

## **Life Depends On Birthweight -The Second John Bateman Lawson Memorial Oration**

**Nimi D. Briggs**

Vice-Chancellor, University of Port -Harcourt, Port- Harcourt, Nigeria.

### **Introduction**

An unstoppable admirer of the late Horatio Oritshejolomi Thomas once asked him when he was Dean of the Medical School at the University of Lagos, if he was also the Dean of the Faculty of Medicine at the University of Ibadan before he transferred to the University of Lagos. Thomas replied: "The University of Ibadan was not that lucky".

Since the University of Ibadan was also not that lucky in having me as an undergraduate medical student, I missed the wonderful privilege of training under the late John Bateman Lawson in my early days. But John Lawson was not one to go unnoticed in the medical community in Nigeria in the 60s let alone in a community of obstetricians and gynaecologists, where he wielded tremendous influence and power. And so it was that as medical students carrying out their posting in her department, the then Head of the Department of Obstetrics and Gynaecology at the University of Lagos, Ursula Gertrude Lister, arranged for us to travel to Ibadan to attend a lecture by John Lawson on the subject of "Malaria in Pregnancy", a subject matter in which he was generally acclaimed to be the world's leading authority. The consternation and awe on the faces of those of us who were seeing John Lawson for the first time as he worked into the classroom could only be matched by those on the face of Hamlet, the prince of Denmark, when he was eventually confronted by his father's ghost. Tall, huge and with an imposing and outstanding personality, John Lawson walked in with a majesty that dwarfed all others. I for one was petrified as I spent the time gazing on his physique and mannerisms; I am not sure I picked up anything he said about "malaria in pregnancy", despite the quality of his erudition.

After that close encounter with the "giant" not much happened again between us for the next decade until the late 70s when I was putting materials together for my MD thesis as a junior lecturer under Kelsey Harrison at the Ahmadu Bello University, Zaria. Before final submission of the thesis, Kelsey had rightly requested that I travel to England to present and discuss my findings with three professors of repute in the field. Two of them will remain anonymous; the third was John Lawson. On reading the material, the first Professor felt that I could obtain both a Ph.D and an MD from the volume and quality of the work. The second was of the view that it was an excellent work that should earn an MD without any difficulty, while John Lawson was of the opinion that the work as presented then, was not good enough even for a master's degree. So it was that my plan to spend just one night with him in his modest, well-appointed Newcastle home with decently mowed

lawns, was converted to a three night stay as he and I sat down, night after night, demolishing the thesis and reassembling it in a completely new form, interrupted only by his beautiful wife Nancy, requesting to refill our refreshment cups. As for the ultimate fate of the MD Thesis, you can surmise that from the fact that of all my degrees, the only one I write against my name as Vice-Chancellor, is Doctor of Medicine. You all can then imagine my joy when I was informed that I have been chosen to deliver today's Lecture in honour of this truly formidable man. It is therefore, with a very grateful heart that I thank the President and members of Council of our great society, the Society of Gynaecology and Obstetrics of Nigeria (SOGON), for giving me this singular honour to publicly acclaim John Bateman Lawson for his contribution to my life and I dare say to the lives of many of us present in this hall today.

John Lawson's contributions to the discipline of Obstetrics and Gynaecology were fundamental, crucial and protean. He left his native Yorkshire in England as a young man and on appointment as Professor of Obstetrics and Gynaecology in Nigeria's Premier University of Ibadan, in 1953, young John was faced with the stark and horrendous realities of obstetric practice in a developing country. Maternal deaths were rife and yet paradoxically considered such an abomination that even the process of recording them was tabooed. The magnitude of eclampsia justified a separate ward for the disease. Cephalo-pelvic disproportion and its fearsome sequelae, ruptured uterus, cardiovascular collapse from massive haemorrhage and fistulae formation were daily occurrences. A strong urge to improve women's health and their reproductive performance became a passion for John Lawson and as this passion rose up to the level of a mission he realized the pivotal role of trained men and women in this crusade and also, that of staging the battle at the international arena. His subsequent return to Newcastle upon Tyne and his directorship of postgraduate studies and later Vice-Presidency of the Royal College of Obstetricians and Gynaecologists, London, at the completion of this assignment in Ibadan in 1969, gave him the opportunity he had wished for, for so long.

