Maternal and environmental factors influencing infant birth weight in Ibadan, Nigeria

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Abstract

Fetal weight at birth is a major determinant of survival, physical growth and mental development of an infant. About 14 percent of all births in Nigeria are born with low birth weight. Studies on birth weight in Nigeria have focused mainly on the biomedical risk factors and have largely ignored the influence the socio-cultural environment which encompasses maternal knowledge, beliefs, and practices during the prenatal period. With the premise that birth weight shows a reverse social gradient, this study examined the effects of maternal, sociocultural and environmental factors on the birth weight of infants in Ibadan. The research adopted a prospective survey design method involving multistage sampling procedure to select 1,138 pregnant women accessing antenatal care services from both orthodox and community health providers. The instrument comprised structured questionnaire, and secondary data were generated from the patients' files retrieved from the antenatal care centres. The study identified a number of maternal, socioeconomic and environmental factors that significantly influence low birth weight and suggested actions that would help reduce the risk factors of low birth weight and promote care-seeking and demand for skilled care at all stages of pregnancy.

Keywords: Antenatal care, high risk pregnancy, skilled care, maternal health, birth weight.

Introduction

One of the salient slogans of the World Health Organization (WHO) is "Children's health is tomorrow's wealth." The concern for children's health and survival finds expression in the continuous monitor by WHO of low birth weight (LBW) worldwide as a public health indicator (UNICEF and WHO, 2004). The World Health Organization has defined low birth weight at birth as less than 2, 500 grams (2.5 kilograms 5.5 pounds) (WHO, 1992). This practical cutoff for international comparison is based on epidemiological observations that infants weighing less than 2.5 kilograms are approximately 25 to 30 times more likely to die than infants with birth weight exceeding this cutoff, and it increases sharply as birth weight decreases (Chang, 2003). More than 20 million infants worldwide, representing 15.5 percent of all births, are born with low birth weight – 95.6 percent of them in developing countries – making low birth weight (LBW) an important infant health problem in many populations. The 2008 Nigerian Demographic Health Survey estimates the incidence of low birth weight in Nigeria to be 14 percent (655 per 1,000), which however varies considerably across social and geographic areas (NPC & ORC Macro, 2009).

At birth, fetal weight is accepted as a parameter that is directly related to the health and nutrition of the mother as well as an important determinant of the chances of the newborn to survive and experience healthy growth and development. Birth weight also shows a reverse social gradient such that increasing disadvantage is associated with decreasing birth weight (Wilcox, 1992; Berney *et al*., 2000). The prenatal period is one of the most vulnerable in the human life cycle. During this period, the mother serves as a gatekeeper and child health is dependent on whether she admits into her own system those elements that are essential to a healthy pregnancy. These include adequate nutrition, timely medical care and sufficient education to make informed choices on behalf of her unborn child. It is also likely to play a key role in the production of social group's differences in infant survival because it is one of the strongest predictors of infant mortality risk (Kramer, 1987). The effect of low birth weight on infant mortality is not only additive but also interactive. The magnitude of the contribution of low birth weight to infant mortality is higher in developing countries given that the survival of such infants is dependent on environmental sanitation, effective post-natal nutrition and rehabilitation, and the availability of medical care (Mondal, 2000). Low birth weight remains a public health problem in many parts of the world and is associated with a range of heath problems, lasting disabilities and even deaths. One-half of low birth weight infants in industrialized countries are born preterm (<37 wk gestation), however, in the developing countries these children are born at term but are affected by intrauterine growth retardation that begins early in pregnancy (Ramakrishnan, 2004).

Pregnancy risk factors are all the aspects of pregnancy that endanger the life of the mother and the baby. These factors may include poor nutrition of the woman, child spacing, maternal age (under 15 years and over 35 years), inadequate prenatal care, lifestyle behaviours (e.g. smoking, alcohol consumption, drug abuse and unsafe sex), overweight, obesity and poverty (Wardlaw & Kessel, 2002). A study by Kazaura *et al.* (2006) reported that several risk factors influence neonatal mortality. These include parity, maternal age, race, marital status, smoking, birth weight, gestation age, labour complications, antenatal care, previous unfavourable outcomes (e.g. stillbirth, neonatal deaths), maternal morbidity (e.g. malaria and HIV infection) and poor socio-economic conditions. Poor nutritional status during pregnancy has been associated with irreversible damage to the infant brain and central nervous system leading to poor brain development and intelligence. There is ample evidence that obesity and non-communicable diseases, for instance, cardiovascular diseases start early in childhood (Wardlaw & Kessel, 2002).

