THE UNIVERSITY OF ZAMBIA

SCHOOL OF MEDICINE

A STUDY OF LOW BIRTHWEIGHT INFANTS DELIVERED AT THE UNIVERSITY TEACHING HOSPITAL IN LUSAKA.

DR. LACKSON KASONKA

DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENT AND FOR THE DEGREE OF MASTER OF MEDICINE IN OBSTETRICS AND GYNAECOLOGY

2001

DEDICATION

This work is dedicated, with affection and pride, to my wife Chimika for the encouragement and to my two children Mutale and Abby Kasonka for their understanding. They allowed me to do this work even at the times I was supposed to be with them, providing parental care.

My family is my source of inspiration. I owe all my life achievements and success to them. I pray that the Almighty Lord continues to bless them.

DEDICATION

This work is dedicated, with affection and pride, to my wife Chimika for the encouragement and to my two children Mutale and Abby Kasonka for their understanding. They allowed me to do this work even at the times I was supposed to be with them, providing parental care.

My family is my source of inspiration. I owe all my life achievements and success to them. I pray that the Almighty Lord continues to bless them.

ACKNOWLEDGEMENTS

My sincere thanks go to the following:

The Department of Human Resource and Training (DHRT), Cabinet Office for the financial assistance. It could not have been possible to meet the financial obligation involved in this study without this help.

Medical Students for working tirelessly side by side with me in data collection.

The dedicated Labour Ward Staff, including midwives and clerks for their cooperation and assistance during data collection.

Mr Joseph Banda and Clement Mwakamui for assisting with data entry and analysis.

Ms Rosemary Willombe for taking care of the typing and printing works.

Dr Lucy O'Brien for her encouragement and advice.

Dr Yusuf Ahmed for constant Supervision and encouragement.

STATEMENT

I HEREBY STATE THAT THIS DISSERTATION IS ENTIRELY THE RESULT OF MY OWN PERSONAL EFFORT. THE VARIOUS SOURCES TO WHICH I AM INDEBTED HAVE BEEN CLEARLY INDICATED IN THE BIBLIOGRAPHY AND ACKNOWLEDGMENTS.

SIGNED _____

DR LACKSON KASONKA

DECLARATION

I HEREBY DECLARE THAT THIS DISSERTATION HEREIN PRESENTED FOR THE DEGREE OF MASTER OF MEDICINE IN OBSTETRICS AND GYNAECOLOGY HAS NOT BEEN PREVIOUSLY SUBMITTED EITHER WHOLLY OR IN PART FOR ANY OTHER DEGREE AT THIS OR ANY OTHER UNIVERSITY, NOR IS IT BEING CURRENTLY SUBMITTED FOR ANY OTHER DEGREE.

SIGNED:_____

DR LACKSON KASONKA

APPROVED BY_____

DR Y AHMED (SUPERVISOR)

APPROVAL

THE DISSERTATION OF DR LACKSON KASONKA IS APPROVED AS FULFILLING PART OF THE REQUIREMENT FOR THE AWARD OF THE DEGREE OF MASTER OF MEDICINE IN OBSTETRICS AND GYNAECOLOGY BY THE UNIVERSITY OF ZAMBIA.

SIGNATURES _____

_____

_____

ABSTRACT

Low birthweight refers to infants born with a weight of less than 2,500 grams. The weight of a neonate at birth has a significant prognostic value and is a major determinant of child survival. Neonatal mortality and morbidity tends to increase proportionately with reduced neonatal birth weight.

Causes of low birthweight in neonates can be multi-factorial. Maternal factors may include her age, marital status, parity, social economic factors, preterm labour, multiple pregnancy, possible complications in the index pregnancy, necessitating pregnancy interruption before term e.g. pre-eclampsia, twinning, antepartum haemorrhage, and others.

This was a retrospective study to: establish the incidence of low birthweight infants delivered at the UTH in Lusaka over a period of twelve months from January to December 1998 and document maternal and infant characteristics (including immediate outcome). There were 11,042 infants born from 10,525 deliveries in 1998 (difference accounted for by multiple pregnancy). There were 2,552 infants born with low birthweight (23.1% of all infants) from 2,279 pregnancies (21.7% of all pregnancies).

Almost a quarter (24.5%) were born to mothers with an age between 13-19 (who were mainly single). 37.7% of mothers with low birthweight were primiparas. 62.6% of pregnancies with low birthweight were preterm. Over half of the low birthweight infants were between 2000-2500g (54.7%), while 6.7% were extremely low birthweight (<1000g). 19.3% of all singleton pregnancies were complicated by low birthweight, but 68.2% of twin pregnancies and all triplet pregnancies were. The odds ratio of a multiple pregnancy being associated with low birthweight was 9.14 (95% CI, 7.15<OR<11.14). An infant born as a twin or triplet had an odds ratio of 6.46 (95% CI, 5.66<OR<7.41) of being low birthweight.

7.5% of low birthweight infants were stillborn and a further 8.6% had a poor Apgar score (between 1-6) at 5 minutes However, 67.8% had an Apgar score of 9 or 10 at 5 minutes. An infant with low birthweight was slightly more likely to be stillborn compared to other infants – odds ratio 1.22 (95% CI, 1.02<OR<1.45). Preterm delivery was the commonest clinical factor associated with low birthweight followed by pre-eclampsia.

The study had documented the magnitude of low birthweight at UTH. Recommendations have been made to follow up with a prospective study to include the district and study in depth maternal and pregnancy risk factors, reasons for preterm delivery and later neonatal outcome.

CONTENTS

TABLES AND FIGURES

ABBREVIATIONS

AIDS	Acquired Immuno-deficiency Syndrome
APH	Antepartum Haemorrhage
ARC	Aids Related Complex
BOH	Bad Obstetrics History
GNP	Gross National Product
HDP	Hypertensive Disorders of Pregnancy
HIV	Human Immuno-deficiency virus
IUGR	Intrauterine Growth Retardation
LBW	Low Birthweight
SGA	Small for Gestational Age
STD	Sexually Transmitted Disease
UTH	University Teaching Hospital
UNZA	University of Zambia
WHO	World Health Organisation

INTRODUCTION

Low birthweight refers to infants born with a birth weight of 2,500g or less. Low birthweight is one of the major causes of high mortality and morbidity and may indicate that a baby did not remain in-utero long enough or that it did not develop well enough. There seems to exist a multi-factorial inter-relationship between the environment in which the mother lives and the growing fetus. A number of factors therefore appear to influence fetal outcome. Psychosocial adversities and social economical problems have traditionally been associated with unfavorable pregnancy outcome regarding birthweight.

Low birthweight, prematurity and intrauterine growth restriction are major determinants of child survival. Low birthweight could be associated with maternal, socio-economical and environmental factors or a combination of them. These include poverty, ignorance and inability to utilize health care services. Early marriage and low family income lead to poor maternal nutrition reserves which in turn leads to reduced fetal nutrition. Poor maternal nutrition is also the result of ignorance, short birth interval, parity and lack of prenatal care.

Toxemia of pregnancy, anaemia and other maternal systemic illnesses are some of the factors influencing growth velocity of the fetus leading to an increased incidence of small for gestational dates infants. Many of these are preventable before pregnancy so that the implementation of preventive public health measures utilizing appropriate technology, at least in developing countries, may be socially and economically preferable to continued financial investment in intensive prenatal services.

LITERATURE REVIEW

Incidence of low birthweight worldwide

Low birthweight continues to be a big public health problem in the developing countries. Numerous studies in Africa and other continents have been conducted to determine the incidence and identify the maternal risk factors associated with this problem.

The results obtained in a four month descriptive study on low birthweight in Nyaza Provincial General Hospital in Kisumu, Kenya indicated that 15.0% of all labour ward deliveries were of low birthweight (1). Premature deliveries accounted for 55.3% while term, small for gestation age infants contributed 44.7% of all low birthweight babies. 4.8% of mothers with low birthweight infants were adolescents. The mean gravidity was 2.5.

This compares with a three month prospective study done at the Jos University Teaching Hospital in Nigeria where the incidence of low birthweight was 12.2% (2). Premature delivery accounted for 61% of these low birthweight infants.

In a report from a study conducted at Sumve District Hospital in Northwest Tanzania, a low birthweight incidence of 14.6% was obtained (3).

In hospital and community based studies in Central Sudan the incidence of low birthweight was reported as 8.2% and 18.1% respectively (4).

A retrospective analysis of 2,401 consecutive births conducted in a Zambian population between August and September 1977, revealed a low birthweight rate of 11.4% of all births (14.2% of all livebirths) (5).

The incidences of low birthweight from outside Africa are similarly high. For example, India currently has the highest under five years mortality rates (above 140 per 1000 livebirths) which is contributed to by a high infant mortality rate that in turn is affected by the high incidence of low birthweight. About seven million Indian babies (30% of all births) born annually are low birthweight (6). The authors state that a social revolution may be required in India before the levels of low birthweight infants can be reduced.

A Malaysian review of 2,613 records of infants delivered at North Okkalapa General Hospital over a period of nine months revealed a low birthweight incidence of 21.1% (7). Intrauterine growth retardation (IUGR) accounted for 18.1% of these, while 13% were associated with preterm delivery.

Effect of Socio-economic Status and Low Birthweight

The question always remains in the background about the relationship between low birthweight and socio-economic status. In a study conducted in a hospital setting in Kigali, Rwanda over a 2 years period, 6,707 singleton births were investigated to find an association between birthweight and socio-economic status (8). The overall incidence of low birthweight was 17.5%. In this survey, it was observed that women of the higher socio-economic groups delivered heavier infants than the lower socio-economic groups. The incidence of low birthweight was 11.5% in the higher socio-economic group and 18.9% in the lower group. The authors suggested that the incidence of low birthweight could be used as an indicator of socio-economic development.

Another study on low birthweight in Jamaica similarly cited socio-economic risk factors and linked other clinical factors to poor pregnancy outcome (9). In Japan, where the

Gross National Product (GNP) per capita is high at $ 23,810, the incidence of low birthweight is only 5%, whereas in India, with a GNP per capita of only $340, the incidence of low birthweight is up to 30%. If socio-economic status were the only significant factor, then there could be no explanation for why Jamaica, with a GNP per capita of $ 1,260 has only an 8% low birthweight (10), not that markedly different from that in Japan.

Maternal Factors and Low Birthweight

To identify maternal risk factors associated with low birthweight, a cohort of 353 systematically selected antenatal clinic attenders in Maputo, Mozambique, was studied prospectively during a period of 12 months (11). The prevalence of low birthweight infants was 8%. Low birthweight was significantly associated with low maternal age, (less than or equal to 19 years), nulliparity and hypertension or convulsions.

A comparative study exploring determinants of low birthweight between Cameroon and the United States identified positive risk factors in both the countries (12). These included unmarried motherhood, female sex of the infants, multiple births and preterm births. Outcome of the previous pregnancy was a positive risk factor in the United States but not in Cameroon.

According to the same study, social scientists have long concluded that premarital childbearing exacerbates problems of both poverty and family instability (12). Out-of-wedlock and adolescent childbearing may reduce a mother's educational attainment, lower the probability of her eventual marriage, increase her probability of welfare recipiency, and decrease family income – factors which can increase the chance of low birthweight.

As a medical cause, maternal malaria seems to predominate as a cause of low birthweight as reported by studies in Tanzania (13), Zaire (14) and Sierra Leone (15). The reasons for this include premature labour, maternal anaemia and also placental parasitaemia contributing to chronic placental insufficiency.

In India, univariate analysis identified the following risk factors as significant for low birthweight; age under 20 years, para 1, maternal height of 145cm or under, maternal cigarette smoking, maternal education of 8 years or less, parity 5 or above and maternal age of 35 years and above (16).

In Ethiopia, in order to determine factors influencing adolescent birth outcome, a total or 212 mothers and their newborns were studied at Tikur Anbessa Hospital, in Addis Ababa (17). Results indicated that adolescent pregnancy was found to be associated with higher rates of premature and low birthweight infants. Newborns of adolescent mothers also had significantly decreased anthropometric parameters (length < 45cm, head circumference < 32cm), and had lower Apgar Scores (<7) at 1 and 5 minutes. The incidence of low birthweight was 27% in mothers aged less than 15 years; 26% in mothers aged 15 – 19; 20% in those aged 20 – 24 and the least (18%) in the 25 - 29 year age group. Many unfavorable economic circumstances and lack of adequate antenatal supervision were believed to contribute to these high rates. Some of the teenage mothers particularly the very young, below 16 years, are physically immature and are still growing children themselves. Their nutrient intake is shared between their own growth needs and those of their fetuses.

Multiple pregnancy also contributes to low birthweight. A Nigerian study in Ibadan found that the incidence of low birthweight was higher in 525 twins compared to 363 singletons (18). In a retrospective study of twins conducted at the University of

Maiduguri Teaching Hospital in Nigeria revealed a perinatal mortality rate of 118/1000. The major risk factors for mortality were preterm delivery and low birthweight (19).

With respect to HIV, a systematic review of the literature published in 1998 (20) addressed the association between maternal HIV infection and perinatal outcome. A two-fold increase in low birthweight was noted (odds ratio of 2.09, 95% confidence interval of 1.86-2.35). (This is elaborated further in the Discussion).

Regarding sexually transmitted infections, a study in Belgium revealed that infection with gonorrhea and untreated syphilis were both associated with prematurity and low birthweight (21). It was concluded in this study that, at least in countries where the prevalence is high, genital infections as well as the risk factors for acquiring them (young age, sexual debut, number of recent partners) play a major role in the etiology of prematurity and low birthweight. The authors further stated that Neisseria Gonorrhea is an important contributor to prematurity and low birthweight, and in high prevalence areas it should be routinely looked for and treated during pregnancy.

The effects of vaginal bleeding on the outcome of pregnancy remains unclear. The data concerning a possible correlation with low birthweight are ambiguous. A study of 2,168 women giving birth to single children, chosen randomly in 2 maternity services in Cotonou, Benin in 1990, suggested that bleeding during pregnancy appears to be a predictor of low birthweight (22).

In Cotonou, Benin, in another study to show the relationship between pregnancy intervals and birth of low birthweight infants, logistic regression analysis - controlled for socio-demographic factors and previous obstetrical history, showed no significant correlation between pregnancy interval and intrauterine growth retardation (IUGR).

However maternal nutritional status, maternal age, number of previous births and education level were correlated with low birthweight (23).

Effects of Low Birthweight

Low birthweight babies are more likely to die and suffer sequelae compared to babies of birthweight greater than 2500g. Accordingly low birthweight is an important determinant of perinatal mortality and morbidity.

For example, in a prospective study of neonatal morbidity and mortality in Dar-es-Salaam, low birthweight carried a seven-fold increased risk of mortality and a three-fold increased risk of morbidity (24). In a two-year prospective study of neonatal deaths at a Nigerian University Teaching Hospital, low birthweight babies accounted for 60% of deaths (25). Severe infections, severe birth asphyxia, respiratory distress syndrome and recurrent apnoea were among the leading causes of death in this study. The survival chances of low birthweight infants in a rural hospital in Ghana attributed a 26.8% mortality (over half in the first 48 hours of life) (26).

There is an excess of morbidity in low birthweight babies. A recent study at Harare, Zimbabwe found that low birthweight was the most important variable determining admission to a neonatal unit with problems ranging from : apnoea, respiratory distress, aspiration pneumonia, neonatal jaundice, poor feeding and sepsis (27).

