2. Can you explain to me what you understand unemployed to mean?
   (Prompts)
   - Would you say someone could be unemployed and still be making money?
   - If yes, why?

3. How do you think the job a mother does might be important to her child's growth?
   (Prompts)
   - How, if at all, do you think a mother working might be good for a child?
   - How, if at all, do you think a mother working might be bad for a child?

   - How, if at all, does the job a mother does influence how a child is looked after?
   - How, if at all, does the job a mother does affect how a child eats?

- In your opinion, how, if at all, does the job a mother does affect a child's health?
- How, if at all, might a mother working affect how a child's illness is treated?

Partner's job:

4. In your opinion, is a child's growth affected differently by a mother's job than by a partner's job?

   (Prompts)

   - How does the job a partner does influence a child's growth?

Marital status

1. What do you think the term partner means?

2. How, if at all, do you think the situation where a mother is living with a partner might affect a child?

3. What positive impacts does a mother living with a partner have on a child?

(Prompts)

- What would you say was the main positive impact?
- What about financial support?
- What about emotional support and someone to talk to about problems for example?
- What about the partner helping with the house?
- What about partner helping with the house?

4. What negative impacts does a mother living with a partner have on a child?

(Prompts)

- What about partner acting to make things more difficult for you?

5. What, if any, affects does a mother living with a partner have on a child's growth and a child's health?
   - Does the influence change depending on the age of the child?
   - If so, how is the effect different when a child is young?

- If so, how is the effect different when a child is older?

6. What do you think a partner adds to a home, that makes it different from a home where a mother does not have a partner?

(Prompts)

- How do you think these differences are important for child growth?

Education

1. How do women learn how to bring up children well?

2. How, if at all, might the level of schooling of a mother influence how she brings up her children?
3. How many years of school education do you think a woman needs to know about bringing children up well?

(Prompts)

- Why do you think this level is important?

4. How, if at all, might the level of schooling of a mother influence her child's growth and development?

(Prompts)

- How, if at all, would her level of schooling affect a child's diet?
- How you think her level of schooling is important in how she cares for a sick child?
- How, if at all, might her level of schooling affect the way she uses health care services?

5. What effect, if any, does a partner's level of education have on a child's growth?
6. In what ways, if at all, are the level of mother's and partner's schooling of different importance to child growth?

(Prompts)

- Do you think one more important than the other?
- In what ways, if at all, is one more/ or not more important than the other?

J. Ending-

1. What in your opinion has the most influence on child growth in your communities?
2. What do you think is the most important factor in a child's world influencing his/her growth in a child's world?
   - Would your answer to this question be different during the time when your child was very young, before he/she went to school?
   - How would it be different?

3. Have we missed anything?
4. Do you have any more questions for us?

Thank you all for coming. We appreciate the effort you have made to get here and the time you have given up in deciding to take part. Your input has been very helpful to our research.
Please feel free to contact us about the study on the Birth to Twenty project phone number 0800-131818, if you have any questions or comments or if you would like to withdraw from the study.

Welcome and Introduction:

A. Greeting-

Hello, how are you?

Thank you for agreeing to participate in the study.

B. Appreciation of their participation, admission that researcher there to learn from them-

It is so great for us that you could find the time to do this interview, because what you have to say is important and useful to our work.

C. Research agenda-

We have asked you to come along today because we are doing a study on child growth between birth and six years of age.

Our study is very interested in how the child's environment influences how urban South African children grow.

So in this work, we want to find out more about two things:

1. more information about the environment in which children, from the communities that you work in, grow up.
2. how you, as a community member, think that characteristics of a child's environment might affect how that child grow physically.

Also, it would be most helpful for this project if you could talk specifically about children from the communities that you work in.

D. Confidentiality & Tape Recording-

Before we begin, I would just like to assure you that what you share with us and the opinions you express in this interview will be treated with complete confidentiality.

You will not be able to be personally identified from the results and you are also free to not answer any questions that you do not feel comfortable with, and can withdraw from the study at any time without any consequences.