Picking a topic that will do some justice to the memory of such a versatile man with which to address such a distinguished audience proved to be daunting.

---

*The Second Professor John Bateman Lawson Memorial Lecture was delivered at the 37th Annual General Conference of the Society of Gynaecology and Obstetrics of Nigeria (SOGON) in Port-Harcourt, 26th November 2003.*

I ultimately settled for low-birthweight because in my opinion, child survival in developing countries helps to define women's reproductive behaviour to a large extent and so, could not have been far from the heart of John Bateman Lawson. In closing this portion of today's lecture on introduction, therefore, let me hasten to add that the message of the lecture is very simple indeed. In essence, it seeks to remind us that aside from birth trauma and asphyxia, low birthweight is an important contributor to perinatal deaths and that in our efforts at reducing the incidence of low birthweight, universal basic antenatal care remains our bulwark. Finally, let me confess that the title of today's address, "Life depends on birthweight" is not completely original. It is an adaptation from "Life depends on the Liver", a professorial inaugural lecture by the late Theodore Francis at the University of Ibadan, who subsequently became the foundation Provost of the College of Health Sciences of the University of Port Harcourt. My citation of the names of several persons in this introduction is a manifestation of the tremendous good fortune I have had in my career in passing through the hands of great men and women. As I, once again, openly thank them all, I pray to the Almighty God to continue to grant eternal rest to those of them who have passed on to the great beyond.

### **General Considerations On Fetal Birthweight and Perinatal Mortality**

The fact that studies on birthweights have attracted the attention of Obstetricians, Paediatricians, Epidemiologists, Statisticians, Public Health Physicians and even Sociologists, is predicated on the knowledge that birthweight is a key indicator of the health of infants at birth, as well as of the mother's reproductive health<sup>1</sup>. By extrapolation, birthweights of babies give some indication about the socio-economic status of the mothers and the quality of their lives. Without prejudice to the confounding variables of genetic factors as well as others which ultimately define birthweights, in general terms, in nations with good social infrastructure, where women's literacy rate is high and where women receive satisfactory health care and supervision during child bearing, birthweights tend to be high and the proportion of low birthweights, small. On the other hand, in poverty stricken nations, where social infrastructures are poor and women constitute a disadvantaged group including in their literacy rates, and their access to health care, birthweights, are lower and the proportion of low birthweights, higher. 40% and 50% of new born babies in Nepal and Bangladesh respectively are of low birthweights. But even at this, it must be stated that birthweights of babies born to mothers who live in resource poor nations with all their disadvantages, but who compensate for the adverse conditions and the deprivation women suffer, through good living, good health and expert care during pregnancy, are not significantly different from those in the economically and socially advanced nations of the

world. For example, birthweights of babies from most healthy, educated and affluent Nigerian women who have had good supervision of their pregnancy and labour are the same as their Finnish counterparts.

Now to the issue of deaths among newborn babies especially within the first week of life. Most of us here know that babies of low birthweights are more likely to die than those of normal birthweights; this forms part of the issue under discussion today. But babies of normal birthweights also die, and contribute to perinatal deaths, especially in the third world countries. This is confirmed by several reports that emanate from Nigeria. In the Zaria Maternity Survey by Kelsey Harrison, it was found that babies who were born at term and with normal birthweights, contributed significantly to perinatal mortality<sup>2</sup>. At the University of Port Harcourt Teaching Hospital, Raphael Orumabo found that 878 (58%) of a total of 1519 babies that were admitted over a three year period into the Special Care Baby Unit (SCBU) where of normal birthweights. Thirty nine of these died giving a percentage contribution of 2.6% to the overall 9.7% of deaths of all babies in the SCBU<sup>3</sup>. The most important cause of perinatal death in a normal sized baby who is born at term in most third world countries, Nigeria inclusive, is birth asphyxia. This asphyxia is usually related to a difficult labour which arises from cephalo-pelvic disproportion in a woman with contracted pelvis. And here again, expert antenatal care in which cephalo-pelvic disproportion is detected and the mode of delivery planned before the onset of labour, is our best approach to reducing perinatal deaths. Additionally, during such a supervised care in pregnancy, nutritional supplements of iron and folic acid as well as malaria prophylactic drugs are often administered. These drugs encourage the growth of mothers in pregnancy, especially teenage primigravidae, leading to the expansion of pelvic size and the reduction of the likelihood of cephalo-pelvic disproportion in labour.