A South African study described the long-term outcome of very low birthweight (<1500g) infants growing up in poor socio-economic conditions in Soweto, South Africa (28). Growth and neurological status were recorded at follow-up visits at 3, 6, and 12 months corrected age. Mortality after hospital discharge, in this study cohort, was extremely high. However, despite marked differences in socio-economic conditions and tertiary care facilities, the handicap rates were comparable with recent studies from developed countries, as were some of the predictors of handicap, e.g., periventricular leukomalacia and porencephaly.

Regarding outcome in low birthweight in multiple pregnancy, the previously cited Nigerian study comparing twins and singletons, found that the incidence of low birthweight was higher among twins (19). Morbidity factors frequently associated with low birthweight among the twins were: perinatal asphyxia, hypothermia, neonatal seizures, and intracranial haemorrhage. Intrapartum asphyxia was particularly common in those preterm low birthweight twins who were also small for gestational age.

Study Justification

The extent of the problem of low birthweight at the University Teaching Hospital and in Lusaka is not clear. In a city which has over 40 000 deliveries a year, it is important to determine the extent of the problem of low birthweight and characteristics of mothers and infants. This would be a prelude to interventions to reduce low birthweight and its excess morbidity and mortality.

OBJECTIVES

To study the magnitude of low birthweight at the University Teaching Hospital in Lusaka, Zambia.

Primary objectives

1. To determine the incidence of low birthweight at UTH in Lusaka during 1998.
2. To describe maternal and infant characteristics associated with low birthweight.
3. To determine the immediate infant outcome of pregnancies complicated by low birthweight.

Secondary objectives

Through the descriptive study to be able to obtain information to generate hypotheses and analytic questions regarding low birthweight at UTH.

METHODS

Study Description

This was a descriptive, hospital based, retrospective observational study.

The methodology was to provide a description of cases of low birthweight infants (including outcome) and the characteristics of the mothers.

Site and Time

The Department of Obstetrics and Gynaecology, University Teaching Hospital (UTH) covering the time frame of one year: January 1st to December 31st 1998.

Study Population

Mothers of infants less than 2,500g and infants of same weights at the UTH.

Data source

The data source was the Labour ward admission and delivery books and case files of women delivering an infant with low birthweight. A standard data collection sheet was utilised to extract information on each case of low birthweight.

Data collected included: mother's age, marital status, parity, gestation, age at delivery and whether it was a single or multiple gestation. Any relevant clinical condition in the mother was also obtained. The author recorded the most important clinical condition first and any other clinical features were included (see overleaf).

Neonatal details obtained included: gender, Apgar score at 5 minutes and weight of the new- born. The selection criterion was neonatal weight equal to or less than 2500g. Midwives routinely obtain and record the information concerning the delivery and

weighed the infants within half an hour of birth. This information was obtained from the delivery register kept on the Labour ward..

The following maternal clinical factors were noted on review of case notes of mothers who had a low birthweight infant :

0. No clinical factor identified
1. Anaemia (Hb <10g/dl) and other blood disorders.
2. HIV/ARC
3. Pre-eclampsia-Eclampsia – Hypertensive disorder of pregnancy.
4. Preterm delivery.
5. Teenage pregnancy.
6. Grand multiparity.
7. Antepartum haemorrhage. (APH) – either placenta praevia or abruptio placenta
8 Viral hepatitis.
9 Bad Obstetric history (BOH) – e.g. recurrent abortions, perinatal deaths etc .
10 Multiple pregnancy but no other clinical factor identified

The information relating to the type of pregnancy (singleton, twin, triplet – defined as plurality as described later) was coded with the maternal details and not as a clinical condition or factor. However during review of the data, this was incorporated with the clinical conditions. Results of syphilis testing was not routinely found in case files and was omitted. Similarly no consistent categorisation of malaria could be obtained from the case files and this was also omitted.

Data manipulation

The data set was entered in Epi Info (version 6) and included variables of maternal, fetal and neonatal interest as indicated previously. It should be noted that the population was only those women who had low birthweight at UTH in 1998 and not all women who delivered at UTH in 1998.

For ease of visualising the data, single variables was either tabulated as simple (and relative) frequency distributions. When more than 2 variables were involved, groups using appropriate class divisions (e.g. birthweight 500-999g, 1000-1499g etc; or gestation <28 weeks, 28-32 weeks etc) were utilised with the (relative) frequency distributions. Due to rounding off errors of the relative frequencies (which were presented as percentages), values may not add up exactly to 100% in all cases. Figures are presented mainly of the relative frequency distribution (with classes on the horizontal axis and relative frequencies on the vertical axis). In labeling tables and figures, it will be assumed they are relative frequency distributions (as a percentage) if not specifically stated.

Statistical Analysis

There were no instances requiring descriptive analysis (e.g. mean, standard deviation etc) (see discussion). Where comparative was performed, this utilised the Chi Square and Odds ratio (together with 95% confidence intervals) with significance set at 5% ($p<0.05$). Analysis was performed using Epi Info.

Ethical Considerations

Approval was obtained from the Research Ethics Committee of the University of Zambia. As all data was collated and grouped in various classes. No individual names or identifying features were selected or presented to be able to jeopardise confidentiality.

Working Definitions

(From : World Health Organisation, International Conference on the Tenth Revision of the International Classification of Diseases, Geneva. WHO, 1991, reference 29)

All fetuses and infants weighing at least 500g, whether alive or dead, are included for statistical purposes.

Low birthweight	Less than 2,500g (up to and including 2,499g)
Very low birthweight	Less than 1,500g (up to and including 1,499g)
Extremely low birthweight	Less than 1000g (up to and including 999g)

Preterm	Less than 37 completed weeks of gestation
Plurality	This was taken to describe the fetal number in the pregnancy i.e. singleton, twin, triplet. This was preferred to multiplicity of the pregnancy

RESULTS

Incidence of low birthweight at UTH in 1998

During the 12 months period (January - December 1998) there were 10,525 deliveries recorded at UTH. Of these, there were 10,013 singleton pregnancies, 507 twin pregnancies and 5 triplet pregnancies. There were no higher order births other than triplets. Therefore, there were a total of 11,042 infants born at UTH in 1998 as described below:

Type	Deliveries	Babies
Singleton	10,013	10,013
Twins	507	1,014
Triplets	5	15
Totals	**10,525**	**11,042**

Of the 11,042 babies, there were 2,552 cases of low birthweight infants during the 12 months period (23.1%). The 2,552 infants were delivered of 2,279 women of the total of 10,525 (21.7%), reflecting the fact that some infants were as a result of multiple pregnancy (twin or triplet). 1345 (52.7%) of the low birthweight infants were female and 1207 (47.3%) were male; comparable sexing was not available for the non-low birthweight infants.

The subsequent results presented relate to the 2,552 cases of low birthweight infants and the 2,279 women.

Monthly incidence of low birthweight deliveries

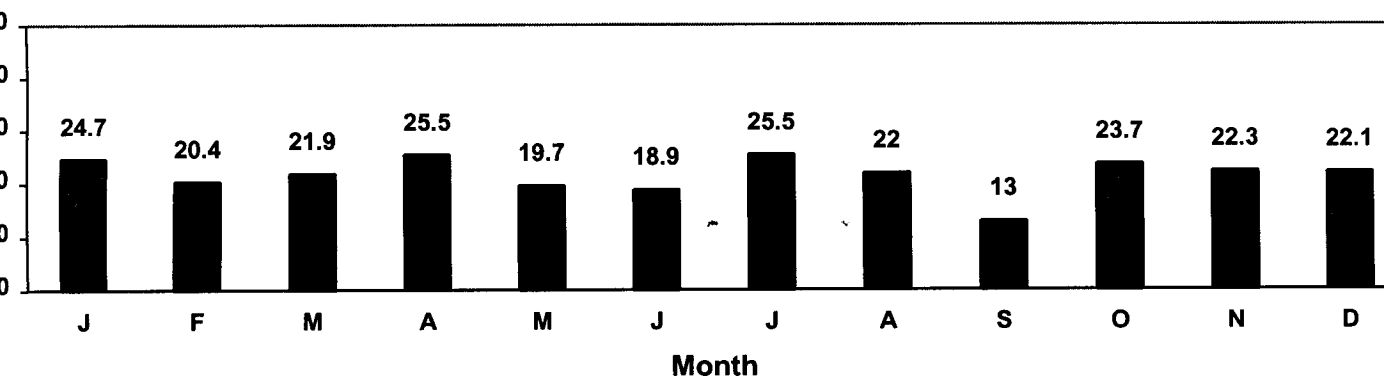
The total monthly deliveries and those complicated by low birthweight are illustrated in Table 1 and Figure 1. They approximate around 20% of deliveries per month. The lowest monthly incidence was in September (13%) while the highest was in July (25.5%).

Table 1 : Monthly distribution of deliveries complicated by low birthweight.

(UTH, 1998, n=2,279)

Month	Total monthly deliveries	Deliveries complicated by LBW infants	% deliveries complicated by LBW infants
January	887	219	24.7
February	889	181	20.4
March	977	214	21.9
April	842	215	25.5
May	878	173	19.7
June	825	156	18.9
July	876	223	25.5
August	859	189	22.0
September	861	112	13.0
October	885	210	23.7
November	840	187	22.3
December	904	200	22.1
Total	**10,525**	**2279**	**21.7**

Figure 1. Percentage of monthly deliveries complicated by LBW, UTH, 1998



Maternal age and marital status

Maternal age

The age distribution of the 2,279 mothers who had low birthweight infants ranged from 13 years to 51 years (See Table 2 and Figure 2A). These were stratified as those between 13 - 19 years, 20 - 24 years, 25 - 29 years, 30 - 34 years, 35 - 39 years and 40 years and above.

The highest number, 728 (31.9%) cases, occurred in the 20 - 24 years age group. There were 559 (24.5%) cases in the teenage group (19 years and below) with the lowest number of 33 cases (1.4%) in the above 40 years age group. There were seven, 13 year old mothers with low birthweight infants (representing the youngest).

Marital status

Of the 2,279 mothers, 1,540 (67.6%) with low birthweight infants were married while the remaining 739 (32.4%) were single (Table 2). Of the teenagers (mothers aged 19 years or less), 428 (57.9%) were single and only 131 (8.5%) were married. Records indicated that most of the teenagers were unwedded schoolgirls living with parents. All the mothers in the over-40 years old age group were married. This is illustrated in Figure 2B as follows: 57.9% of single women who had a pregnancy complicated by low birthweight were aged 13-19 years and that only 8.5% of married women who had a low birthweight delivery were aged 13-19 years. Conversely, 31.5% of married women who had a pregnancy complicated by low birthweight were aged 25-29 years compared to 6% who were single.

Table 2 : Maternal age distribution by marital status of mothers delivering infants with low birthweight (n = 2,279)

Marital Status			
Maternal age	**Married** n (%)	**Single** N (%)	**Total** N (%)
13 - 19	131 (8.5)	428 (57.9)	559 (24.5)
20 - 24	486 (31.6)	242 (32.7)	728 (31.9)
25 - 29	485 (31.5)	44 (6.0)	529 (23.2)
30 - 34	238 (15.5)	22 (3.0)	260 (11.4)
35 - 39	167 (10.8)	3 (0.4)	170 (7.5)
40 + YRS	33 (2.1)	0 (0.0)	33 (1.4)
Total	**1540 (100%)**	**739 (100%)**	**2279 (100%)**

Figure 2A: % Frequency distribution of LBW deliveries by maternal age group (n=2,279)

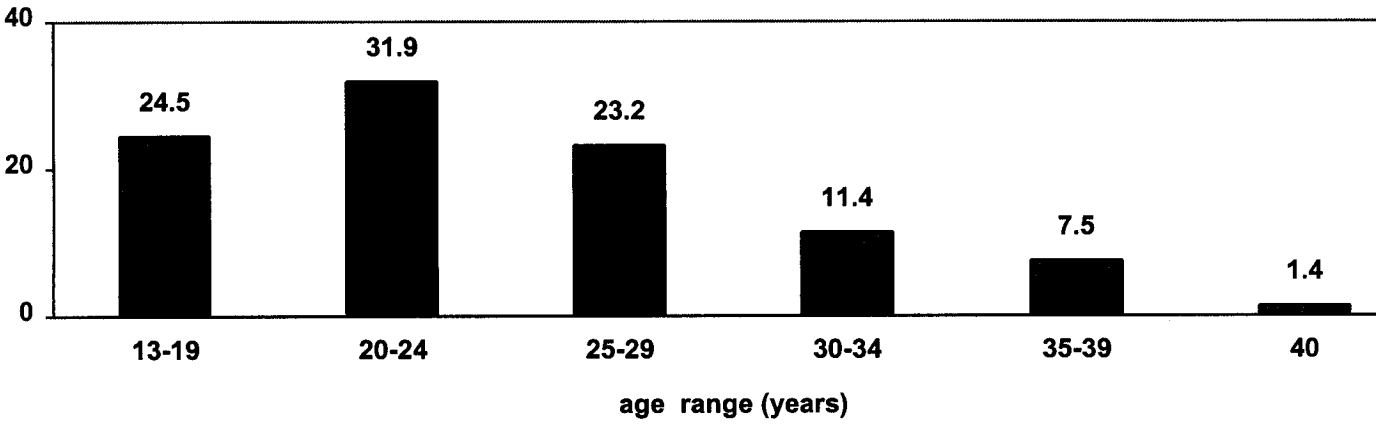
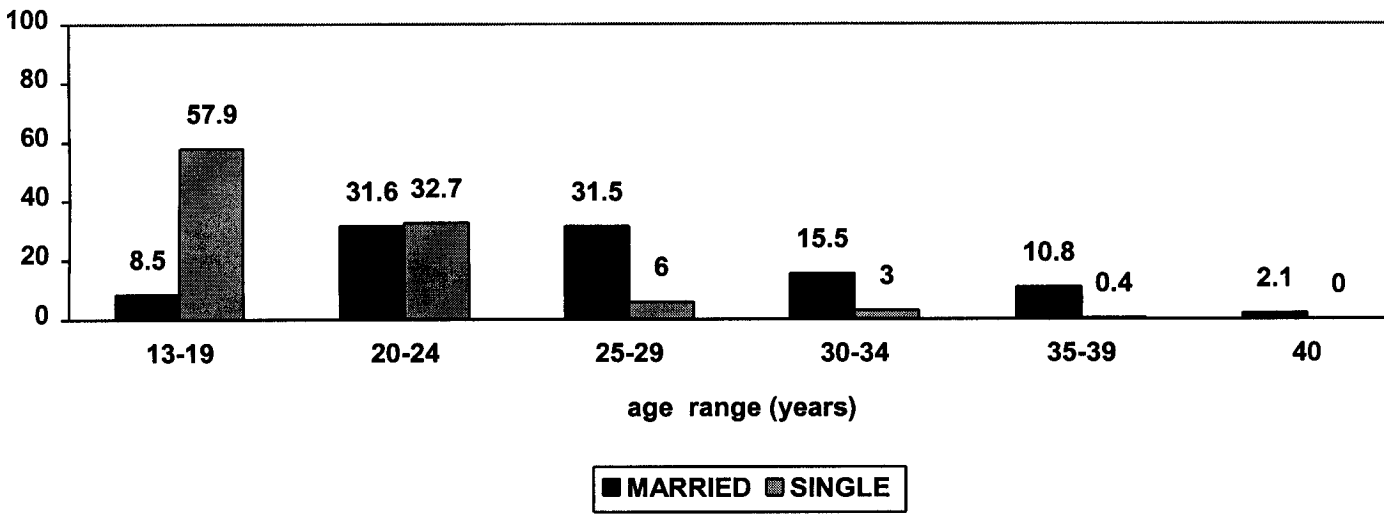


Figure 2B: Marital status and age of mothers delivering LBW infants (n=2,279)



Parity and marital status

Before delivery, of the 1,540 married mothers with low birthweight infants, 227 (14.7%) were primiparous, 1,180 (76.6.%) had between 1 - 5 children, while 138 (8.6%) had a parity of 6 or more. By contrast, of the 739 non-married mothers, 632 (85.5%) had been primiparas, 105 (14.2%) had between 1 - 5 children and only 2 (0.3%) had a parity of 6 or more. Table 3 shows the distribution of parity by marital status. Figure 3A illustrates the relative frequency distribution of parity while in Figure 3B it is illustrated by marital status.