A unifying framework in research

findings is the large maternal and socio-economic disparities in the birth weight of infants; in line with this, many authors have highlighted the importance of considering social and class factors in addition to biological ones to explain LBW. In particular, significant associations have been found between low socioeconomic status and low birth weight (Rodríguez *et al*., 1995; Lekea-Karanika *et al*., 1999). These socioeconomic differences have been found in many countries, even in those where access to prenatal care is universal (Kramer *et al*., 2000).

While it is important to describe the independent effects of different behavioral and socioeconomic risk factors, we must bear in mind that these factors are not isolated events in women's lives, but are a part of many interrelated and complex behaviour and environmental risks. Many of the known determinants of a baby's birth weight are not within a woman's immediate control. Clearly, the relationship between lifestyle risk factors and birth weight is complex and is affected by psychosocial, socioeconomic, and biological factors; it is also clear that birth weight outcomes are socially stratified. For many women in the developing world, economic, social and cultural factors make it difficult for them to obtain the necessary food and health care, which are closely interrelated. Some researchers consider that health, therefore, may be an important determinant of opportunities in life and this process termed 'selection by health', and suggest that health 'selects' people in different social strata (Wadworth, 1999).

Some of the major determinants of birth weight in developing countries include maternal nutritional status at conception, gestational weight gain in accordance with dietary intake, parental socioeconomic status, malaria, anemia, and chronic infections during pregnancy (Podja and Kelly, 2000; Koupilova *et al*., 2000; Kramer et al., 2001). Social demographers (Singh and Yu, 1996) have long emphasized the importance of "nonmedical" barriers – behavioural, social, environment, and economic – to good or adverse birth outcomes. Likewise, people's health occurs within cultural systems that are concerned with broader issues of well-being than addressed by the physician's concerns with disease and injury. Other environmental factors that have been identified include socio-cultural traditions and customs concerning pregnancy, access to good quality prenatal care, culturally embedded demands for unlimited numbers of children (Nwokocha, 2004).

Most research on birth weight outcomes in Nigeria have focused mainly on identifying risk factors of clinical/ medical importance. There are limited studies on socio-cultural risk factors, knowledge, beliefs and practices in relation to patterns of prenatal care seeking and maternal health behaviour as it influences infant birth weight. This present study is therefore designed to investigate the influence of maternal and environmental factors on infant birth weight in the city of Ibadan. In particular, the influence of nonmedical factors, such as socio-cultural and environmental settings and nutritional practices during pregnancy, are held constant in examining the effect of the conventional maternal variables. A study of this nature is important in view of the persistent high infant and child mortality in Nigeria and the need to identify critical variables that are amenable to appropriate intervention to enhance the survival and life chances of children.

Methods

The study was carried out in the city of Ibadan, the capital of Oyo State, Nigeria. A facility-based (multi-center) cross-sectional prospective survey was used to collect data from 1138 pregnant women. Three modalities of care: primary care settings, public hospitals, and private sources (private hospital, and faith-based maternity center). Six major health facilities at the primary, secondary, tertiary public and private levels of health care within Ibadan metropolis were purposively selected. A health facility was considered a major maternity center if its annual deliveries were $\geq$500 for a primary health center, and $\geq$1, 000 for secondary and tertiary health facilities. After a review of delivery registers across several antenatal centers, 1 primary health center, 1 secondary level private health facility, 2 secondary level public maternity hospitals, the only tertiary health facility in the city and 1 faith maternity center were selected. The average deliveries in the 2 years preceding the study were: primary health center (500), secondary maternity hospitals (1,500/750), the tertiary health facility (2000), the private secondary health facility (1, 100), and the faith-based maternity center (1,000). Ethical clearance was obtained from the University of Ibadan/ University College Hospital Institutional Review Committee before data collection commenced. Permission was also sought from each of the health facilities included in the study, using formal letters from the Department of Sociology, University of Ibadan and the Oyo State Ministry of Health.

The target population comprised pregnant women who attended the antenatal clinics intending to give birth in each facility. The number of participants selected from each health facility was based on the annual delivery rate. In each facility, participants were selected by simple random technique from the list of women visiting the antenatal centers for their appointments. Interviews were conducted on clinic days in the participating health facilities. The cohort of pregnant women was followed prospectively from recruitment into the study until delivery. The survey spanned a period of 6 months to allow for expected differences in the expected delivery dates (EDD) for the different women. Within the 6 months, repeated visits were made to each facility to record information from the patient files of the respondents. Samples were selected purposively following the inclusion and exclusion criteria. The inclusion criterion for the baby was being a live-birth singleton infant; exclusion criteria for the mothers were being non- antenatal care card holders, having still born babies, multiple pregnancies, and congenital abnormal babies.

