STUDY ON FACTORS ASSOCIATED WITH LOW BIRTH WEIGHT BABIES AT UITENHAGE HOSPITAL

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Masters in Public Health (MPH) degree:
Department of Public Health,
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Supervisor:
Dr G Reagon

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Student name: LTV Oliver
Student Number: 9837231
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Executive summary

The incidence of Low Birth Weight (LBW) babies born in the Uitenhage Provincial Hospital would seem to be a cause of concern from a public health point of view. The incidence of 21% recorded during 1999 is markedly higher than the 7% recorded in the United States of America in 1998 and the average of 17% noted for developing countries. Some health concerns related to LBW babies are Sudden Infant Death Syndrome, scholastic performances later in life, and several chronic diseases in adults associated with them having been born as LBW babies.

With an unemployment rate of 45% in the Uitenhage District, the question arises as to whether the high incidence of LBW could be associated to poor socio-economic circumstances. Several international studies in this regard have been conducted and have suggested such association.

A cross-sectional analytical study was thus conducted of all births recorded at the Uitenhage Hospital over a period of two months ending June 2000. The private hospital in the district did not wish to participate in the study, resulting in mostly disadvantaged mothers who make use of the public hospital, being included in the study. The main findings of the study are as follows:

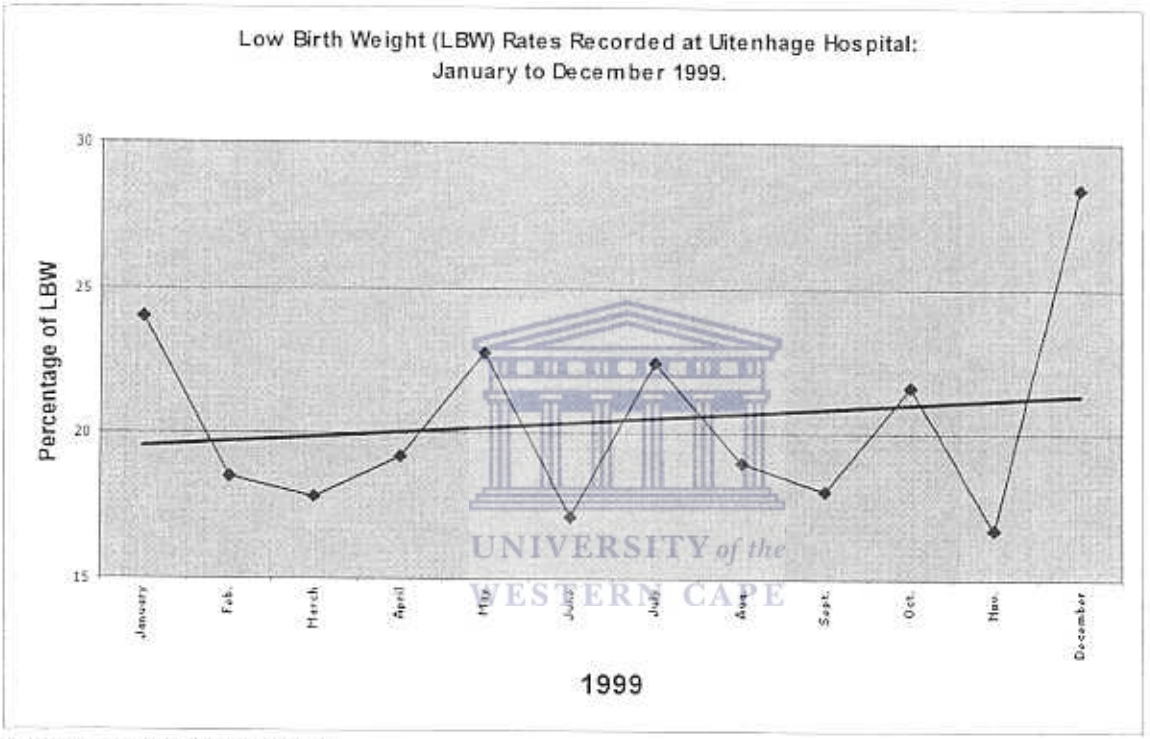
- 63 (21.2%) out of 297 births were LBW
- 34% of the families reported a monthly income of under R500, 64% an income of less then R1001 per month and 85% an income of less then R2001 per month
- the LBW incidence (and odds ratios) decreased as the level of income increased
- unemployed mothers had a higher incidence of LBW than mothers employed mothers (although not statistical significant)
- the incidence of LBW was consistently higher for mothers who reported not having access to basic amenities in their homes, namely electricity, water and toilet facilities
- the incidence of LBW at the public hospital is markedly higher than that recorded at certain private hospitals (i.e. 4.15%)
- the incidence of LBW was higher for mothers living in informal housing, as compared to those living in formal housing
- no conclusive deductions could be made about the association between certain characteristics of the mother and the incidence of LBW, namely her age, weight and height
- single mothers had a higher incidence of LBW than married mothers
- the influence of antenatal clinic services on the birth outcome under investigation could not be ascertained by this study

In comparing the findings relating to the socio-economic indicators (income, employment status of mothers, access to infra-structure, marital status of mother and LBW incidence of public versus private hospitals) to other variables such as characteristics of the mother and utilisation of antenatal clinic services, there appears to be a clearer association between the socio-economic variables and the incidence of LBW, than between the other variables and the incidence of LBW.

1. Background

A birth weight of 2500 grams or below is commonly regarded as a measure of low birth weight, while 1500 grams or under is described as very low birth weight. The United States of America recorded an incidence of 7.6% of Low Birth Weight (LBW) of all live births during 1998 (Guyer et al: 1999), while Morris et al (1999) reports the average incidence of LBW in developing countries to be 17% of all live births. Yet in Uitenhage, the incidence of LBW from January to December 1999 at the Uitenhage Hospital was close to 21%. The following graph depicts the trend over this time period.

Graph 1: Incidence of LBW recorded at Uitenhage Hospital: 1999



Source: routine monthly PHC statistics.

Having regard for the poor health ramifications generally associated with LBW babies, it has become necessary to investigate the matter in order to identify public health factors that could be the causes to this high incidence rate and to consequently implement strategies to counter-act these causes. As will be seen later, some of the poor health outcomes associated with LBW are:

- increased infant mortality and morbidity
- motor and cognitive limitations
- increased sudden infant death syndrome (SIDS)
- adverse effects on special education
- increased risk of insulin resistance and type II diabetes later in life
- increased risk of hypertension

Having regard of the fact that the incidence of low birth weight in the USA is only 7.6% of all births and 17% for developing countries, it would appear that an incidence of 20.5% in the Uitenhage Hospital should be a cause for concern from a public health point of view.

2. Uitenhage Health District

The district consists of three magisterial districts with the following population figures:

- Uitenhage 212,487
- Kirkwood 36,623
- Steytlerville 5,800
- Total 254,910

The population figures are based on the 1996 Census figures and adjusted for an annual growth rate of 2.7%.
The racial distribution is as follows:

- Black 54.2%
- Coloured 27%
- Asian 0.01%
- White 16.2%
- Unspecified 2.1%

The Uitenhage Hospital is a provincial hospital, and as such services mostly the "state" patients, namely those that cannot make use of private health facilities. Unemployment in the district was recorded at 45.2% during the 1996 census. The average number of admissions to the hospital for the period 1994 to 1999 is 15437 per annum, and during the 1999 calendar year (January to December), a total of 2767 births were recorded at the hospital.

3. Literature review

3.1. Low birth weight and public health

The question that needs to be asked is whether a high incidence of low birth weight (LBW) should be a public health concern. Several studies allude to the unfavourable health outcomes experienced in the short- and long-term by LBW infants.

Misra and Nguyen (1999) state that LBW increases infant morbidity and mortality world wide. This is borne out by other publications. Guyer et al (1999) mention that 65% of infant deaths in the USA during 1997 were infants who were born with LBW. This is a high incidence, considering the fact that only 7.6% of infants were born with a LBW. Sowter et al (1999) did a study on the relationship between sudden infant death syndrome (SIDS) and LBW, and concluded that the rate of SIDS is considerably higher among infants with a very LBW and moderate LBW, than among infants with a normal birth weight. A study done at Baragwanath Hospital (Cooper et al, 1999) found that the survival rates of LBW infants have improved since the early 1950's. But still, they reported that only 32% of infants born with a birth weight less than 1000g survived during 1995/1996 and 79% with birth weights between 1000 to 1499g.

Kogan (1995), in commenting on the social causes of LBW, remarked that the manifest importance of reducing the incidence of LBW is most obvious for the first year of life. Apart from the fact that LBW is the most single important factor affecting infant mortality and morbidity, there also seems to be "growing evidence that adverse consequences of LBW continue through-out the life cycle."

LBW would also seem to increase the risk of developing certain chronic diseases later in life. Williams et al (1999) state that intrauterine growth retardation and LBW have been associated with an increased risk of insulin resistance and type II diabetes later in life. Longo-Mbenza et al (1999) concluded from their studies that antenatal stress leading to LBW may be associated with programming induced by foetal under-nutrition, which in turn leads to the emergence of cardiovascular disease and increased risk of hypertension.

In assessing the impact of LBW on educational outcome in kindergartens, Resnick et al (1999) studied 339,171 school records of children who had entered kindergarten between 1992 to 1995, and compared this to birth records of 1985 to 1990. They concluded that children with birth weights of less than 1000g experienced the greatest adverse effect with education.

Leviton et al (1999) identified echolucent images of cerebral white matter, seen on cranial ultrasonographic scans of LBW newborns, which predict motor and cognitive limitations.

Another effect of LBW relates to the impact on the health budget. Lightwood, Phibbs and Glantz (1999) deduced from their studies that an annual reduction of smoking in 1% among pregnant women would reduce the incidence of LBW by 1300 in the United States of America, which in turn would reduce the direct medical costs by $21million per annum.

3.2. Low birth weight and influencing factors

In approaching the problem of LBW from a public health perspective, it would seem to be appropriate to investigate those factors that may be effecting the health status of the broader community of Uitenhage, rather then only those factors that relate to individuals specifically. In this regard it is necessary to identify factors outside the direct ambit of health services and clinical treatment, as will be seen from the following discussions.

Kost et al (1998) studied the effects of pregnancy planning on birth outcomes and infant care. They argued that a planned pregnancy would have a positive effect on the mother's prenatal behaviour, which in turn would have a positive impact on the pregnancy outcomes and subsequent health care of the infant. By means of multiple logistic regression analysis, they studied data of 11,670 births during 1998. They concluded that the proportion of infants born with a health disadvantage, namely premature delivery, LBW and infants who are small for gestational age, is significantly lower if the pregnancy was intended, then if it was mistimed or unwanted. They also found that the proportion of infants who are breastfed and receive well-baby care by age 3 months are highest if the pregnancy was planned. Nahar, Afroza and Hossain (1995) found that the age, weight and height of the mother were further risk factors for LBW of their babies. They state that mother of less than 20 years and more than 35 years, weighing less then 40 kg and having a height of less than 140cm had the highest risk of giving birth to LBW babies. They also noted that the incidence of LBW was highest (73.2%) among the primigravidae mothers and 36.8% among mothers who had no antenatal check-up, but it was 15.9% among those who had check-ups more than 7 times. The age of the mother was also found to be a determinant of LBW by Makhiji and Murthy (1990).

