

Appendix 2: LOW BIRTH WEIGHT

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GLOSSARY

Low Birth Weight

Births weight < 2500g

Preterm

Born before 37 completed weeks of pregnancy

Neonatal Period

Birth till day 28 of life

Early Neonatal Period

Birth till day 7 of life

Period between 28 weeks of pregnancy until day 28 of life

Low Birth Weight Rate (%)

= $\frac{\text{Total number of births} < 2500\text{g}}{\text{Total number of births in the same period}} \times 100$

Perinatal Mortality Rate
(per 1000 births)

= $\frac{\text{Total number of stillborns and neonatal deaths}}{\text{Total amount of births in the same period}} \times 1000$

Neonatal Mortality Rate
(per 1000 live births)

= $\frac{\text{Total number of neonatal deaths}}{\text{Total amount of live births in the same period}} \times 1000$

Early Neonatal Mortality Rate= $\frac{\text{Total number of neonatal deaths in the first week of live}}{\text{Total amount of live births in the same period}} \times 1000$
(per 1000 live births)

Infant Mortality Rate
(per 1000 live births)

= $\frac{\text{Total deaths under one year of age}}{\text{Total amount of live births in the same period}} \times 1000$

ABBREVIATIONS

| | |
|------|--|
| ENMR | Early Neonatal Mortality Rate |
| FAS | Fetal Alcohol Syndrome |
| IQ | Intelligence Quotient |
| IUD | Intrauterine Death |
| IUGR | Intrauterine Growth Restriction |
| LBW | Low Birth Weight |
| LBWR | Low Birth Weight Rate |
| MRC | Medical Research Council |
| PMNS | Peninsula Maternal and Neonatal Service |
| PMR | Perinatal Mortality Rate |
| PPIP | Perinatal Problem Identification Program |
| US | United States |
| WHO | World Health Organization |
| WIC | Women, Infants, and Children's program |
| AMPS | All Media & Products Survey |

A. INTRODUCTION

Birth weight is an important determinant of perinatal, neonatal and postneonatal outcomes. Poor intra-uterine growth increases the risks of perinatal, infant and childhood mortality and morbidity. One of the goals of “A World Fit for Children”, the Declaration and Plan of action adopted by the United Nations General Assembly Session on Children in 2002, was to reduce the low birth weight incidence by a third in 2010. Addressing the low birth weight burden of disease would contribute significantly towards the Millennium Development Goals for reducing child mortality (WHO). Moreover, it has been shown that low birth weight could predispose individuals to cardiovascular risk factors, such as hypertension, diabetes and obesity. Thus, the infant born with a birth weight under 2500g could be an ‘at risk’ individual for life!

Low birth weight refers to those infants born weighing less than 2500g. Preterm infants are born before 37 completed weeks of pregnancy. Low birth weight is not synonymous with preterm deliveries. Thus, a low birth weight infant could be born preterm or could be born at term gestation following a period of poor intrauterine fetal growth

The low birth weight incidence rate has been used as an indicator of socio-economic and general health status of women and the community at large. The South African low birth weight rate compares on par with the global rate of 15%. However, an incidence of 4% in Sweden, 6% in Switzerland and 8% in the United Kingdom illustrates the improvement in especially upstream factors needed to decrease our low birth weight rate and its implications.

B. IMPACT AND BURDEN OF LOW BIRTH WEIGHT

a. INCIDENCE

1. GLOBALLY

Over 20 million babies are born each year weighing less than 2500g worldwide, resulting in a Low Birth Weight Rate (LBWR) of 15,5%. 95.6% of all Low Birth Weight babies are born in developing countries. Africa has a reported incidence of 14,3%. The highest LBWR of 18.3% is reported in Asia, specifically south-central Asia at 27%. This becomes particularly alarming when an incidence of only 7% is reported for the more developed United Nations Regions [1](#).

2. NATIONALLY

The latest Saving Babies 2003 Report, reports an overall LBWR of 15.4% for South Africa. The incidence of Low Birth Weight (LBW) in Metropole, City and Towns and Rural areas were respectively 17.6%, 17.6% and 13.3% for 2003 [2](#).

3. PROVINCIALY

The Saving Babies 2003 Report cites a LBWR of 19,8% for the Western Cape. The higher LBWR reported in the Western Cape in relation to the rest of the country mostly results from the much higher LBWR in Rural areas in our Province. This is illustrated by an average LBWR of 24.4% reported by the Boland/Overberg Region between 2001 and 2005. [3](#)

4. METROPOLITAN Cape Town

The Peninsula Maternal and Neonatal Service (PMNS) provides a comprehensive maternity and neonatal service to expecting mothers and neonates.

Tertiary level: Groote Schuur Hospital

Secondary level: Mowbray Maternity Hospital

Primary Level: New Somerset Hospital
Six Midwife Obstetric Units (Guguletu, Hanover Park, Khayelitsha,
Mitchells Plain, Retreat and Vanguard)
District: False Bay Hospital

During 2005, 34293 births were recorded in the PMNS. Of these, 5218 (15.2%) were born with a weight less than 2500g. Over the past six years the LBWR for the PMNS has remained between 15 – 17%. In Khayelitsha the LBWR is 7,6% compared to Mitchell’s Plain with a LBWR of 10,2%. This shows that in the predominantly African communities there is a lower incidence of LBW compared to the mostly Coloured communities, this could be as a result of a 60% smoking rate among Coloured women in the Western Cape.

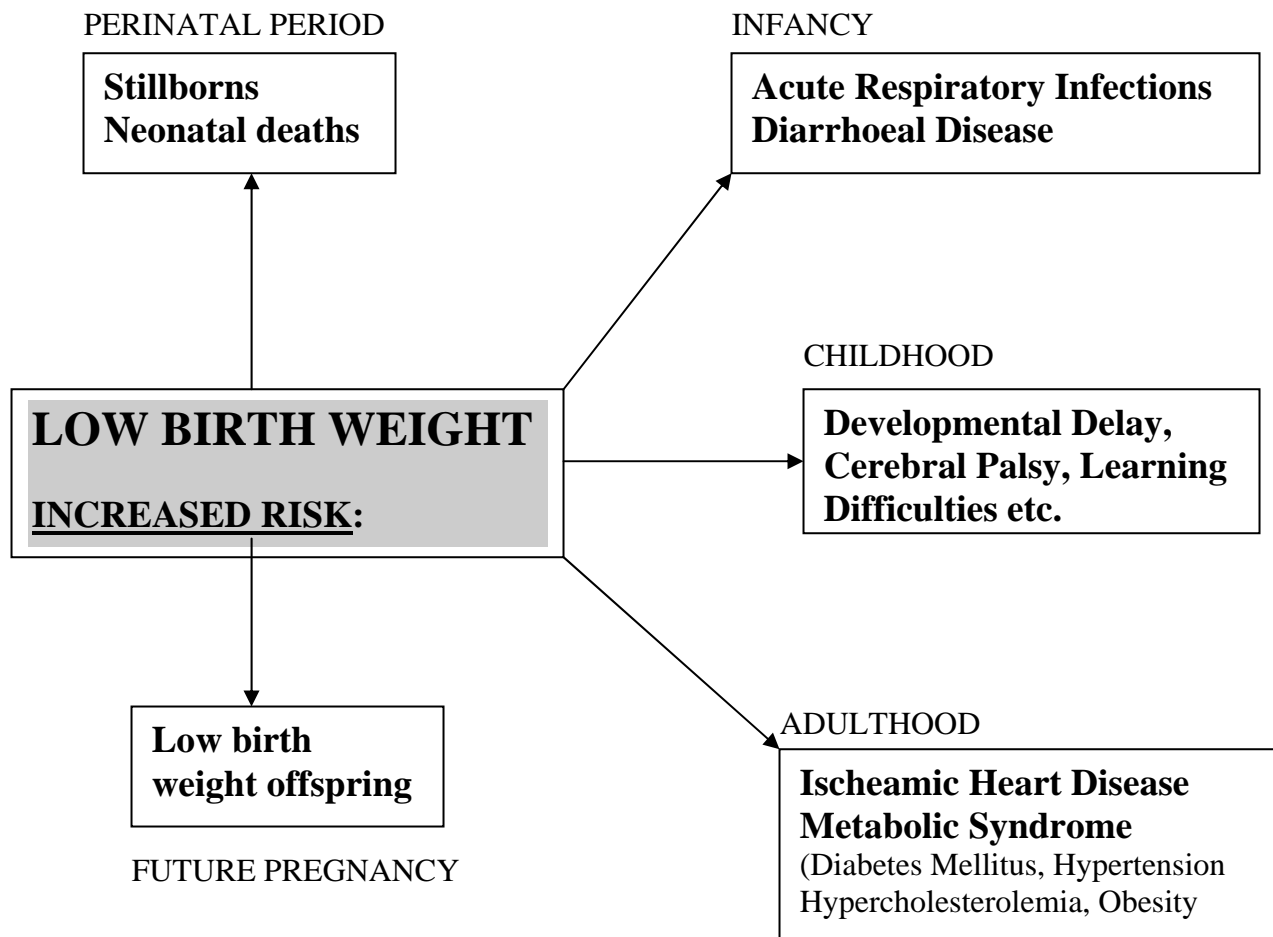
b. FINANCIAL IMPLICATIONS RELATED TO LOW BIRTH WEIGHT

Unfortunately, no estimation of cost could be found regarding the burden of low birth weight in South Africa. Neither was any similar data available for other developing countries.