Record appraisal format was used for reviewing the antenatal care cards. Maternal and family health history, obstetric history, expected delivery dates (EDD), gestational age (ultrasound assessment), medical complications since conception, and birth weight of the baby were extracted from the medical record of the individual respondents. Maternal ages, weight at enrollment during pregnancy, height, gravida status, parity, and any major illness at the time of enrollment of index pregnancy were linked by identification numbers. Neonatal data included date and year of birth, infant sex, and birth weight in kilograms (kg). These records were obtained by field teams under the supervision of medical record officers; and these records were collected cumulatively for all participants until delivery.

Information was collected from the mother for socioeconomic characteristics, obstetrical history, intake of iron and vitamins, knowledge on antenatal advice, danger signs of pregnancy and low birth weight in infants through face to face interview by structured interview form. The questionnaire was used to collect information from all women age 15-49 on background characteristics, birth history and childhood mortality, fertility preferences, knowledge and use of family planning methods, antenatal and delivery care, women's work and husband's background characteristics, household information, episodes of illness, dietary practices.

Household environmental factors include source of drinking water, time to water source, type of toilet facility, sharing of toilet facility, type of main flooring material of the household, type of cooking fuel and use of mosquito net. The socioeconomic factors include variables such as maternal educational level, paternal educational level, employment status of mothers and household index of the family. We assessed the amount of antenatal care utilization via Adequacy of Prenatal Care Utilization Index (APNCUI), which is based on observed and expected number of visits. We determined the expected number using the month of initiation of care and gestational age, based on the schedule of visits, as recommended by the American College of Obstetrics and Gynaecology (ACOG). Subsequently we calculated the ratio of observed to expected number of visits in order to obtain the four groupings of APNCUI: Adequate plus, Adequate, Intermediate, and Inadequate utilization of services (Kotelchuck, 1994).

In-depth interviews were conducted to assess maternal meanings, beliefs, knowledge, perception and attitudes towards practice and content of antenatal care received, cultural practices towards health care and nutrition during pregnancy, and their perception about the health of the fetus in termsof weight at birth.

Quality control of data was undertaken concurrently, daily or on day-after basis. Cleaning of data, checking for inconsistencies and elimination of errors were done before data coding and entry. The quantitative data were computer-processed and analyzed with relevant software. Simple descriptive analysis and Chi-Square test were conducted to determine the risk factors of low birth weight. Logistic regression analysis was used to assess relationship between LBW and maternal socio-cultural contexts, reproductive and health service related factors. The dependent variable, birth weight was categorized into "0" (normal birth weight $\leq$ 2.5kg) and "1" (low birth weight $\leq$ 2.5kg). For each independent variable, the category found to be at lowest risk in the odds of having a LBW baby in descriptive analyses was selected as the reference group and scored as '0' for constructing odds-ratios.Statistical significance was defined as $P < 0.05$.

Results

The data comprised 1,138 live singleton deliveries. The mean age of mothers was 28.7 years (±5.0 years) and the mean parity was 1.25. Teenage pregnancies occurred in only 2.8 per cent of births, whereas mothers of parity 5 and above accounted for 6 per cent. Mean maternal weight and height was 66.2 kg and 156.93 cm respectively. The mean month for initiation of antenatal care was 5.45 months which indicates that most mothers began antenatal care at about the end of the second trimester of pregnancy. The mean gestational age was 39.1 weeks, and it ranged between 32and 42 gestational weeks. The mean number of antenatal visits by mothers was 5.97 visits.

Table 1 below summarizes the distribution of newborns by bio-demographic characteristics. There were more male births than female births (53.1% vs 46.9%), which gives a sex ratio at birth of 113 males to 100 females. More than half of the children in this study are second born and above (65.5%), while only 36.5 percent are first born. The mean birth weight for the infants was 2.97kg (± 0.52kg) and ranged between 1.6 and 4.8kg; the majority (79.5%) had normal birth weight, and 20.5% (233) were low birth weight babies. Pre-term delivery index (<37 weeks) was 4.5 per cent (N = 51) and of this number, 48 (94.1%) weighed below 2.5kg. Among the 233 infants that were low birth weight, 185 (79.4%) were born at term, while 20.6% (48) were born pre-term.