I would also like to ask your permission to tape record the interview and take notes, because this really helps us in our analysis. Is this ok?

Interview Topics:

E. Opening

About yourself:

1. How would you describe the job you do?
2. How long have you been doing this type of work?
3. How long have you worked in this community?

The community you work in:

4. What community does this school/church/association serve?
5. You work in this community but do you also live here?
6. How would you describe the community you work in?

- Do you think the neighbourhoods in this area tend to be similar to one another?
- If not could you tell me how they are different?

F. Themes

Electricity-

1. Can you tell me about the electricity supply in your community?

- What is the extent of homes in this community that would have electricity supply?
- How reliable do you think the supply is in this area, e.g. are power cuts common?

2. How, if at all, do you think that electricity supply might be important in child health or growth?

- Could you give me an example, could you give me more detail?

Type of home-

1. Could you put these types of home in order from best to worst?
2. Why that order?
3. Could you tell me if you think this type of home would have an effect on the health and growth of children who live in the home?
   - What kind of an effect?
   - How do you think that it would have that effect?

House ownership-

1. In your community, can you rank residents living under the following living arrangements from best to worst?
2. Is it always best to own/rent?

Home repairs-

1. Would you think many of the houses in this community are in need of repair?
- What kind of repairs?
- What about badly leaking roofs or broken doors and windows?
2. Do you think that a child, in this community, who lives in a house that needs a lot of repairs would grow differently to a child in a house which was not in need of repairs?

3. Could you put the following types of roofing material in order for me from least good to best?
- Why did you choose that order?
4. Do you think the growth and health of children in houses with (upper and lower extremes of roofing material) roofs are different to one another?

5. Do you think many of the homes in this community are troubled by rats?
6. Do you think the health and growth of children living in homes that are troubled by rats is different to those living in homes not troubled by rats?

Drugs

1. In the communities you work in, do you think it is a common occurrence for people to take drugs?
2. Do you think that the community you work in, would consider drug taking to be a problem?
3. How, if at all, do you think that children from homes in which people take drugs are impacted?

4. Do you think taking drugs would have been a common occurrence in this community 12-13 years ago?

Mother's education & partner's education-

1. How do women learn how to bring up children well?

2. How, if at all, might the level of schooling of a mother influence how she brings up her children?
- How many years of school education do you think a woman needs to know about bringing children up well?
- Why do you think this level is important?

3. How, if at all, would her level of schooling affect a child's diet?
- How you think her level of schooling is important in how she cares for a sick child?
- How, if at all, might her level of schooling affect the way she uses health care services?

4. What effect, if any, does a partner's level of education have on a child's growth?
5. Do you think that the level of education of the mother or father is more important to child health and growth?

Now I would like you to think back to around 13 years ago, around the time of 1990/1991.

1. How do you think mother's level of schooling at that time would influence the way she would take care of young children or babies?
2. How, at that time, do you think her level of schooling affected how she would care for a sick child?
3. At that time, how, if at all, do you think that her level of schooling might affect the way she would use health services?

Job

1. How would you describe the term unemployed?
- What happens to people who are unemployed?
- Do they get help from government?
- Is the help enough to survive on?
- If not who gives help?

2. How would you describe the term informal sector?

Mother's job:

1. In your opinion, what impact does it have on a community when lots of mothers are working compared to communities where they do not work?
2. How, if at all, do you think a mother working might be good for a child?
3. How, if at all, do you think a mother working might be bad for a child?

4. How, if at all, does the job a mother does influence how a child is looked after?
5. How, if at all, does the job a mother does affect how a child eats?
6. In your opinion, how, if at all, does the job a mother does affect how often a child is sick?
7. How, if at all, might a mother working affect how a child's illness is treated?

G. Ending-

1. Do you know of any programmes in your community to improve child growth?
- Can you tell me about these?
- What age of children are targeted in these programmes?

2. What in this community do you think is positive for the physical growth and size of a child?
3. What do you think is negative for the physical growth and size of a child?