Table 3 : Distribution of parity of mothers delivering infants with low birthweight by marital status (n = 2,279)

	Marital Status		
Parity	**Married**	**Single**	**TOTAL**
0	227 (14.7)	632 (85.5)	859 (37.7)
1-5	1,180 (76.6)	105 (14.2)	1,285 (56.4)
>5	133 (8.6)	2 (0.3)	135 (5.9)
Total	**1,540 (100)**	**739 (100)**	**2,279 (100)**

Figure 3A: % Frequency distribution of LBW deliveries by parity (n=2,279)

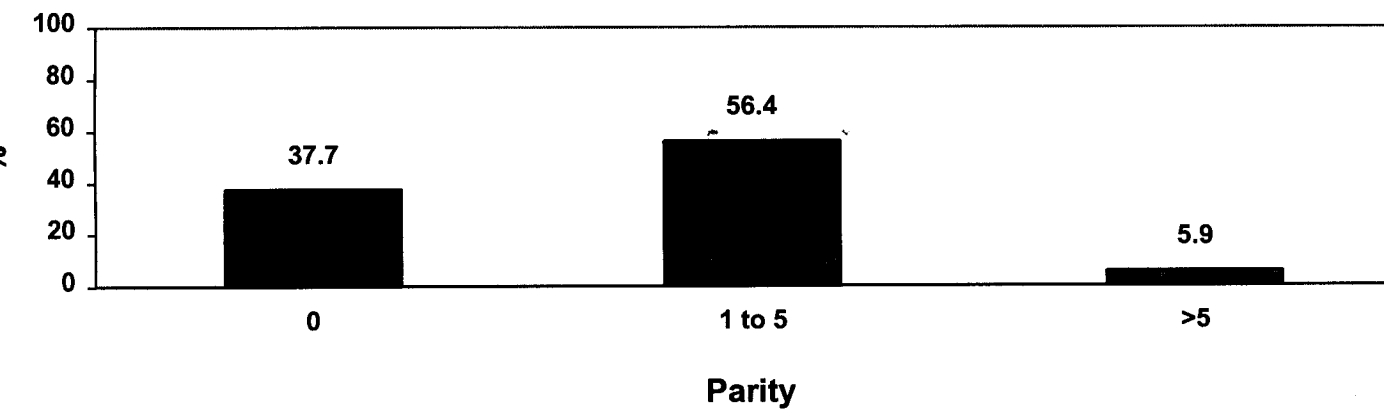
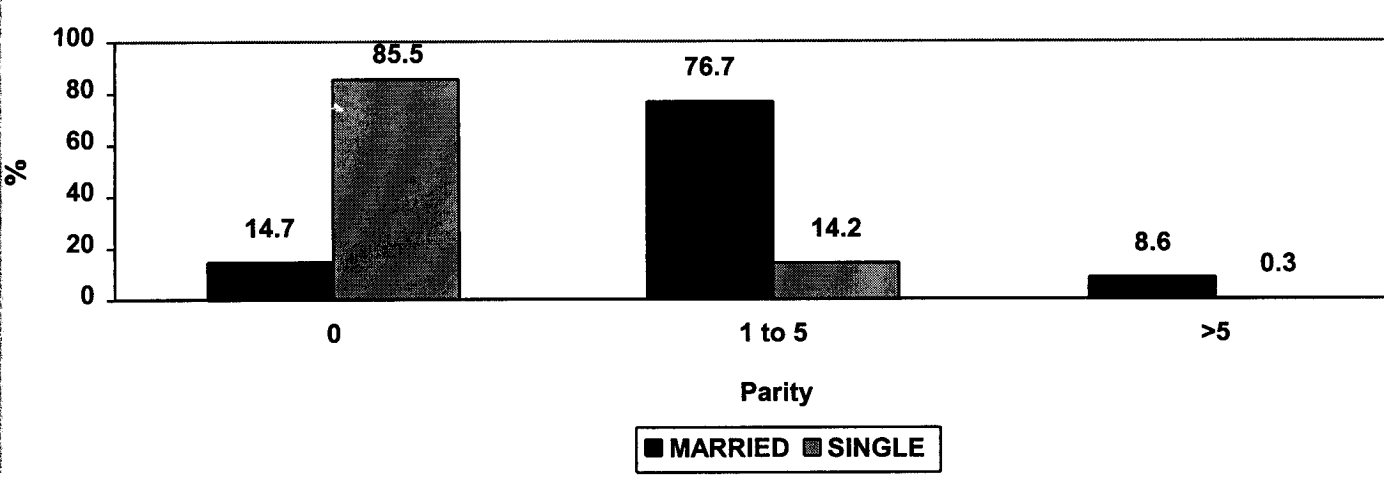


Figure 3B: Parity and marital status of mothers delivering LBW infants (n=2279)



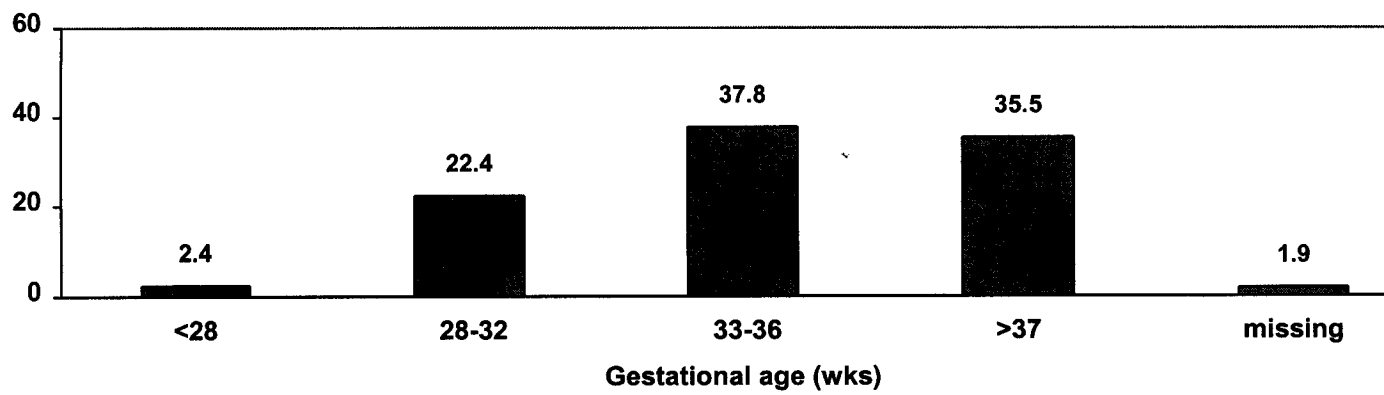
Gestational Age

The gestational ages at delivery of the 2,279 low birthweight infants ranged from 26 to above 37 completed weeks. 1,426 (62.6%) of low birthwight infants were premature (less than 37 completed weeks, 810 (35.5%) were delivered after 37 completed weeks gestation. In 43 cases (1.9% of all cases) the gestational age was not recorded. Table 4 and Figure 4 illustrates the gestational ages of the 2,279 cases of low birthweight infants.

Table 4 : Gestational age of mothers delivering infants with low birthweight (n=2,279)

Gestational Age	Frequency	Percentage
<28	55	2.4
28-32	510	22.4
33-36	861	37.8
>37	810	35.5
Missing	43	1.9
TOTAL	**2,279**	**100.0**

Figure 4: Gestational age of mothers delivering LBW infants, UTH, 1998, (n=2279)



Marital status and gestational age

Of the women delivering low birthweight infants, there were many more married than unmarried among those that were beyond term (>37 weeks) : 567 (71.4%) compared to 227 (28.6%). However the percentages of single and married women for a particular gestation group were quite similar. Table 5 and Figure 5 illustrates the distribution of gestation age with relation to marital status.

Table 5: Distribution of gestational age of mothers delivering infants with LBW by marital status (n=2,279)

	Marital Status		
Gestation age	**Married** n (%)	**Single** n (%)	**Total** N (%)
<28	31 (2.0)	24 (3.3)	55 (2.4)
28-32	339 (22.0)	171 (23.1)	510 (22.4)
33-36	568 (36.9)	293 (39.6)	861 (37.8)
>37	576 (37.4)	234 (31.4)	810 (35.5)
Missing	26 (1.7)	17 (2.3)	43 (1.9)
Total	**1,540 (100)**	**739 (100)**	**2,279 (100)**

Figure 5: Gestational age and marital status of mothers delivering infants with LBW (n=2279)

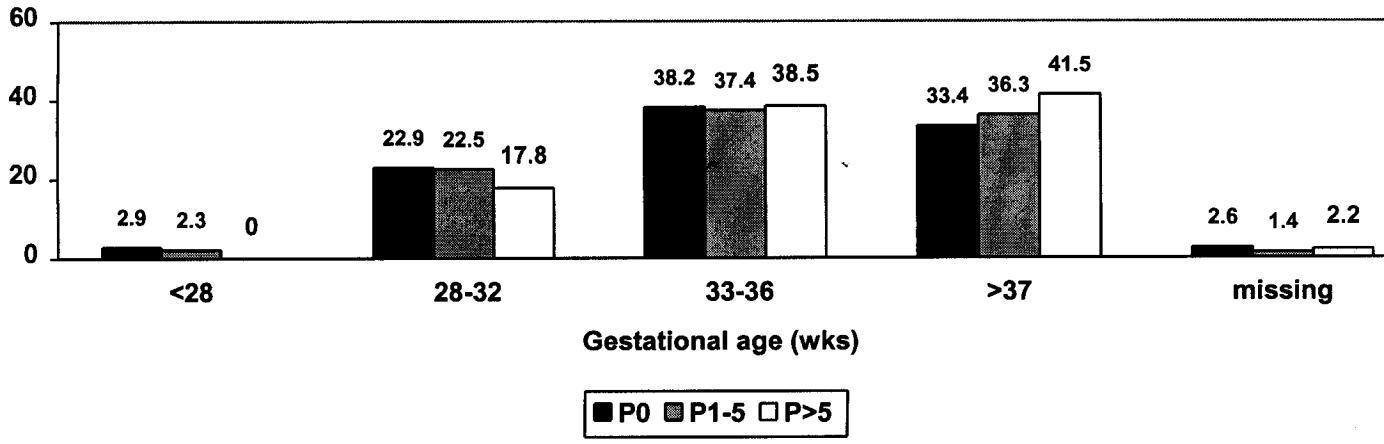
Parity of women and gestation age of LBW infants

Out of 859 primiparas with low birthweight infants, 287 (33.4%) were beyond term (>37 weeks). 550 (25+197+328) (64.0%) had preterm deliveries (<37 completed weeks) while the gestation was not recorded in 22 cases (2.6%). This compares with term deliveries of 467 (36.3%) in the para 1 - 5 group and 56 (41.5%) in the grand multiparous group who delivered low birthweight infants. Table 6 and Figure 6 shows gestational age distribution with relation to parity.

Table 6: Gestational age distribution by parity of women delivering infants with low birthweight (n=2,279)

	Parity			
Gestational Age (weeks)	**0** n (%)	**1-5** n (%)	**>5** n (%)	**Total** N (%)
<28	25 (2.9)	30 (2.3)	0 (0)	55 (2.4)
28-32	197 (22.9)	289 (22.5)	24 (17.8)	510 (22.4)
33-36	328 (38.2)	481 (37.4)	52 (38.5)	861 (37.8)
>37	287 (33.4)	467 (36.3)	56 (41.5)	810 (35.5)
Missing	22 (2.6)	18 (1.4)	3 (2.2)	43 (1.9)
Total	**859 (100%)**	**1,285 (100%)**	**135 (100%)**	**2,279 (100%)**

Figure 6: Gestational age and parity of mothers delivering infants with LBW (n=2279)



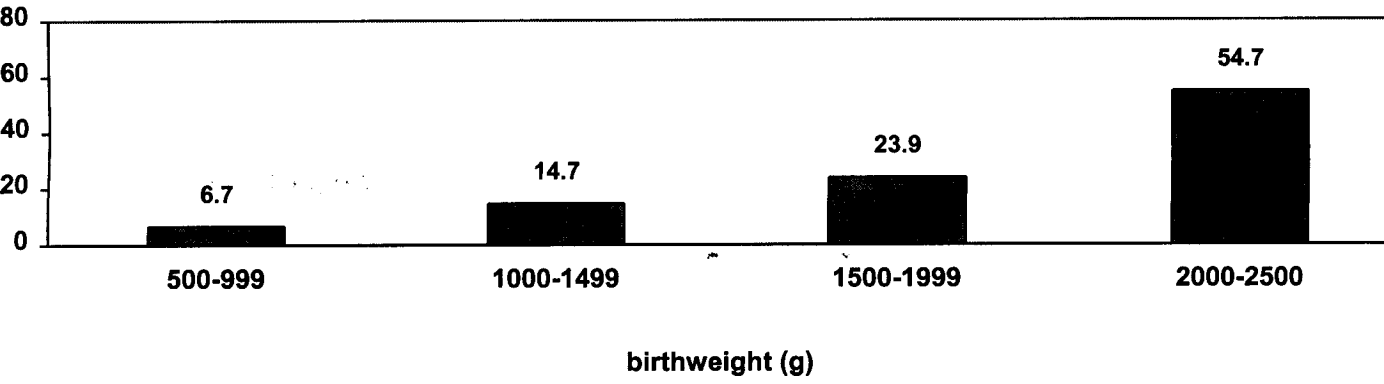
Birthweight distribution of low birthweight infants

The distribution of birthweights ranged from 500g to 2,500g. Birthweights were stratified within the following categories: 500-999g, 1000-1499, 1500-1999g and 2000-2500g. The distribution is tabulated in Table 7 and illustrated in Figure 7. The majority, 54.7%, were between 2000 and 2500g while 6.7% of low were less than 1000g in weight.