A study by Castetbon et al (1999) found a relationship between HIV infection and birth weights, as they found that there were a greater proportion of LBW infants being born to HIV positive women.

Mondal (1998) states that the mother's age might be another determinant, as mothers under the age of 20 years had a higher incidence of LBW infants. The author found that parity had a significant influence on the incidence of LBW, with the higher incidence of LBW being found in the 5+ parity.

Some studies have been conducted into the influence of tobacco smoke on birth weights. In analysing the relationship between LBW, smoking and costs, Lightwood, Phibbs and Glantz (1999) came to the conclusion that an annual decrease of 1% of the prevalence of smoking among pregnant women, over a period of 7 years, would reduce the number of LBW infants by 57,000, and would save $572m. Encouraging pregnant women to stop smoking before the end of the 1st trimester would have the greatest benefit in this regard. Spravue et al (1999) concluded from their study on the interaction between maternal smoking and pregnancy outcomes, that self-reported maternal smoking during the second trimester is associated with fetal growth restrictions in a dose-response manner. A study by Jadsri and Jadsri (1995) led to a similar conclusion, adding the fact that the father's smoking habit could also be associated to the birth weight of the infant.

Morris et al (1999) state that the high incidence of LBW's of all births recorded in developing countries is more likely to be due to poor social circumstances. In looking at socio-economic and work related determinants on pregnancy outcomes, Tuntiseranee et al (1999) studied a cohort of 1797 pregnant women visiting antenatal clinics during September 1994 to November 1995. They looked at the relationship between certain socio-economic indicators and pregnancy outcomes. The indicators were family socio-economic status, maternal education, maternal occupation, family income and work exposures, while the pregnancy outcomes were based on birth weights, LBW, small for gestational age and preterm deliveries. Their conclusion was that the mean birth weight is correlated to the socio-economic indicators, with the family income being the major indicator in this regard. Waly et al (1977) also found a correlation between birth weight and family income.

Parker, Schoendorf and Kiely (1994) defined the socio-economic indicators used in their study as follows:

- maternal education
- paternal education
- maternal occupation
- paternal occupation
- family income

Their pregnancy outcomes taken into consideration were LBW, small for gestational age and preterm deliveries. Using the data from the 1988 National Maternal and Infant health Survey in the United States of America, they estimated the odds ratios for relationships between the socio-economic indicators and birth outcomes. The concluded that nearly all the indicators were associated with LBW, but not necessarily to the other pregnancy outcomes mentioned above. Stein et al (1987) did a similar study and found income to be an independent predictor of birth weight.

Longo et al (1999) examined the relationship of non-medical factors and LBW. The factors taken into consideration were:

- socio-economic status
- social class
- education
- race
- social support

Their study was based on the hypothesis that, for women without chronic health problems, social and class factors are more predictive of LBW then medical factors alone. Studying data for the period December 1989 to March 1991, they compared the pregnancy outcomes (as relates to birth weight) of women according to their age, race and maternal residence. Birth outcomes were classified as very LBW, moderate LBW and normal birth weight. Their hypothesis was supported by the results of the study and they thus concluded that the variables they studied play an important role in prediction of birth outcomes.

Spencer et al (1999) used two indicators for socio-economic status measures, namely an area based measure of material deprivation, and the social class categories of the Registrar General of the United Kingdom. Their conclusion was that a substantial proportion of births under 2500g and under 1500g are statistically "attributable" to social inequality. They suggest that this proxy measure of socio-economic status may be a better discriminator in the study of pregnancy outcomes (in this study population) than classification by occupational social class. Latif, Green and Li compared the birth weights of two neighbouring boroughs in Bro Taf, the only difference between them being the socio-economic status of the two communities. They found a higher infant mortality rate and a greater number of deaths attributable to LBW in the deprived borough. The deprived area had a higher percentage of children with learning problems, which they associated with LBW. They found a greater proportion of LBW and very LBW in the deprived area, and found that more mothers from this area were in their teens and early teens.

Pattenden, Dolk and Vrijheid (1999) followed a similar approach, coming to a similar conclusion. They however added that the status of the mother (i.e. single or married) should also be considered when investigating LBW, as the lone mother seemed to have a higher incidence of LBW.

In comparing rural and urban areas with each other, as relates to deprivation and LBW, Reading, Raybould and Jarvis (1993) concluded that although deprivation is a clear determinant for LBW (when compared to affluent areas), there was also a greater likelihood for urban infants to be LBW infants, compared to their rural counterparts. This they ascribed to social or environmental factors unrelated to current levels of deprivation. Nahar, Afroza and Hossain (1998) found a similar trend when comparing the LBW of infants born to families from urban areas, rural areas and affluent areas. They recorded a LBW incidence of 36.8% for the urban slum area, 20.9% for the rural area and 18.3% for the affluent community. Related to the socio-economic conditions of the mother was also her level of education. They found that the distribution of LBW infants was higher (48.2%) among mothers who had never gone to school. They concluded that the reduction in the incidence of LBW can only be brought about if the socio-economic conditions are uplifted, and that this is related to the education of people, especially mothers. Hughes and Simpson (1995) indicate a similar approach to addressing LBW, stating that a broader definition of health is required. The definition should "incorporate social dimensions, recasting the focus of research and interventions from pregnancy outcomes and infant health exclusively to include the notion of women's health more globally, expanding the research agenda to unravel the paradox of socio-economic factors and health, and....assuring adequate support to individuals and families, including both adequate income and health care."

Fein (1995) would seem to concur with the above assessment after reviewing several studies, stating that there is a growing inequality in health status between those of higher and those of lower socio-economic status. The author came to the following conclusion: "Clinicians and teachers in internal medicine should incorporate this knowledge (i.e. the growing inequalities) in assessing patients and adopt a perspective that takes account of socio-economic factors in diagnostic and management decisions."

The significance of the above studies must be seen within the South African and Uitenhage District context. In the Annual Health Review of 1997, it is stated that 40% of households in this country earn less than 6% of the country's income, while the richest 10% earn in excess of 50%. Federl (1998) states that the world's 225 richest persons have a combined wealth equal to the annual income of the poorest 47% of the world's population (i.e. over one trillion dollars).

According to the 1996 census, unemployment in the Uitenhage District was 45.2%, with the highest rate being 57.7% for males in one of the communities, and 62.9% for women in another community. A study conducted by the District Office in 1997 found the unemployment rate in Khyamnandi (population of 4888) to be 51%. But further analysis revealed that only 520 of the total population actually received an income, meaning that 10.6% of the population had to financially maintain the other 89.4% of the population. A further compounding factor for this community, is the fact that they would certainly be included in the 40% of the poorest households mentioned in the previous paragraph.

4. Aim

To investigate factors associated with low birth weight (LBW) at Uitenhage Hospital.

5. Purpose

To recommend interventions to reduce the prevalence of LBW of all live births recorded at Uitenhage Hospital.

6. Objectives

1. To determine the prevalence of low birth weight (LBW) infants born at Uitenhage Hospital.
2. To assess the relationship of LBW to the following factors:

- age of mother
- height of mother
- weight of mother
- number of children
- smoking habits of mother
- smoking habits of father
- marital status of mother
- number of visits to antenatal clinics
- health status of mother, as regards chronic health conditions
- income of family/mother
- quality of accommodation of mother

7. Methodology

7.1. Study design

A quantitative cross-sectional analytic study was conducted by means of structured interviews, using close-ended questionnaires.

7.2. Definition of terms

Low Birth Weight (LBW): a birth weight of less than 2500 grams
Very low birth weight: a birth weight of less than 1500 grams
Smoking habits of mother: whether smoking during pregnancy
Marital status: whether mother living as single person, or living with a partner
Quality of accommodation: formal vs informal dwelling
Odds Ratio (OR): the prevalence odds ratio calculated for the sample group

7.3. Study population

Children who were born at Uitenhage Hospital, over a period of two months ending 30 June 2000.

7.4. Sample size

A total of 304 mothers were interviewed The proposed number was 281, based on the likelihood of a 22% expected frequency of LBW deliveries, with a worst frequency of 25% for 2767 deliveries expected over a period of 12 months. The sample size was calculated according to a statistical confidence level of 80%, using the Epi-info computer software package.

7.5. Sampling procedure

All children who were born in the hospital during the period of approximately two months, ending June 2000 were included in the study.

7.6. Scope of study

The study should be applicable to all communities living in similar socio-economic conditions as those living in the drainage area of Uitenhage Hospital.

7.7. Ethical considerations

Only mothers who consented to participating in the study were interviewed. All information is confidential and the names of the participants are coded and held in private. There are no direct or indirect benefits to be derived by the study population.

7.8. Data collection

Data was collected by means of record reviews and interviews, using close-ended questionnaires. A record review of births registered at the local municipality (Uitenhage TLC) was also conducted.

7.9. Data analysis

Data was analysed by means of computer software programmes, using the Epi-info programme. The data was subjected to bivariate analysis. Multivariate logistic regression could not be done (no programme available to district office and researcher).

8. FINDINGS

8.1. Birth weights

The study was conducted over approximately 2 months and data collection was concluded in June 2000. A total of 304 mothers were interviewed. Unfortunately, some of the interview-questionnaires were not completed satisfactorily, and of the 304 returns only 297 reflected the birth-weight of the new-borns correctly. A summary of these can be seen in Graph 2: Annexure A.

The mean weight was 2917g, with the median at 2940g. A total of 63 (21.2%) of the births were LBW babies, which is consistent with the total of LBW babies recorded during 1999, i.e. 21% of the births.

8.2. Socio-economic Indicators

The following indicators were analysed as proxy-measures for the socio-economic status of the mothers interviewed for the study.

8.2.1. Income

Morris et al (1999) and Waly et al (1977) stated that family income was a strong indicator of birth outcomes. With Uitenhage having such a high unemployment rate (45% according to 1996 census), it was expected that the income recorded in this study would generally be low. The following categories were recorded:

Table 1: Family Income per Month

Income (R)	Number of Families	Percentage (%)
0	14	5
1 – 500	87	29
501 – 1000	92	30
1001 – 2000	69	22.7
2001 – 3000	34	11
3001 – 4000	7	2
>4000	1	0.3
Total	304	100

There are thus 193 families (64%) who indicated that they earn less then R1001 per month, and 101 (34%) who earn less then R501 per month.

When comparing levels of income to birth outcomes, the following pattern emerges: as the level of income increases, the incidence of LBW babies decreases. This can be clearly seen in graph 3 (Annexure A). The mentioned graph would suggest the groups with no income and lower income are at greater risk then the other groups. The odds ratio for the no-income group is 2.16 (CI = 0.54 – 7.47), but as the income increases, the odds ratio decreases, i.e. to 1.55 (CI = 0.84 – 2.85), 0.81 (95% CI of 0.35-1.89) and to 0.26 (95% CI of 0.05-1.26) for the groups earning less then R501, R2000 and R3000 respectively. There would thus seem be an association between levels of income and LBW. Even if the information provided by the mothers were not one hundred per cent correct, they could not have influenced the birth outcome to correspond so closely with their stated levels of income.