### **Low Birthweight Babies**

Low birthweight babies are, as defined by World Health Organization (WHO), those who, irrespective of the circumstances, are born with weights at birth are 2500g and beyond<sup>4</sup>. This definition, as all will agree, suffers from a problem as it converts

Birthweight which is a continuous variable into dichotomous compartments. But it has been widely used and it is good enough for our purpose today. Babies born with low birthweights are born either preterm (<7 completed weeks of gestation) or small for gestational age (<10<sup>th</sup> percentile for gestational age) or both. In Nigeria, approximately 60% low birthweights are small for gestational age<sup>6</sup>. Current estimates are 25 million low birthweight infants are born every year, and of these, 21million are born in developing countries<sup>5</sup> especially in the South Asian Region.

In 2000, of all babies that were born in the United States of America, 308, 470 (7.6% of all births) were of low birthweight, the percentage having risen from a previous one of 6.8% in 1985. The black low birthweight rate was twice the white rate. In Canada, low birthweight babies make up about 5.5% of all live births but the ratio from many other industrialized countries, like Norway, where the incidence is 3%, is lower than those for the USA and Canada. In developing countries, the incidence of low birthweight is even higher and is reported to be as high as 30-50% IN SOME Asian and African Countries<sup>4</sup>

In comparison to normal birthweight babies, low birthweight babies are more likely to die or have complications in the neonatal period. Indeed lower birthweight has been shown to be directly related to both immediate, long term and very long-term development and well-being. But this risk is not evenly distributed among all low birthweights thus forcing a further classification into **low birth**, **very low birth** and **severely low birthweight babies** . (Table 1). In order then to understand why low birthweight constitutes such an important determinant of child survival, let us now examine weight specific mortalities in low birthweight babies.

**Table 1: Classification Of Low Birthweights**

Classification	BirthWeight
Low BirthWeight	1500 -2499
Very Low BirthWeight	1000 -1499
Extremely Low BirthWeight	< 1000

Macrosomic babies with very high birthweights (< 4500g) also have their own problems. This lecture is not about them and happily, their number in any birthweight survey is small although some recent evidence from the University of Port Harcourt Teaching Hospital is suggesting that their numbers are increasing.

**Mortalities In Low Birthweight Babies**

Reference has already been made to the high mortalities that are associated with low birthweight babies. The additional information in this part of the lecture is that mortality rates are not uniform among the different classifications of low birthweight babies, as the smaller the weight of the baby, the higher the mortality rate. In a study by Oruamabo and Ogunremi of mortality patterns among 422 low birthweights that were admitted into the SCBU of the University of Port Harcourt Teaching Hospital between January 1984 and June 1986, virtually all babies who weighed below 1000g at birth died while only 3% of those who weighted between 2001-2499g died (Table 2).

“In the United States of America in the year 2000,

although infants who weighted less than 1500g at birth were only 1.4% of all live births, they constituted up to 50% of all deaths of new borns.

Approximately 25% of all infants weighting less than 1500grams died by age 1, compared to 2% of infants born at 1500-2499 grams and 0.3% of infants born at 2500grams or more<sup>7</sup> The story is the same in all parts of the world: smaller birthweights are associated with higher perinatal mortalities.

**Table 2: Mortality In 422 Low Birthweight Babies**

Weigh distribution (gramms)	Total Number	Number Died	Percentage
1000	20	18	90.0
1000 -1500	88	45	51.1
1501 -2000	178	22	12.4
2001 -2499	136	4	3.0
Total	422	89	21.1

**Morbidities In Low Birthweight Babies**

Do the problems of Low birthweight new borns end once the babies survive?

How do such neonates fare when they grow to become children and adults.