Table 7: Birthweight frequency distribution (n=2,552)

Birthweight (g)	Frequency	Percent
500-999	*171*	*6.7*
1,000-1,499	375	14.7
1,500-1,999	610	23.9
2,000-2,500	1,396	54.7
Total	**2,552**	**100**

Figure 7: Birthweight frequency distribution (%, n=2552)



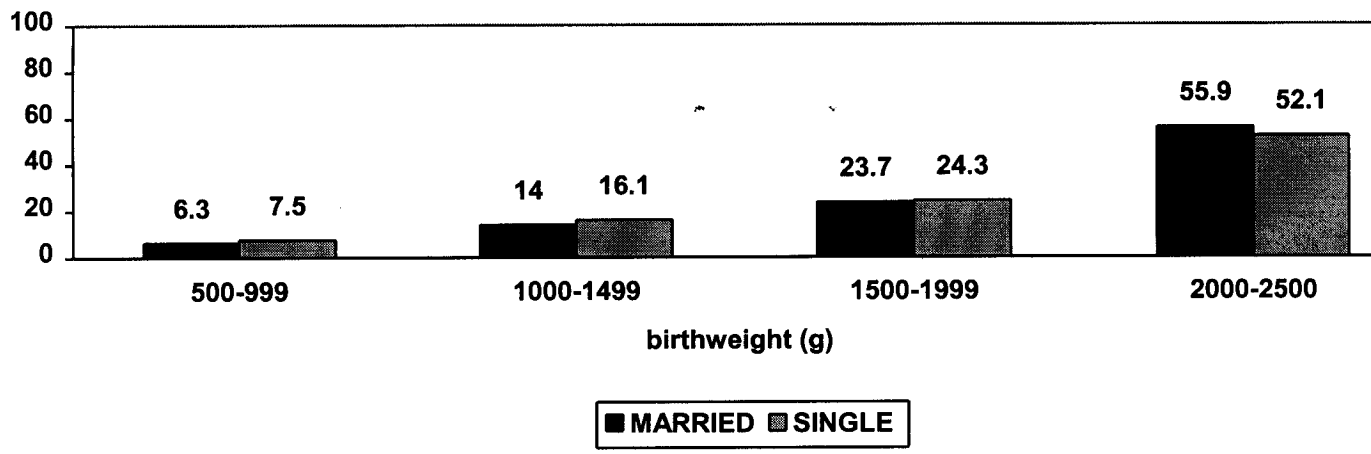
Marital status and low birthweight distribution

Table 8 and Figure 8 shows the weight distribution of the low birthweight infants and the marital status of the mothers. Considering relative frequencies, there were slightly fewer married women than single among those women who had low birthweight, apart from in the 2000-2500g category. Note that there were 2,279 mothers but 2,552 infants –in the case of twin or triplet pregnancies the mothers are counted more than once.

Table 8: Distribution of birthweight by marital status of women delivering infants with low birthweight (n = 2,552)

	Marital Status		
Birthweight (g)	**Married** n (%)	**Single** n (%)	**Total** N (%)
500-999	111 (6.3)	60 (7.5)	171 (6.7)
1000-1499	246 (14.0)	129 (16.1)	375 (14.7)
1500-1999	416 (23.7)	194 (24.3)	610 (23.9)
2000-2500	980 (55.9)	416 (52.1)	1396 (54.7)
Total	**1,753 (100)**	**799 (100)**	**2,552 (100)**

Figure 8: LBW infants and their mothers marital status by birthweight (n=2552)



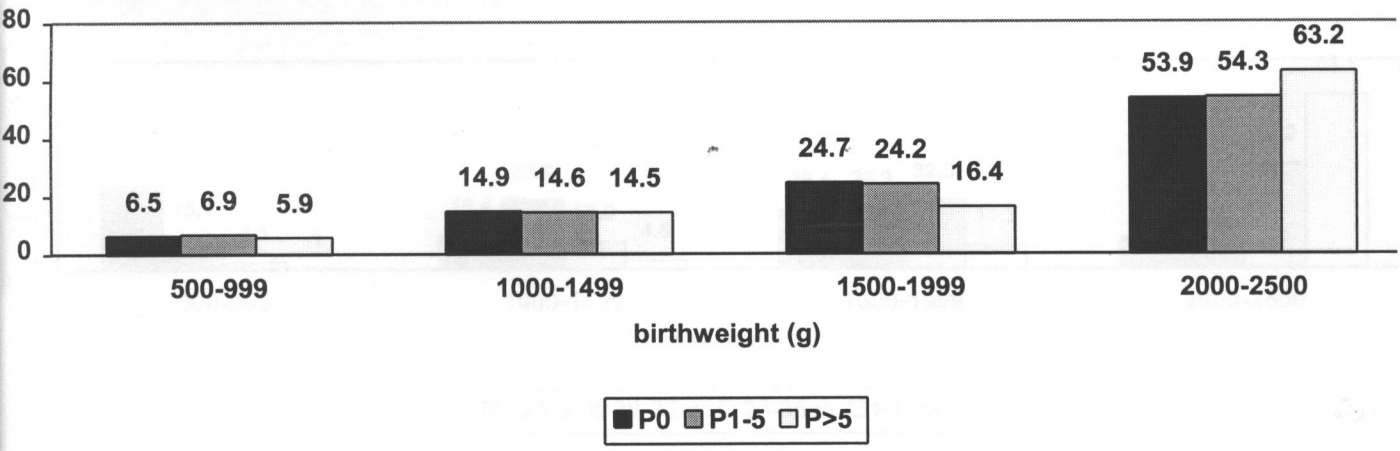
Parity and low birthweight

As illustrated in Table 9 and Figure 9, different parities did not appear to influence birthweight. The percentages of extremely low birthweight (less than 1000g) in those who had been primipara was 6.5% compared to 6.9% and 5.9% in the other two parity groups. Primiparae women had a greater proportion of infants in the 1000-1499g and 1500-1999g group but less in the 2000-2500g group.

Table 9: Birthweight distribution by parity of women delivering infants with low birthweight (n = 2,552)

	Parity			
Birthweight	**0** n (%)	**1-5** n (%)	**>5** n (%)	**Total** N (%)
500-999	60 (6.5)	102 (6.9)	9 (5.9)	171 (6.7)
1000-1499	138 (14.9)	215 (14.6)	22 (14.5)	375 (14.7)
1500-1999	229 (24.7)	356 (24.2)	25 (16.4)	610 (23.9)
2000-2500	499 (53.9)	801 (54.3)	96 (63.2)	1396 (54.7)
Total	**926 (100)**	**1,474 (100)**	**152 (100)**	**2,552 (100)**

Figure 9: LBW infants and their mothers parity by birthweight (n=2552)



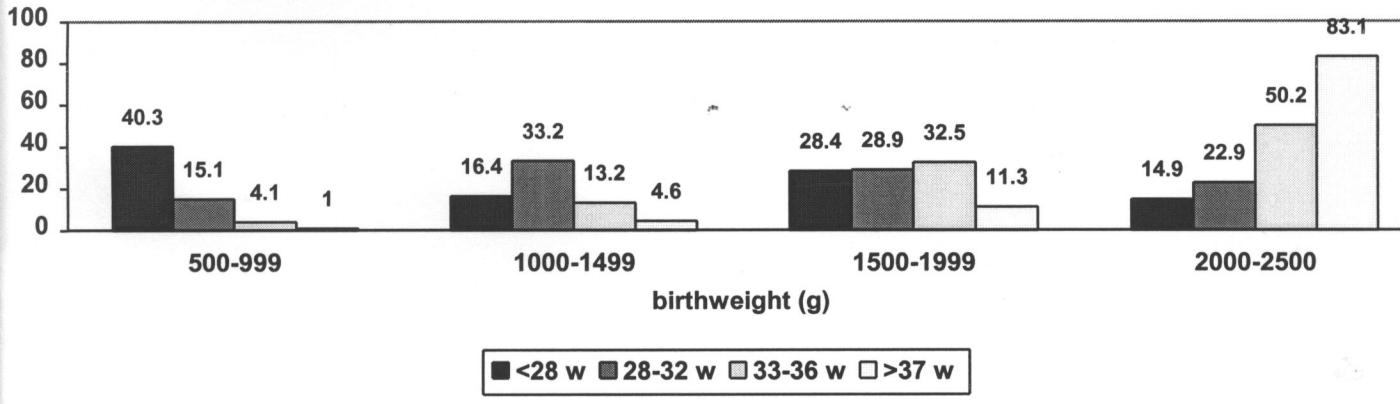
Gestation and low birthweight distribution

Most extremely low bithweight infants were <28 weeks gestation, similarly most infants between 2000-2500g were >37 weeks gestation. However, it is noteworthy that there were 10 infants with birthweights between 2,000 and 2,500g in the group less than 28 weeks gestation; and conversely, there were 9 (1%) in the >37 week gestation group who had had a birthweight less than 999g (Table 10). The issue of unsure or wrong gestation will be addressed in the Discussion.

Table 10: Distribution of birthweight by gestational age of women delivering infants with low birthweight (n = 2,552)

	Gestation (weeks)					
Birthweight (g)	**<28** n (%)	**28- 32** n (%)	**33 – 36** n (%)	**>37** n (%)	**Missing** n (%)	**TOTAL** N (%)
500-999	27 (40.3)	85 (15.1)	40 (4.1)	9 (1.0)	10 (20.8)	171 (6.7)
1000-1499	11 (16.4)	187 (33.2)	129 (13.2)	41 (4.6)	7 (14.6)	375 (14.7)
1500-1999	19 (28.4)	163 (28.9)	318 (32.5)	101 (11.3)	9 (18.8)	610 (23.9)
2000-2500	10 (14.9)	129 (22.9)	491 (50.2)	744 (83.1)	22 (25.8)	1,396 (54.7)
Total	**67 (100)**	**564 (100)**	**978 (100)**	**895 (100)**	**48 (100)**	**2,552 (100)**

Figure 10: Birthweight and gestation of infants with LBW



Maternal age and low birthweight

Birthweight at delivery in relation to maternal age of those who had low birthweight is presented in Table 11and Figure 11 as A and B. In Table 11A and Figure 11A, low birthweights are presented by age groups. Relative frequencies are calculated within each birthweight class division. Considering relative frequencies, within an age group e.g. 13-19, it can then be seen that there were proportionally more infants of weight 1000-1499g than any other LBW category. In the 25-29 age group, there were more infants of extremely low birthweight (<1000g) than any other LBW category. This was also so in the 40+ age group.

The same information can be viewed in Table 11B and Figure 11B vis: within a weight class e.g. 500-999g, those over 40 years old ranked highest in terms of those who had LBW (10.5% of 40 + year old had extremely low birthweight, compared to 6.5%, 6.8%, 7.7% ...etc in the other age groups). Similarly in the 1000-1499 g group, 13-19 year olds were ranked higher than any other age groupings in terms of those who had LBW (17.0% compared to 14.9%, 12.2%, 13.6%...etc).

Table 11A: Birthweight distribution in relation to maternal age (n = 2,252)

	Low Birthweight (g)				
Maternal age (years)	**500-999 n (%)**	**1000-1499 n (%)**	**1500-1999 n (%)**	**2000-2500 n (%)**	**Total N (%)**
13 – 19	39 (22.8)	102 (27.2)	144 (23.6)	315 (22.6)	600 (23.5)
20 – 24	55 (32.2)	121 (32.3)	187 (30.6)	449 (32.2)	812 (31.8)
25 – 29	47 (27.5)	75 (20.0)	157 (25.7)	335 (24.0)	614 (24.1)
30 – 34	18 (10.5)	40 (10.7)	67 (11.0)	170 (12.2)	295 (11.6)
35 – 39	8 (4.7)	31 (8.3)	49 (8.0)	105 (7.5)	193 (7.6)
40+	4 (2.3)	6 (1.6)	7 (1.1)	21 (1.5)	38 (1.5)
Total	**171 (100)**	**375 (100)**	**611 (100)**	**1,395 (100)**	**2,552 (100)**

Figure 11A : Maternal age and birthweight of infants with LBW

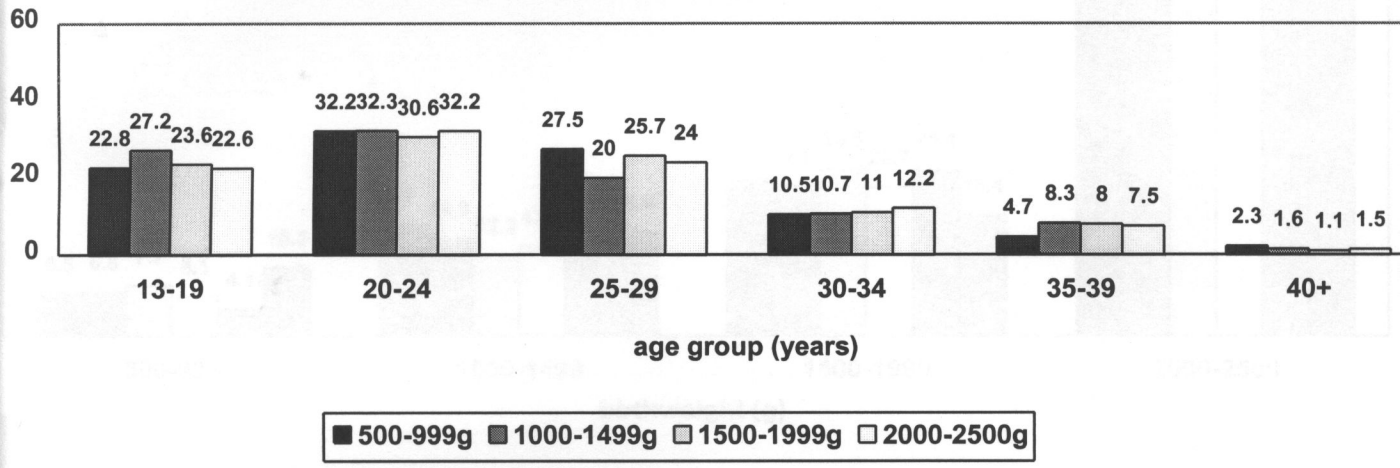
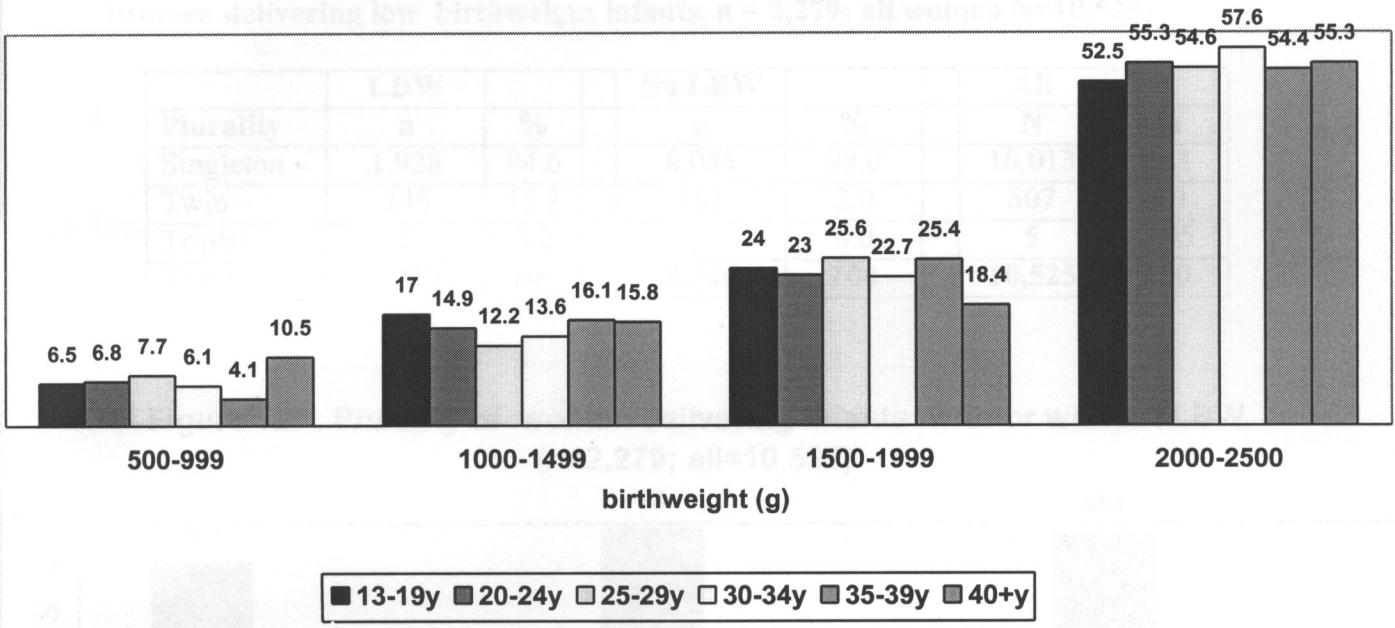