Table 1 Bio-Demographic distribution of infants

Characteristics	Frequency (%)
Sex of Infant	n = 1138
Male	604 (53.1)
Female	534 (46.9)
Birth Order	**n = 1138**
First birth (1)	415 (36.5)
Second birth (2)	301 (26.4)
Third birth and above (3+)	127(37.1)
Birth Intervals	n = 773
1 - 24 months	501 (64.8)
25 – 36 months	145 (18.8)
37 months+	127 (16.4)
Birth Weight	**n = 1138**
Normal (2.5 kg+)	905 (79.5)
Low (≤ 2.4kg)	233 (20.5)
Mean	2.97kg (±0.52kg)
Gestation Length	**n = 1138**
Term (≥ 37 weeks)	1087 (95.5)
Preterm (<37 weeks)	51 (4.5)

The mean birth weight in this study (2.97 kg) is comparable to those found in other studies. In a Pakistani study conducted by Najmi (2000), the mean birth weight of 1156 neonates was 2.9 kg. These results were also comparable with the studies published for countries such as India (Tripathy *et al*., 2002; Mathai *et al*., 1996), Bangladesh (Dhar *et al*., 2002), Ghana (Klufio *et al*., 2001) and New Guinea (Dryden, 1997).

Table 2 Distribution of women with low and normal birth weight by maternal socioeconomic and household characteristics

Variable/Groups	LBW No (Row %)	NBW No (Row %)	X^2 (P)
Marital Status			
Married	190 (18.9)	815 (81.1)	13.002
Not Married	43 (32.3)	90 (67.7)	(.000)**
Educational Qualification			
No formal	3 (33.3)	6 (66.7)	10.90
Primary	41 (23.6)	133 (76.4)	(.000)**
Secondary	104 (24.0)	329 (76.0)	
Tertiary	85 (16.3)	437 (83.7)	
Type of House			
Single/Two Room(s)	154 (23.9)	491 (76.1)	10.57
Flat/Duplex	79 (16.0)	414 (84.0)	(.001)**
Source of Drinking water			
Well/Surface/Tanker	71 (30.0)	175 (70.0)	13.55
Pipe/Borehole/Bottled	162 (18.2)	730 (81.8)	(.000)**
Toilet Facilities			
Flush toilet	108 (16.7)	538 (83.3)	12.94
Pit/Latrine/Bush	125 (25.4)	367 (74.6)	(.000)**
Type of cooking fuel			
Electricity/Gas/Kerosene	64 (6.6)	97 (93.4)	42.79
Charcoal/Firewood/Straw	169 (10.5)	808 (89.5)	(.000)**
Use a Mosquito Net			
Yes	36 (19.4)	150 (80.4)	0.14
No	193 (20.3)	745 (79.7)	(.765)

**significance level (P<0.050); LBW = low birth weight; NBW = normal birth weight

Table 3 Distribution of infant birth weight by maternal bio-demographic **characteristics**

Characteristics	LBW (Row %)	NBW (Row %)	X^2 (P)
Maternal Age at Birth			
15-19	20(62.5)	12(37.5)	
20-24	56(28.9)	138(71.1)	60.8
25-29	93(16.7)	363(82.3)	(.000)**
30-34	43(13.3)	280(86.7)	Df=4
35+	41(26.8)	117(3.2)	
Parity of Mothers			
0	112(27.0)	303(73.0)	19.14
1-2	81(15.4)	445(84.60	(.000)**
3-6	40(20.3)	157(79.7)	Df=2
Sex of Child			
Male	105(17.4)	499(82.6)	11.27
Female	128(30.0)	406(70.0)	.004** Df=1
Weight of Mothers (Kg)			
40-49	9(47.4)	10(52.6)	
50-59	132(40.5)	194(59.5)	
60-69	60(14.4)	356(85.6)	131.93
70-79	23(9.2)	226(90.8)	(.000)**
80+	9(6.9)	122(93.1)	Df=4
Height of Mothers(CM)			
140 – 144	4(33.3)	8(66.7)	
145 – 149	51(46.4)	59(53.6)	
150 – 154	89(28.4)	202(71.6)	
155 – 159	65(17.6)	304(82.4)	90.77
160 – 164	16(7.2)	206(92.8)	(.000)**
165 – 170	12(11.1)	96(88.9)	Df=6
170 – 174	4(11.8)	30(88.2)	
Gestational Age at Delivery			
<37 weeks	48(94.1)	3(5.9)	177.8
$\geq$37 weeks	185(17.0)	992(83.0)	(.000)**
			Df=1