4. What are you most proud of in the community you work in?

5. What are you least proud of in the community you work in?
6. What do you think are the biggest barriers to improving child growth in your community?

Thank you for talking the time to answer these questions, your answers will be most useful to our research.

Please feel free to contact us about the study on the Birth to Twenty project phone number 0800-131818, if you have any questions or comments, or if you would like to withdraw from the study.

In-depth Interview Topic Guide

Participants: South African healthcare nurses

PhD Qualitative Project, BT20, Johannesburg, South Africa

Welcome and Introduction:

A. Greeting-

Hello, how are you?

Thank you for agreeing to participate in the study.

B. Appreciation of their participation, admission that researcher there to learn from them-

It is so great for us that you could find the time to do this interview, because what you have to say is important and useful to our work.

C. Research agenda-

We have asked you to come along today because we are doing a study on child growth between birth and six years of age.

Our study is very interested in how the child's environment influences how urban South African children grow.

So in this work, we want to find out more about two things:

1. more information about the environment in which children, from the communities that you work in, grow up.
2. how you, as a healthcare nurse, think that characteristics of a child's environment might affect how that child grow physically.

- So although I know that you will know a lot about child health and growth in general, it would be most helpful for this study if you could talk specifically about children from the communities that you work in.

D. Confidentiality & Tape Recording-

Before we begin, I would just like to assure you that what you share with us and the opinions you express in this interview will be treated with complete confidentiality.

You will not be able to be personally identified from the results and you are also free to not answer any questions that you do not feel comfortable with, and can withdraw from the study at any time without any consequences.

I would also like to ask your permission to tape record the interview and take notes, because this really helps us in our analysis. Is this ok?

Interview Topics:

Today we are going to discuss 8 themes:

- General questions about your work.
- How the following aspects of a child's environment influence child growth.
  - Water & toilet facilities
  - Cooking and heating fuels
  - Medical aid
  - Social support around pregnancy
  - Childcare
  - Employment
  - Education

E. Opening

So first I would like to get a little bit of an idea about you and the work you do here.

1. Could you tell me what type of a healthcare nurse you are?
- And about how many years you have been a nurse?

2. Have you always worked in this hospital or clinic?
- How long have you worked here?

3. What kind of patients do you usually see?
- What age children do you see?
- Have you always worked with children?

4. What do you in this ward/clinc?
- What sort of procedures do you do?
- What do you tend to do most often?

- Does measuring children's growth or monitoring how big or small they are come into your work?
- If so how much, is it a big part of what you do?
- Until what age do you usually track a child's growth at this clinic?
- Do you use or ask to check the child's growth chart?

5. Could you tell me what type of advice if any is given to mothers if their child is not growing well?
- How often is a mother recommended to go to the clinic to check how her child is growing and her child's growth chart?
- What is the procedure in the hospital or clinic if a child is identified who is not growing well?

6. Thinking about services in the hospital or clinic where mothers can find out about their child's growth, could tell me what you think makes it easy for mothers or caregivers to access the services that your clinic offers?
- Now could you tell me what you think makes it difficult for this to happen?

7. In your opinion is the growth of their child something that mothers are aware of or worried about?
- What makes you think that?
- Do mothers ask how their children are growing in comparison to other children?
- Do mothers ask you to track their child's growth?
- Do mothers ask you to look at their child's growth chart?

8. How do you see the way children grow in the community that uses this hospital or clinic as a health issue, do you think it is a health problem?
- Is child growth in the community which uses this hospital or clinic mostly bad or good?

9. How would you describe people who come to this clinic or hospital?
- Where do they come from?

- Do people from other areas of Johannesburg come to use this clinic?
- What do you think the reasons might be that they are coming to this clinic?
- Would people come here before coming to a clinic?

F. Themes

All the information you have provided me with so far is very useful and I would now like to ask you some more specific questions on how you think certain things about a child's environment influence their growth.

Water & toilet facilities-

Here are three types of water source.