Table 11B: Maternal age distribution in relation to birthweight category (n = 2,252)

	Maternal age (years)						
LBW (g)	**13-19 n (%)**	**20-24 n (%)**	**25-29 n (%)**	**30-34 n (%)**	**35-39 n (%)**	**40+ n (%)**	**Total N (%)**
500-999	39 (6.5)	55 (6.8)	47 (7.7)	18 (6.1)	8 (4.1)	4 (10.5)	**171 (6.7)**
1000-1499	102 (17.0)	121 (14.9)	75 (12.2)	40 (13.6)	31 (16.1)	6 (15.8)	**375 (14.7)**
1500-1999	144 (24.0)	187 (23.0)	157 (25.6)	67 (22.7)	49 (25.4)	7 (18.4)	**611 (23.9)**
2000-2500	315 (52.5)	449 (55.3)	335 (54.6)	170 (57.6)	105 (54.4)	21 (55.3)	**1,395 (54.7)**
Total	**600 (100)**	**812 (100)**	**614 (100)**	**295 (100)**	**193 (100)**	**38 (100)**	**2,552 (100)**

Figure 11B : Low birthweight and maternal age (n=2552)



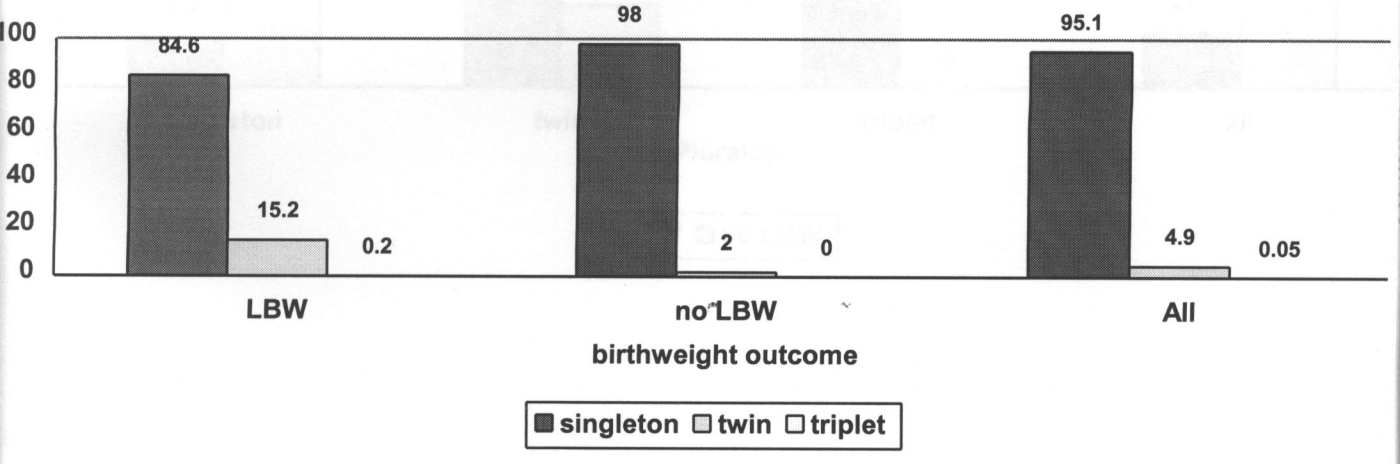
Multiple pregnancy and Low Birthweight – Maternal considerations

During the 12 months period in 1998, 2,279 women (of 10,525, 21.7%) had low birthweight infants. The plurality of all women is presented in Table 12A below. Most of the 2,279 women who had a pregnancy complicated by low birthweight were singleton pregnancies (1928, 84.6%); in 346 pregnancies (15.2%) there was at least one twin with LBW and 5 (0.2%) pregnancies with LBW were triplet pregnancies (Figure 12A). The majority of the LBW infants were from singleton pregnancies but twins were over-represented as a proportion.

Table 12A: Distribution of plurality of pregnancies by infant weight outcome (women delivering low birthweight infants, n = 2,279; all women N=10,525)

	LBW			No LBW			All	
Plurality	**n**	**%**		**n**	**%**		**N**	**%**
Singleton	1,928	84.6		8,085	98.0		10,013	95.1
Twin	346	15.2		161	2.0		507	4.9
Triplet	5	0.2		0	0.0		5	0.05
Total	**2,279**	**100**		**8,246**	**100**		**10,525**	**100**

Figure 12A: Plurality of women deliverlng infants with or without LBW (n=2,279; all=10,525)

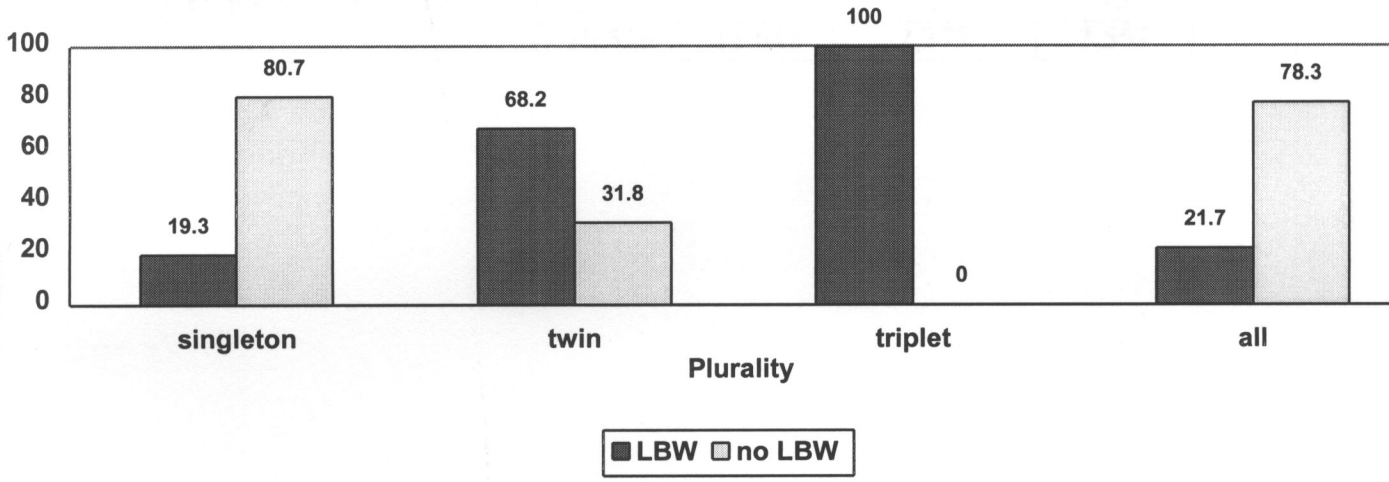


Similarly the proportion of LBW infants in each category (singleton, twin or triplet) is presented in Table 12B and Figure 12B. 19.3 percent of singleton pregnancies were complicated by a low birthweight infant. By contrast 68.2% of twin pregnancies and all 100% of triplet pregnancies were complicated by low birthweight.

Table 12B: Distribution of birthweight outcome by plurality of all pregnancies (women delivering low birthweight infants, n = 2,279; all women N=10,525)

	Plurality			
	Singleton	**Twin**	**Triplet**	**All**
	n (%)	n (%)	n (%)	**N (%)**
LBW	1928 (19.3)	346 (68.2)	5 (100)	**2,279 (21.7)**
No LBW	8085 (80.7)	161 (31.8)	0 (0)	**8,246 (78.3)**
All	**10,013 (100)**	**507 (100)**	**5 (100)**	**10,525 (100)**

Figure 12B: Type of pregnancy complicated by LBW (n=2279; all=10,525)



Twin pregnancies

There were 507 twin pregnancies in 1998. 346 twin pregnancies were complicated by low birthweight. However, of these, in 83 only one of the twin was low birthweight, while in 263 cases, both were. In a remaining 161 twin pregnancies neither twin was low birthweight. By contrast all 5 triplet pregnancies had all three infants born as low birthweight. This is summarised below in Table 13 below:

Table 13: Summary of presence or absence of LBW of all newborn infants by plurality

Plurality	Complication	Mothers	All infants	Mothers who had LBW infant	LBW infants
Singleton	LBW	1928	1928	1928	1928
	No LBW	8085	8085		
Twins	1 LBW	83	83	83	83
	1 not LBW		83		
	Both LBW	263	526	263	526
	None LBW	161	322		
Triplets	All LBW	5	15	5	15
Total		**10,525**	**11,042**	**2,279**	**2,552**

Infants

There were 11,042 babies delivered in 1998, of which 2,552 were low birthweight. Of the low birthweight infants, 1928 were singleton, 609 were twin and 15 were triplets. This is summarised in Tables 14 A and B and illustrated in Figures 14A and B. Note the figures are similar to that in Figures 12 A and B in which the number of mothers (pregnancies/deliveries) was tabulated as opposed to the number of infants.

Table 14A: Distribution of plurality by infant weight outcome (low birthweight infants, n = 2,279; all infants N=11,042)

	LBW			No LBW			All	
Plurality	**n**	**%**		**n**	**%**		**N**	**%**
Singleton	1,928	75.6		8,085	95.2		10,013	90.7
Twin	609	23.9		405	4.8		1014	9.2
triplet	15	0.6		0	0		15	0.14
TOTAL	**2552**	**100**		**8,490**	**100**		**11,042**	**100**

Figure 14A: Plurality of LBW infants (n=2552)

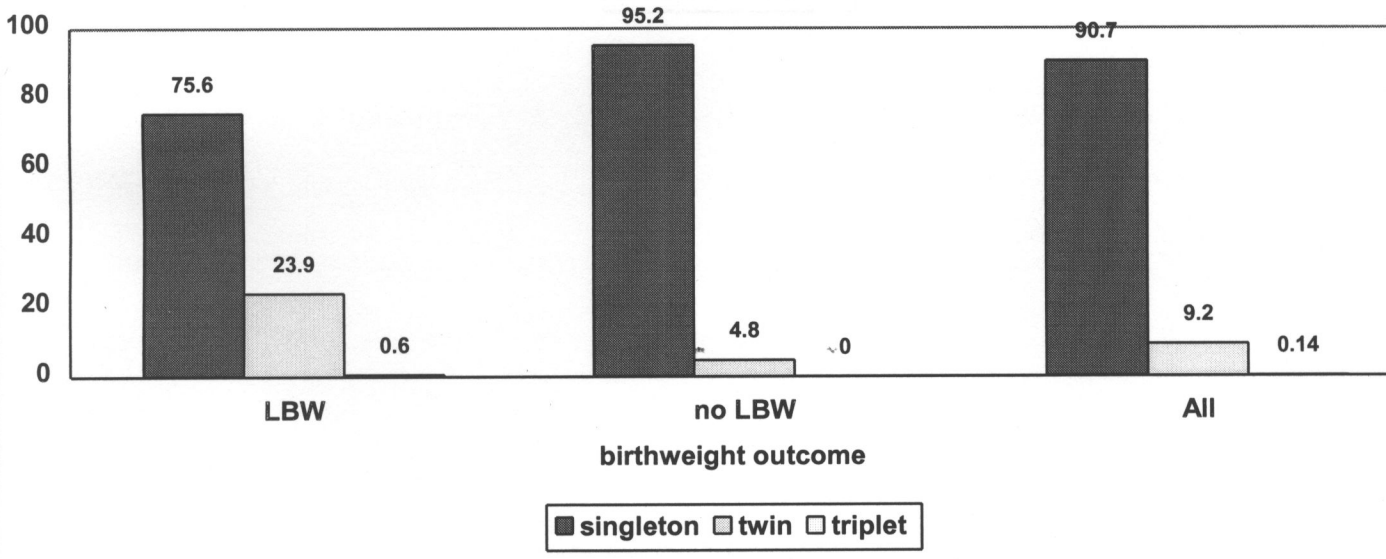
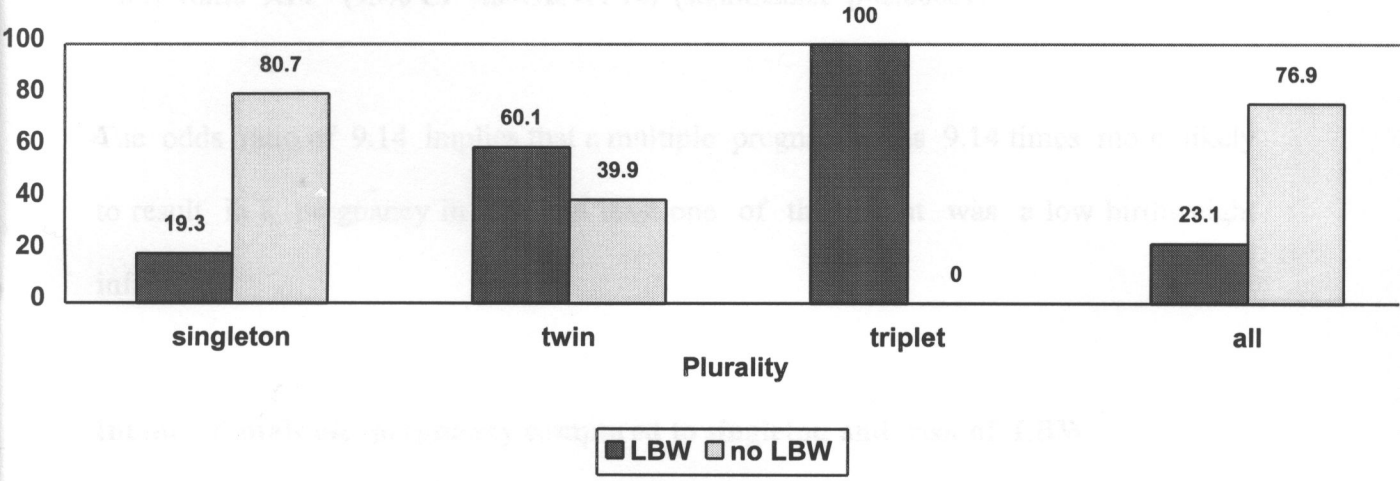


Table 14B: Infant birthweight outcome by plurality
(low birthweight infants, n=2,279; all infants N=11,042)

	Plurality			
	Singleton	**Twin**	**Triplet**	**All**
	n (%)	n (%)	n (%)	**N (%)**
LBW	1,928 (19.3)	609 (60.1)	15 (100)	**2,552 (23.1)**
No LBW	8,085 (80.7)	405 (39.9)	0 (0)	**8,490 (76.9)**
All	**10,013 (100)**	**1,014 (100)**	**15 (100)**	**11,042 (100)**

Figure 14B: LBW Infants by type of pregnancy (n=2552; all=11,042)



Multiple pregnancy as a risk factor for low birthweight

Multiple pregnancy compared to singleton pregnancy and risk of LBW

Considering all 10,525 deliveries in 1998, in order to assess whether multiple pregnancy was more likely to be associated with a pregnancy complicated by low birthweight, the data in Table 12A was analysed to calculate the Odds ratio. The 2 x 2 contingency table is set up as described below:

	LBW	No LBW	Total
Multiple	351	161	712
Singleton	1928	8085	10,013
Total	2,279	8,246	**10,525**

Odds Ratio 9.14 (95% CI 7.5<OR<11.14) (significance p<0.00001)

The odds ratio of 9.14 implies that a multiple pregnancy was 9.14 times more likely to result in a pregnancy in which at least one of the infant was a low birthweight infant.