Unfortunately, here also, the story is not a good one as the impact of birthweight appears to extend well beyond infancy<sup>1</sup>. Baker in 1988 hypothesized that fetal under nutrition, for which low birthweight is a marker, may permanently programme the body, for example, by reducing the number of cells in specific organs, changing the distribution of cell types and influencing metabolic processes<sup>8</sup>. These programmed changes may be associated with a variety of chronic disease outcomes during adulthood and old age.

The diseases include **diabetes Mellitus** especially type 2 diabetes, hypertension and cardiovascular disease<sup>11</sup>. In addition, birthweight may affect physiological and developmental outcomes extending from infancy through childhood and into adulthood. Significant association has been found to exist between birthweight and school age disabilities<sup>12</sup>, behavioural problems<sup>13</sup>, school age reading and mathematics scores<sup>14,15</sup>, cognitive function during adulthood<sup>16</sup>, and reproductive outcomes such as low birthweights and pre term births <sup>18,19</sup>. Furthermore, low birthweight babies especially those born prematurely are at risk for a variety of neurological problems ranging from cerebnral palsy, mental retardation and vision problems from retinopathy. Hyperbilimbinaemia may also lead on to kemicterus.

**Causes Of Low Birthweight**

Earlier in this lecture we had indicated that low birthweight may be as a result of Intrauterine growth retardation, prematurity or both. However, it is not

always possible to identify an aetiological factor for a low birthweight especially those that are born small but at term. So, our approach here will be to examine, briefly, those factors that are associated with intrauterine growth retardation on one hand and pre-term labour on the other.

### **Intrauterine Growth Retardation (iugr)**

Several variables contribute ultimately to the weight of a new born baby.

The maximum growth potential for that particular fetus which is genetically determined is important and so also is the amount of nutrient which is transferred from the mother through the placenta to the fetus for growth and energy requirements. Slow fetal growth in the presence of a good supply of nutrients and energy across a normal placenta may be the result of genetic factors<sup>2</sup>. It is this supposition that probably accounts for some of the varying racial and ethnic differences in birthweights and for the smaller size of females at birth compared with males<sup>2</sup>. But fetal under nutrition which is rampant in developing countries where low birthweight is common, is the most important cause of IUGR. Fetal under nutrition results from poor maternal nutrition and health which often predate pregnancy and are accentuated by deprivation and lack of care in pregnancy. A poorly fed mother does not gain weight satisfactorily in pregnancy and failure to gain an average 0.4-0.5 kg per week especially in the last two trimesters can be taken as indicative of poor intrauterine fetal growth.

The issue of anaemia, especially in pregnancy (Hb < 11 g/dl), which deserves the next consideration in developing countries is tied up also with that of maternal nutrition as poorly fed mothers tend to be anaemic especially in the absence of disease conditions that predispose to bleeding. Malaria, with particular reference to falciparum malaria, which is endemic in all parts of Nigeria as in many other tropical countries, is an important contributor to fetal growth restriction and maternal anaemia which also bears on fetal outcome especially in primigravidae. The red cell haemolysis, folate deficiency and placental parasitization caused by repeated malarial infection in pregnancy, result in reduced oxygen carrying capacity by maternal red cells, fetal growth retardation and a compensatory placental hypertrophy.

Kidney and cardiovascular diseases which cause pre-eclampsia, hypertension and chronic renal disease cause inadequate placental function through their ability to damage maternal spiral vessels in the chorio-decidua space which reduces blood flow to the placenta.

### **Pre-term Births**

Three important causes stand out as major aetiological factors for preterm births. They are maternal ill health, trauma and uterine distension.

Any major illness of the mother especially if it is one of sudden onset in pregnancy and is associated with fever, dehydration and constitutional disturbances, like acute malaria, urinary tract infection or gastroenteritis can

cause an abortion or preterm labour. Also local infections in the birth canal like cervicitis or chorioamnionitis can weaken fetal membranes causing an early rupture of membranes, leading to premature labour.

Abdominal massage in pregnancy from TBAs is common in Nigeria. Even mothers who are booked for antenatal care often submit themselves to this practice as it is believed to be of some benefit to the baby in utero.

Unfortunately, the practice can lead to premature placental separation (abruptio placentae) and labour or even rupture of the gravid uterus. In addition, accidents, including those involving vehicles and motorbikes (Okada) and feuds are increasingly becoming sources of danger to pregnant women.