The incidence of LBW babies was also compared to the employment status of the parents. Although no association could be found between the outcome and the employment status of the father, there did seem to be an association when looking at the status of the mother, as well as the cases where both parents were reported to be unemployed.

Table 2: Employment status of Mother

Employment status of mother		Outcome: Birthweight			Total (of recorded outcomes)
		<2500g	≥2500g	outcome not recorded	
Exposure	not employed	52	182	3	234
	employed	11	52	4	63
	Total	63	234		297

The above gives an odds ratio of 1.38 (95% confidence interval of 0.64 – 3.03).

The risk factor seems to increase where both parents were reported to be unemployed, as seen in the following table.

Table 3: unemployment status of both parents

Employment status of father and mother		Outcome: Birthweight			Total (of recorded outcomes)
		<2500g	≥2500g	outcome not recorded	
Exposure	Neither parent employed	20	73	4	93
	At least one parent employed	43	161	3	204
	Total	63	234		297

From the above table, one finds that the odds ratio increased from 1.38 for the mother, to 1.73 (CI of 0.6 – 5.13) when both parents are unemployed.

8.2.2.Other possible socio-economic indicators

In South Africa, access to basic amenities is often a benefit enjoyed by only the more affluent and advantaged. Therefore, access to amenities such as electricity, water, toilet facilities in the house and the type of house (i.e. formal vs. informal type of materials and construction) could be used as indicators for socio-economic development.

8.2.2.1.Electricity

Table 4: Access to Electricity in House

Electricity		Outcome: Birthweight			Total (of recorded outcomes)
		<2500g	≥2500g	outcome not recorded	
Exposure	No electricity	47	130		177
	Electricity available	16	104		120
	Total	63	234	7	297

59.6% of mothers reported not having electricity at home, of which 47 (27%) had an unfavourable birth outcome (compared to only 17% of those with electricity). This converts to an odds ratio of 2.35 (CI = 1.21-4.6) for those without electricity at home.

8.2.2.2.Water

Table 5: Access to water in house

	Water point in home	Outcome: Birthweight <2500g	≥2500g	outcome not recorded	Total (of recorded outcomes)
Exposure	No water point in home	37	126		163
	Water point in home	26	108		134
	Total	63	234	7	297

45% of mothers reported having running water points available in their homes. Of the 163 without this amenity, 37 (23%) recorded LBW, with an odds ratio of 1.22 (CI=0.67-2.23).

8.2.2.3.Toilet

Table 6: access to toilet in house

	Toilets in house	Outcome: Birthweight <2500g	≥2500g	outcome not recorded	Total (of recorded outcomes)
Exposure	No water-borne toilet in house	39	139		178
	Water-borne toilet in house	24	95		119
	Total	63	234	7	297

60% of mothers reported an absence of water-borne toilets in their houses, of which 22% gave birth to babies under 2500g. This gives an odds ratio of 1.11 (CI = 0.60-2.05).

8.22.4. Type of house

Table 7: Type of house

Type of house		Outcome: Birthweight <2500g	≥2500g	outcome not recorded	Total (of recorded outcomes)
Exposure	Informal	28	88		116
	Formal	35	146		181
	Total	63	234	7	297

The mothers living in informal housing constitute 39% of the 297 cases recorded above. Of them 28 (24%) recorded LBW, compared to the 20% of the mothers living in formal houses. The odds ratio for informal housing is therefore 1.33 (CI = 0.73-2.42).

Summarised graphically, the above association between LBW and the mentioned socio-economic factors can be seen quite clearly in graph 4 (Annexure A).

8.3. Births at public facility versus birth outcomes recorded at private facilities.

Another proxy-measure could be the comparison between birth outcomes registered at the public facility (as representing the place where the poor and disadvantaged give birth) and birth outcomes registered at private facilities (as representing the place where the more advantaged, who can afford the high costs charged at these places, give birth).

Data obtained from the records kept by the Uitenhage TLC revealed that, during January to June 2000, 241 births were registered at three private hospitals. Of these, only 10 (4.15%) were LBW babies.

8.4. Race

The birth outcomes of the different racial groups were analysed, due to the racial history of South Africa. The Apartheid system practiced until 1994 resulted in people of "Colour" (Blacks, Coloureds and Asians) being disenfranchised and consequently excluded from the mainstream economy. It could therefore be argued that they would be more likely to have the unfavourable birth outcome, should the hypothesis be true that mothers living under poor socio-economic circumstances are more likely to give birth to LBW babies.

Table 8: Racial distribution of mothers who gave birth at the Uitenhage Hospital during the study.

Race	Number	Percentage
Asian	1	0.3
Black	174	57.2
Coloured	122	40.1
White	7	2.3
Total	304	100

Graphically, the percentage of LBW babies per race groups are pictured in graph 5 (Annexure A)

The number of "Whites" is very low, and so it is not feasible to compare birth outcomes to them as the previously "advantaged" group of South Africa. But the relationship between Coloureds and Blacks look as follows:

Table 9: birth outcomes of Coloureds and Blacks

	Race Group	Outcome: Birthweight <2500g	Outcome: Birthweight ≥2500g	Outcome: Birthweight outcome not recorded	Total (of recorded outcomes)
Exposure	Coloured	32	87	0	119
	Black	30	140	4	170
	Total	62	227		289

The Coloured community seems to be at a higher risk, compared to the Blacks and Whites. Of their 119 births, 32 were LBW (26.8%), giving them a prevalent odds ratio of 1.72 (95% confidence limit of 0.94 – 3.14), compared to the Blacks.

8.5.Characteristics of the mother

8.5.1.Age

Mondal et al (1998) reported that, in their study, a higher incidence of LBW babies were recorded for mothers under the age of 20 years. In the Uitenhage study, the association between LBW incidence and the age of the mother was examined for four groups, namely:

1. Incidence of LBW for mothers aged 20 and under (as a possible risk group), as opposed to mothers aged over 21 years.
2. Incidence of LBW for mothers aged 22 and under (i.e., the 25th percentile, as a possible risk group), as opposed to mothers aged over 22 years.
3. Incidence of LBW for mothers over the age of 31 years (i.e., the 75th percentile, as a possible risk group), as opposed to mothers aged 31 years and under.
4. Incidence of LBW for mothers aged 35 and over (as a possible risk group), as opposed to mothers aged under 35 years.

From graph 6 (Annexure A), it appears there may be a slight risk for the mothers <21 years, but in this study the risk is more evident when looking at mothers under the 25 percentile (22 years). The odds ratio follows the same trend, increasing from 1.07 (95% CL of 0.5 – 2.24) to 1.20 (95% CL of 0.62 – 2.3) for the two groups respectively. The situation for the older mothers shows a marked swing when comparing the mothers at the 75 percentile to mothers only 3 years older, i.e. the over 31 year with the over 34 year old group. Here the odds ratio increases from 0.85 (95% CL of 0.40-1.75) to 1.46 (95% CL of 0.66 – 3.19).

8.52.Weight of Mother

The mean weight of the mothers was 62.83kg, with the median at 60.0kg, the 25 percentile at 51kg and the 75 percentile at 72kg.

As there were only 2 cases with a weight of <40kg, comparisons were made for the groups starting at ≤51kg (i.e. 25 percentile). The mothers were categorised into 5 possible risk groups as regards this variable, namely:

- those with a weight ≤ the 25 percentile of 51kg
- those with a weight ≤ the median of 60kg
- those with a weight ≤ the 75 percentile of 72kg
- those with a weight > the 75 percentile of 72kg
- those with a weight ≥ 85kg

The odds ratio supports the picture reflected in the graph 7 (Annexure A), starting at 1.70 (CI = 0.85-3.37) for the group of mothers <52kg, and decreasing as the weight increases (odds ratio of 1.11 with 95% confidence interval of 0.53-2.36) for the group <73kg.

When comparing the outcomes for mothers over the 75 percentile, the converse seems to be applicable, as the odds ratio increases from 0.90 (CI = 0.42 – 1.89) to 2.54 (CI = 0.9-7.03) for the group over 84kg.

8.53.Height of Mothers

The height of mothers was also evaluated on the basis of the median (161cm), the 25 percentile (156cm) and the 75 percentile (168cm). The findings are summarised in graph 8 (Annexure A).

There does not seem to be much difference between the birth outcomes of mothers who are <150cm in height as compared to those who are taller (RR of 0.95), but due to the small number of cases of LBW for mothers <150cm no conclusions can be drawn from this. But when comparing those who fall under the 25 percentile (156cm) to the other outcomes, there seems to be a significant OR of 2.72 (CI = 1.4-5.28) for this group. This risk decreases as the height increases, and for the group lying under the median (161cm) the OR is 1.37 (CI = 0.63-2.25). The risk decreases to an OR of 0.55(0.24-1.27) for the group lying above the 75 percentile (168cm).

8.5.4.Marital status

Pattenden et al (1999) recommended that the status of the mother should be borne in mind, as they had found a higher incidence of LBW among the "lone" mothers, i.e. mothers who were neither living with the father of the expected child, nor any other partner. The Uitenhage study distinguished between the "married" mother (either legally married or permanently living with partner), the single (lone) mother and divorced mother. The distribution is as follows:

Table 10: marital status of mothers

Marital status	Number	Percentage
Divorced	3	1
Married	75	25
Single	226	74

When comparing the incidence of LBW babies to the marital status of the mother, it appears that the mothers who are single are at greater risk of having LBW babies. They have an odds ratio of 1.73 (95% CL of 0.81 – 3.78). Graphically this can be seen in graph 9 (Annexure A).

8.6 Complications

Complications for this study are defined as mothers who were tested positive for pre-eclamptic toxaemia (or pregnancy induced hypertension) (PET) and Syphillis (WR).

The WR measurement did not reflect any distinct association (relative risk of 0.94), but the PET status reflected some association.

Although only 32 of the 296 cases were PET-positive (11%), 14 (or 44%) of these 32 cases recorded the undesirable outcome whilst only 49 (19%) of the negative cases gave birth to babies of <2500g. This gives an odds ratio of 3.50 (CI= 1.52-8.02).

Graph 10 (Annexure A) clearly shows the higher incidence of LBW in the PET-positive group.

8.7 Method of birth

Due to the concern of births before arrival (BBA), and as this may relate to socio-economic factors (poor development, poor literacy levels and education, lack of access to services, etc), it was decided to also see if there was an association with LBW.

Table 11: Comparison between BBA and normal births

	Method of birth	Outcome: Birthweight <2500g	Outcome: Birthweight ≥ 2500g	Outcome: Birthweight outcome not recorded	Total (of recorded outcomes)
Exposure	BBA	7	10	n/a	17
	Normal	42	168	n/a	210
	Total	49	178	n/a	227

From the above, it would seem that there is an association between BBA and LBW, as the odds ratio is 2.80 (CI = 0.9-8.60). Of the above 17 BBA cases, only 2 did not attend ANC visits. But 6 of the 7 LBW babies born before arrival were "black", with the 7th one being "coloured". None of the cases were PET positive, but all the "black" mothers were single and the "coloured" mother divorced.

This would suggest that further, more in-depth investigation into this phenomenon might be indicated.