1. Can you put these in order for me from best to worst depending on their influence on child growth and health?
2. What would be the difference in growth and health between the different types?
    - What would be the influence in very young children or babies?
    - What would be the influence in young children between about 2- 5 years?
    - What would be the influence in older children between about 6- 8 years?
3. How, if at all, might sharing source of water with other families make a difference to a child's growth?

Here are three types of toilet facilities.

4. Can you put these in order for me from best to worst depending on their influence on child growth and health?
5. What would be the difference in growth and health between the different types?
    - What would be the influence in very young children or babies?
    - What would be the influence in young children between about 2- 5 years?
    - What would be the influence in older children between about 6- 8 years?

Cooking fuel and heating fuel-

1. In your opinion, do certain cooking fuels have an influence on a child's health and growth?
2. How might they have such an influence?
    - What about paraffin, coal, wood, fuel-gas or electricity?

Medical aid-

1. Do many people in the community you work in have MedicalAid?
2. In your opinion, what kind of difference does having MedicalAid make to a child?
    - What happens to children living in families without MedicalAid?

Now I would like you to think back a little bit for me, to what type difference there was between people who had and did not have MedicalAid a number of years ago and the effect this would have had on them.

3. What kind of difference, if any, do you think it made to children's health in 1990/1991 around the time that Mandela was released from prison?

- What kind of difference, if any, do you think it made to children's health a few years later in about 1994 around the time of the first elections?

Social support around pregnancy-

1. In what ways, if at all, do you think the growth and health of a baby is affected by whether or not the mother wants to be pregnant at that time?

2. How is the growth and health of a baby is affected by whether or not the mother feels the family emotional conditions are right and ready for a baby at that time?

3. How is the growth and health of a baby is affected by whether or not the mother feels the family is financially ready for a baby at that time?

Childcare-

1. If a mother can't take care of her children during the day, e.g. she is not at home, who takes care of the child, what happens?
2. What other services would she use, e.g. day care centre, crèche, schools, nanny, granny, neighbour.
   (Write these down as they are said...)

3. Can you rank the different types of childcare services from best to worst in terms of the influence you think they have on a child's health and growth?
   - Which is best?
   - Why did you choose that order?

4. How do you think that these types of childcare service influence the health of children?
5. How do you think that these types of childcare service influence their nutrition?
6. How do you think that these types of childcare service influence their growth?

7. Do any mothers use extra help to take care of children, even if she is at home during the day?

- What type of help might she use?
- What type of woman would use such help?

Employment-

Mother's job:

1. How, if at all, do you think a mother working might be good for a child?
2. How, if at all, do you think a mother working might be bad for a child?

3. How, if at all, does the job a mother does influence how a child is looked after?
   - How, if at all, does the job a mother does affect how a child eats?
   - In your opinion, how, if at all, does the job a mother does affect a child's health?
   - How, if at all, might a mother working affect how a child's illness is treated?

4. In your opinion, what impact does it have on a community when lots of mothers are working compared to communities where they do not work?

Mother's education & partner's education-

1. How do women learn how to bring up children well?

2. How, if at all, might the level of schooling of a mother influence how she brings up her children?
   - If it does, how many years of school education do you think a mother needs to know about bringing children up well?

3. How, if at all, might the level of schooling of a mother influence her child's growth and development?
   - How, if at all, would her level of schooling affect a child's diet?
   - How you think her level of schooling is important in how she cares for a sick child?
   - How, if at all, might her level of schooling affect the way she uses health care services?

4. What effect, if any, does a partner's level of education have on a child's growth?

5. Do you think one more important than the other?
   - In what ways, if at all, is one more/ or not more important than the other?

Now I would like you to think back to around 13 years ago, around the time of 1990/1991.

6. How do you think mother's level of schooling at that time would influence the way she would take care of young children or babies?
7. How, at that time, do you think her level of schooling affected how she would care for a sick child?
8. At that time, how, if at all, do you think that her level of schooling might affect the way she would use health services?

9. Do you think the effect of a partner's level of education on the growth of a small child or baby would have been different at that time?