Finally to abdominal distention where I wish to observe that conditions that tend to overstretch the uterus, lead to premature labour polyhydramnios multiple pregnancy. Hydramnios may be associated with poorly controlled diabetes, placental tumour, fetal malformation or multiple pregnancy which is not uncommon from pregnancies that are obtained following In Vitro Fertilization (IVF) and Embryo Transfer (ET) techniques. Up to half of all twin pregnancies, 80% of triplet pregnancies and all quadruplets are of low birthweights. Babies born with weights and at periods that are close to normal are less affected by complications and so, survive better. On the other hand, extremely low birthweight babies who are also born very premature, do very badly even where highly sophisticated neonatal care that is backed up by the most modern medical technology is available. Finally, let it be noted that even when such sophisticated modern medical technology is used to salvage such babies, it does so at great expense to the tax payer. It is reported that in the United States, each year, pre-term deliveries cost about \$4.6 million more than babies born after 37 weeks of gestation and that rearing all low birthweight babies from infancy to 15 years of age costs \$5.5 billion to \$6 billion more than if they had been of normal birthweights<sup>20</sup>.

### **Prevention Of Low Birthweight The Place Of Prenatal Care**

The point was made earlier that the identification of specific aetiological causes in cases of low birthweights especially of low birthweight babies that are born at term is difficult. So, preventive measures that are directed to specific causes are not always feasible. But happily, the world literature on the issue of prevention of low birthweights is replete with information to the effect that genetic issues aside, women who have satisfactory pre-conception and prenatal care are less likely to have low birthweight babies. Preconception care here means the totality of the antecedents in the life of the would-be-mother, from her childhood days to the time she embarks on child bearing, while prenatal care or antenatal care indicates the nature of care and supervision she has in relation to the specific pregnancy. Girls who are born into families where they are wanted,

who live in a healthy and clean environment that reduces the chances of intercurrent infections from malaria, gastroenteritis and respiratory disease, who have adequate nutrition and potable water who avoid teenage as well as unwanted pregnancies, and who go to school and conclude secondary education, have good reproductive performance and outcomes when they eventually embark on childbearing. Such girls often attain their full growth potentials and also acquire good health-seeking behaviours which enable them to have good reproductive outcomes including the birth of normal sized babies.

As for prenatal or antenatal care, abundant evidence exists to confirm that it has a profound impact on reproductive outcome and although several studies have been undertaken on this subject matter, the findings of the Zaria Maternity Survey of 22,774 consecutive Hospital births, probably represents the best example in our setting. Of women who had never had any formal education nor received antenatal care, which was 33% of the survey population, maternal mortality was 29 per 1000 deliveries, perinatal mortality was 258 per 1000 total births and 26% of the babies were of low birthweight. With education and antenatal care combined, as was the case in 10% of the survey population, the maternal mortality rate was 2.5 per 1000 deliveries, perinatal mortality rate was 30 per 1000 total births, and only 8% of the babies were of low birthweight (Table 3). The antenatal care to which

**Table 3: Literacy, Antenatal Care & Obstetric Outcome Zaria Maternity Survey Of 22,774 Consecutive Birth\***

SOCIAL STATUS	MM Per 1000	PM Per 1000	LBW %
Illiterate, No ANC	29	258	26
Literate + ANC	2.5	0	8

\*Harrison, 1985

reference is being made here is not the sophisticated set up in which biochemical profiles of pregnant women including the values of their Pregnancy Associated Plasma Protein (PAPPA) can be measured. But one with the most basic of equipment and facilities. One or two rooms with a hard surfaced bed on which clean sheets can be spread, a sphygmomanometer and stethoscope for measuring, blood pressure and a weight and height scale for recording maternal height and weight. Then a convenience which could double as a sluice room for obtaining and examining urine specimens and also some equipment for haemocrit or haemoglobin estimation. A tape measure for assessing symphysio-fundal height and a Pinard fetal stethoscope complete the requirement. Such a set up should be run by a qualified midwife, free of charge and should be universally accessible to all pregnant women in the country. The midwife must give health talks including the tenets of Primary Health Care (PHC), the value of good personal hygiene, nutrition in pregnancy, the value of immunization to pregnant women and new born babies and also, the use of drugs

that are administered to pregnant women.