The cost of neonatal intensive care and expenses in the first year of life per surviving preterm low birth weight baby was estimated at \$ 8,443 in 1987 and \$ 48,183 in 1995 for the Canadian population. Permanent disability secondary to perinatal problems was estimated at \$676,800 per preterm low birth weight baby. It is predicted that a 20% reduction in preterm births could result in a saving of 2-billion dollars per annum in Canada [4](#).

It is reported from the USA that low birth weight is responsible for 10% of all cost related to child health care between the ages of 0 to 15 years. In 1998, 3.5 to 4 million children between the ages of 0 to 15 years had a birth weight of less than 2500g in the US. Health care, education and childcare for these children cost \$5.5 to \$6 billion more than those born weighing more than 2500g [5](#).

c. IMPACT OF LOW BIRTH WEIGHT ON HEALTH



- PERINATAL PERIOD

In the PMNS, auditing of Perinatal deaths (500g and above) is done using the Perinatal Problem Identification Programme (PIIP). This program was developed by Dr Johan Coetzee and is currently supported by the Provincial Maternal Child and Women’s Health (MCWH) Units. Data is forwarded to The Medical Research Council (MRC) and is included in the biannual Saving Babies Report.

PMNS PERINATAL INDICES: YEAR 2005

| BIRTH WEIGHT GROUPS | PERINATAL MORTALITY RATE (PMR) (per 1000 births) | EARLY NEONATAL MORTALITY RATE (ENMR) (per 1000 live births) |
|---|---|--|
| All births above 500g | 30.2 | 7.8 |
| All births above 1000g | 16.9 | 3.8 |
| All births above 2500g | 6.6 | 2.1 |
| Low Birth Weight (500 – 2500g) | 161.6 | 44.3 |

The table above clearly demonstrates the markedly higher PMR and ENMR in low birth weight babies. The chances of an adverse pregnancy outcome (risk for both stillborns and neonatal deaths) are 20 – 24% worse in those cases born weighing less than 2500g.

Spontaneous Preterm Labour accounts for 32 % of all Obstetrical causes of perinatal deaths in low birth weight births in the PMNS. This is followed by antepartum haemorrhage (i.e. abruptio placentae) and hypertension. (see fig.1).

Immaturity related disorders such as extreme prematurity, intraventricular bleeds, necrotising enterocolitis and hyaline membrane disease accounts for 67% of neonatal deaths in babies weighing less than 2500g at birth in the PMNS. (see fig.2).

It is important to note that neonatal mortality has decreased substantially over the past years in the US. In the United States the infant mortality rate of 100 per 1000 live births at the turn of the century has decreased to 13.1 per 1000 live births by 1980. This was due mainly to the reduction in neonatal deaths brought about by the introduction of Neonatal and Perinatal Intensive Care Units [11](#).

Fig. 1 PMNS 2005: Primary Obstetric Cause of Perinatal Deaths in Low Birth Weight Births

(As calculated by PPIP)

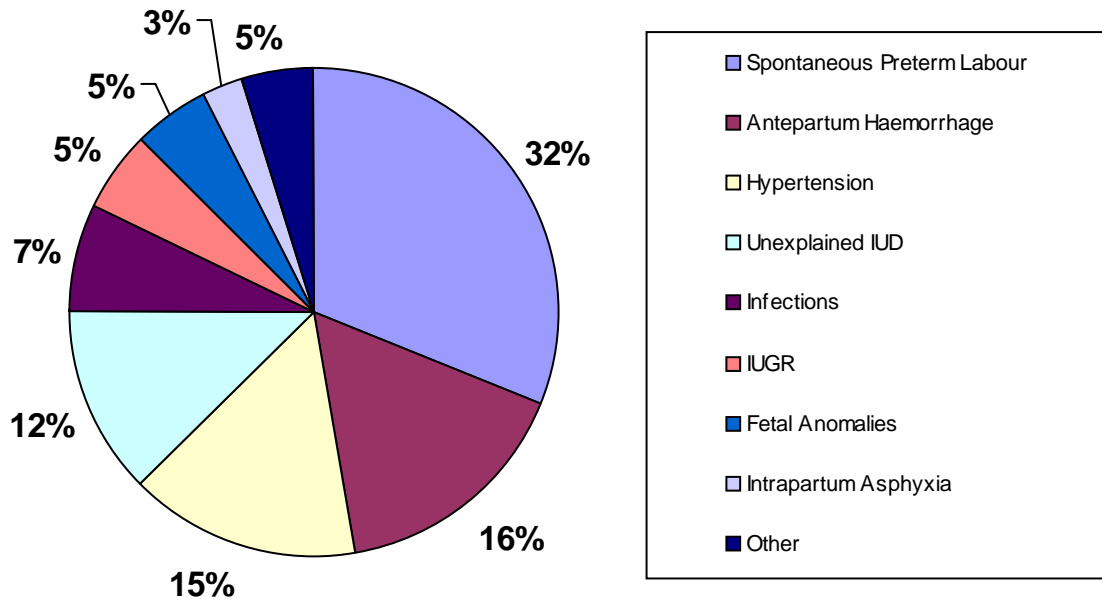
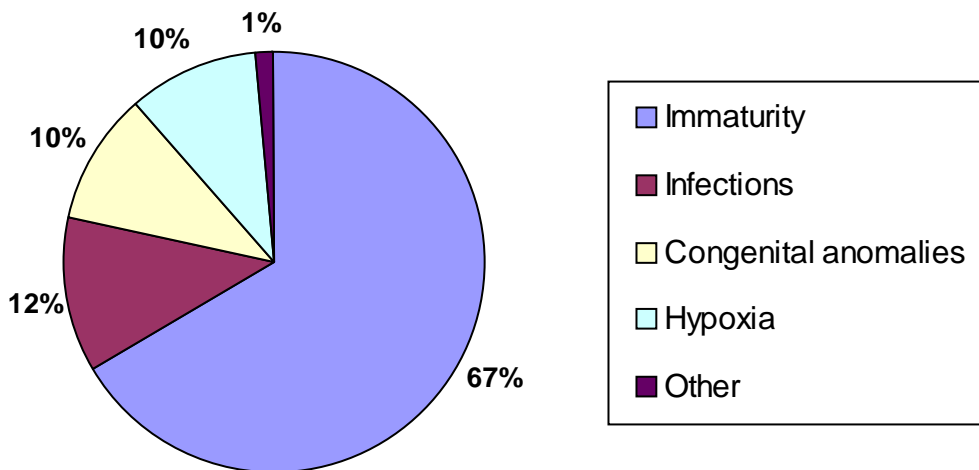


Fig. 2 PMNS 2005: Final Causes of Neonatal Deaths in Low Birth Weight Neonates

(As calculated by PPIP)



• INFANCY

According to the South African Health Review 2000 cited by Shung-King et al, low birth weight accounts for 19.7% of all deaths under one year of age. (Perinatal problems being the most common cause at 22%).