G. Ending-

- Thinking about communities that the families who use this ward or clinic come from, what in your opinion is the thing that has the most positive influence, whether or not it is something that we have talked about, on child growth in such communities?

- What do you think has the most negative influence?

- Have we missed anything important to child growth?

Thank you for taking the time to answer these questions, your answers will be most useful to our research.

Welcome and Introduction:

A. Greeting-

Hello, how are you?

Thank you for coming, hope everyone managed to get here without too much trouble.

B. Appreciation of their participation, admission that researcher there to learn from them-

It is so great for us that you could come, because what you have to say is important and useful to our work.

The information and opinions that you have can be helpful to us because they give us more information and teach us about people's ideas on the subject.

C. Research agenda-

We have asked you to come along today because we are doing a study with children in the Birth To Twenty project.

Our study is very interested in how children grow and scientists know that the local world that children grow up in can affect how they grow physically.

So in this work, we want to find out more about two things:

1. more information about the world that children in your communities grow up in and
2. how you, as mothers and caregivers, think that parts of that world might affect how children in your communities grow physically.

D. Confidentiality & Tape Recording

Before we begin, I would just like to assure you that what you share with us and the opinions you express in this interview will be treated with complete confidentiality.

You will not be able to be personally identified from the results.

You are also free to not answer any questions that you do not feel comfortable with.

You may also withdraw from the study at any time without any consequences.

However, due to the nature of talking in a group, what you say will be shared with each other. So we would ask you to respect each other's privacy and not express or share, with people outside the group, the opinions of your fellow group members that you hear from each other this afternoon.

Thank you.

I would also like to ask your permission to tape record the interview and take notes, because this really helps us in our analysis.

Is this ok, do you agree to the discussion being tape-recorded?

E. Ground rules-

So before we start talking about this, there are just a few ground rules that will help to make the discussion more successful.

We would like that

- only 1 person talks at a time

so that we can hear what each person has to say on the tape, and don't miss comments that may be very important and useful.

We would like to ask that everybody gets a chance to talk.

There are no right or wrong answers to the issues we are talking about and everybody's opinions are important to us.

Discussion Topics:

F. Opening-

So, maybe if we start by just getting to know one another a little bit... you are all mothers or caregivers of a BT20 child, right?

1. Do you think we could go round in a circle and tell one another our first name, the first name of our child that is in the BT20 study?
   I'll start, my name is ...

2. Great, now can we do the same thing, but tell each other what you personally like about being a mother?

Great, thank you.

G. Introductory-

1. I was wondering, are some children of the same age taller or shorter or bigger or smaller than others the same age?
   - So, do all children of the same age grow the same?

2. Why do you think this might be?

3. How do they grow differently?

4. Is there anything that can indicate or show if your child is growing badly or too slowly?
   - What things?

   - Do most mothers or caregivers in your community also know about these things that can indicate if the child is growing badly?

5. If you are worried about the child's growth where do you go for help?

   - Would most women in your community also do this?

6. What age does a child have to be when you can stop worrying about his/her growth?

7. In what ways, if at all, might how a child grows influence their lives?

8. How do you think how a child grows might be important to their health, if at all?

H. Key-

Now I would like to ask you some more questions about specific things in a child's world and your opinions or ideas on how these influence growth will be really helpful to our work.

Consumer durables

1. Can you put each one of these photos into one of these two piles?

(Photos to include television, car, radio, fridge, washing machine, telephone, toys.)

The first pile is for things you think that most households your area would have and the second pile is for things that only a very few households in your area would have.

- Would you all agree with this ordering?
- Why not?

- Why do more people in your area own these type of things (items in first pile)?
- Why do few people in your area own these type of things (items in second pile)?

2. Can you think of any ways that the growth of children may be different in households which have
   - TV
   - Car
   - Radio
   - Fridge
   - Washing machine
   - Telephone
   - Toys

3. Now I would like you to think back for me a little bit to the time when your child who is in BT20 was born...

   Can you again put the photos in piles of those that most households would have had and only a very few households would have had, in 1991, just after your child was born.