Furthermore, the mothers should be persuaded to have supervised confinements.

Such an antenatal care in addition to undertaking the delivery of uncomplicated normal pregnancies will isolate high risk mothers and transfer them to the Supervising General Hospitals. Antimalarial drugs, as well as iron and folic acid supplements which are known to reduce the incidence of low birthweight babies by as much as 16% as well as bringing about many other benefits to mother and baby, must be given throughout pregnancy. Such care even when all is well enables women to acquaint themselves with the hospital environment and practice and so they report early when things go wrong. This enables the medical team to respond to specific issues before they cause damage to mother or baby. Such examples include the management of pre-eclampsia, anaemia, the use of tocolytics for premature contractions, cervical stitch for incompetent cervix, and oral hygiene for periodontal disease.

The point that is being made in this part of the lecture is that the prevention of low birthweight involves a spectrum of care from a teenager not desiring pregnancy all the way to a pregnant mother-to-be and the birth of a child. It calls for a systematic approach to reproductive health care which ultimately affects babies outcomes. Women that have good reproductive care have lower rates of low birthweights<sup>22</sup>. In this respect, I wish to congratulate Her Excellency, Honourable Justice Mary Odili, the wife of the Executive Governor of Rivers State for founding The Adolescent Project (TAP) which has taken up the responsibility of looking after the reproductive health of adolescents in Rivers State.

Female literacy, preconception care and antenatal care including expert care during delivery hold the key to improved reproductive outcome including the lowering of the incidence of low birthweight babies.

## Conclusion

JB Lawson, as he was popularly known, in whose honour today's lecture is being held, was a foundation member of our great Society, SOGON. Together with men like our first president, the late Okoronkwo Ogan, and Moses Majekodunmi, he helped shape the direction of thinking of this Society which, among others, places optimum premium on the pursuit of the health of women and their children with all the resources at its disposal.

This alone justifies today's gathering and the repeated recourse to his name.

But he did more for the disciplined and vigorously, for SOGON, the touch-bearer of Women's Health in Nigeria, through his teaching and writings, the training of his colleagues and the establishment of a first class Department of Obstetrics and Gynaecology at the University of Ibadan where scholarship and research flourished. His book, **Lawson and Stewart's Obstetrics and Gynaecology in the Tropics and**

anaemia in pregnancy (Hb <6g/dl). The use of **Developing Countries** which was published By **Edward Arnold**, could rightly be regarded as the response of the developing world to **Monro Keer's Operative Obstetrics** from the developed World.

It was under his headship of department that Ibadan carried out some ground-breaking researches which are still of global relevance till this day. Some of these epoch making events deserve a brief mention. The identification of Hb 10g/dl as opposed to 11g/dl as defined by WHO, as the point at which anaemia in pregnancy becomes a clinical problem. Blood volume changes in anemia in pregnancy and the use of the transfusion of packed red cells along with a rapidly acting diuretic in the treatment of cases of severe methotrexate in cases of chorio carcinoma and the resultant massive improvement in prognosis. Use of malarial chemoprophylaxis in pregnancy. The introduction of family Planning in Nigeria. Vaginal delivery after one previous caesarean section. Twin Pregnancy in Yoruba land.

Furthermore, John Lawson trained scores and scores of Nigerians who are today occupying commanding heights in the discipline within and outside our country. At least four of our past presidents: the Rev. Adenuga, the late Wole Ojo, the late Vincent Aimakhu and Linus Ajabor as well as great names like Kelsey Harrison, the late Percy Nylander, Wole Akande, Tayo Ogunbode, Tunji Adeleye, Pat Ibezeakor, Tunde Adelusì all passed through him at one time or the other.

Although I did not train under him, I did so under Kelsey Harrison, a protégé of JB Lawson and Kelsey was never short of stories about John Lawson. So it was, we were told, that John Lawson was in the operating theatre one day when he was informed that two men had come from Administration to berate a staff nurse for not reacting to the query she had been sent regarding her inability to fill out her leave form properly. On hearing the news, John Lawson rushed out of the theatre, quickly changed his boots and

Grabbed the two men by their heads and pushed them out through the door of the theatre

Exclaiming "we are very busy here". That is my wish for SOGON to be very busy with the issues that touch on Women's Health Childbearing, Malignancies, infertility, fertility regulation and so on, for to my mind, there can be no better way of honouring the great John Lawson.