As other childhood mortality indices, the infant mortality rate (IMR) is an indicator of our country's socio-economic status. The South African Demographic and Health Survey 2003 reports an IMR of 43 per 1000. It is important to note that this average figure does not demonstrate the marked variations and discrepancies that exist between various population groups and regions. The WHO advocates an infant mortality rate of less than 50 per 1000. However, the WHO Report 2000 reports much lower IMR for countries of similar socio-economic status to SA, such as Mexico, Brazil and China with incidences of 30, 33 and 31 per 1000 respectively. This demonstrates that the inability of SA to care for our children is not purely financial but also in the way resources are allocated and managed [6](#).

The poor immunity of low birth weight babies predisposes them to infections, especially diarrhoeal disease and lower respiratory infections. This contributes to the high mortality noticed in these babies. Many of the same risk factors resulting in a baby starting life with a low birth weight continue to predispose them to admissions and mortality due to infections, diarrhea and respiratory infections. (i.e. poor socio-economic conditions, poor sanitation, lack of clean safe water, smoking exposure, alcohol and limited access to health care) For example, smoking during pregnancy not only increases the risk of a baby born weighing less than 2500g, but exposure in the household continues to put the low birth weight baby at risk of an infant death.

- CHILDHOOD

Low birth weight infants are at high risk of motor, cognitive, behavioral and emotional problems. This could be as a result of the primary cause of them being low birth weight or could be secondary to problems experienced during the neonatal period.

Hank et al report from Cleveland, USA that follow up of 20 year old surviving very low birth weight infants found a lower IQ, lower graduation rate from high school, lower academic scores and higher rates of neurosensory impairments than controls of normal birth weights [7](#).

Poverty has been identified as a risk factor for low birth weight. Unfortunately the negative impact of poverty does not end there for the low birth weight infant. Poor quality of the home environment (air pollution, lack of water and electricity and poor sanitation), poor home care and poor parental physical and mental health, along with family economic pressures and general resource poor communities result in the lack of stimulation and interaction with the child. This contributes to poorer physical health, lower cognitive development, worse behavioral/ emotional development and an increased risk of abuse and neglect [38](#).

- ADULT DISEASE PROFILE

Barker et al have published several studies demonstrating a relationship between low birth weight especially those born small for gestational age and the risk of ischemic heart disease, hypercholesterolemia, diabetes, hypertension, obesity and strokes in adulthood. This so called 'Barker Hypothesis' has received some criticism in the literature, but is supported by other studies. Further studies continue to be conducted to determine the effect of Low Birth Weight on adult disease profiles.

A significant reduction in early deaths of cardiovascular origin for birth weights more than 3856g in relation to the low birth weight study population born between 1907 and 1924 has been demonstrated. Lawlor et al confirmed this association again in a large study of 10803 babies born between 1950 and 1956. Even though this study was done at a time when infant mortality was low the association between low birth weight and cardiovascular risk factors remained the same. [8](#)

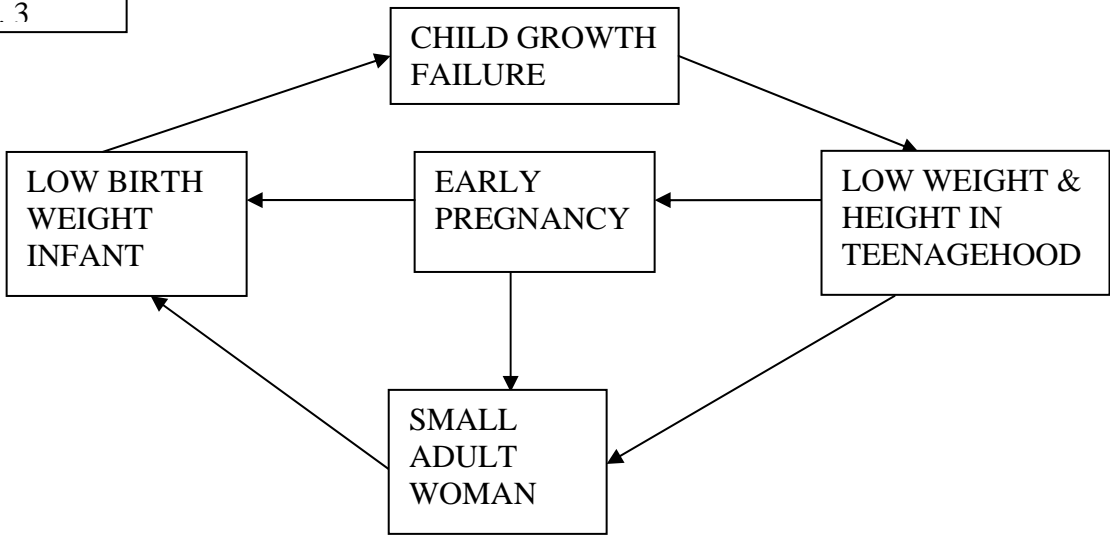
Syndrome X or Metabolic Syndrome, the so-called thrifty phenotype, is constituted hypertension, hyperlipidemia (raised triglycerides and/or low HDL), type 2 diabetes mellitus or glucose intolerance and central obesity or increased waist circumference. Barker, Hales et al. showed a 10 fold increased risk for development of Syndrome X in men with birth weight less than 2.9kg in relationship to those weighing more than 4.3kg at birth. Gestational age, social class, smoking and ethanol intake in pregnancy did not confound this association. [9](#)

Low birth weight has been found to have an association with the development of glucose intolerance and Type 2 Diabetes Mellitus. The Nurses' Health Study conducted in the US demonstrated this clearly. The relative risk for development of Diabetes in this large cohort of almost 70 000 women decreased from 1.83 for those born weighing less than 2267g to 0.83 for those over 4535g at birth. This was statistically significant. (P< 0.001) Other studies confirmed a significant association between low birth weight and both insulin resistance and insulin deficiency predisposing to the development of type 2 diabetes later in life. [10](#)

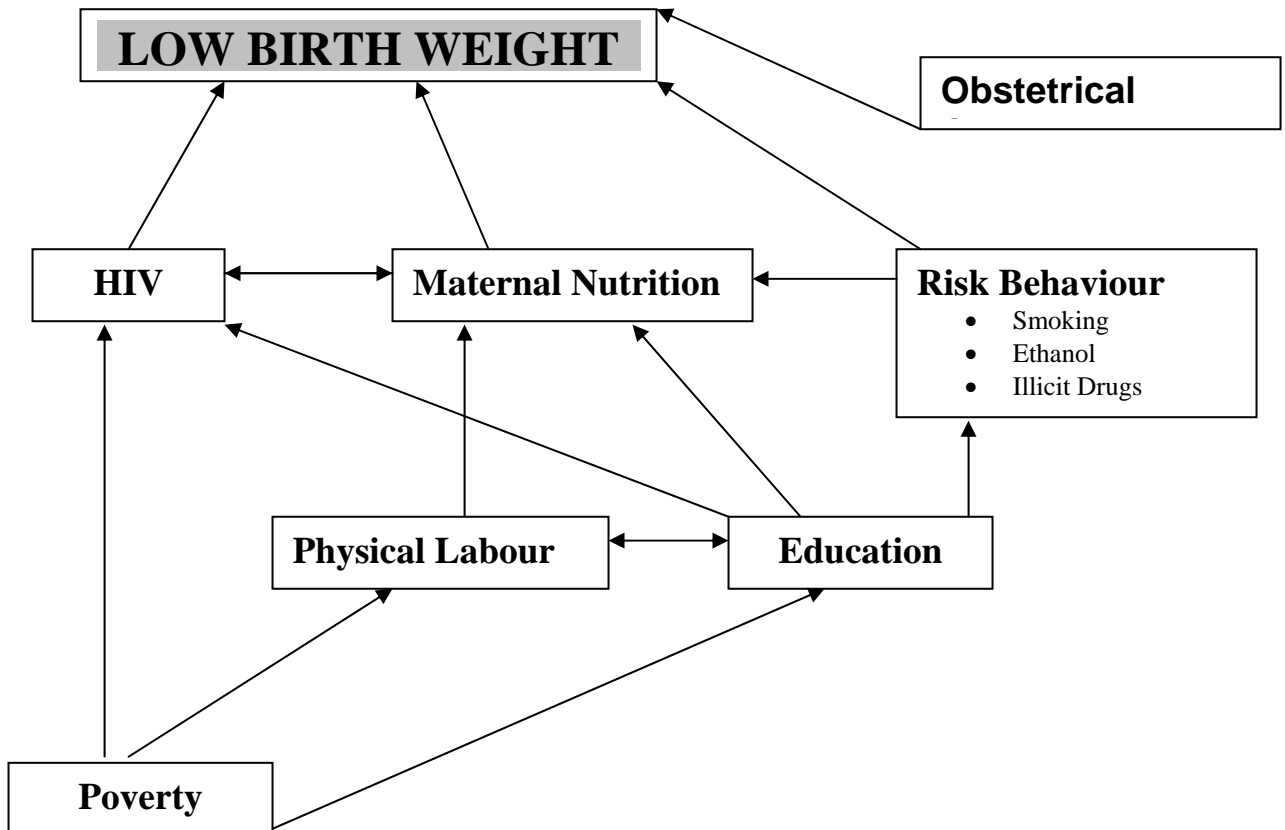
- FUTURE PREGNANCY

It has been observed that female low birth weight neonates often continue a pattern of poor growth as children and teenagers. Pregnancy at a young age in this group often results in a next generation of low birth weight infants. Thus, the cycle and burden of low birth weight continues [23](#). (see fig.3)