8.8 Antenatal visits

It was not possible to ascertain whether the pregnancies were planned or not (Kost et al, 1998), but the antenatal clinic (ANC) visits could possibly be seen as an indicator of the mother's sense of responsibility to her unborn child (although there could be many other factors that could influence whether the mother visits the ANC services or not, for example accessibility of clinics). Visits to the ANC services could also have a positive influence on the attitude of the mother, which in turn could have a positive impact on birth-outcomes. ANC visits as part of primary health care, i.e. the early detection and treatment of probable problem areas, could further contribute to the quality of the birth outcome.
Analysis of the baby birth weights (LBW) in relation to the ANC visits revealed the following:

Table 12: Number of mothers who visited ANC clinic at least once.

Visited ANC clinics		Outcome: Birthweight			Total recorded
		<2500g	≥2500g	not recorded	
Exposure	no visits	8	17	3	25
	visited	56	216	4	272
	Total	64	233	7	297

The risk of low birth weight among mothers who did not attend the ANC services is 8 out of the 25, or 32%. Equally, of the 272 who visited the clinics, the incidence of LBW is 56 or 21%. The odds ratio is thus 1.82 (95% CL of 0.68 – 4.75).

8.8.1. Timing of first ANC visit into pregnancy (weeks)

The study also aimed at ascertaining the impact that the timing of the first visit may have on the outcome. The mean time for the first visit was 24.8 weeks, with the median being at 25 weeks. The 25 percentile was at 20 weeks and the 75 percentile at 29 weeks.

Table 13: Period of first ANC visit (weeks of pregnancy)

1st ANC visit (weeks)	Number of responses	%
<20	23	20
21-29	64	57
30-36	20	18
37-39	6	5

The timing of the first visit did not seem to have an impact on the birth outcome. The odds ratio for the group waiting to the 25th week, for instance, was 0.50 (95% Confidence limit of 0.13-1.76). But for the group who only visited the ANC services from week 30, the odds ratio increased to 0.79 (95%CL of 0.13-3.31).

Table 14: comparison of outcomes and first visit to ANC services: 29 weeks (i.e. 75 percentile)

	1st ANC visit	Outcome: Birthweight <2500g	Outcome: Birthweight ≥2500g	Total (of recorded outcomes)
Exposure	After week 29	3	23	26
	Up to week 29	12	73	85
	Total	15	96	111

Graphically the situation can be seen in graph 11 (Annexure A).

8.8.2.Number of ANC visits

A further variable in ascertaining the impact of ANC services on birth outcomes, is the number of times the mother visits the clinics during her pregnancy. The median recorded in this case is 4 visits, with the 25 percentile of 3- and the 75 percentile of 6 visits. The graph of the findings (graph 12: annexure A) seems to indicate a strong association between this variable and LBW.

The odds ratio follows the same trend as seen in the graph, i.e. it decreases as the number of visits increases (from an odds ratio of 2.84 (CI = 1.48-5.43) for the group with less then 3 visits, to 2.19 (CI = 0.97-5.09) for the group with less then 7 visits).

8.9.Parity

The median was 2 children, with the 25 percentile being 1 and the 75 percentile being 3. The data seems inconclusive, as seen from graph 13 (Annexure A). Ignoring the reading for the parity of 0 children and ≥ 6 (due to the lack of data), the other outcomes vary in such a manner that no deductions can be made.

9. Discussion

9.1 Birth weight

The number of LBW's recorded in the study, i.e. 63 (21.2%), is consistent with the total LBW's recorded at the Uitenhage Hospital during 1999 (21%). But it is much higher then the 7.6% recorded in America (USA) for 1998 (Guyer, 1999) and the average of 17% of all live births reported by Morris (1999) for developing countries. Even if looking at the proportions of births under 2000g (27 or 9%), one finds a higher incidence of LBW than that reported in the USA.

9.2 Income and employment status of parents

Morris et al (1999) and Waly et al (1977) stated that family income was a strong indicator of birth outcomes as relates to weight. Steyn et al described income as an independent predictor of LBW. Income is especially relevant in South Africa, with the Annual Health Review (1997) stating that the poorest 40% of households earn less then 6% of the counties income, while the richest 10% earn in excess of 50%.

With 64% of respondents earning less then R1001 per month, and some 87% less then R2001, it is clear that practically the whole sample group could qualify as being impoverished. Ideally this sample group should have included more births to families in the higher income bracket, but the only private hospital in the district (where these cases may have been found) does not wish to participate in a study of this kind. This could also be the basis of the vast racial discrepancy found in the study. Only 7 births were recorded to "white" mothers, which makes it difficult to come to any conclusions with any degree of confidence. One would anticipate that data on more "white" births would also have given more representative data on income in the higher income-brackets. For example, a record review of the births from private institutions that were registered at the Uitenhage Transitional Council during the period January to June 2000 reflected a much lower incidence of LBW among this group, namely 10 of 241 births (4.15%) as compared to the public hospital's (i.e. Uitenhage Hospital's) 63 out of 297 (21.2%).

Yet, even in this "improvised" sample of the study, there seems to be a clear link between the income and the incidence of LBW. The group with no income is at greater risk then the other group, with an odds ratio of 1.63. As the income increases, the odds ratio decreases, i.e. to 0.81 and to 0.26 for the groups earning less then R2000 and R3000 respectively. Although the odds ratios are not significant from a statistical point as the 95% confidence intervals for all the OR's range from <1 to >1, the findings collectively would indicate an association between the variables as there is a discernable trend in the incidence rates and odds ratios (i.e. the fact that the incidence rates decrease as the income levels increase). Note should also be taken here that, although the odds ratio drops, the incidence of LBW for the higher earning groups is still of concern (still at approximately 21% for the group earning less then R3000). There would thus seem be an association between levels of income and LBW. Even if the information provided by the mothers were not one hundred per cent correct, they could not have influenced the birth outcome to correspond so closely with their stated levels of income.

Equally, the employment status of the mother individually, and of both parents collectively, also indicate an increase in the odds ratio respectively. Although not statistically significant (as the 95% confidence intervals for both ranges from <1 to >1), the trend appears clear. This is especially relevant when comparing these outcomes to the odds ratio of the fathers, where no association could be found.

9.3 Infra-structure

The pattern of higher incidence of LBW babies for mothers who lack most of the basic infrastructure such as water in the house and electricity indicates an association between these socio-economic variables and birth weight. The odds ratios range from 2.35 (95% confidence interval of 1.21 – 4.6, thus significant) for the lack of electricity, to 1.33 (informal houses), 1.22 (no water in house) and 1.11 (no toilets in house). The last three variables are not statistical significant (95% confidence intervals for all three ranges between <1 and >1), but the fact remains that the incidence of LBW is higher for the more disadvantaged groups. Once again, more data of more affluent communities would have enriched the quality of this study, but the findings consistently indicate a higher incidence of LBW for the mothers who lack the basic infrastructure.

9.4.Race

As indicated in the chapter on limitations of the study (chapter 10.2), the racial distribution of this study is not representative of the broader community in the district. According to the 1996 Census, Blacks constitute 54% of the population, Coloureds 37% and Whites 16%. But in this study the distribution is 57%, 40% and 2% for the different groups respectively. This situation affects the findings in that it is not a truly representative reflection of the broader community in this area, as the Whites are under represented. In South Africa, with its history of racial discrimination, one would have anticipated a higher incidence of LBW among Blacks and Coloureds, when comparing them to Whites and even Asians.

However, in this study, the association that can possibly be made between race, socio-economic factors and birth outcomes of the above two groups (i.e. Blacks and Coloureds as opposed to Whites and Asians) is around the issue of the high proportion of admissions to the public hospital under the first group, compared to the low proportion of the second. This would indicate that the previously disadvantaged (Coloureds and Blacks) are still more likely to be poor and needy. This could be argued to be the reason for the high incidence of LBW babies born in the public (Uitenhage-) hospital (21.2 % as opposed to the 4.15% born at the private hospitals mentioned under the discussions).

It would appear that race, as also found in the study of Longo et al (1999), could be associated to the incidence of LBW, especially the Coloureds with 26% of their babies being born as LBW. But even the Blacks at 18% are higher then the average reported for developing countries. In South Africa, smoking could be a confounder in this regard as the Coloured communities have been found to have a higher proportion of people smoking then any other group. Unfortunately the study did not succeed in measuring the association between smoking and LBW, as the responses from the mothers were not credible.

9.5.Age

Nahar et al (1995) found that the age of the mother was associated to the incidence of LBW, stating that mothers <20 years and over 35 years of age were more likely to give birth to LBW babies. In this study, 22.4% of mothers under 20 years had LBW babies, with an odds ratio of 1.07. In increasing the number of cases by comparing the group within the 25 percentile (22 years) with the older mothers, one does find that the odds ratio increases to 1.20, and the incidence of LBW to 23.8%. The odds improve as age increases into the ranges of the median (27 years) and the 75 percentile (31 years). But when the age goes beyond this, the odds seem to worsen again. For the age group of 35 and over, the incidence increases to 27% and the odds ratio to 1.46. It needs to be noted that the 95% confidence intervals for all these odds ratios ranges from <1 to >1 and are therefore not significant. The fact that the odds ratio for the under-20 year group is 1.07 therefore makes it difficult to confidently come to any conclusions, based on the findings of this study.

Of interest from the data collected, is the high number of mothers under the age of 20 (n=50; 16.7%). Of these 50, 18 were under the age of 18 years, with the youngest mother being 14 years. Bearing in mind the high prevalence and incidence of HIV infection in South Africa, together with the issue of development of the youth and the empowerment of women, it would appear that this occurrence may require greater in-depth research and strategies to counter-act this trend.

9.6.Weight

Nahar et al (1995) stated that a mother with a weight of less then 40kg was more likely to have a LBW baby. In this study there is only 2 cases that fall within this category, so this statement could not be measured here. However, using the 25 percentile as a measure for low weights of mothers, 69 cases were found with a weight of 51kg or under. The odds ratio for this group (1.7 with 95% confidence interval of 0.85 – 3.37) decreases as the weight increases, up to the 75 percentile (72kg) where the odds ratio levels out to 1.11. After this, the trend reverses as the weight increases, i.e. the odds ratio increases as the weights increases. (odds ratio of 2.54 for the group over 84 kg). The trend between age, weight and LBW seem to be similar as that found by Nahar et al, but as the odds ratios are not significant one can only base ones conclusions on the incidence rates.

9.7 Height

Again, Nahar et al stated an association between LBW and the height of the mother, namely the shorter the mother, the higher the incidence of LBW babies. Using the 25 percentile as an indicator, 73 cases are within this group (≤ 156m). Of these, 25 (34%) gave birth to LBW babies (odds ratio of 2.72 with significant 95% confidence interval of 1.4 – 5.28). The odds ratio decreases to 1.37 when looking at the median (161cm), and to 0.55 up to the 75 percentile (168cm).

The last two odds ratios are not significant (95% confidence intervals range from <1 to >1), which makes it difficult to come to any firm conclusions and more data and further analysis seems to be required in this regard.