Infant of multiple pregnancy compared to singleton and risk of LBW

Similarly considering all 11,042 infants delivered in 1998, in order to assess whether an infant born as a twin/triplet was more likely to be low birthweight compared to a singleton, the data in Table 14A was analysed to calculate the Odds ratio. The 2 x 2 contingency table is set up as described below. A twin or triplet infant was 6.46 times more likely than a singleton to be low birthweight.

	LBW	No LBW	Total
Twin/triplet	624	405	1,029
Singleton	1,928	8,085	10,013
Total	2,552	8490	**11,042**

Odds Ratio 6.46 (95% CI, 5.66<OR<7.41) (significance p<0.00001)

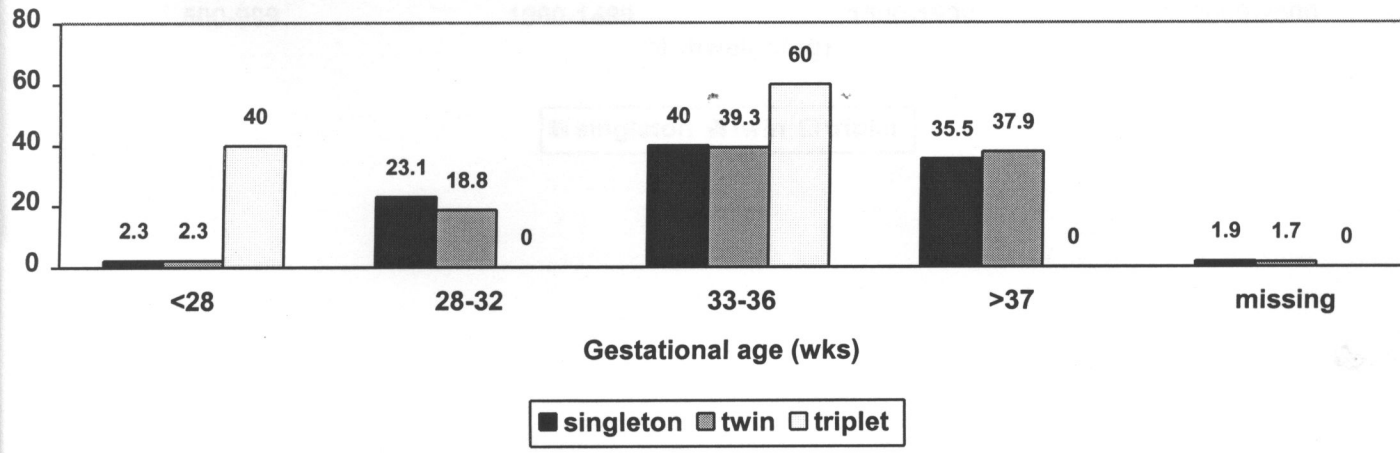
Gestational age and number of fetuses (plurality)

Considering the plurality of the pregnancies that were complicated by low birthweight, there did not appear to be much difference in the gestations of the singleton and twin pregnancies complicated by low birthweight infants: 35.2% of singleton pregnancies with low birthweight infants were term (>37 weeks) compared to 37.9% of twin pregnancies that were complicated by low birthweight infant. 2 of the 5 triplet pregnancies that were complicated by LBW infants were in pregnancies that were less than 28 weeks while 3 were between 33-36 weeks gestation; none went to term.

Table 15: Distribution of gestational age by plurality of pregnancies complicated by low birthweight (n=2,279)

	Plurality			
Gestational Age	**Singleton n (%)**	**Twin n (%)**	**Triplet n (%)**	**Total N (%)**
<28,(i.e. 27 and less)	45 (2.3)	8 (2.3)	2 (40.0)	55 (2.4)
28-32	445 (23.1)	65 (18.8)	0	510 (22.4)
33-36	772 (40.0)	136 (39.3)	3 (60.0)	861 (37.8)
>37	679 (35.2)	131 (37.9)	0	810 (35.5)
missing	37 (1.9)	6 (1.7)	0	43 (1.9)
Total	**1,928 (100)**	**346 (100)**	**5 (100)**	**2,279 (100)**

Figure 15: Gestational age and plurality of pregnancies complicated by LBW (n=2279)



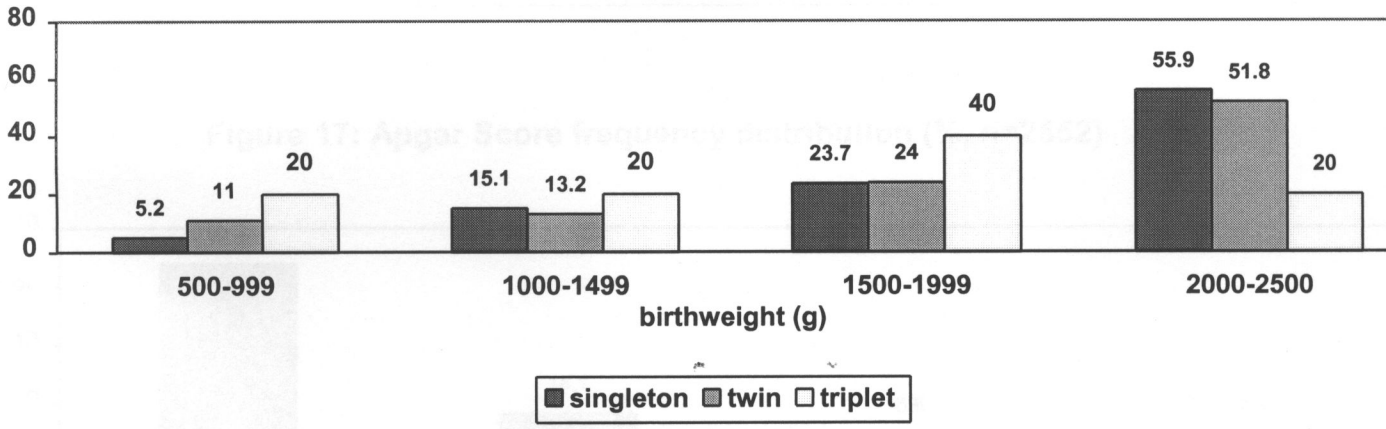
Plurality and birthweight distribution of low birthweight infants

Triplets were over-represented in the extremely low birthweight (<1000g) and very low birthweight (<1500g) categories compared to those between 2000 and 2500g. This is reflected in Table 16 and Figure 16

Table 16: Distribution of birthweight by plurality of pregnancies complicated by low birthweight (n=2,279)

	Plurality			
Birthweight (g)	**Singleton (1)** n (%)	**Twin (2)** n (%)	**Triplet (3)** n (%)	**Total** N (%)
500-999	101 (5.2)	67 (11.0)	3 (20.0)	171 (6.7)
1000-1499	292 (15.1)	80 (13.2)	3 (20.0)	375 (14.7)
1500-1999	458 (23.7)	146 (24.0)	6 (40.0)	610 (23.9)
2000-2500	1,078 (55.9)	315 (51.8)	3 (20.0)	1,396 (54.7)
Total	**1,929 (100)**	**608 (100)**	**15 (100)**	**2,552 (100)**

Figure 16: Plurality and birthweight of pregnancies complicated by LBW (n=2279)



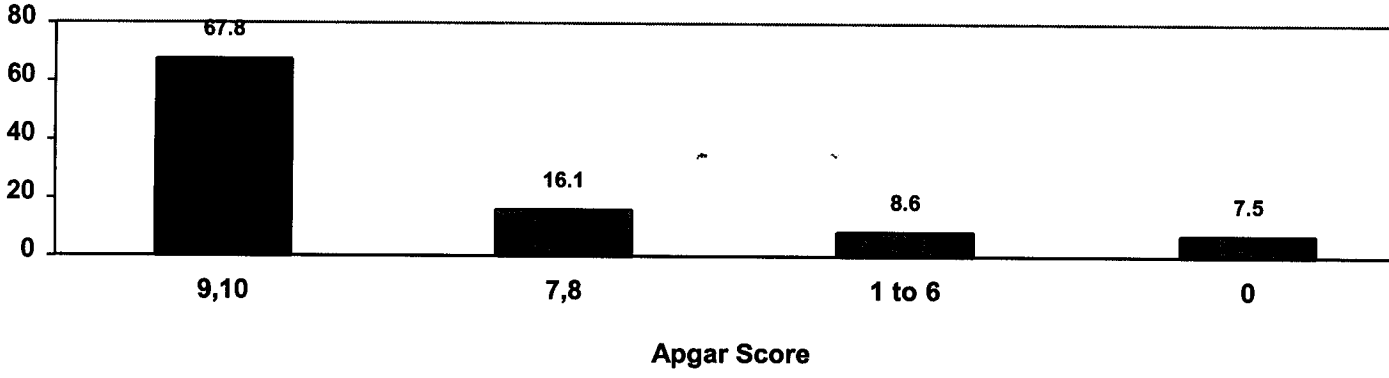
Apgar Scores of infants born with low birthweight

Immediate neonatal assessment and evaluation was performed at delivery and recorded in the patient files and delivery register as the Apgar score at 1 and 5 minutes. It was noted that data was complete only for the 5 minute Apgar Score and whether the infant was a stillborn or not. Table 17 and Figure 17 shows the Apgar Score distribution frequency for all 2,552 low birthweight infants. 1,731 (67.8%) of low birthweight infants had Apgar Scores of 9 or 10 at 5 minutes. It was noted that 191 (7.5%) low birthweight infants were stillborn. 8.6% of low birthweight infants had Apgar Scores of between 1 and 6, while 16.1% of low birthweight infants had Apgar scores of 7 and 8.

Table 17 : Apgar Score frequency distribution (n = 2,252)

Apgar Score	Frequency	%
9-10	1,731	67.8
7-8	410	16.1
1-6	220	8.6
0	191	7.5
Total	**2,552**	**100**

Figure 17: Apgar Score frequency distribution (%, n=2552)



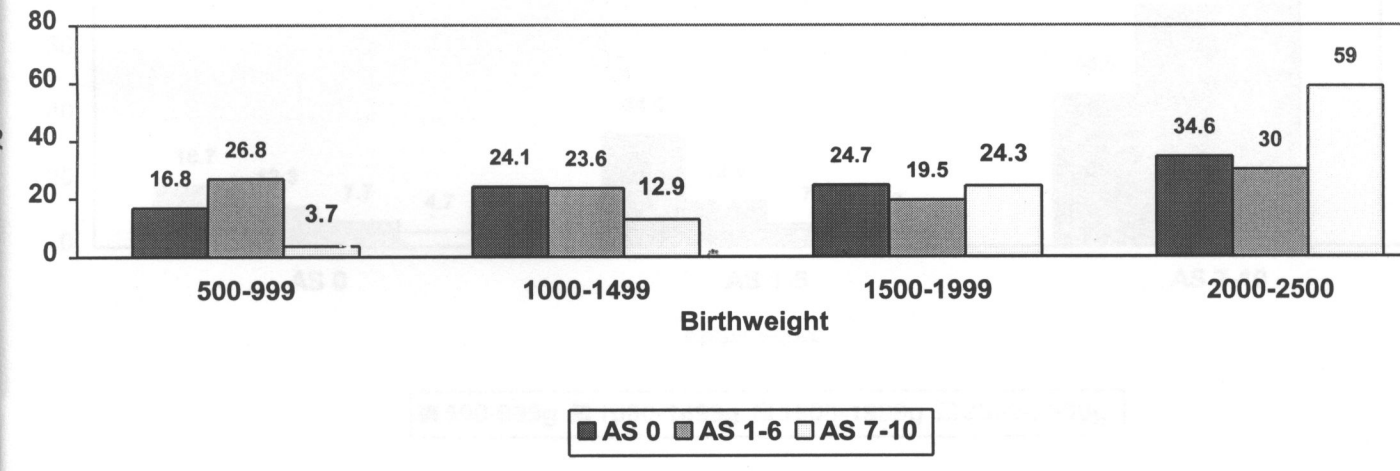
Apgar score by low birthweight category

In Table 18A and Figure 18A, are shown the Apgar score in each weight category of low birthweight. In the 500-999g category, there were proportionally more infants who had an Apgar score of 1-6 (26.8%), followed by stillbirth (16.8%) and then lowest was good Apgar scores (3.7%) even though the numbers of 500-999g infants with a good Apgar score was 80 – the highest. By contrast in the 2,000-2,500g category, proportionally most infants had good Apgar scores followed by stillbirth.

Table 18A: Distribution of birthweight by Apgar score category for low birthweight infants (n= 2,552)

	Apgar score			
Birthweight (g)	**0** n (%)	**1-6** n (%)	**>7** n (%)	**Total** N (%)
500-999	32 (16.8)	59 (26.8)	80 (3.7)	**171 (6.7)**
1000-1499	46 (24.1)	52 (23.6)	277 (12.9)	**375 (14.7)**
1500-1999	47 (24.7)	43 (19.5)	520 (24.3)	**610 (23.9)**
2000-2500	66 (34.6)	66 (30.0)	1,264 (59.0)	**1,396 (54.7)**
Total	**191 (100)**	**220 (100)**	**2,141 (100)**	**2,552 (100)**

Figure 18A: Apgar score of infants with LBW by birthweight category

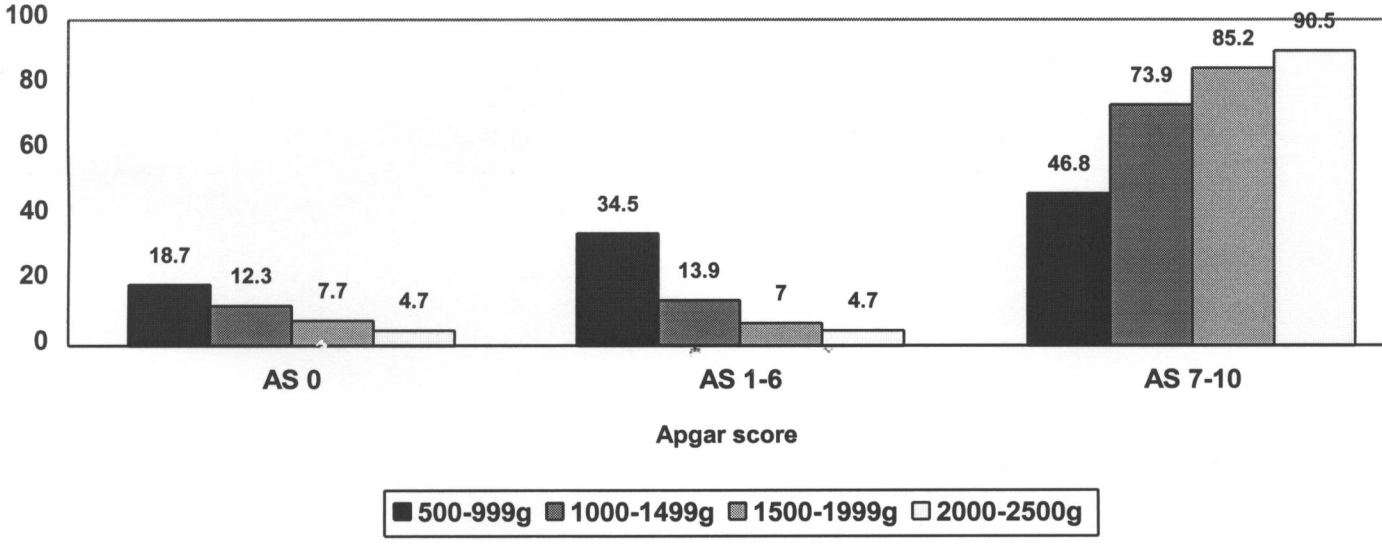


In Table 18B, Apgar scores are distributed within weight categories. Again considering relative frequencies, there were more stillbirths in the category 500-999g and least in the 2,000-2,500g category. Similarly, the proportion of good Apgars scores (>7) in each weight category increased with heavier infants (from 46.8% to 90.5%).