Fig. 3



C. IDENTIFYING LOW BIRTH WEIGHT RISK FACTORS



- **Risk behaviour**

Fetal Alcohol Syndrome had a prevalence of 40,5 - 46,4 per 1000 children between 5 and 9 years in a wine growing community of the Western Cape in 1997, according to the Investigations for National Institutes of Alcoholism & Alcohol Abuse report. In a repeat study in a similar community in the Western Cape, the incidence of FAS amongst the grade 1 pupils in 1999-2000 was 65,2-74,2 per 1000. In the last study, 92% of the women reported drinking in pregnancy and 88% reported drinking throughout pregnancy [94-96](#). In the US, the prevalence varies between 0,3 -1,5 per 1000 live births [31](#). The worldwide incidence is reported as 1,9 per 1000 live births.

More than 2 drinks per day is associated with a reduction in mean birth weight of about 200g [20](#). Binge drinking of more than 5 drinks per occasion is associated with an increased risk of IUGR [19](#). Binge drinking in excess of 100ml(7drinks) of absolute Alcohol (AA) per week (equivalent to 1litre of wine or 2 litres of beer) as well as drinking 2 or more drinks per day (>30ml AA) increases the risk of Fetal Alcohol Syndrome(FAS) [42](#).

In the US, the economic cost associated with FAS related health problems is \$321 million per year [20](#).

Smoking during pregnancy increases the risk of a LBW offspring. In the US, smoking accounts for 20% of low birth weight births, 8% of preterm births and 5% of perinatal deaths [47](#). Perkin [22](#) found that smoking reduces the birth weight of the affected infant by 207g. There is a 100g reduction in birth weight for every 1 microgram/liter rise in serum cotinine levels – a measure of the amount of smoking. This shows a dose dependent effect of smoking on birth weight. The Western Cape has the highest prevalence of tobacco smoking in the country. According to data from All Media & Products Survey (AMPS), 49% of smokers were Coloured in the Western Cape, while 37% were White, 28% were Indian and 22,7% were African in 2000.

In another study, tobacco smoking in pregnancy reduced birth weight by 232g, head circumference by 0.72cm and length by 0.82cm at birth [29](#). Offsprings of mothers who smoke 1 or more packs of cigarettes per day during pregnancy have an IQ score that on average is 2,87points lower than children born to nonsmoking mothers [30](#).

In an economic analysis by Lightwood et al [18](#), it was found that an annual reduction of 1% in smoking rate would result in a reduction of LBW infants by 1300 in the US. This would save \$21million in direct cost for health care of these infants.

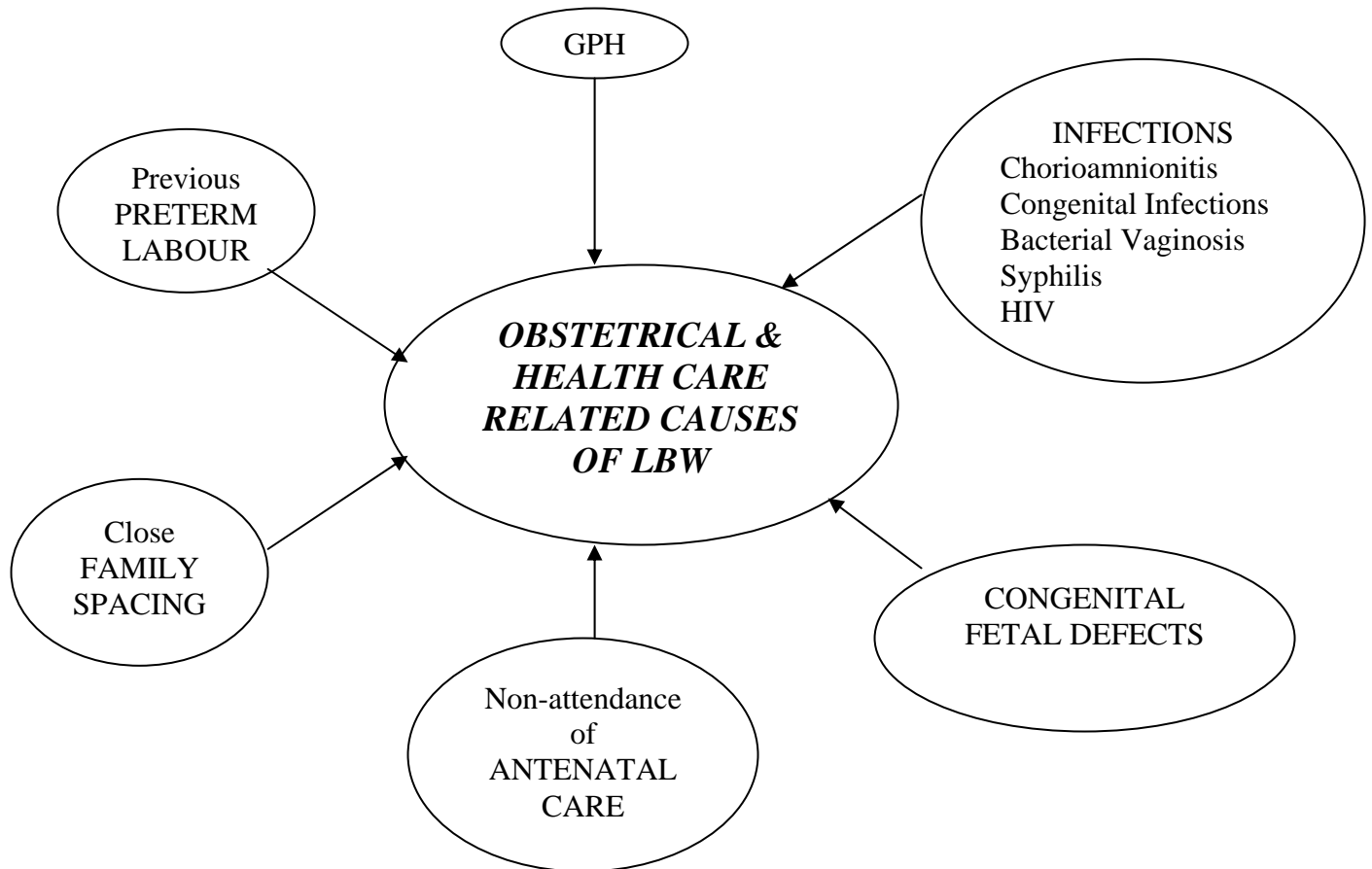
Illicit drugs used during pregnancy put a baby at risk of being born with a low birth weight.

A baby exposed to cocaine in utero will weigh 250g less than a baby not exposed. Cocaine also affects length with a deficit of 0.98cm at birth [29](#). Babies exposed to methamphetamine (TIK) in pregnancy are small for their age compared to babies of the same age not exposed to tik [43](#).

- **Physical labour**

In a study done by Lima et al in North East Brazil, it was found that agricultural work for the full 9 months of pregnancy resulted in a reduction in birth weight of 117g. The same work for 6, 7 or 8 months of pregnancy did not have the same impact in birth weight. This was thought to be due to either adverse effect on growth only occurs in the 9th month of pregnancy or that freedom from physical labour in the 9th month of pregnancy allows for fetal catch up growth [90](#). Even in Ethiopia, pregnant women engaged in hard labour had a lower mean weight gain and lighter infants than housewives with domestic help or women working in sedentary jobs with domestic help [91](#).