**significance level (P<0.050)

Table 2 shows the distribution of women by their infant birth weight status – proportions with a low birth weight (LBW) and a normal birth weight (NBW) baby – with respect to selected maternal socioeconomic and household environmental conditions. The results show that the relationship between all maternal socioeconomic and household variables and infant birth weight is significant except the use of mosquito net for sleeping. Generally these results indicate higher incidence of having low birth weight babies as a woman's socio-economic status declines. The proportion of women with low birth weight babies is higher among mothers who were not married, women who had below tertiary-level education, those who lived in households with one or two rooms and those whose source of drinking water was well/surface/tanker. Also, women whose households use charcoal/firewood/straw, and pit/latrine/ bush toilet facilities had a higher proportion of low birth weight babies.

Table 3 displays variations of birth weight as a function of maternal bio-demographic and antenatal care variables. The highest prevalence of low birth weight (about 63 percent) was observed among teenage mothers (15-19 years), and the proportion decreases as age increases until age 35 and above where about 27 percent of the women have low birth weight babies (X^2=60.8; P<0.05). The Table also shows that women having their first birth and those with 3-6 children are more likely to have low birth weight babies relative to those with 1-2 children. Clearly birth weight is influenced by the sex of a child; whereas about 17 percent of male babies were born with low birth weight 30 percent of female babies had low birth weight at birth. The result also shows that birth weight monotonically rises as mothers' weight increases; in other words, big mothers have big babies (X^2=131.93; $P<0.05$). Height of mothers also roughly shows the same general pattern; short women (140cm – 154cm) have smaller babies than tall women (160cm – 174 cm) (X^2=90.77; P<0.05). As expected, pre-term deliveries had a strong influence on birth weight. Mothers who had their babies before 37 weeks gestation had 94.1% of their babies in the LBW group as compared with 17% of those who had their babies after 37 weeks. All maternal characteristics shown in Table 3 were significantly related with infant birth weight (P<0.05).

The relationship between maternal antenatal behavioural variables and infant birth weight is analyzed in the Table 4. All the variables displayed in the Table were significantly associated with infant birth weight (P<0.05). Women who initiated antenatal care late, that is, in the third trimester of pregnancy (7-9 months), had 26.7% of their babies in the LBW group relative to about 20 percent and 9 percent of women who initiated ANC in the second and first trimester (X^2=13.39; P<0.05). Also about 27 percent of women with less than six antenatal care visits had low birth weight babies relative to 15 percent of those who had more than six ANC visits(X^2=23.6; P<0.05). Women who did not use prenatal supplement such as vitamin/mineral and iron folates, those who did not use anti-malaria drugs (IPT), and those who restricted their diet during pregnancy by observing some food taboo were more likely to have low birth weight infants. Likewise, women who presented no illness during pregnancy have bigger babies relative to those who had some illness; whereas 13.4 percent of the former had low birth weight babies, 38.3 percent of the latter did so.

Table 4 Distribution of infant birth weight by Maternal Antenatal care behaviours

Antenatal care Characteristics	LBW (Row %)	NBW (Row %)	X^2 (P)
Initiation of ANC			
1-3 Months	7 (8.5)	75 (91.5)	
4-6 Months	159 (19.8)	646 (80.2)	13.39
7-9 Months	67 (26.7)	184 (73.3)	(.000)**
Number of ANC visits			
<6	144 (26.6)	398 (73.4)	23.60
6	89 (14.9)	507 (85.1)	(.000)**
Use of Multivitamin Supplements			
No	174 (36.6)	301 (63.4)	130.71
Yes	59 (8.9)	604 (91.1)	(.000)**
Use Iron Folates			
No	182 (33.2)	367 (66.8)	104.68
Yes	51 (8.7)	538 (91.3)	(.000)**
Use of IPT			33.68
No	129 (29.2)	313 (70.8)	
Yes	104 (14.9)	592 (85.1)	(.000)**
Presence of Illness			
No	205 (36.8)	313 (70.8)	159.89
Yes	28 (4.8)	592 (85.1)	(.000)**
Observed Food Taboo			
No	124 (38.3)	200 (61.7)	88.11
Yes	109 (13.4)	705 (86.6)	(.000)**

**significance level (P<0.050)

Table 5 shows the results of logistic regression models for low birth weight, presented as odds ratios. The dependent variable, infant birth weight, was categorized into "0" (normal birth weight ≥ 2.5kg) and "1" (low birth weight ≥ 2.5kg). A risk odds ratio significantly greater than one indicates that women with a particular attribute are likely to have a low weight baby compared to those in the reference category, whereas an odds ratio less than one indicates that women with this attribute are likely to have a normal weight baby compared to those in the reference category.