   You can choose to leave some of the photos out if you wish.
   - Would you all agree with this ordering?
   - Why not?

   - Why do more people in your area own these type of things (items in first pile)?
   - Why do few people in your area own these type of things (items in second pile)?

4. What about when your child who is in BT20 started to go to school, around the time after the general elections... could you do the same thing please?

   - Would you all agree with this ordering?
   - Why not?

   - Why do more people in your area own these type of things (items in first pile)?
   - Why do few people in your area own these type of things (items in second pile)?

Water & toilet facilities

1. Can you put these different types of water facility in order from best to worst?
   - Why this order?

(Talking about the best water facility)

2. How is this important to growth and health of babies aged 0-2 years?
3. How is this important to growth and health of children 2-4 years?
4. How is this important to growth and health of children 5-6 years?

5. How, if at all, would sharing sources of water with other families make a difference?

1. Can you put these photos of different types of toilet facilities in order for me, from worst to best?

   - Do you all agree with this order?
   - Why this order?

2. Can you think of any ways the type of toilet in a house might influence the growth of very young children and babies aged 0-2 years?
3. Can you think of any ways the type of toilet in a house might influence the growth of children aged 2- 4 years in that household?
4. Can you think of any ways the type of toilet in a house might influence the growth of older children, e.g. 5- 6 year olds in that household?

Employment

1. What do you think being a housewife means?
   - In your opinion, is being a housewife a job?
   - Would you say that women who are housewives could be described as "having a job"?
   - Can women who have other jobs, also be housewives?

2. Can you explain to me what you understand unemployed to mean?
   - Would you say someone could be unemployed and still be making money?

- If yes, why?

3. How, if at all, do you think a mother working might be good for a child?

4. How, if at all, do you think a mother working might be bad for a child?

5. How, if at all, does the job a mother does influence how a child is looked after?
6. How, if at all, does the job a mother does affect how a child eats?
7. In your opinion, how, if at all, does the job a mother does affect a child's health and if they fall ill?
8. How, if at all, might a mother working affect how a child's illness is treated?

Partner's job:

9. How does the job a partner does influence a child's growth?
   - What is good?
   - What is bad?

Marital status

1. What do you think the term partner means?

2. What positive impacts does a mother living with a partner have on a child?

   - What would you say was the main positive impact?
   - What about financial support?
   - What about emotional support and someone to talk to about problems for example?
   - What about the partner helping with the house?
   - What about partner helping with the house?

3. What negative impacts does a mother living with a partner have on a child?

   - What about partner acting to make things more difficult for you?

4. What, if any, affects does a mother living with a partner have on a child's growth and a child's health?

5. What do you think a partner adds to a home, that makes it different from a home where a mother does not have a partner?

- How do you think these differences are important for child growth?

Education

1. How do women learn how to bring up children well?

2. How, if at all, might the level of schooling of a mother influence how she brings up her children?
3. How many years of school education do you think a woman needs to know about bringing children up well?

    - Why do you think this level is important?

4. How, if at all, would her level of schooling affect a child's diet?

5. How you think her level of schooling is important in if her child is ill often?

6. How, if at all, might her level of schooling affect the way she uses health care services?

Partner's education

7. What effect, if any, does a partner's level of education have on a child's growth?

8. Do you think one of partner's education or mother's education is more important than the other?
    - Why?

I. Ending-

1. In addition to what we have already talked about what other things do you think are important for a child to grow properly?

   - Why do you think these are important?

2. In your opinion what has the most influence from a child's home world to child growth?

3. In your opinion what has the most influence from a child's local community to child growth?

4. Have we missed anything?

Do you have any more questions for us?

Thank you all for coming. We appreciate the effort you have made to get here and the time you have given up in deciding to take part. Your input has been very helpful to our research.
Please feel free to contact us about the study on the Birth to Twenty project phone number 0800-131818, if you have any questions or comments or if you would like to withdraw from the study.