- **Obstetrical Risk Factors**



Non- attendance of antenatal care is a symptom of poverty, as one may not have money to go to the clinic. It is also physically less accessible for mothers with less time (due to may be working long hours, etc) and less knowledge/education to use the service. The system that is used at the clinics due to staff shortage makes accessibility to health care difficult on an already socially deprived community.

It has been shown that short inter-pregnancy intervals (close family spacing) are associated with preterm delivery [24](#). Infants conceived 18-23 months after a previous live birth have a lower risk of being LBW, Preterm or IUGR [37](#).

- **HIV**

HIV pandemic is still a big problem in our country, with 30,2% of pregnant women being HIV positive at booking nationally and 15,7% in the Western Cape in 2005. Symptomatic HIV infection was found to have an increased rate of miscarriages, low birth weight, intrauterine fetal death and preterm delivery in India. This is partly because HIV infection predisposes to chorioamnionitis, which in itself puts the fetus at risk of the above outcomes. In Kenya, 9% of all HIV positive mothers gave birth to a LBW baby. 17% of the symptomatic HIV positive mothers gave birth to LBW babies, while 6% of the

asymptomatic group did. Infants of HIV positive mothers were found to have a mean birth weight of 130g lower than infants of HIV negative mothers [92](#).

- **Poverty**

Poverty increases the risk of LBW or preterm offsprings [17](#). High rates of poverty are thought to be the underlying factor in racial / ethnic differences in pregnancy outcomes in the US, particularly between African Americans and Whites [45](#). Poverty increases the risk of adverse outcomes in a variety of mechanisms. This includes, risk behaviour (teen pregnancy, smoking, drinking, taking illicit drugs in pregnancy), inadequate access to appropriate health care, other aspects of poor communities (sanitation, etc) and experiences of racism, for African Americans. The effects of poverty on pregnancy are complex and increase the risk of both preterm and IUGR offspring [41&45](#).

D. PREVENTION/REDUCING THE INCIDENCE OF LOW BIRTH WEIGHT

1. PRIMARY PREVENTION (addressing upstream determinants)

- **EDUCATION** – in a study done in Britain, both formal education and antenatal care were found to have tremendous impact on LBW and its implications. PMR was found to be 256 per 1000 births and a LBW rate was 26%, amongst women who had never had any formal education and never initiated antenatal care. With education and antenatal care attendance, the PMR dropped to 30 per 1000 births and LBW rate to 8%. This shows that formal education, by changing social attitudes, holds the key to improvements in maternal and perinatal health.

In a study done in India in 1996, the LBW rate was 23-30,3%, yet in Kerala state the LBW rate was 13,3% across the state in 1996. Kerala state had an education level of 86% among women in 1991 compared to other areas of India. There is a 90% antenatal care attendance and 95% of mothers deliver in hospital. Maternal low pre-pregnancy weight seems to play a big role in the incidence of LBW. To change this will take generations as under nutrition is a historical issue [93](#).

- **SOCIAL GRANTS** – like Child Support Grant (CSG) are of great help in meeting the needs of the impoverished children of up to 14 years of age.¹ It may not be a lot of money, but for an impoverished family, it may be everything. Of even more benefit is the Care Dependency Grant (CDG), which is aimed at children with disability up to the age of 18

¹ The impact of the CSG is reviewed in the background paper on malnutrition [appendix 1]. See: Agüero JM, Carter MR, Woolard I. The Impact of Unconditional Cash Transfers on Nutrition: The South African Child Support Grant. Center for Global Development. July 2006.

<http://www.cgdev.org/doc/events/11.07.06/unconditional%20cash%20transfers.pdf> [accessed 24 January 2007].

years. As expressed above, these children have an increased risk of both mental and physical disabilities, they therefore benefit a lot from this grant. The CDG allows for the medical needs of the child to be met, in spite of the impoverished background from which they come.

- **EMPLOYMENT**- employed women have access to nutritious food and can afford to sustain the availability of the food and therefore are likely to lead a healthier life than unemployed women. They can afford to pay for transport to go to a health facility and are likely to present early if problems arise during pregnancy. This puts them at less of a risk of giving birth to a LBW offspring.
- **TRANSPORT** – would have to be available at all times, especially ambulances, to carry patients to hospital. Public transport would have to be safe and easily accessible until late at night. This would allow a pregnant woman to present early when pregnant for antenatal care and when in labour. Presenting earlier would result in timeous referral to the next level of care and prevent most of the problems associated with being LBW.
- **HEALTH RELATED SERVICES** - Family planning prevents unwanted pregnancies, reduces closely spaced births and reduces teen pregnancies. Thus, could result in a decreased LBW incidence.

Ensuring regular antenatal care would be advantageous. Women who do not receive regular antenatal care are more likely to give birth to a LBW baby [44](#)

Providing all pregnant women with health insurance coverage, should improve antenatal care attendance. Women who are casual workers don't attend antenatal care for fear of losing their jobs, as they don't get sick leave & maternity leave benefits.

Pregnancy amongst teenagers tends to be concealed and hence they do not present for antenatal care. Health promotion in this regard should be targeted to this age group.

Medical conditions associated with LBW like Gestational Proteinuric Hypertension, congenital infections and cervical incompetence should be noted early in pregnancy. In order to ensure appropriate treatment for these conditions an integrated efficient and accessible perinatal service is essential.

- **NUTRITION** - Prepregnancy weight, nutritional status and weight gain in pregnancy are good determinants of birth weight. Improving these will not only reduce, but will prevent LBW. The WHO recommends a weight gain of 1 kg/month in the last 2 trimesters, in order to prevent LBW. A pregnant woman therefore, should have access to adequate nutrition before during and after delivery in order to maintain a good nutritional status.

In the US, the Women, Infants and Children (WIC) program has been in existence since 1972, being funded by the department of agriculture. This program provides food supplements for low-income pregnant & postpartum women, as well as children under 5 years of age, considered to be at nutritional risk. Its aim is to improve pregnancy outcomes, such as prematurity, infant and fetal mortality.

In 1997, there were more than 7 million people benefiting from WIC each month. Findings from evaluation of the WIC program have shown improved births with reduced LBW & VLBW rates by 25% and 44% respectively [88](#). Another analysis found the incidence of LBW to be 13,1% for non-participants and 10,2% for WIC participants [81](#).

Poverty acts to limit access to appropriate nutrition and hence influence weight gain in pregnancy. It was in this context that micronutrient supplements rather than food became attractive to many international agencies in the 1990s [82](#).

Women should take micro-nutrient supplements in order to supplement their diet during pregnancy. Micronutrients are cheap & can improve dietary quality by providing several key nutrients like iron, folic acid, vitamin A & zinc. Studies by Fawzi et al, on multivitamin supplements in pregnancy showed a significant reduction in preterm birth, stillbirth and miscarriage rates [27](#).

Preconceptual administration of folic acid reduces the risk of neural tube defects.[66-73](#). Preconceptual administration of folic acid 1-5mg daily for 1-2 months to a woman conveys an 80% protection for neural tube defects [42](#). Neural tube defects incidence has fallen in the developed countries, especially those that have promoted preconceptual folic acid supplementation and food fortification with folic acid. In March 1996, the US Food & Drug Administration announced that it would permit addition of folic acid to enriched flour and other enriched cereal grain products. This was mandatory by January 1998. The level of fortification was set at 0,14mg folic acid per 100g cereal grain product. At this level the intake of folic acid for the target and the general population would be kept below 1000 micrograms per day, which is deemed to be the safe upper limit. This level of fortification was estimated to increase the average daily intake of folic acid in women of childbearing age by 100 micrograms [69](#). Canada followed suit, permitting fortification in 1996 with addition of folic acid to white flour and enriched pasta at 0,15mg per 100g flour and 0,20mg per 100g of pasta. In November 1998, fortification was mandatory in Canada. Since the implementation of fortification, the neural tube defect incidence fell by 78% in Newfoundland, North America, which has historically had the highest incidence of 3,4 per 1000 births [70-71](#). Data from China suggests that folic acid supplementation is a feasible public health objective in the developing countries as well [65&73](#).