The first model examines variations in birth weight as a function of maternal socio-demographic variables. This is the baseline model and the variables included maternal age, education, marital status, and household index. The latter variable was derived from household scores on type of house, type of toilet facilities, type of cooking fuel, and source of drinking water. The continuous scores formed by these, with the highest score of 18, were re-categorized into percentiles: 25th percentile which is low index (≤12.0); 50th percentile which is middle index (12.01-14.0); and 75th percentile which is the high index (14.1-18). The second model included maternal reproductive health factors. In the third model, maternal behavioural and antenatal care variables were added. Model 4 included all the variables in the previous models with the introduction of the illness variable.

Table 5 Logistic regression model for low birth weight

Variables/categories	Model 1	Model 2	Model 3	Model 4
Age of Respondents				
15-19	4.747**	3.828**(1.02,8.8	3.828** (0.83,	3.441** (1.06, 8.98)
20-34 (Ref.)	1.000	1.000	1.000	1.000
35+	1.960** (0.30,	2.874** (1.21,	2.784** (1.21,	2.332** (0.53, 13.52)
Maternal Level of Education				
Below Secondary	2.377** (1.19,	1.822** (1.03,	.287** (0.11, 0.54)	.307** (0.12,0.73)
Secondary	.916 (0.67, 1.62)	.852 (0.55, 1.45)	.492** (0.39, 1.24)	.435** (0.35, 1.29)
Tertiary (Ref.)	1.000	1.000	1.000	1.000
Marital Status				
Married (Ref.)	1.000	1.000	1.000	1.000
Not Married	5.994** (2.40,	3.504** (1.28,	5.213** (1.97,	5.048** (1.92, 7.63)
Household Index				
Low	1.066 (0.61, 1.66)	1.749 (1.28,	1.047 (0.50, 1.61)	1.319 (0.56, 2.14)
Middle	.873 (0.55, 1.45)	.782 (0.25, 2.49)	.782 (0.35, 1.03)	.495 (0.23,0.97)
High (Ref.)	1.000	1.000	1.000	1.000
Sex of Child				
Male (Ref)		1.000	1.000	1.000
Female		1.539** (1.17,	1.539** (1.01,	1.591** (1.05, 2.54)
Parity				
0		1.167 (0.28,	1.167 (0.75, 1.78)	1.054 (0.79, 2.22)
1-2 (Ref.)		1.000	1.000	1.000
3-6		1.398 (1.11.	1.398 (0.71, 1.74)	.913 (0.86, 0.90)
Maternal Weight		.936** (0.90,	.936**(0.91, 0.95)	.961** (0.92, 0.97)
Maternal Height		.931*** (0.89,	.931***(0.89, 0.96)	.930*** (0.88, 0.96)
Gestational Age at				
≥37 weeks (Ref.)			1.000	1.000
≤ 36 weeks			87.393**(20.39,29	46.967**
Initiation of ANC				
1-3 months (Ref.)			1.000	1.000
4-6 months			3.433** (1.38,	4.733** (1.97, 14.60)
7-9 months			4.026** (1.77, 12.01)	4.595** (1.81, 13. 69)
Number of ANC visits				
≤6 (Ref.)			1.000	1.000

>6	1.566** (1.11,	1.537 (1.06, 2.43)
Use of Vitamin		
No	2.967** (1.23,5.01)	2.784**(1.17,4.97)
Yes (Ref.)	1.000	1.000
Use of Iron folate		
No	3.678** (1.84,	4.157** (1.81, 5.51)
Yes (Ref.)	1.000	1.000
Use IPT		
No	.687 (0.41,1.05)	.732 (0.41, 1.25)
Yes (Ref.)	1.000	1.000
Observed Food Taboo		
No (Ref.)	1.000	1.000
Yes	2.945** (1.98,5.13)	2.726** (1.94, 5.11)
Presence of Illness		
Yes		41.189** (17.64, 100.17)
No (Ref.)		1.000