Table 18B: Distribution of low birthweight infants by Apgar score (n = 2,552)

	Birthweight (g)				
Apgar Score	**500-999** n (%)	**1000-1499** n (%)	**1500-1999** n (%)	**2000-2499** n (%)	**Total** N (%)
0	32 (18.7)	46 (12.3)	47 (7.7)	66 (4.7)	191 (7.5)
1-6	59 (34.5)	52 (13.9)	43 (7.0)	66 (4.7)	220 (8.6)
>7	80 (46.8)	277 (73.9)	520 (85.2)	1,264 (90.5)	2,141 (83.9)
Total	**171 (100)**	**375 (100)**	**610 (100)**	**1,396 (100)**	**2,552 (100)**

Figure 18B: Birthweights by Apgar score category



Comparative analysis of low birthweight and stillbirth

Data was available for stillbirths relating to all babies born in 1998, regardless of birthweight. Of the 11,042 babies born, 716 (6.5%) were stillbirths. Of the 716 stillborn, 191 cases occurred in those babies with low birthweight. Accordingly the contingency table is as follows :

	Stillborn	**Liveborn**	**Total**
LBW	191	2371	**2552**
Not LBW	525	7955	**8490**
Total	**716**	**10,326**	**11,042**

Odds ratio = 1.22 (95% confidence interval: 1.02<OR<1.45)

Chi Square = 5.18 p=0.02

The inference is that low birthweight is associated with an increased risk of stillbirth.

Clinical Conditions and risk factors in women delivered of low birthweight infants

On review of the case files, there were a number of clinical conditions and risk factors (referred to in the text as 'factor' subsequently) associated with mothers who delivered low birthweight infants (Tables 19 and 20).

No identifiable factor

219 (9.6%) mothers had no identifiable factor to explain the low birthweight (they were neither carrying a multiple pregnancy nor was the gestation below 37 weeks).

Primary factor

A number of women had more than one factor extracted from case files. A primary factor was chosen based on published clinical conditions and risk factors known to be associated with low birthweight. For example, pre-eclampsia was deemed primary if another factor was anaemia (recognising that anaemia can also contribute to low birthweight). Preterm labour was the commonest factor (see below). If it was associated with pre-eclampsia or antepartum haemorrhage, these were cited as the primary factor. The primary factor for each of the 2,279 cases is presented in Table 19.

From Table 2 it is noted that 559 (24.5%) women were teenagers (aged under 19 years). However in only 155 (6.8%) was this the only factor (Table 19). Similarly many more grandmultiparas are present in the cohort (5.9%) (Table 3) , but only in a proportion was this a primary factor (2.1%) (Table 19).

Multiple factors

As some women who had low birthweight had more than one factor, these are tabulated in Table 20. This illustrates that some women had only one factor but others had more than one, in some cases up to four.

Table 19 : Primary clinical condition or risk factor affecting women who had a pregnancy complicated by low birthweight (n=2,279)

Primary Clinical condition or risk factor	n	%
Preterm delivery	1,173	51.5
Pre-eclampsia (HDP)	394	17.3
Unknown	219	9.6
Teenage pregnancy	156	6.8
Antepartum Haemorrhage	119	5.2
Multiple pregnancy only*	74	3.2
Grand multipara	48	2.1
HIV/AIDS	43	1.9
Anaemia	42	1.8
Bad Obstetric History	10	0.4
Hepatitis	1	0.04
All	**2,279**	**100**

* see section on multiple pregnancy overleaf

Note that the leading factor was preterm labour and occurred as a primary factor in 51.5% of cases. This was followed by women who had pre-eclampsia or hypertensive disorder of pregnancy : 394 cases (17.3%) (without necessarily having preterm delivery). As noted in Table 20, 192 of these 394 cases (48.7%) were also associated with preterm delivery (vaginal or caesarean, induced or spontaneous).

Multiple pregnancy

This has been extensively presented in the earlier sections of the Results. As illustrated in Table 12A and Table 13 it is noted that there were 351 cases of multiple pregnancy complicated by low birthweight infants. In only 74 cases (3.2%) were there no other factor(s), and accordingly multiple pregnancy was the primary factor. In other situations multiple pregnancy was not coded as a primary factor. Taking all multiple pregnancies then, (with or without any other condition) they complicated 15.4% (351 of 2,279) pregnancies in which there was low birthweight (see also Table 12A).

Anaemia

As a primary factor this was present in 42 cases (1.8%) but complicated a total of 90 (4.0%) pregnancies (in the others it was a secondary factor).

Other

Aids related complex (ARC- presenting with tuberculosis, herpes zoster, chronic enteritis) accounted for 43 (1.9%) cases in which it was the deemed the main factor. There were a further 38 cases (2 associated with pre-eclampsia and the other 36 associated with preterm delivery). Accordingly, there were a total of 81 cases (3.6%) of ARC associated with low birthweight.

Table 20 : All clinical conditions and risk factors in 2,279 women who had pregnancy complicated by LBW

Clinical condition				n	subtotal	%
1st	2nd	3rd	4th			
0				219	219	9.6
1				33	42	1.8
1	5			6		
1	6			3		
2				31	43	1.9
2	1			9		
2	5			2		
2	6			1		
3				124	394	17.3
3	1			3		
3	1	5		1		
3	1	6		1		
3	2			1		
3	4			136		
3	4	1		2		
3	4	2	5	1		
3	4	5		45		
3	4	6		3		
3	4	7		4		
3	4	9		1		
3	5			48		
3	5	7		1		
3	6			13		
3	6	7		1		
3	7			4		
3	8			1		
3	9			4		
4				795	1173	51.5
4	1			16		
4	1	5		8		
4	1	6		1		
4	2			27		
4	2	1		6		
4	2	5		3		
4	5			243		
4	6			49		
4	8			4		
4	9			21		
5				155	156	6.8
5	9			1		

Key	Factor
0	unknown
1	Anaemia
2	HIV/AIDS
3	pre-eclampsia
4	Preterm labour
5	teenage pregnancy
6	Grand multipara
7	APH
8	Hepatitis
9	BOH
10	Multiple pregnancy only as risk factor

Continued overlea

Table 20 continued

Clinical condition				n	Subtotal	%	Key	Factor
1st	2nd	3rd	4th					
6				*47*	*48*	*2.1*	***Key***	***Factor***
6	9			1				
							0	unknown
7				30	119	5.2	**1**	Anaemia
7	4			55			**2**	HIV/AIDS
7	4	5		11			**3**	pre-eclampsia
7	4	6		3			**4**	Preterm labour
7	4	1	6	1			**5**	teenage pregnancy
7	4	9		1			**6**	Grand multipara
7	5			13			**7**	APH
7	6			5			**8**	Hepatitis
							9	BOH
8				1	1	0.04	**10**	Multiple pregnancy only as risk factor
9				10	10	0.4		
10				74	74	3.2		
		Total		**2279**	**2279**	**100.0**		

Note : that there were 351 multiple pregnancies that had a pregnancy complicated by LBW. However only the 74 that were not associated with any other clinical condition or risk factor are included in this table. The remaining multiple pregnancies were not primary factors and are not included in the table.

DISCUSSION

Nature of the study and data presentation

As the maternal and neonatal data for all deliveries at UTH in 1998 was not collected but only for those with low birthweight, the discussion will be restricted only to this group studied. Comparisons will not be made with all deliveries unless that information is available. Where relevant, suggestions would be made to explain how a case control or whole population study would allow comparisons to be made.

In keeping with the descriptive nature of the subset of deliveries at UTH, data was presented grouped in categories (e.g. 559 women who were 13-19 years, or 728 who were 20-24 years etc). Similarly the low birthweights were presented grouped in categories (171 were 500-999g, 375 were 1000-1499g etc). Relative frequencies were calculated so as to be able to compare directly within each group and category e.g 6.3% of those weighing 500-999 were married and 7.5% were single (Table 8). In describing data of different categories for different factors (marital status, parity etc) the means of that category could have been compared instead. However, it was felt that comparison of frequencies within the categories would be more informative and provide a visual illustration of the magnitude and differences.

Incidence

Delivery of low birthweight infants is an issue of serious concern in both obstetric and neonatal practice. The incidence of low birthweight infants appears to be particularly high in the developing world compared to the industrialised countries. During the twelve months period (January to December 1998) of this study, the incidence of low birthweight at the UTH was 23.1% affecting 21.7% of all deliveries (the difference

being accounted for by multiple pregnancies). This was considerably higher than in other African countries e.g. 15% in Kenya (1); 12.2% in Jos, Nigeria (2); 14.6% in Tanzania (3); 11.4% at UTH in Lusaka in 1977 (5). However, in Asia low birthweight accounted for 21.1% in Malaysia (7) and even higher in India (30%) (6).

It is noted that the incidence of low birthweight at UTH in Lusaka was 11.4% in 1977. At that time the majority of deliveries took place at UTH, with a much smaller proportion in the district clinics. By 1998, a total or 10,525 deliveries took place at UTH, while another 33,009 deliveries took place in ten midwifery-led district clinics. The protocol allows for all complicated pregnancies (e.g. multiple pregnancies, those with hypertensive disease, premature labour etc) to be referred to UTH for management. However there are still an unknown number of cases of low birthweight occurring at the clinics. The incidence in greater Lusaka, taking all deliveries into account, would be the 2,279 pregnancies affected by low birthweight at UTH plus any at the clinics. The denominator would be 43,534, giving an incidence of at least 5.2% and more if those affected at the clinics were included in the numerator. There are believed to be low birthweight infants delivered in the clinics (below 2500g but above 2000g) that would not necessarily have been referred to UTH as they may not have required any neonatal care. The extent of the problem in the whole population of delivering women in Lusaka would have to be addressed by a city-wide audit of low birthweight. Furthermore home deliveries would have to be taken into account, of which there are believed to be approximately 10% (unpublished – Community Survey, Woman Friendly Health Services Project: Central Statistical Office, Lusaka; Department of Obstetrics and Gynaecology, UTH; Institute of Child Health, London).

Monthly variation

Delivery of low birth weight infants may vary from month to month as a result of seasonal variations of the factors precipitating its occurrence, e.g malaria. In this study the monthly incidence of pregnancies affected by low birthweight over the twelve months did not show any obvious patterns. It is believed that the incidence of malaria is less in the cooler months of June and July. However, the two months had widely differing incidences (18.9% and 25.2%) reflecting that an analysis would have to be conducted to differentiate reasons like malaria, multiple pregnancy and hypertensive disorders which may affect low birthweight.

Maternal Age marital status and parity

In this study population of women with low birthweight a substantial percentage (24.5%) were in the teenage age group (aged 13-19 years, Table 2) and seven of these were only 13 years old. The distribution was otherwise across the age range. This was most probably a reflection of the distribution of ages in the delivering population. A hospital based study in Malawi (30) that looked at the effects of maternal age on infant birthweight revealed that teenage pregnancy had an adverse effect. This finding can be explained by the fact that teenage mothers are usually themselves growing and of small stature, and so give birth to small babies. Furthermore many teenagers are in school and tend to conceal their pregnancies and thus deprive themselves of a chance to utilise antenatal care services. Pregnancy complications such as anaemia, sexually transmitted diseases, hypertensive disorders and many other conditions that may lead to intrauterine growth restriction and subsequently low birthweight would not be identified early and be treated where possible. Most of the younger mothers who had delivered low birthweight infants were single (Table 2 and Figure 2B).

The parity of women who had low birthweight infants included 37.7% who had their first delivery (Table 3). It is interesting to note that most of the primiparas who had low birthweight infants were single (85.5%, Table3 and Figure 3B).

In order to assess the importance of maternal age, marital status and parity as risk factors for low birthweight, data would be needed of ages, marital status and parity for all women who had delivered infants that were of weight greater than 2,500g to compare with those who had a low birthweight infant. This had not been within the scope of this work and could be addressed in the future.

Gestation

As tabulated in Table 4 and illustrated in Figure 4, 35.5% of women who had low birthweight infants had a pregnancy of greater than 37 completed weeks (i.e. term). It would be interesting to study how many of these were wrong dates, or whether the infants were growth retarded. Accurate dating with sure dates and a dating ultrasound would be required for this.

The gestations of the women who had low birthweight infants did not appear to depend markedly on marital status, although there were proportionately more single than married women in each preterm category (<28 weeks, 28-32 weeks, 33-36 weeks) (Table 5 and Figure 5). Similarly there was a suggestion that of those women who had low birthweight infants, primiparas tended to have more premature births (Table 6).

Birthweight Distribution.

Although low birthweight is a general definition of all births less than 2,500g, it is noted in the study that over half of the infants with low birthweight (54.7%) had a birthweight of between 2,000 and 2,500g (Table 7). Unless severely growth retarded, these infants would probably need no more than minimal neonatal care and expect to have a good outcome. Those infants with very low birthweight (less than 1500g) numbered 546 – (375 with weight 1000-1499g and 171 with weight 500-999g). These represented 21.4% of all low birthweight infants that would require much more intensive neonatal care. Note the 171 infants delivered with birthweight less than 1000g (referred to as extremely low birth weight). Previous audits of birthweight-specific survival at the UTH neonatal unit had suggested an extremely poor chance of survival for such infants - often less than 5% (Personal communication, Y Ahmed).

As illustrated in Table 8, comparing only those women who had low birthweight, more single women compared to married had infants less than 2,000g. Of those women with low birthweight, it was only in the 2,000-2,500g group were there more married than single women. However, no obvious pattern was seen for parity (Table 9), though those with parity greater than 5 seemed to have more infants in the 2,000 to 2,500g range compared to other ranges.