Women taking calcium supplements have a reduced incidence of preterm delivery and low birth weight babies, especially if they have hypertensive disorders [85](#).

- **SMOKING** - it is essential to link women with services trained at curbing smoking and improving nutrition especially during pregnancy [23&80](#). Up to 25% of LBW deliveries could be avoided if pregnant women did not smoke [83](#).

The American Cancer Society encourages women to quit before or during the first 4 months of pregnancy, as this will reduce their risk of a LBW infant to the same level as a non-smoking woman [89](#). As much as 48% of women quit smoking in pregnancy than at any other point in their lives. Unfortunately, 50% of women who quit smoking in pregnancy relapse at 6 months & 70% at 1 year postpartum [48&49](#). In a study done by Walker et al in the years 2001 to 2003, protection of the fetal health was the primary reason women quit smoking [78](#). Successful strategies such as clinical advice, self-help

booklets and counseling are frequently used for smoking cessation [50-56](#). Having a strong incentive, such as fetal health, helps many women resist cravings [79](#).

Girls & young women should be discouraged from starting to smoke. Promising strategies for this include education, restriction of advertising to young people, reduced access to tobacco, increase cigarette taxes and restricting smoking in public places [86](#). In South Africa, tobacco control dates back to the 1970's, where tobacco smoking was banned in the cinemas. In 1993, the first Tobacco Products Control Act was passed, and got implemented in 1995 [97-98](#). In 1995, health warnings were introduced on tobacco packaging & tobacco advertising on billboards. In 1999, the Tobacco Products Control Amendment Act was passed and was implemented in 2001 [99-100](#). The AMPS reported a decrease in the prevalence of tobacco smoking from 32,6% in 1993 to 27,1% in 2000 [101](#). The further reduction in prevalence reported by the South African Demographic & Health Survey from 34% in 1996 to 24,6% in 1998 could possibly be as a result of the health warning labels.

- **PRECONCEPTUAL COUNSELLING**:-expansion of access to preconception counseling & care is important, as birth weight is affected by choices women make even before they are pregnant, e.g. avoidance of smoking, drinking alcohol, taking illicit drugs as well as taking good food and adhering to safer sex practices.
- **ALCOHOL**: Fetal Alcohol Syndrome (FAS) has a potential to be preventable because of its direct cause – maternal drinking, which is presumed to be a preventable behaviour.

3 prevention strategies have been used in the US:

1. **Universal Prevention Approaches** :- Reduction of drinking in pregnancy can be attributed to universal prevention messages like reading material, radio and TV advertisements [74](#). In a study by Hankin, use of alcohol beverage warning labels against FAS Hankin [75-77](#) helped mostly in light drinkers. Warning signs on buses and billboards [58,61,64](#) are also helpful in curbing maternal drinking habits.
2. **Selective Prevention Approaches** :- Screening should occur at the clinics that provide primary and prenatal care to low-income women, using questionnaires [57&59](#). Once these women are detected, factors that affect readiness and the actual turning point towards abstinence become paramount [59](#).
3. **Indicated Prevention Approaches** :- A woman with one child with FAS is likely to have other kids affected by alcohol. [31](#) Self help groups like Alcoholic Anonymous & Women for Sobriety might effectively be involved in after care support for these women [59](#).

2. SECONDARY PREVENTION (addressing downstream determinants)

- Parental education – is aimed at teaching mothers early signs of labour and encouraging them to present early to the nearest health facility when in labour.
-
- Clinical markers - look for and confirm signs of labour, monitor the fetus, estimate gestational age, monitor mother's BP, urine and temperature
- Ultrasound markers - monitor amniotic fluid index, to confirm if it is normal, increased or decreased. It also aims to confirm fetal heart beat and viability, position of the placenta, fetal defects as well as discrepancy between gestational age and dates, be it multiple pregnancy or IUGR.
- Management of preterm labour includes bed rest, tocolysis (stopping labour in order to give antenatal steroids), giving antibiotics when appropriate and administration of antenatal steroids to mature the lungs in order to prevent unnecessary prolongation of NICU stay.

3. TERTIARY PREVENTION

Health care related:-

- Antenatal glucocorticosteroids to be given to the mother to mature the fetal lungs.
- Mother to be treated for the associated medical problems including infections, GPH, etc.
- Reducing premature related morbidity & mortality by using effective ventilation, surfactant administration, by liberal antibiotic use and appropriate fluid management

Transport - it is safer to transfer a fetus in utero to a tertiary or secondary center. Availability of transport from home to hospital at all times is crucial, if we are to save lives and prevent morbidity. Availability of quick appropriate and safe transport from primary to a tertiary center is equally important in order to make a difference in these children's lives. Women with access to adequate health care services before, during and after childbirth have better pregnancy outcomes and healthier babies [87](#).

E. CONCLUSION

Low birth weight babies irrespective of cause, constitute a major health problem to the individual infant, his / her family and to the society at large. Aetiology of preterm or low birth weight infant is multifactorial and often there is an interplay between factors.

The impact of low birth weight on perinatal as well as infant mortality rates cannot be over-emphasized. South Africa's LBWR of 15,4% is higher than that for other middle

income countries. The LBWR of 15-17% in the Western Cape raises concerns about what can be done to improve it.

The important determinants of low birth weight include:

- Poverty which impacts on maternal nutrition, employment, level of education and availability of transport
- Smoking
- Alcohol
- Health system, e.g antenatal care attendance, ambulance availability, etc.

Poverty plays a pivotal role in the aetiology of LBW. It has been found to be an important contributor to low birth weight differences between Blacks and Whites in the US [17,41&45](#). Poverty acts to limit access to appropriate nutrition and hence influence weight gain in pregnancy, and this is how micronutrient supplementation became attractive to international agencies in the 1990s [82](#).

The US-based WIC program provides food supplements for low-income pregnant & postpartum women, as well as children under 5 years of age, considered to be at nutritional risk. Its aim is to improve pregnancy outcomes, such as prematurity, infant and fetal mortality. On evaluation the WIC program was found to reduce low birth weight & very low birth weight rates by 25% & 44% respectively [88](#). The incidence of low birth weight was found to be 13,1% among non-participants and 10,2% among WIC program participants [81](#).

Folic acid administration pre-conceptually as well as folic acid fortification of certain foods reduces the incidence of neural tube defects, which is a risk factor for low birth weight [66-73](#).

Calcium supplementation in pregnancy reduces the risk of gestational proteinuric hypertension [83](#).

In a study by Lima in North East Brazil showed that agricultural work for the full 9 months of pregnancy reduces birth weight by 117g, and not, if the same work was stopped at 6,7 or 8 months [90,91](#). This suggests that agricultural work should be stopped before the 9th month of pregnancy.

Formal education by changing social attitudes, holds the key to improvement in maternal and perinatal health. This is highlighted by an Indian state called Kerala, in which the level of education among women in 1991 was 86%. The antenatal care attendance among pregnant women is 90% and hospital delivery is 95% in Kerala, hence, the low birth weight rate was 13,3% in 1996 compared to 23%-30,3% in the rest of India.

Up to 25% of LBW deliveries could be avoided if pregnant women did not smoke [83](#). As much as 48% of women quit smoking in pregnancy than at any other point in their lives. Unfortunately, 50% of women who quit smoking in pregnancy relapse at 6 months & 70% at 1 year postpartum [48&49](#). The American Cancer Society encourages women to quite before or during the first 4 months of pregnancy, as this will reduce their risk of a LBW infant to the same level as a non-smoking woman [89](#). Successful strategies such as clinical advice, self-help booklets and counseling are frequently used for smoking cessation [50-56](#). Promising strategies for this include education, restriction of advertising to

young people, reduced access to tobacco, increase cigarette taxes and restricting smoking in public places [86](#). Since the passing of the Tobacco Products Control Act in 1993, the incidence of smoking dropped from 32,6% in 1993 to 27,1% in 2000 [101](#).

The farming areas of the Western Cape have the highest incidence in the world of Fetal Alcohol Syndrome. There should be massive drug abuse awareness campaigns in schools, churches, on billboards, radios, television, community news papers, etc in order to curb pregnant women from consuming alcohol [58,61,64,74 -77&94-96](#).