Table shows OR and CI in parentheses; ** Significant at < 0.05

Results from the Model 1 shows that mothers in age groups 15 - 19 (OR = 4.74 ; CI=2.87-8.45) and 35+ years (OR=1.96; CI=0.30-3.79) presented significantly increased odds of having a low birth weight infants compared to mothers aged 20- 34 years. The effect of maternal education had the expected direction, with mothers whose educational attainment was below secondary education having significantly higher risk for having a low weight baby (OR=2.37; CI=1.19-4.50); mothers with a secondary level education showed reduced odds of having a low weight baby (OR=0.91; CI=0.67-1.62) although it was not statistically significant. Mothers who were not in a formal union presented statistically significant increased odds of having a low weight baby (OR=5.99; CI=2.40-11.30). Low score in household index increased odds of having low birth weight babies (OR =1.06; CI=0.61-1.66), whereas medium score presented slightly reduced odds (OR=0.87; CI=0.55-1.45) although these are not statistically significant. Marital status of the mother was the strongest predictor of the odds of having a LBW baby in this first model; unmarried mothers are about six times more likely to have low birth weight baby relative to women who are currently married.

All maternal biological factors in Model 2, except maternal parity, were significant in predicting the odds of having a low birth weight infant. Female babies were significantly more likely to be low birth weight (OR =1.53, CI=1.17-2.00) relative to male babies. Weight and height of mothers were significantly related to the odds of having a normal weight baby. In other words, the higher the weight and height of women, the less likely they are to have low birth weight babies.

Model 3 includes the set of variables in the previous two models and controlled for maternal behavioural and antenatal care variables. Mothers who initiated antenatal care in the second

(OR=3.433; CI=1.38=10.29) and third trimester (OR=4.026; CI=1.77-12.01) had significantly increased odds of having low weight babies relative to mothers who initiated prenatal in the first trimester. Women who initiated antenatal care (ANC) in the second and third trimester are respectively 3.4 times and 4 times more likely to have low birth weight babies. Mothers who had less than 6 antenatal care visits also had increased odds for a low weight baby (OR=1.56; CI=1.11-2.79) compared to mothers who had at least 6 visits. Mothers who did not use vitamin/ mineral and iron supplements presented significantly increased odds of having a low weight baby compared to mothers who used them; they were approximately 3 and 4 times more likely to have LBW babies respectively. The result for the use of IPT for malaria surprisingly was in the inverse direction, with women who reported non-use of IPT having reduced odds for a LBW baby, but the result was not statistically significant. Mothers who observed some food taboo by avoiding particular food items were about 3 times more likely to have LBW babies. The gestational age at delivery index was the variable most strongly associated with the risk of having a low birth weight baby. Mothers who delivered before 37 completed weeks of gestation had a greatly increased odds (OR = 87. 39) of having a low weight baby compared to mothers who had a term pregnancy.

In the final model that included a measure of maternal health, women who reported suffering from health problems during their pregnancy had significantly increased odds (OR=41.18, CI=17.64-100.17) of having a LBW infant. The number of ANC visits ceases to be a significant predictor of low birth weight with the inclusion of the illness variable. In other words, the illness factor mitigates the effect of the number of ANC. The result for maternal education changed in the opposite direction with the inclusion of the prenatal variable in the third model; with mothers of below secondary and secondary level education having significantly reduced odds of having a low birth weight baby. A possible explanation could be that the content of antenatal care mitigates the effect of inadequate maternal education.

Discussion

This study was carried out to examine the influence of maternal and socio-environmental factors on infant birth weight in Ibadan. The main research question is how the socio-economic status of women and the context in which they live affect the birth weight of their babies as well as the pregnancy process. About one-fifth of 1,138 deliveries recorded in this study were low birth weight babies, with large variations along bio-demographic and socio-economic gradients. As expected, low birth weight deliveries were higher among babies whose gestation ages were below 37 full weeks. The finding underlines the effect intrauterine growth restriction rather than prematurity which is a common factor for low birth weight in developing countries. This could be due, among other unrecorded factors, to poor maternal nutrition and diet around and during pregnancy which adversely affect foetal and neonatal outcomes. Low gestation age was the variable that had the strongest association with low birth weight.

The relationship between all maternal socioeconomic and household variables and birth weight was significant except the use of mosquito net by sleeping by mothers. The likelihood of having infants with low birth weight was higher among mothers who were not married and mothers who had below tertiary-level education; mothers who lived in households with one/two rooms for sleeping, whose source of drinking water was well or surface water; mothers who use charcoal/firewood/straw for cooking, and used pit/latrine/bush toilet facilities. The higher risk of giving birth to low birth weight babies by mothers who are not in marital unions compared with married ones reflects the importance of socioeconomic support on maternal health and birth outcomes.