9.8 Marital Status.

Pattenden et al (1999) found in their study that there was a higher incidence of LBW among "lone" mothers, i.e. those not legally married or living with a partner. Marital status could be regarded as an indicator of socio-economic status of the mother (the single mother being more likely to be financially disadvantaged, when seen within the South African context of high unemployment rates and gender inequality in salaries between working men and women). In this study, a similar situation was found. Of the 304 respondents interviewed, 226 (74%) were "lone" mothers. Of them, 23% gave birth to LBW babies, compared to the 15% recorded among the "married" mothers (odds ratio of 1.73 with 95% confidence interval of 0.81 – 3.78).

In South Africa, with its high incidence and prevalence of HIV and AIDS, the high percentage of "single" mothers was noted with concern. Although not in the ambit of the study, the question arises as to why this phenomenon is occurring and to what degree this is contributing to the HIV problem of the country. In a study (Summary Results of the South African Demographic and Health Survey, 1998, for the Eastern Cape.) that included interviews with 649 girls aged 15 – 19 from the Western Region of the Eastern Cape, 48.6% indicated that they have had sexual intercourse. But of these, only 21.2% had used a condom during their last intercourse. This, coupled to the risk of this group having LBW babies, would certainly make it an event requiring further in-depth investigation.

9.9 Method of Birth

Of the 17 BBA deliveries, 7 (41%) are LBW. Although there would appear to be an association between BBA and LBW, a more in-depth investigation would be required before any conclusions can be made from this. BBA could be indicative of accessibility of services, but could also relate to socio-economic issues such as literacy – and educational level of parents, employment status, etc. and would justify further study.

9.10 ANC visits

The incidence of LBW among mother who did not attend ANC services is 32% (odds ratio of 1.8). This would seem to be comparable to the 36.8% found by Nahar et al (1999). But although there appears to be an association, it does not seem to be effected by the timing of the first visit. The 25 percentile for the 1st visit was 20 weeks. On the basis that mothers visiting after this period (81 mothers) should be at greater risk then those visiting earlier (30 mothers), the study found the following: of the 81 at risk, only 7 (8.6%) recorded LBW (odds ratio of 0.26). Even when looking at the cases where mothers waited until at least the 30th week of pregnancy (i.e. the 75 percentile of this study), the odds ratio only increases to 0.79. It would thus appear that this factor is not relevant for the specific birth outcome of this study, i.e. the birth weight of newborns. The above findings are further complicated by the fact that none of the odds ratios are significant (95% confidence intervals range between <1 and >1).

However, the total number of visits would appear to be of some importance. The odds ratio ranges from 2.84 (95% confidence interval of 1.48 – 5.43) to 2.75 (95% CI = 1.48 – 5.09) to 2.41 (95%CI = 1.16 – 5.08) as the number of visits increases from 3 to 4 to 6 (i.e. the 25 percentile, the median and the 75 percentile). Unfortunately, due to the study design, the reason for this cannot be investigated further as follow-up to the mothers is not possible. It can therefore not be ascertained whether there is an explanation for this finding.

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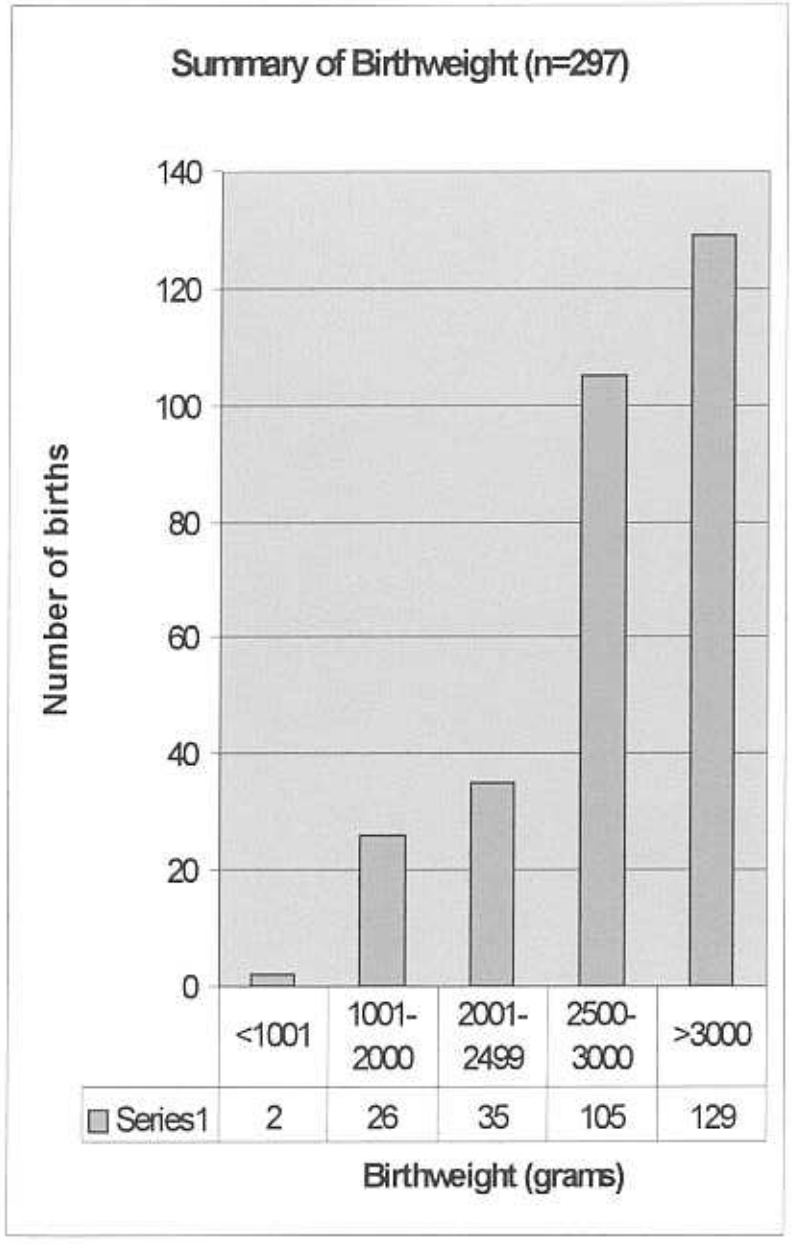
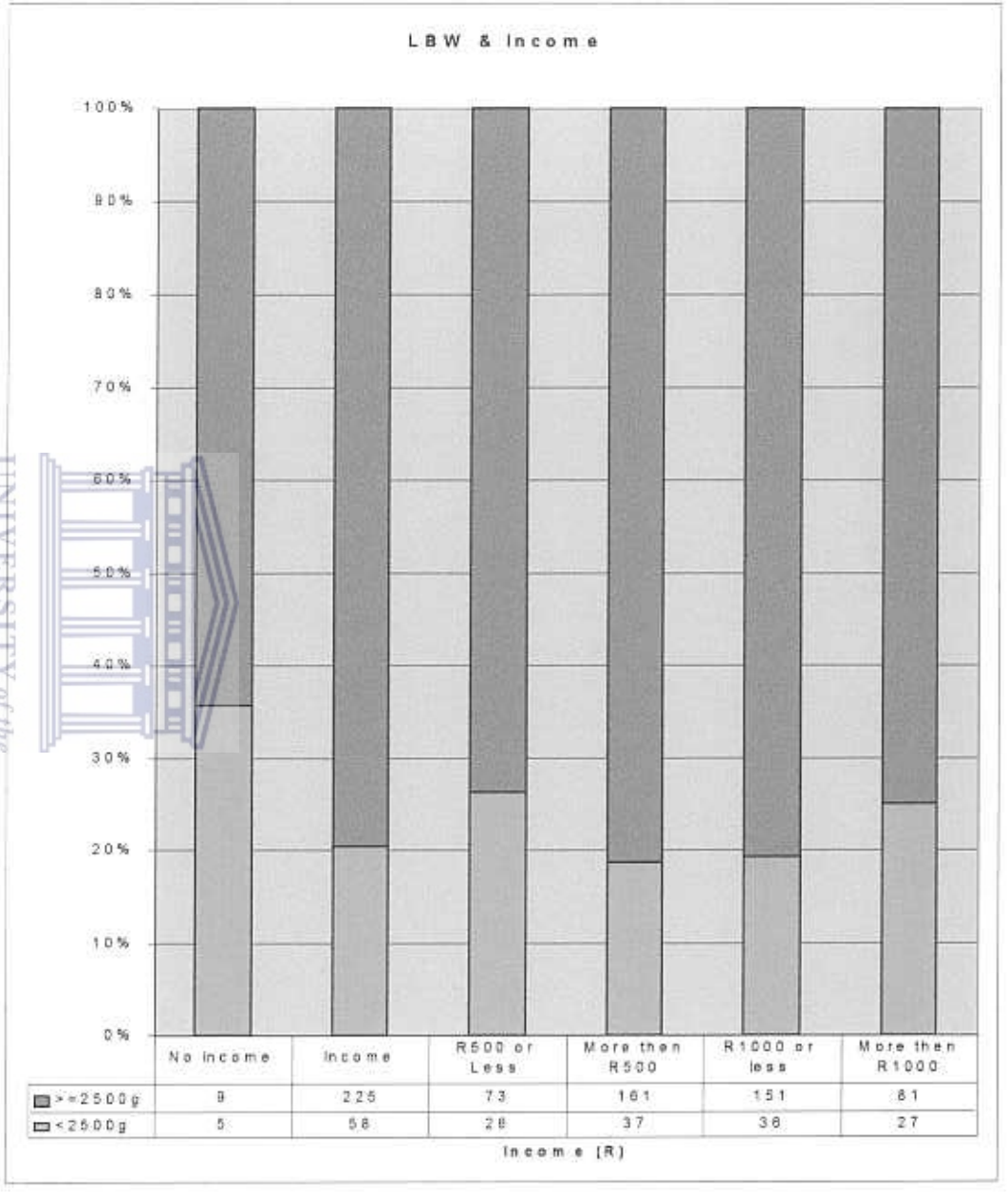
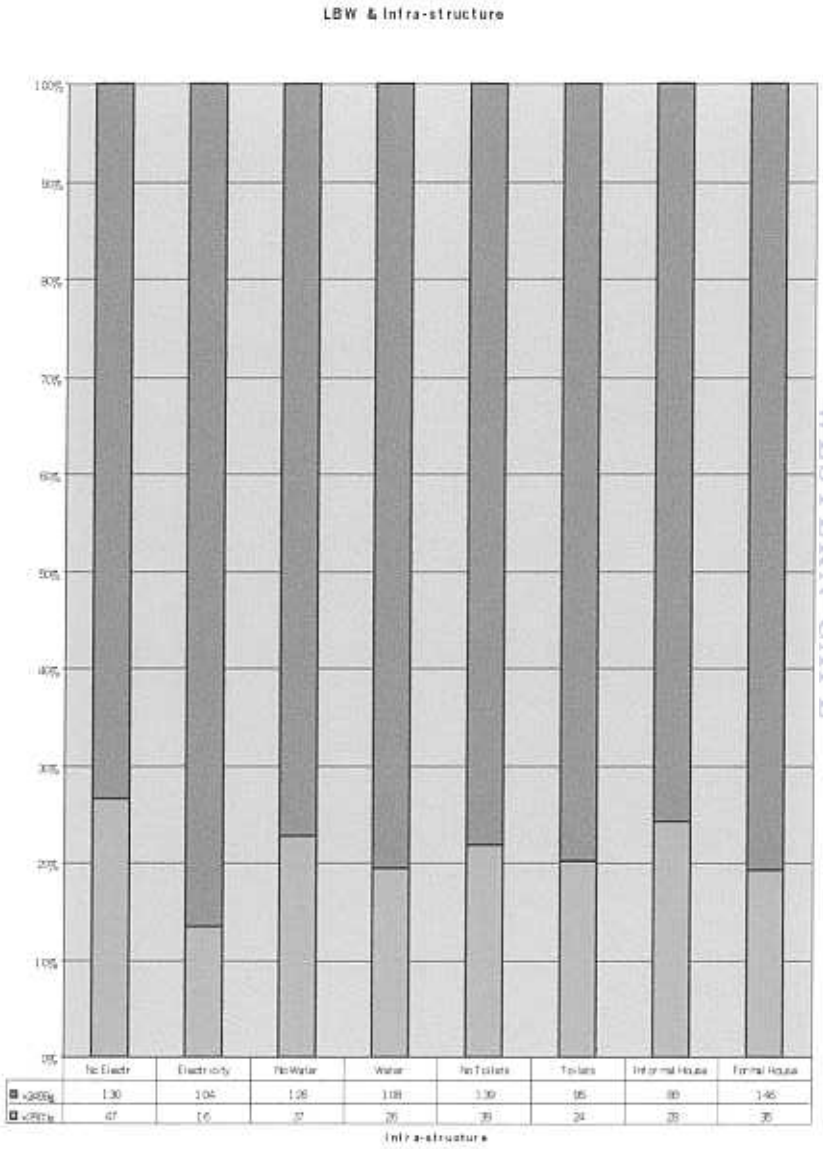
Graph 2: Summary of Birthweights