Unavailability of reliable transportation system is a contributor to the low birth weight incidence. There should be an availability of effective, affordable and easily accessible transport system, even for rural areas. Women with access to adequate health care services before, during and after childbirth have better pregnancy outcomes and healthier babies [87](#). In a Safe Motherhood Newsletter, Issue 1, Oct-Dec. 1993, by Z. Huque & D. Olonchimeng, maternity rest homes were associated with a reduction in perinatal mortality and maternal mortality & morbidity in Mongolia, 1986. Unfortunately this success was not quantified and none of the studies on maternity villages quantified the differences in birth weight between maternal village attendees and non-attendees.

F. REFERENCES

1. UNICEF, WHO, Low Birth Weight Country, Regional and Global estimates
2. Saving Babies 2003, MRC...
3. Data provided by Dr D. Greenfield, Provincial PPIP Co-ordinator of the Western Cape Maternal, Child and Womens' Health Directorate.
4. Toronto Public Health study on Low Birth Weight in Canada.
5. Lewit EM, Barker LS et al. The direct cost of low birth weight. *Future Child* 1995 Spring; 5(1): 35-56.
6. Facts about child deaths: an overview for decision makers and service providers in South Africa, prepared by Dr Maylene Shung-King and Paula Proudlock, Childrens' Institute, University of Cape Town, May 2002.
7. Hack M, Flannery J et al. Outcomes in young adulthood for Very Low Birth Weight Infants. *N Engl J Med* 2002;347(2): 141.
8. Lawlor DA, Ronalds G, Clark H, Smith GD, Leon DA. Birth weight is anversely associated with incidence of coronary heart disease and stroke among individuals born in the 1950's: findings from Aberdeen Chlidren of 1950s prospective cohort study. *Circulation* 2005 Sept 6;112(10): 1414-8. Epub 2005 August 29.
9. Barker DJ, Hales CN, Fall CH et al. Birth weight and adult health outcomes in a biethnic population in the USA. *Diabetologia* 1994;37:624.
10. Rich-Edwards JW, Colditz GA et al. Birth weight and risk for type 2 diabetes mellitus in adult women. *An Intern Med* 1999 Feb 16; 130: 278-84.
11. McCormick MC. The contribution of low birth weight to infant mortality and childhood morbidity. *N Engl J Med* 1985;312:82-90.
12. Goldenberg RL et al. Prevention of preterm birth. *N Engl J Med* 1998;339:313-20.
13. Goldenberg RL et al. Prevention of preterm birth. *N Engl J Med* 1998;339:313-20.
14. Kramer MS et al. Determinants of preterm birth rates in Canada from 1981 to 1983 and from 1992 to 1994. *N Engl J Med* 1998;339:1434-39.

15. Kramer MS et al. Intrauterine growth retardation and gestational duration determinants. *Paediatrics* 1987;80: 502-11.
16. Kramer MS. Effects of energy and protein intakes on pregnancy outcomes: an overview of the research evidence from controlled clinical trials. *Cochrane Database System Review* 2003;1.
17. Kramer MS et al. Socio-economic disparities in preterm birth: causal pathways and mechanisms. *Paed. Perinat. Epid* 2001;15: 104-23.
18. Lightwood JM et al. Short-term health and economic benefits of smoking cessation: low birth weight. *Paediatrics* 1999;104:1312-20.
19. Lundsberg LS et al. Low to moderate gestational alcohol use and intrauterine growth retardation, low birth weight and preterm delivery. *Annals Epidemiology* 1997;7: 498-508.
20. Abel EL et al. 'J-shaped' relationship between drinking during pregnancy and birth weight: reanalysis of prospective epidemiological data. *Alcohol Alcohol* 1995;30:345-55.
21. Abel EL et al. Smoking during pregnancy: a review of effects on growth and development of offspring. *Hum Biol* 1980;52: 593-625.
22. Perkin SL et al. Canadian tertiary care centre study of maternal and umbilical cord cotinine levels as markers of smoking in pregnancy: relationship to neonatal effects. *Can J Pub Health* 1997;88:232-37.
23. Ramakrishnan U. Nutrition and low birth weight: from research to practice. *Am J Clin Nutr* 2004;79: 17-21.
24. Baso et al. Pregnancy within 8 months of a previous birth showed an increased risk of preterm delivery. *Am J Obs & Gyn* 1998 Feb; 178: 259-63.
25. Ceesay SN et al. Effects on birth weight and perinatal mortality of maternal dietary supplements in rural Gambia: 5year randomized controlled trial. *BMJ* 1997; 315:786-90.
26. ACC/SCN. Second report on world nutrition situation Geneva: ACC/SCN, WHO & Washington, DC: IFPRI, 1992.
27. Fawzi WW et al. Randomized trial of effects of vitamin supplements on pregnancy outcomes & T-cell counts in HIV infected women in Tanzania. *Lancet* 1998;351:1477-82.
28. Walter T et al. Fortification. In: Ramakrishnan U,ed. *Nutritional anaemias*. Boca Raton, FL: CRC Press, 2001: 153-84.
29. Shakaran S et al. Association between patterns of Substance Use and Infant Birth Weight, Length and Head circumference. *Paed* 2004; 114:e226-e233.
30. Batty GD et al. Effects of maternal smoking during pregnancy on offspring's cognitive ability: Empirical evidence for complete confounding in the US National Longitudinal Survey of Youth. *Paed* 2006; 118:943-50.
31. May TA et al. Epidemiology of fetal alcohol syndrome in a South African community in the Western Cape province. *Am J Pub Health* 2000;90:1905-12.
32. Center for Disease Control and Prevention, US, 2000. Department of Health & Human Services (DHHS) Publication No.00-1232. July 2000.
33. Goldenberg et al. Intrauterine infection and preterm delivery. *N Engl J Med* 2000;342(2): 1500-7.
34. DHHS, US. *Health People 2010: Understanding and improving Health*. Second Edition. Washington, DC: US Government Printing office; November 2000.
35. Scholl TO, Johnson WG. Folic acid influence on outcome of pregnancy. *Am J Clin Nutr* 2000;71: 1295s-1303s.

36. US Preventive Services Task Force. Screening for bacterial vaginosis in pregnancy: recommendations and rationale. *Am J Prev Med* 2001;20(3s):59-61.
37. Zhu BP et al. Effect of the interval between pregnancies on perinatal outcomes. *N Engl J Med* 1999; 340: 589-94.
38. Brooks-Gunn J, Duncan GJ. The effects of poverty on children. *Future of children* 1997;7(2): 65-71.
39. Shonkoff JP, Phillips DA, op cit. Chapters 10-12.
40. Duncan GJ, Brooks-Gunn J. Family poverty, welfare reform and child development. *Child Dev* 2000;71:188-96.
41. Villar J, Bellizan JM: The relative contribution of prematurity and fetal growth retardation to low birth weight in developing and developed societies. *Am J Obs & Gyn* 1982;143: 793-98.
42. Viljoen D. Oxford, Southern Africa, *Handbook of Paediatrics*, Chapter 3.
43. Smith L, et al. Effects of prenatal metamphetamine exposure on fetal growth and drug withdrawal symptoms in infants born at term. *J Dev Behav Pediatr.* 2003 Feb;24(1): 17-23.
44. Shore R, for Annie E. Casey Foundation. *KIDS COUNT Indicator brief/ Preventing low birth weight*, July 2005.
45. Hoyert DL et al. Infant mortality and low birth weight among Black and White infants in the US, 1980-2000. *National Vital Stat Rep* 2002; 50:1—102.
46. Atallah AN et al. Calcium supplementation during pregnancy for preventing hypertensive disorders and related problems. *The Cochrane Library*, Issue 3.
47. US Department of Health and Human Services. *The health benefits of smoking cessation. A report of the Surgeon General, 1990.* Rockville, Maryland: Public Health Service, Center for Disease Control, Office on Smoking and Health, 1990. (DHHS Publication No.(CDC) 90-8416).
48. Colman GJ. Trends in smoking before, during, and after pregnancy in 10 states. *Am J of Prev Med* 2003;24(1):29-39.
49. Pickett KE et al. Fluctuations of maternal smoking during pregnancy. *Obstetrics & Gynae* 2003;101(1):140-7.
50. McBride CM et al. Prevention of relapse in women who quit smoking during pregnancy. *Am J Public Health* 1999;89:706-11.
51. Secker-Walker RH et al. Smoking relapse prevention during pregnancy. A trial of co-ordinated advice from physicians and individual counseling. *Am J Prev Med* 1998;15:25-31.
52. Secker-Walker RH et al. Smoking relapse prevention counseling during prenatal and early postnatal care. *Am J Prev Med* 1995;11:86-93.
53. Valanis B et al. Maternal smoking cessation and relapse prevention during health care visits. *Am J Prev Med* 2001;20:1-8.
54. Van't Hof S et al. Randomized control trial of a postpartum relapse prevention intervention. *Tob Control* 2000;9(3):64-66.
55. Lowe JB et al. Smoking relapse prevention methods for pregnant women: a formative evaluation. *Am J Health Promotion* 1997;11:244-6.
56. Erschoff DH et al. Relapse prevention among women who stop smoking early in pregnancy: a randomized clinical trial of self-help intervention. *Am J Prev Med* 1995;11:178-84.
57. Chang G. Women and alcohol abuse in primary care: Identification and intervention. *Am J on Addictions* 1997;6(3):183-192.