The use of logistic analysis showed the net effects of socio-economic factors, bio-demographic and prenatal care factors on predicting infant birth weight. Four models were included in the analysis. Significant risk factors for delivering a low birth weight infant include maternal age less than 25 years, first parity, maternal weight and height, late initiation of antenatal care, preterm delivery, presence of illness, and use of dietary supplements. Pre-term delivery was found to be the major factor affecting low birth weight rate, the influence of the other maternal factors is distinctly lower.

The findings showed that the odds of having a low birth weight baby was significantly higher among teenage mothers (15-19) and older women (35+), mothers with below secondary education, and mothers who were not in a marital union. However, the effect of education changed in the inverse direction with the inclusion of other variables, indicating that better educated mothers prefer to have smaller babies. Having a pre-term delivery has the highest odds of predicting infant birth weight. Initiating prenatal care after the first trimester, non- usage of prenatal supplements, and restricting diets, were significantly associated with the odds of having a low weight baby. The inclusion of socioeconomic index did not change the above results. Mothers in the high socioeconomic group had a slightly lower odd of having a weight baby than mothers in the other socioeconomic index categories; although it was not statistically significant.

The inclusion of maternal behaviour and prenatal care variables changes the pattern of the relation shown by maternal education in the first two models. Women with secondary education or below have a significantly lower likelihood of having a low birth weight baby relative to those with tertiary education. Women with higher education are probably more precautious about their weight during pregnancy as well as the weight of their babies, and try to avoid having big babies. Being more educated, they have more access to information and are more aware of the disadvantages of having big babies, such as having a tear during child delivery or having an episiotomy. The result of the final model implies that the disparities in birth weight observed among the respondents could be drastically reduced if there is less disparity in the socio-economic and prenatal care variables. The results suggest adequate utilization of prenatal care is important to infant birth weight and that the effects of socioeconomic characteristics of the community on infant birth weight are mediated through their effects on utilization of prenatal care and access to a medical facility.

Conclusion

This study provides empirical support for the links that exist between maternal health and prenatal behavioural variables and infant birth weight: maternal weight and height (anthropometric variables), maternal age, parity, gestational age, initiation of ANC and use of prenatal supplements. The results corroborate findings of several other studies, which underscore the association between anthropometric and reproductive variables and birth outcomes.

More importantly, this study contributes to the understanding of the individual and collective effect of maternal, socio-cultural and environmental factors influencing infant birth weight in Ibadan. It identified that maternal health behaviour in the prenatal period is shaped by factors working in her immediate environment comprising the socio-cultural endpoints. It also identified the level of maternal knowledge and perception about infant birth weight and thus highlighted possible areas of intervention to promote better health outcomes for pregnant women. An emergent theme from the in-depth interviews and focus group discussion carried out with the respondents suggests that infant birth weight per se is not perceived to be a critical determinant of newborn health or well-being, nor a trigger for care seeking during pregnancy.

This study shows that bio-demographic and prenatal care variables have the strongest influence in determining the birth weight of a baby among respondents in the study. However, Socio-economic and demographic factors are significantly associated with prenatal care, which is one of the behavioural factors associated with low birth weight. Low socio-economic status may be a social cause of other nutritional, toxic, anthropometric, or infectious factors that may themselves be causal factors of low birth weight in infants. Also, the influence of social class may be exerted through intermediate factors, which may be biologic, such as maternal weight, parity, and age; or may be environmental, such as stress and inadequate prenatal care utilization.

It is suggested that programmes that work to reduce the rate of low birth weight infants should focus on improving maternal lifestyle choices by increasing access, utilization and quality of care, while addressing the intractable socio-economic disparities that continue to indirectly contribute to the incidence of low birth weight. Socio-cultural factors influenced the growth of foetus and outcomes of pregnancies. Most women lacked knowledge of the pregnancy risk factors that adversely affect infant birth weight, and the exact mechanisms by which the risk factors act to cause the adverse effects. Intervention programmes and behaviour change communication during pregnancy should focus on significant risk factors associated with low birth weight, and target pregnant women at risk. Health education for pregnant women should be strengthened to promote care-seeking and demand for skilled care at all stages of maternity. This way healthier infants are produced who have a better chance of surviving and becoming tomorrow's wealth.

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