Thank you all for your attention.

## Reference

- Narayan Sastry, Jon Hussey [September 2002). Explaining Race and Ethnic -
- Disparities in Birthweights in Chicago Neighbourhoods". Rand, Labour and Population Program Working Paper Series 02-14.
- Oruamabo Raphael S. "Mortality in Infants of Birthweight 2500g and above: Hospital based review in Port Harcourt, Nigeria." *West Afr. J. Med.* 1993, 12:1, 34-39
- WHO Division of Family Health. @The incidence of low birthweight, A critical review of available information". *World Health Statistics Quarterly*, 1980, 33:197-224.
- David Osrin and Anthony Castelo. "Low birthweight in Maternity Care in Developing Countries". E.d. John B. Lawson, Kelsey A. Harrison and Staffan Bergstrom. RCOG Press Publishers.
- Oruamabo, RS, John, CT. "Antenatal Care and Fetal Outcome, especially low birth weight in Port Harcourt, Nigeria". *J. of Trop. Paed.* 1989, 3, 173-177.
- Child Health USA 2002. Maternal and Child Health Bureau. Health Status Infant. Very low birth weight. Baker, DJP, Molsers, "Babies and Disease in later life". Second Edition. 1998.
- Baker, DJP. Molsers, "Babies and Disease in later life" Second Edition. 1998. London. **BMJ Publishing Group**.
- Baker, DJP, Hales, CHD, Fall, C, Osmond, K and Clark, PMS "Type 2(non-insulin-dependent) diabetes mellitus, hypertension and hyperlipidaemia (Syndrom X): Relation to reduced fetal grow". *Diabetologia* 1993, 36:62-67
- Low, CM, MdeSwiet, C, Osmond et al, "Initiation of Hypertension in utero and its amplification through life". *BMJ* '993, 306:24-27
- ich-Edwards JW, Stamfer, MJ, Manson JE et al. Birthweight and the risk of cardiovascular disease in a cohort of Women followed up since 1976 *BMJ* 1997, 315:396-400.
- Avchen, Rachel Nonkin, Kerth G Scott and Nig. A Mason "Birthweight and school-age disabilities: a population-based study" *Am J. Epidemiol*-12001. 154:895-910
- Somerfeld, K, Ellersten, B, and Mark estad J., "Personallity and behaviour in eight-year old, non-handicapped children with birthweight under 1500g", *Acta paediatrica* 1993 82:723-728.
- Board man, JD, Powers, DA., Padilla, YC. And Hummer RA. "Low birth weight, soial factors and development outcomes amon children in the United States". *Demography* 2002 39:353-368
- Jefferis, BJ. MH., Power C and Hertzman C. "Birthweight, Childhood socioeconomic economic environment and cognitive development in the 1958 British Birth cohort study" *British Medical Journal* 2002. 325:1-6.
- Richards, M. Hardy R., Kuh, D. and Wadsworth, MEJ @Birthweight and cognitive function in the British 1946 birth cohort: Longitudinal population based study". *British Medical Journal*. 2001. 322:199-203
- Dattonl, and Bernett nG. "Is biology destiny? Birth weight and life chances" *American Sociological Review* 2000. 65:458-467.
- Wang, X., Zucherman, GA, Corwin MJ "Familillial aggress of low birth weight among whites and blacks in the United States." *New England Journal of Medicine* 1995. 333:1744-1749
- Porter, TF., Fraser AM, Hunter Cy, Ward RA and Varner MW. "Risk of Pre-term births across generations". *Obstetrics and Gynaecology* 1997. 90: 63-67.
- NCQA Health Choices. 2001. State of Managed Care Quality Report. Prenatal and Post-natal Care.

- 21 Parol Christian. Folic acid and iron supplement reduce risk of low birth weight. *British Medical Journal* , 2003; 326:571-574.
- 22 Dartmouth Medical School News. DMS Communicators (603)650-1492.