Gestation and low birthweight

Table 10 illustrates the problem with gestation. There were 10 cases of infants less than 28 weeks gestation who had a birthweight between 2,000-2,500g (most probably suggesting wrong dates). Similarly nine case who had a birthweight less than 1,000g were greater than 37 completed weeks gestation (term). This is plausible but more

likely it can be explained by wrong dates. This problem probably exists throughout the series. The importance of this is to address the problem of prematurity as a cause of low birthweight together with intrauterine growth retardation. In some cases both may exist (i.e. growth retarded but also premature infants).

In considering low birthweight and maternal age (Table 11) no obvious trends can be noticed among the cohort, although what was being looked for was women at extremes of age having more extremely low birthweight infants.

It can be noted that there is some duplication in presentation of data regarding maternal age, gestation, parity and marital status against the low birthweight classes. This was done to illustrate various points.

Multiple pregnancy and low birthweight

Table 12A and Figure 12A illustrates that although twin pregnancy only accounted for 4.9% of all deliveries at UTH in 1998, they accounted for 15.4% of pregnancies in which there was low birthweight (predominantly accounted for by twin pregnancies). This indicates that, nevertheless, most of the pregnancies complicated by low birthweight were as a result of singleton pregnancies – 84.6% (because of their larger number). When considering the infants instead of the pregnancies, (see Table 14A it is noted that 75.6% of LBW infants were singletons while the other 24.5% infants were as a result of multiple pregnancy)

Looking at the same data from another perspective, (Table 12B and Figure 12B) 19.3% of all singleton pregnancies were complicated by low birthweight but 68.2% of

twin pregnancies and 100% of triplets were complicated by low birthweight. Similarly Table 14B and Figure 14B illustrates that 60.1% of infants who were twin and all 100% of triplet infants were low birthweight. Multiple pregnancy and being born as a twin or triplet is therefore strongly associated with low birthweight. This is may be due to prematurity but also due to placental insufficiency (but see below).

Multiple pregnancy and gestational age

Considering those pregnancies complicated by low birthweight, there were slightly more twin pregnancies than singleton pregnancies that were term (37.9% vs 35.2%, see Table 15). This suggests that there is a probably a greater tailing off in growth in the latter part of pregnancy in twin pregnancy.

Multiple pregnancy and birthweight distribution

Although numbers are small, there were a lot more triplet pregnancies that had very low birthweight and extremely low birthweight (Table 16). Singletons predominated in the 2,000 to 2,500g category again supporting the statements above.

Apgar Scores – outcome of low birthweight infants

191 or (7.5%) of all low birthweight infants were stillborn, while a further 220 (8.6%) had a poor Apgar score (between 1 and 6) (see Table 17). However the majority of low birthweight infants had a good Apgar score at 5 minutes. Later outcomes, e.g early neonatal outcome (within 7 days), neonatal outcome (at 30 days) were not documented within this study and could be the focus of future investigation. However a study to measure the survival chances of low birthweight infants in a rural hospital in Ghana (26) indicated that a good Apgar score at birth has a positive prognostic value for survival. In

their study 1,528 (68.4%) low birthweight infants were born with a one minute score of 9. This reduced the chances of neonatal ward admissions and subsequent morbidity. Interestingly, in our study, 67.8% of low birthweight infants had an Apgar score of 9 or 10 (Table 17) even at 5 minutes.

Within infants with low birthweight, it was the extremely low birthweight infants (infants weighing less than 1,000g) who had a poorer Apgar score and more stillbirth (Tables 18A and B).

Low birthweight was a risk factor for stillbirth when considering all deliveries at UTH in 1998 (Odds ratio 1.22, page 44). Further analysis would be needed to determine what the risk factors among low birthweight infants were that determined a risk for stillbirth e.g. multiple pregnancy, mode of delivery, concomitant maternal illness. Increased stillbirth and perinatal mortality had been documented in studies among low birthweight infants in Kenya (1) and Mozambique (11).

Clinical conditions

Prematurity

Prematurity was by far the commonest factor in low birthweight infants. 1,426 (62.6%) deliveries complicated by low birthweight occurred prior to 36 completed weeks of gestation (Tables 4,19,20). In 1173 case (51.5%) this was the primary factor (Table 19,20). The others were attributable to pre-clampsia and antepartum haemorrhage (the conditions either precipitating preterm labour, or as was often the case in pre-eclampsia, labour needed to be induced for maternal considerations). In the Kenyan study (1) 55.3% of low birthweight was accounted for by prematurity, and 61% in Jos,

Nigeria (2). The Jos and UTH data are similar reflecting their referral hospital status.

Multifetal pregnancies

Even though the majority of cases of low birthweight pregnancies were in singleton pregnancies (as there are more singleton pregnancies), multi-fetal pregnancies (twin or triplet) were a common cause of low birthweight infants, as has been described in other studies (12,19). This is accounted for, in part, to the higher incidence of preterm delivery. In this study, analysis showed that multiple pregnancy is associated with a markedly increased risk of pregnancy complicated by low birthweight (see page 38. OR 9.14, 95% CI 7.5<OR<11.14). Also an infant born as a twin or triplet is over 6 times more likely to be low birthweight (OR 6.46, 95% CI 5.66<OR<7.41 see page 38).

Anaemia

Laboratory proven anaemia (Haemoglobin concentration of less than 10g/dl) was prevalent in 90 (4.0%) women delivering low birth weight infants – in 42 cases it was noted to be the primary factor, in the others it was a secondary finding. Haemoglobin estimations were not always available for logistical reasons and it is believed that there would have been many more cases of anaemia. Both HIV and malaria contribute to anaemia in pregnancy in addition to nutritional factors (see below). Malaria and nutritional factors are important risk factors in young mothers.

Malaria

Data on malaria was not collected in this study because of inconsistencies in reporting – often a presumptive diagnosis only was made. Nevertheless malaria contributes to low birthweight (13,14,15) through anaemia, premature labour and parasitaemia of the placenta. A study in Malawi also noted an association between HIV and malaria that contributed to low birthweight (31).

HIV/AIDS

A number of women with HIV/AIDS are now seen at UTH. For purposes of this study, in a number of cases, there was presumptive evidence of Aids related complex (ARC - herpes zoster, chronic diarrhoea, chronic cough or tuberculosis). HIV testing is not very common and so not all cases could be confirmed serologically. A study in Kigali, Rwanda demonstrated that prematurity and low birthweight was commoner in HIV positive women (32). A systematic review of the world literature and a meta-analysis of over 31 papers revealed that HIV infected women had a 2 fold increase in giving birth to an infant with low birthweight and 4 fold increase in stillbirth (20). This is anticipated to become an important factor in Lusaka which has a seroprevalence approaching 30% in the pregnant population (as quoted in the Sentinel surveillance).

Multifactorial

The large number of factors highlighted suggests that low birthweight may be multifactorial. Interventions would need to be part of a number of strategies as opposed to single interventions. A case-controlled study of low birthweight vs non-low birthweight complicated pregnancies would be necessary to determine risk factors and clinical factors common in predisposing to low birthweight. Alternatively data on

all deliveries in a given time interval would be necessary to determine specific factors responsible for low birthweight.

STUDY LIMITATIONS

This study was retrospective and had a number of limitations. Being retrospective some data was absent from the records which could have been useful to analyze. For example we could have been able to look at confounding factors like level of maternal education, social background, past obstetric history including delivery interval and antenatal problems, to compare whether these could have an influence on low birthweight outcome or not. In a prospective study such information could have been more accurately obtained by interviewing the mother and performing appropriate tests (for anaemia, malaria HIV after counseling).

Furthermore, a study to include all deliveries in a given time interval, or a case control study would have enabled specific risk factors for low birthweight to be determined. This would be done through comparative analysis of factors like age, parity, gestation, marital status in mothers with low birthweight infants and those without. Also outcome in infants with low birthweight and those with birthweight greater than 2,500g could be assessed. A future study could look into some of these factors. Other recommendations for a future study are described below :

- Assess importance of contribution to low birthweight of infants born in the district (and why there are born there)
- Assess importance of seasonal variation in low birthweight
- Assess importance of maternal age, marital status, as a factors in low birthweight
- Assess antenatal care utilisation as a risk factor
- Accurate assessment of gestation.

CONCLUSION

This study has shown that low birthweight is common at UTH. This probably reflects the high incidence in the city of Lusaka and perhaps the whole country, as some of these patients are referrals from the peripheral areas around the City of Lusaka. The low birthweight infants suffer sequelae and are at great risk for neonatal deaths. The study described the maternal and infant characteristics in the group of low birthweight infants.

It has been shown from literature review that various environmental factors affecting the mother, and the fetus in turn are responsible for this undesirable fetal outcome. A large proportion of premature deliveries cannot be prevented. Attention should be paid to those factors that can be prevented. Optimum case management of those conditions that result in low birthweight should be adhered to to minimise the attendant morbidity and mortality.

RECOMMENDATIONS

This study would need to be followed up with a prospective study that will take into account confounding factors to pregnancy outcome, e.g. nutrition status, level of maternal education, birth interval and antenatal care.

Bearing in mind the limitations of this retrospective study it is anticipated that the following further recommendations can be made:

- Improve on the quality and accessibility of antenatal care services to reduce the incidence of adverse pregnancy outcomes.
- Referral protocols from clinics in Lusaka to UTH should be strengthened.
- Hospital staff should be aware of common causes that lead to premature delivery so as to be more vigilant in case management for those conditions.
- Anaemia treatment and prevention should be intensified.
- Community awareness campaigns should be launched in schools and homes to enlighten the dangers of teenage pregnancies. This would significantly discourage early marriages.
- Issues of contraception among adolescents and teenagers should be destigmatised in order to minimise the incidence of teenage and unwanted pregnancies.

REFERENCES

1. Were EO, Karnya JK. Low birth weight deliveries at the Nyanza General Hospital Kisumu, Kenya. East Africa Medical Journal. 1994; 71 (10): 667 - 70
2. Wright EA. Low birth weight in the Plateau region of Nigeria. East African Medical Journal. 1990; 67 (12): 894 - 9
3. Waltraven G.E.L: Mkanje R.J. B Aster H.A.G.H. The aetiology at birth weight in rural area of Tanzania. Tropical Medicine and International Health. 1997; 2(6): 558-667
4. Taha TET and Gray RH. Distribution and determinants of low birth weight in Central Sudan. Johns Hopkins School of Public Health, Johns Hopkins Population Center. Maryland. 1994. 24 Papers on Population. WP 99 – 04
5. Davis VE. Low birthweight: some considerations in a Zambian population. Medical Journal of Zambia. 1977; 11 (4): 103 - 9
6. Dhar CM, Shar CN, Bhat IA, Butt N. Low birthweight and outcome of poor socioeconomic interaction. Indian Journal of Maternal and Child Health. 1991; 2(1): 10 – 13
7. Tin TT, Thida M, Maung MM, Wai KT. Maternal influences on low birth weight. Malaysian Journal of Reproductive Health. 1994 ; 12 (1): 32 – 7
8. van Sprundel M, Buve A, Serufilira A et al. Birth weight and social economic status: a study in Kigali, Rwanda International. Journal of Epidemiology 1988 ; 17 (3): 579-81
9. Peabody JW and Gertler PJ . Are clinical criteria just proxies for socio-economic status? A study or low birth weight in Jamaica. J. Epidemiol Community Health. 1997; 51 (1): 90 - 5

10. Defo BK, Partin M. Determinats of low birth weight: a comparative study. J Biosoc Sci. 1993; 25 (1): 87 - 100

11. Bacci A, Manhice CM, Machungo F. Outcome of teenage pregnancy in Maputo, Mozambique. Int. J Gynaecol Obstet. 1993; 40 (1): 19 - 23

12. Bronars SG and Grogger J. The economic consequences of unwed motherhood. American Economic Review. 1994; 84 (5) 1, 141 - 56

13. Mbise RL, Boersma ER. Factors associated with low birth weight in the population of Dar es Salaam, Tanzania. Trop Geogr Med. 1979; 31(1): 21 - 32

14. Brahin BT and Verhoeff F. Malaria as a factor of low birth weight in Zaire. Lancet 1996. Feb 24; 347 (9000); 552

15. Morgan HG. Placental malaria and low birth weight neonates in urban Sierra Leone. Annals of Tropical Med. and Parasitology. 1994; 88 (6): 576 - 80

16. Amin N, Abel R, Sampathkumar V. Maternal risk factors associated with low birth weight. Indian Journal of Paediatrics. 1993; 60 (2): 269 – 74

17. Ali M, Luseged S. Factors affecting adolescent birth outcome. Ethiop Med Journal 1997; 35 (1): 35 - 42

18. Okbogo ME and Familusi JB. Low birth weight and its correlates among Nigerian twins. African Journal of Health Sciences. 1997; 26(1-2): 5-7

19. Bobzom DN, Audu BM. Outcome of twin pregnancies in Maiduguri, Nigeria Journal of Obstetrics and Gynaecology. 1997; 17(13); 261 – 263

20. Brocklehurst P and French R. The association between maternal HIV infection and perinatal outcome : a sytematic review of the literature and meta-analysis. Br J Obstet Gynaecol 1998; 105(8), 836-48.

21. Donders GC, Desmyters J, de Wet DH. The association of gonorrhea and syphilis with premature birth and low birth weight. Geritourin Med. 1993; 69 (2): 98 - 101

22. Fourn L, Takpara I, Zohoun T. Pregnancies complicated by hemorrhage and birth of low birth weight Infants in Cotonou (Benin). Sante. 1994; 4 (6): 407-11

23. Badirou-Fatoke F, Ayiri B, Aguessy-Alyi B. Low birth weight neonates at the Lagune Maternity Hospital in Cotonou, Benin. Annales de Pediatrie. 1997; 44(4), 288

24. Manji KP, Massawe AW, Mgone JM. Birthweight and neonatal outcome at the Muhimbili Medical Centre, Dar es Salaam, Tanzania.
East Afr Med J. 1998;75(7):382-7

25. Njokanma OF, Olanrewaju DM. A study of neonatal deaths at the Ogun State University Teaching Hospital, Sagamu, Nigeria. J Trop Med Hyg. 1995; 98(3) 155-
60

26. van der Mei J. Survival chances of low birth weight infants in a rural hospital in Ghana. Trop Geogr Med 1994;46(5):313-7

27 Kambarami RA, Chidede O, Kowo DT. Kangaroo care for well low birth weight infants at Harare Central Hospital Maternity Unit-Zimbabwe.
Cent Afr J Med. 1999; 45(3):56-9

28. Cooper PA, Sandler DL. Outcome of very low birth weight infants at 12 to 18 months of age in Soweto, South Africa. Pediatrics. 1997; 99(4):537-44

29. World Health Organisation, International Conference on the Tenth Revision of the International Classification of Diseases, Geneva. WHO, 1991

30. Nyirenda T, Cusac AS, Mtimuni BM. Effects of mothers age, parity and antenatal clinic attendance of infants birthwweight. Malawi Med J. 1991; 7(3) 110-12

31. Verhoeff FH Brabin BJ, Chimsuku L, Kazembe P, Broadhead RL. Malaria in pregnancy and its consequences for t he infant in rural Malawi. Ann Trop Med Parasitol 1999 Dec ; 93 Suppl 1:S25-33

32. Castetbon K, Ladner J, Leroy V, et al. Low birtweight in infants born to African HIV-infected women : relationship with maternal body weight during pregnancy: Pregnancy and HIV Study Group (EGE). J Trop Pediatr 1999 45(3): 152-7