TELEPHONE

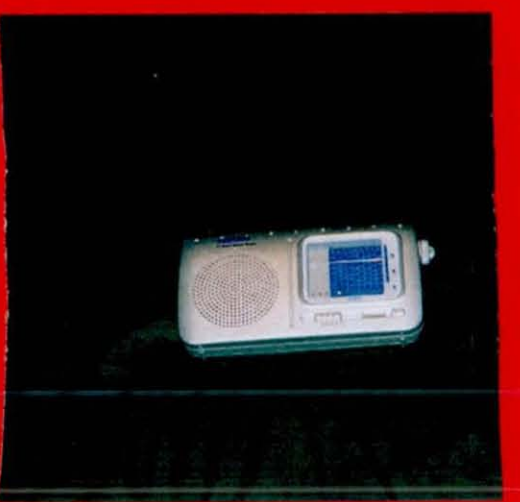
CAR

WASHING MACHINE

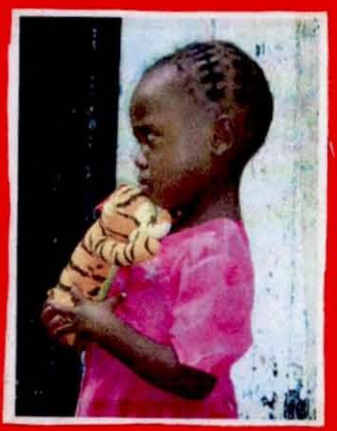
FRIDGE

T.V.

RADIO



TOYS

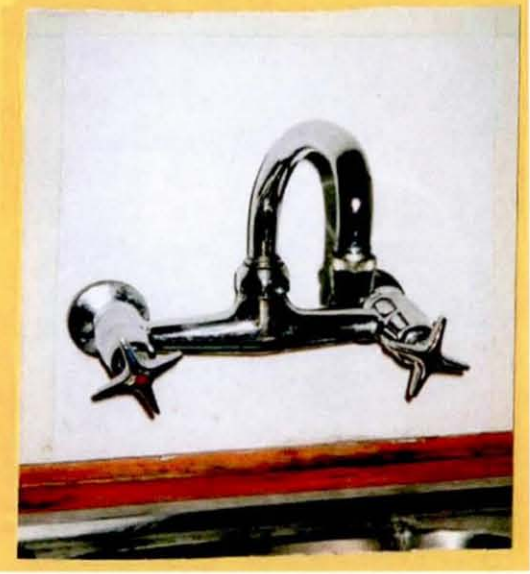


INDOOR
COLD TAP
ONLY

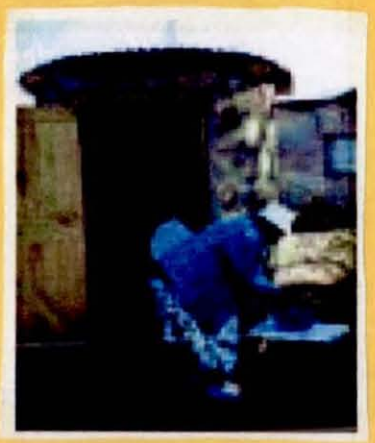
OUTDOOR
TAP ONLY

PIT LATRINE

INDOOR HOT + COLD TAP



OUTDOOR FLUSH TOILET



INDOOR FLUSH TOILET

Informed consent form:

I agree to myself

_____

being a participant in the study conducted by "Birth to Twenty" to investigate socio-economic status and child physical growth and health in Johannesburg and Soweto.

The research has been explained to me and I understand what will be expected of me.

The details of the study are clear to me.

I agree to participation on the condition that:

1. The Committee for Research on Human Subjects at the University of Witwatersrand has approved the study protocol and procedures.

2. All results will be treated with the strictest confidence.

3. My name will not be mentioned in the analysed results published in reports, theses, scientific and professional journals.

4. The research team will do all they can to maintain my comfort and dignity.

5. My participation is voluntary.

6. I can withdraw from the study at any time and no consequences will follow on withdrawal from the study.

Participant _____ Date _____

Interviewer _____ Date _____

Informed consent form:

We also request permission to have your contact details.

Address:

Telephone Number: