Prevalence and Correlates of Low Birth Weight and Preterm Birth among Kenyan Women

Sudeep Karki

A thesis

submitted in partial fulfillment of the

requirements for the degree of

Master of Public Health

University of Washington

2016

Committee:

Grace C. John-Stewart

Judd Walson

Program Authorized to Offer Degree:

School of Public Health – Department of Global Health

University of Washington

Abstract

Prevalence and Correlates of Low Birth Weight and Preterm Birth among Kenyan Women

Sudeep Karki

Chair of the Supervisory Committee:

Grace C. John-Stewart, MD, MPH, PhD

Division of Allergy and Infectious Diseases, Department of Medicine, Epidemiology, Global Health, and Pediatrics

Background: Preterm birth is a major cause of infant morbidity and mortality, particularly in sub-Saharan Africa. We determined the prevalence and risk factors of preterm birth (PTB) and low birth weight (LBW) among mother-infant pairs attending 6-week immunization visits in Kenya.

Methods: This analysis used data from a nationally representative cross-sectional survey of mother-infant pairs attending week 6 infant immunization visits conducted June-December 2013 at 120 maternal child health (MCH) clinics across Kenya. Facilities were selected using probability proportionate to size sampling. Singleton infants with the MCH booklet-verified infant birth weight were included in the analysis. Logistic regression models were used to determine potential correlates of PTB and

LBW. All analyses were weighted to ensure representativeness and to account for the complex sampling design.

Results: Overall, 656 mother-infant pairs out of 691 were included in this analysis (94.9% of all mother-infant pairs attending 6 week visits), of whom 55 (8.4%) were HIV-positive. The mean maternal age was 25 years (95% CI: 24.8-25.8) and mothers had a mean of 10 years (95% CI: 9.7-10.4) of education; 71.4% of women had annual household income ≤10,000 Ksh (US$ 97.85). The reported prevalence of PTB was 20.8% (14.8-28.5) and LBW was 3.7% (2.6-5.4). Prevalence of PTB and LBW were significantly higher among HIV-positive than HIV-negative mothers (LBW 9.8% vs. 3.2%, PTB 32.1%, p=0.005 vs. 19.8%, p=0.02 respectively). In multivariate analyses, maternal HIV infection was significantly associated with both PTB (aOR=2.7, 95% CI: 1.1-6.3, P=0.03) and LBW (aOR=1.9, 95% CI: 1.1-3.4, P=0.02) while household income ≤10,000 was a significant correlate of PTB (aOR=2.7, 95% CI: 1.4-5.0, P=0.002), and maternal weight was a significant correlate of LBW (aOR=0.9, 95% CI=0.9-0.9, P=0.03).

Conclusion: Maternal sociodemographic, nutritional and HIV status were associated with the adverse birth outcomes. HIV prevention and management strategies and maternal nutritional supplementation in the perinatal period may be important interventions to reduce PTB and LBW.

Acknowledgements

Firstly, I would like to express my sincere gratitude to my thesis Chair Prof. Grace C. John-Stewart for the continuous support of my Master's thesis, for her patience, motivation, and immense knowledge. Her guidance helped me in all the time of research and writing of this thesis. I could not have imagined having a better advisor and mentor for my Master's thesis.

Besides my thesis chair, I would like to thank my thesis committee: Prof. Judd Walson for his insightful comments and encouragement. My sincere thanks also goes to my mentor and friend Jillian Pintye for sharing expertise, and sincere and valuable guidance and encouragement extended to me.

I take this opportunity to express gratitude to all of the Department of Global Health faculty members, staffs (Jennifer Tee) and friends for their help and support. Last but not the least, I would like to thank my family: my parents and to my wife for supporting me spiritually throughout writing this thesis and my life in general.

Table of Contents

I. Background and Rationale:

Globally, an estimated 20 million infants are LBW representing 15.5% of all births, and almost all (95.6%) LBW infants are born in developing countries.[1] There are 15 million PTB annually, and more than 1 million of infants born preterm die due to early complications.[2] The rate of PTB is increasing, particularly in sub-Saharan Africa and South Asia where over 60% of global PTBs occur.[2] PTB is the major cause of LBW because infants born early have had insufficient gestational time to accrue weight, though both conditions independently contribute to infant morbidity and mortality and can exist in the absence of one another. Pathogenesis of preterm labor is not well understood, but may be the result of pathological insults resulting in early idiopathic activation of parturition onset.[8] Multiple mechanisms are thought to initiate the preterm labor, including infection or inflammation from infectious diseases, including malaria, HIV and sexually transmitted infections, stress and other immunologically mediated processes.[8] As many of these risk factors result in systematic inflammation, increasing stimulation of the 'inflammatory pathway' might explain the association between PTBs and multiple risk factors.[8] As biological mechanisms for PTB are elucidated, further data on risk factors in high burden settings could help identify mothers at increased risk for PTB, particularly in sub-Saharan Africa where the majority of HIV-infected women of reproductive age live.[18,20]

Previous studies on PTB in sub-Saharan Africa have found that maternal low income, and education, prenatal smoking and young or older age (<19 years and ≥35 years) are associated with increased risk for PTB.[11-13] Additionally, mothers who experience psychological or social stress during pregnancy are at an estimated ~2-fold increased risk

of PTB.[8-10] Other obstetric characteristics reported by previous studies to be associated with PTB include early pregnancy bleeding, history of previous stillbirth, high parity, fewer antenatal care (ANC) visits, history of previous abortion, and nulliparity.[14-18] Maternal nutritional factors including shorter height (<150 cm), low absolute body weight (<45 kg), low mid-upper arm circumference (MUAC) (<23 cm) and low BMI are associated with increased risk of adverse pregnancy outcomes, including PTB.[10-21] Several studies have also implicated maternal infectious diseases as a risk factor for PTB in sub-Saharan Africa, including malaria and its treatment, HIV, cytomegalovirus, sexually transmitted infections including trichomoniasis, gonorrhea, and chlamydia[21-22] and periodontal disease.[49]