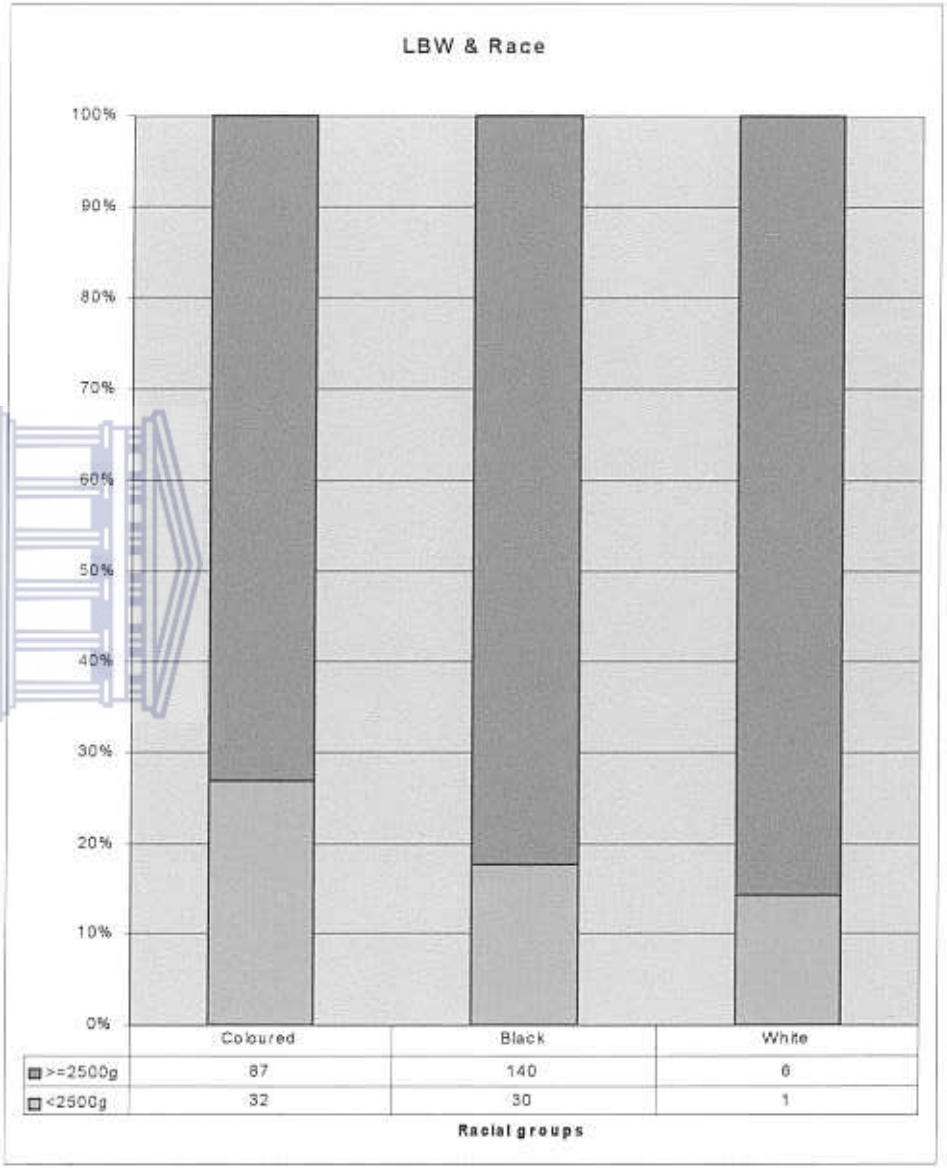
Graph 3: LBW and Income



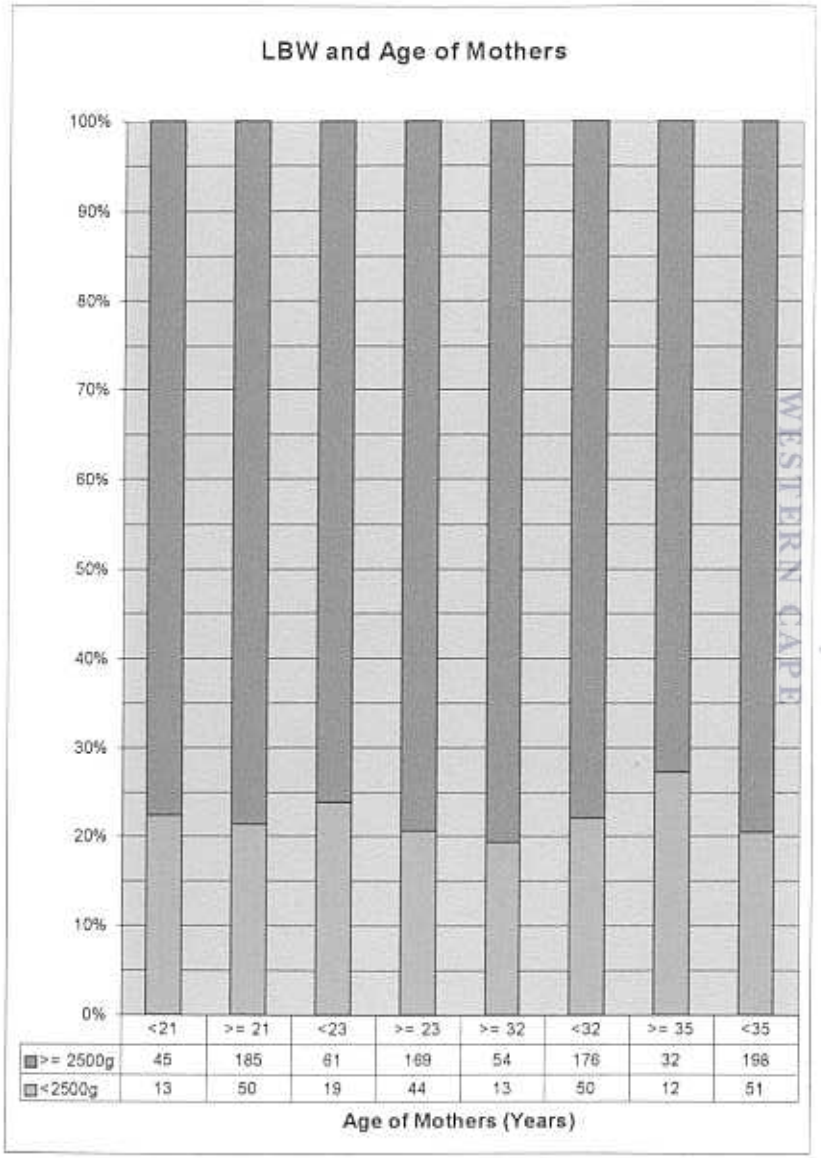
Graph 4: LBW and Infra-structure



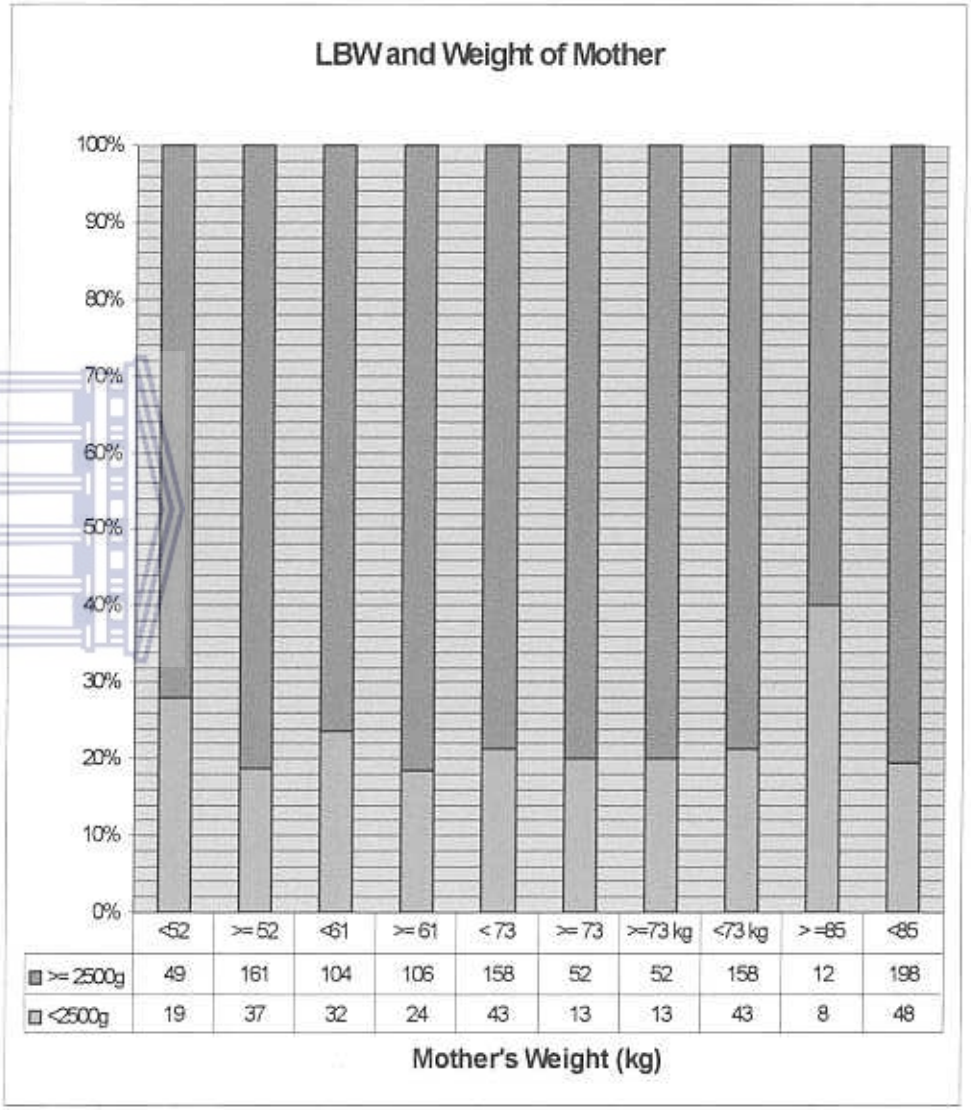
Graph 5: LBW and Race



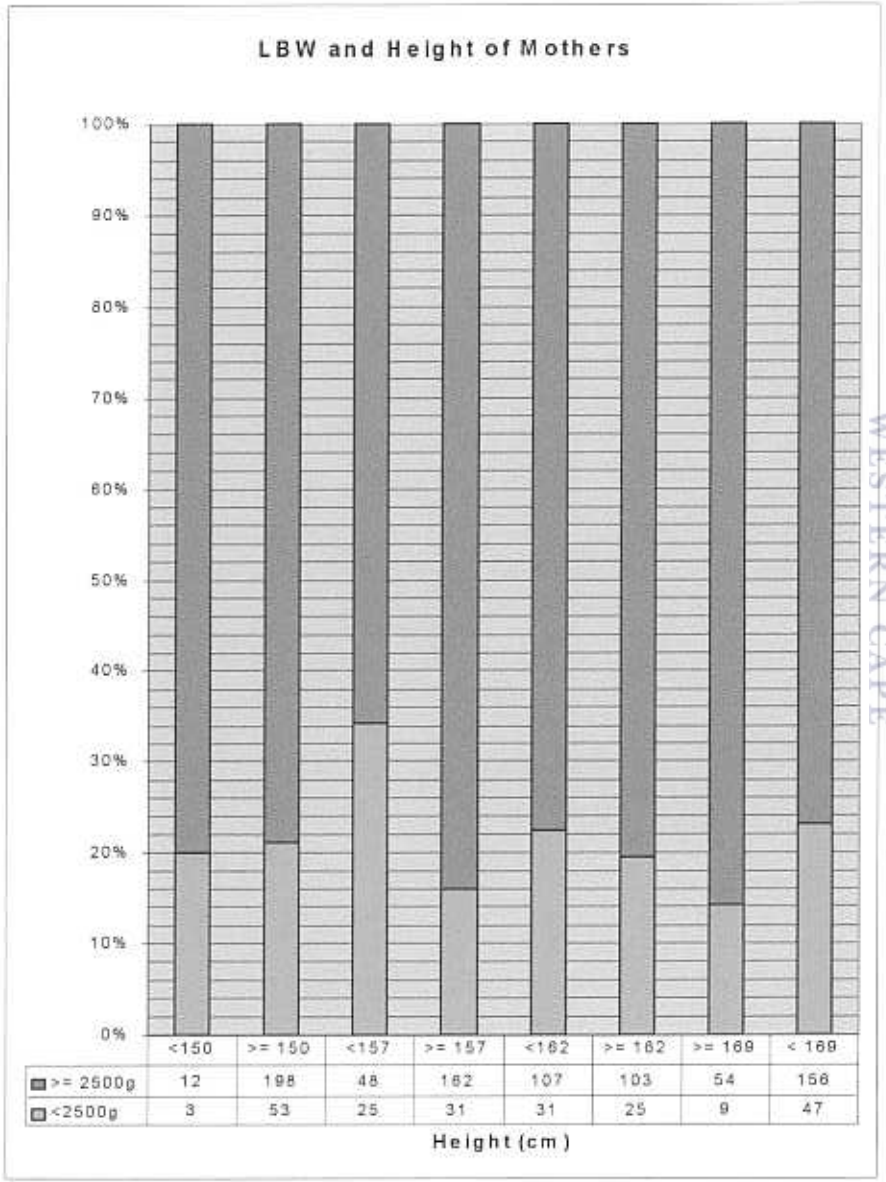
Graph 6: LBW and age of mothers



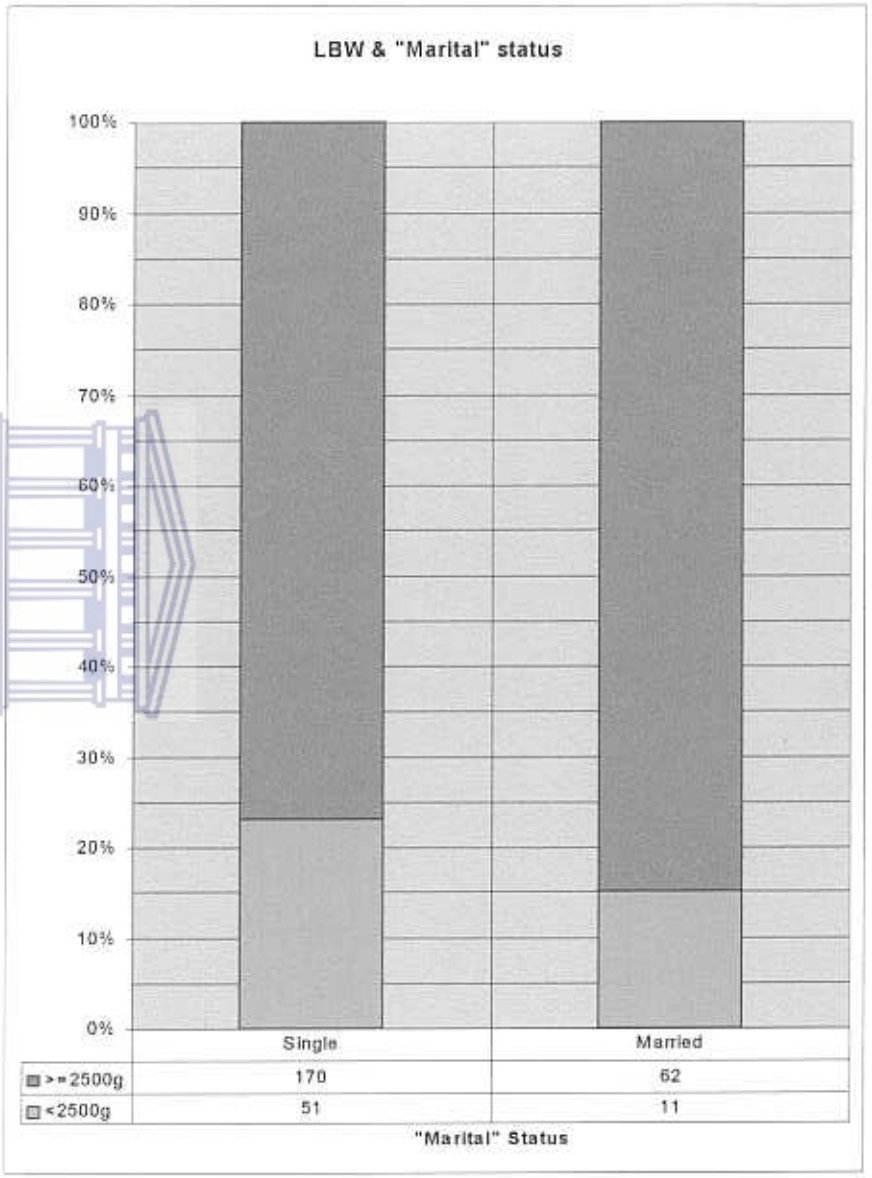