58. Fitzgerald P. FAS persists despite broad public awareness. *Michigan Medicine* 1988;87(5):262-268.
59. Kaskutas LA. Pathways to self-help among women for sobriety. *Am J of Drug & Alcohol Abuse* 1996;22(2):259-80.
60. Kaskutas LA et al. Relationship between cumulative exposure to health messages, awareness and behaviour related drinking during pregnancy. *Am J of Health Promotion* 1994;9(2):115-24.
61. Little RE et al. Public awareness & knowledge about risks of drinking during pregnancy in Multnomah County, Oregon. *Am J of Public Health* 1981;71(3):312-14.
62. Little RE et al. An evaluation of the pregnancy & health program. *The Journal of the National Institute on Alcohol Abuse & Alcoholism, Alcohol Health & Research World* 1985;10:44-53,71,75.
63. Sokol RJ et al. The T-ACE questions: Practical prenatal detection of risk drinking. *Am J of Obstet & Gynae* 1989;160(4):863870.
64. Weiner L et al. FAS/FAE: Focussing prevention on women at risk. *International J of Addiction* 1989; 24(5):385-95.
65. Liu S et al. Comprehensive evaluation of food fortification with folic acid for primary prevention of neural tube defects. *BMC Pregnancy & Childbirth* 2004;4:20.
66. Laurence KM et al. Double –blinded randomized controlled trial of folic acid treatment before conception to prevent recurrence of neural tube defects. *Br Med J (Clin. Res. Ed)* 1981;282:1509-11.
67. Smithells RW et al. Further experience of vitamin supplementation for prevention of neural tube defects' recurrence. *Lancet* 1983;1:1027-31.
68. Czeizel AE et al. Prevention of the first occurrence of neural tube defects by preconceptual vitamin supplementation. *New Engl J Med* 1992;327:1832-35.
69. FDA: Food standards: amendments of standards of identity for enriched grain products to require addition of folic acid. *Federal Register* 1996;61:8781-97.
70. Wald NJ et al. Folic acid food fortification to prevent neural tube defects (letter). *Lancet* 1998;351:834.
71. Daly S et al. Minimum effective dose of folic acid for food fortification to prevent neural tube defects. *Lancet* 1997: 3501666-69.
72. Honein MA et al. Impact of folic acid fortification of the YS food supply on the occurrence of neural tube defects. *JAMA* 2001;285:2981-86.
73. Berry RJ et al. Prevention of neural tube defects with folic acid in China. *New Engl J Med* 1999;341:1485-90.
74. Waterson EJ et al. Drinking & smoking patterns amongst women attending an antenatal care clinic. *Oxford J Med, Alcohol & Alcoholism* 1989;24(2):163-73.
75. Hankin JR et al. Identification & care of problems associated with alcohol ingestion in pregnancy. *Semin in Perinatol* 1995;19(4):286-92.
76. Hankin JR et al. A time series analysis of the impact of the alcohol warning label on antenatal drinking. *Alcoholism: Clinical & Experimental Research* 1993;17(2):284-89.
77. Hankin JR et al. Heeding the alcohol beverage warning label during pregnancy: Multiparae versus Nulliparae. *Journal of the study of alcohol* 1996;57(2):171-77.
78. Walker S et al. Safe Babies: The Determinants of postpartum smoke-free and relapse states. *Smoke-free Families Program of the Robert Wood Johnson Foundation.*
79. The Tobacco Use & Dependence Clinical Practice Guideline Panel, Staff, Consortium Representatives. *Treatment of Tobacco Use & Dependence – A Systems Approach: A Guide for Health Care Administrators, Insurers, Managed Care*

- Organizations and Purchasers. US Dept of Health and Human Services. Public Health Service, Nov 2000. Available at: <http://www.surgeongeneral.gov/tobacco/>.
80. Alexander GR et al. The role of prenatal care in preventing low birth weight. *Future Child*. 1995;5(1):103-120.
 81. Brown HL et al. The impact of the Women, Infant and Children Food Supplement Program on Birth Outcome. *Am J Obstet & Gynae* 1996;174(4):1279-83.
 82. UNICEF/UNU/WHO. Composition of multi-micronutrient supplementation to be used in pilot programmes among pregnant women in developing countries. Report of a workshop, New York, UNICEF, 1999.
 83. Kleinman J et al. The effects of maternal smoking on fetal and infant mortality. *Am J of Epid* 1988;127(2):274-82.
 84. Dickinson E, 2004. Preventing low birth weight. Erlanger Hospital Tennessee. Available at: www.erlanger.org
 85. Mulvihill C et al. Prevention of low birth weight: Assessing the effectiveness of smoke cessation and nutritional interventions: Evidence briefing. London: Health Development Agency
 86. Center for Disease Control and Prevention, 2004b. Cigarette use among high school students in the US, 1991-2003. Available at: www.cdc.gov/mmwr/preview/mmwrhtml/mm5323a1
 87. Institute of Medicine, committee to study outreach for prenatal care,1988. *Prenatal care: Reaching mothers, reaching infants*. Washington, DC: National Academic Press.
 88. Owen A & Owen G. Twenty years of WIC: a review of some effects of the program. *J Am Dietet Assoc* 1997;97:777-82.
 89. Ford LG et al. Prevention & early detection clinical trials: opportunities for primary care providers & their patients. *C A Cancer J Clin* 2003;53:82-101.
 90. Lima M et al. Influence of heavy agricultural work during pregnancy on birth weight in North East Brazil. *Intern J of Epidem* 1999;28:469-74.
 91. Tafari N et al. Effects of maternal under nutrition and heavy physical work during pregnancy on birth weight. *Br J Obstet & Gynae* 1980;87:222-26.
 92. Braddick MR et al. Impact of maternal HIV infection on obstetric and early neonatal outcome. *AIDS* 1990;4(10):1001-5.
 93. Raman Kutty V. Why low birth weight is still a problem. Discussion paper No.57, Kerala Research Programme on local level development centre for developmental studies Thiruvananthepuram. ISBN No. 81-87621-60-5.
 94. Viljoen DL et al. Fetal Alcohol Syndrome epidemiology in a South African community: a second study of a very high prevalence area. *J Stud Alcohol* 2005;66(5):593-604.
 95. Viljoen DL et al. Fetal Alcohol Syndrome in South Africa, 2001. *MMWR* 2003;52(28):660-2.
 96. Viljoen DL et al. Characteristics of mothers of children with Fetal Alcohol Syndrome in the Western Cape Province of South Africa: a case control study. *J Stud Alcohol* 2002;63:6-17.
 97. Swart D, Reddy P. Strengthening comprehensive tobacco control policy development in South Africa using political mapping. Medical Research Council,1998.
 98. Tobacco Products Control Act No.83,1993. Government Gazette No. 14916, vol. 337, 1993.
 99. Tobacco Products Amendment Act 1999 Regulations. Government Gazette, Regulation Gazette No. 6689, vol.414, No. 20687, 1999.
 100. Tobacco Products Amendment Act No. 12, 1999.

101. Van Walbeeck C. Recent trends in smoking prevalence in South Africa. The economics of tobacco control in South Africa, 2002 (unpublished book).