Graph 7: LBW and Weight of mothers



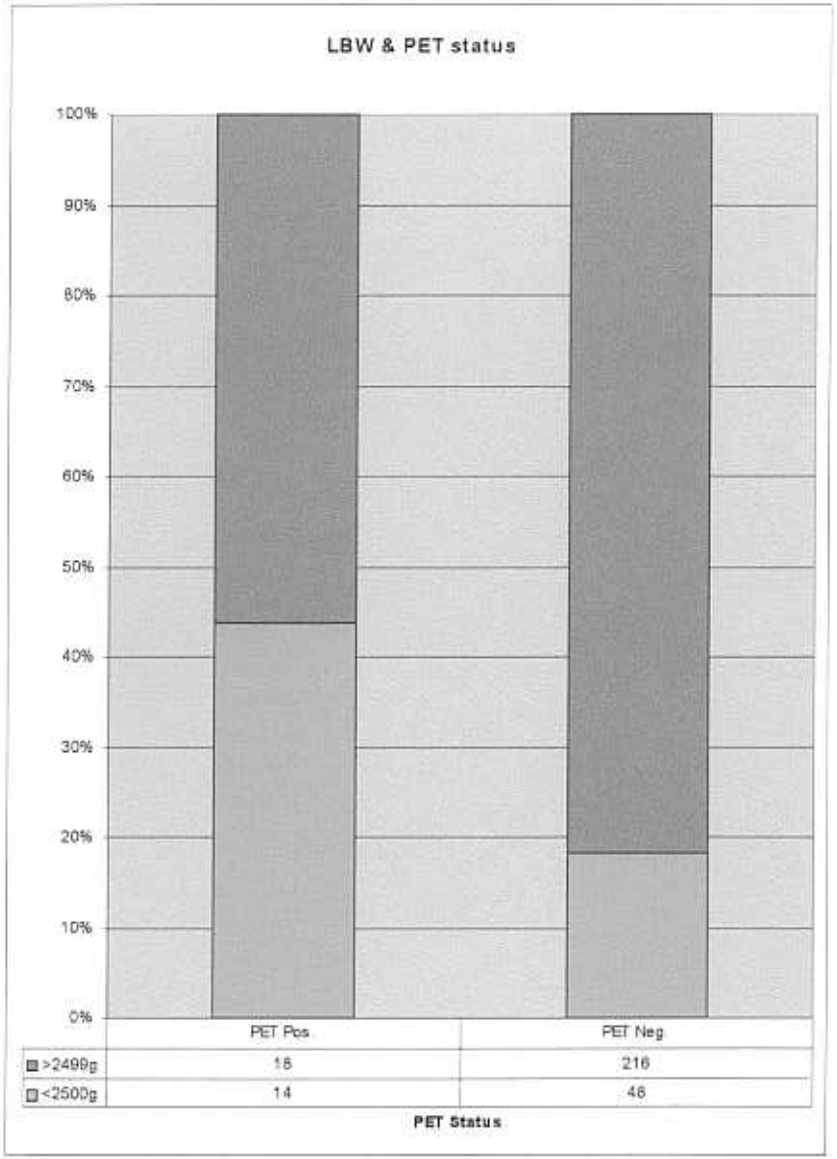
Graph 8: LBW and height of mothers



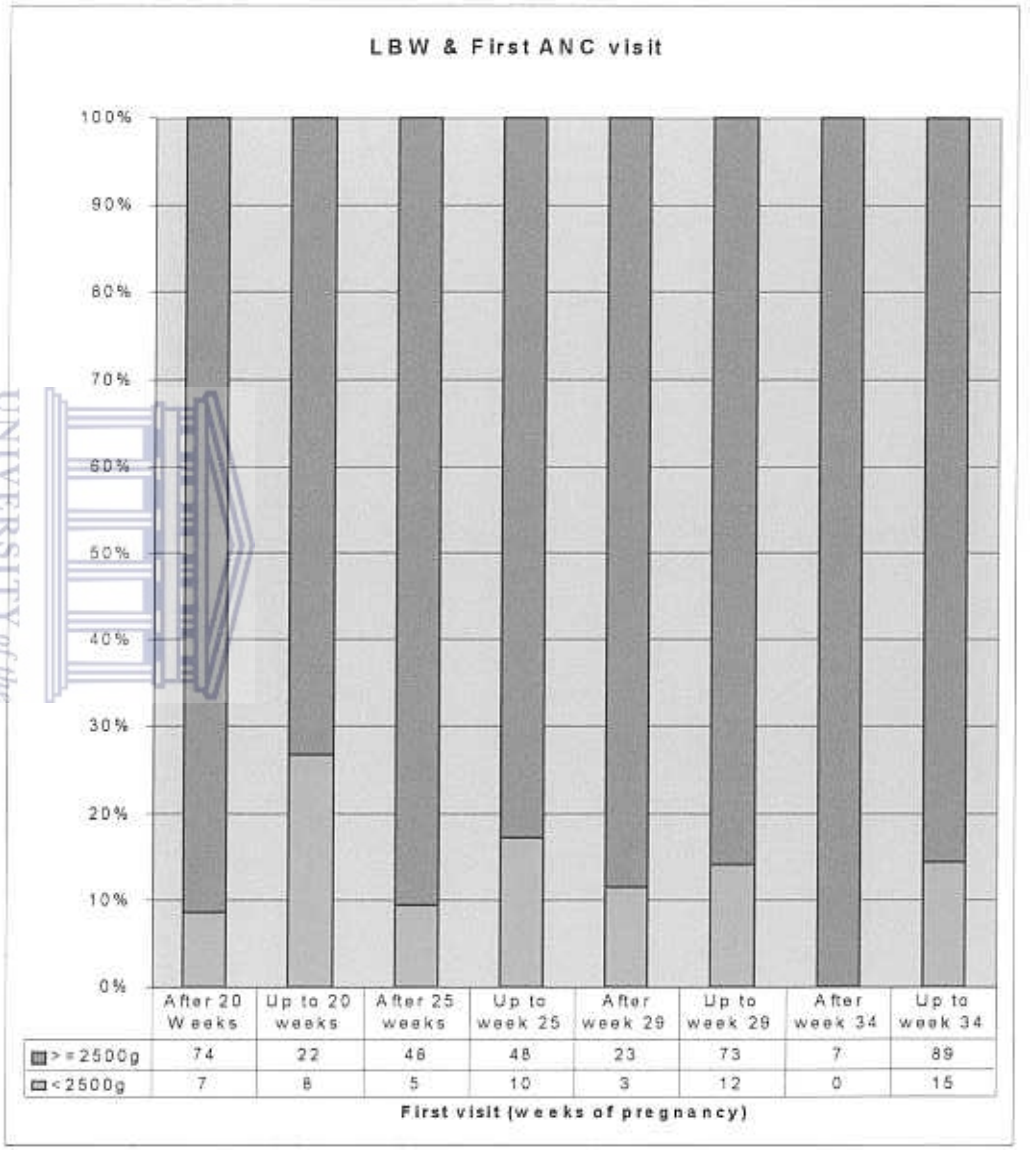
Graph 9: LBW and "Marital" status of mother



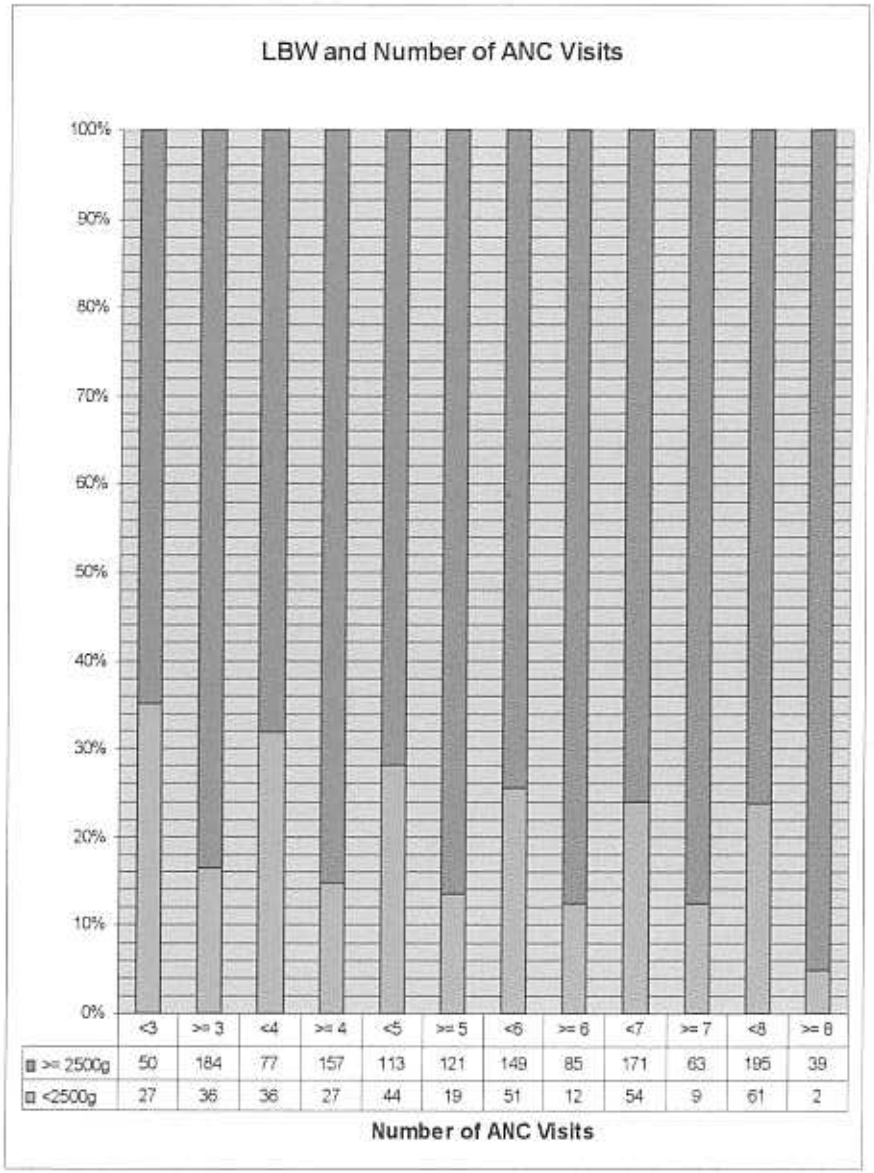
Graph 10: LBW and "PET" status of mothers



Graph 11: LBW and first visit to ANC services

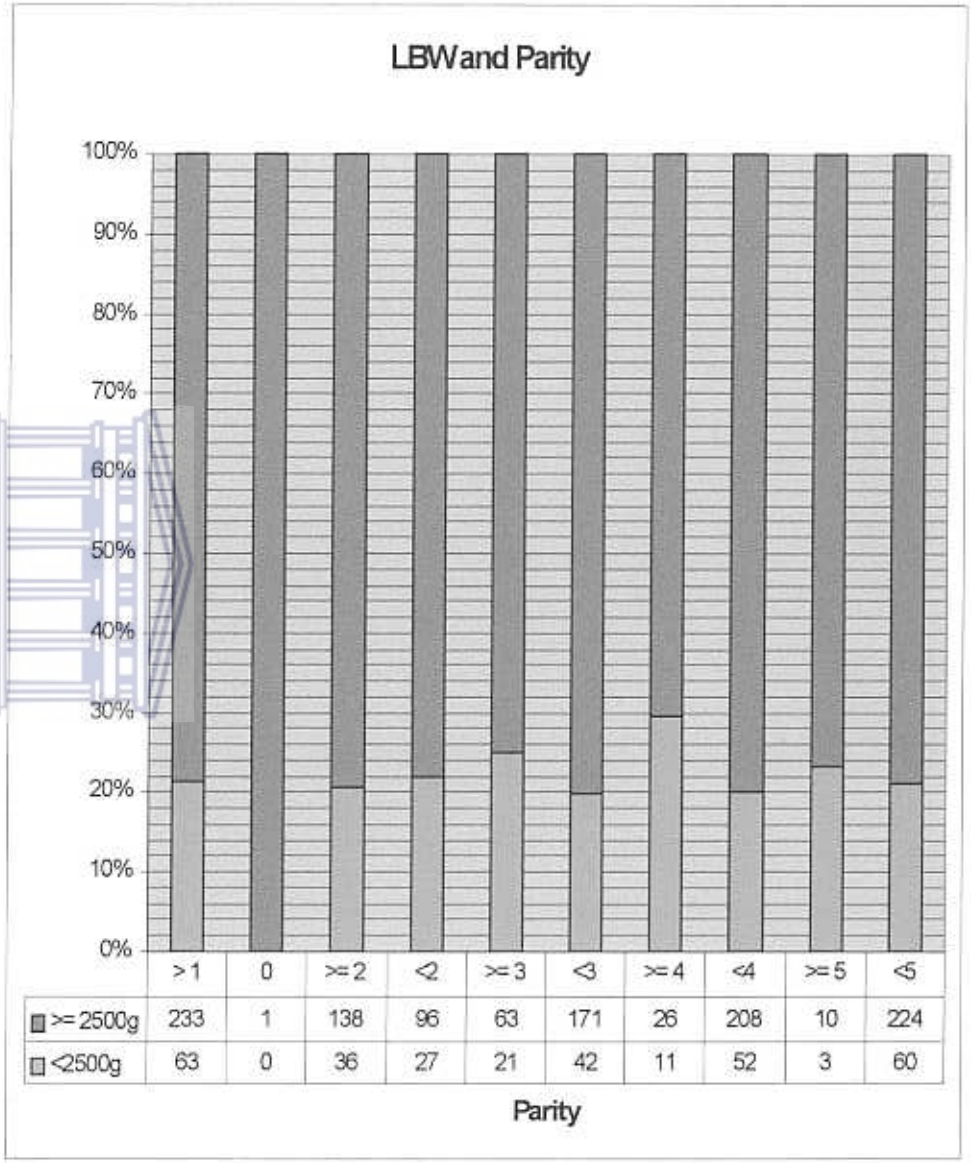


Graph 12: LBW and number of visits to ANC clinics



	<3	>=3	<4	>=4	<5	>=5	<6	>=6	<7	>=7	<8	>=8
>=2500g	50	184	77	157	113	121	149	85	171	63	195	39
<2500g	27	36	36	27	44	19	51	12	54	9	61	2

Graph 13: LBW and parity



	>1	0	>=2	<2	>=3	<3	>=4	<4	>=5	<5
>=2500g	233	1	138	96	63	171	26	208	10	224
<2500g	63	0	36	27	21	42	11	52	3	60