Less is known about risk factors for LBW, independent of PTB, in sub-Saharan Africa. Socio-demographic and behavioral maternal correlates of LBW found in previous studies include smoking, low education and income, inadequate prenatal care and younger/older age.[30-34] Similar to PTB, poor maternal nutritional status has also been associated with LBW in sub-Saharan Africa.[32-34]LBW has also been associated with prenatal infectious diseases such as malaria, HIV, helminthic infections, and genitourinary tract infections.[30-34] Environmental factors such as maternal exposure to air pollutants[35-37] and untreated drinking water[38] are also associated with both LBW and PTB.

Rationale:

Identifying risk factors for LBW and PTB in the context of high HIV prevalence could help identify mothers at high risk and inform intervention planning efforts. Understanding whether HIV modifies the effect of risk factors for PTB and LBW would further benefit antenatal care programs that care for HIV-infected women who are at increased for poor

obstetric outcomes. This study primarily aimed to determine the prevalence and correlates of LBW and PTB in a nationally representative survey from Kenya. We also aims to compare correlates of LBW and PTB in HIV-infected and uninfected mothers to determine whether HIV modifies the effect of correlates on LBW and PTB. The results of the study will be useful for public health policies and programs for prevention of PTB and LBW and may provide indicators to identify women at elevated risk for these outcomes.

II. Methodology:

The study used data from a national cross-sectional survey on PMTCT in Kenya.

a) Study Design:

This was cross-sectional study nested within a public health evaluation of Kenya's national PMTCT program. The parent study evaluated the effectiveness of the national PMTCT program by sampling mother-infant pairs at large maternal-child health facilities across Kenya. The parent study used probability proportionate-to-size sampling to randomly sample 120 facilities among all maternal-child health facilities in Kenya that had >1000 ANC clients per annum.

b) Study Population and Procedure:

Mobile teams including a nurse and a laboratory technician visited the 120 sites and evaluated mother-infant pairs coming for routine 6 week immunizations. Following written informed consent, a questionnaire was administered to assess information on maternal and infant socio-demographic, medical characteristics. The 120 sites included all the 7 provinces: COSTAL, CENTRAL, RIFT VALLEY, WESTERN, EASTERN, NAIROBI and

NYANZA. The study data is based on self-report and verified by the mother's Maternal & Child Health (MCH) Booklet, a form of clinical records used in Kenya.

c) Outcome:

Low birth weight (LBW) (Dichotomous; YES if <2500 g; NO if ≥2500 g) using infant birth weight confirmed in MCH booklet.

Preterm birth (PTB) (Dichotomous; Yes if <37 weeks; No if ≥ 37 weeks) using gestational age at birth confirmed in MCH booklet.

Mobile team administering the questionnaire on birth weight and gestational age validated the mother's self-reported information with the data on MCH booklet.

d) Inclusion Criteria:

Singleton infants with the MCH booklet-verified infant birth weight were included in the analysis. The study used data from the subset of mothers whose infant birth weight and gestational age were verified by MCH Booklet. Mother-infant pairs with twin birth, birth weight and gestational age not verified by MCH booklet and unknown maternal HIV status were excluded from the study to validate as well as increase the accuracy of self-reported data. Figure 1 shows the study sample selection flow diagram.

e) Statistical Methods:

Descriptive Analysis:

The prevalence of LBW and PTB was determined and a 95% confidence interval estimated using the weights for survey design.

Comparison of low birth weight and preterm birth prevalence between HIV infected and uninfected mothers:

Mean birthweight and estimated gestational age were compared between HIV infected and uninfected mothers using t-test weighted for survey design. Logistic regression models weighted for survey design were used to examine the association between LBW and PTB (dichotomous variable) and maternal HIV status as well as other potential correlates.

Correlates of low birth weight and preterm birth:

Maternal age has been associated with LBW and PTB.[3,5,14,15] We hypothesized that adolescent or older mothers (<21 or >40 years) would be more likely to have LBW and PTB. Age was modeled as a continuous variable and categorized (>24 years: adult, ≤24 years: young adult, <21 years: adolescent) to separate adolescent from older mothers.

Maternal education has been found to be determinant of LBW and PTB.[6,7,17] We hypothesized that mothers with a lower level of education would be more likely to have LBW and PTB. Education was modeled as ordinal variable (Primary, Secondary/Higher) to separate low level from high level of education.

Maternal body mass index (BMI) [4,11,12,34] and MUAC[17] are significant cofactors of LBW and PTB. BMI and MUAC were modeled as categorical variable using the WHO recommended cut-offs (BMI kg/m2: <18.5 underweight ≥18.5 normal, MUAC cm: ≤23 malnourished, >23 normal).[39-40] The number of ANC visits has been associated with LBW and PTB.[17] ANC visit number was modeled as continuous variable.

Chi square tests (weighted for survey design) for proportions and t-tests (weighted for survey design) for continuous measures were used to detect differences in characteristics for LBW versus no LBW and PTB versus no PTB. Logistic regression models weighted for survey design were used to estimate associations of relevant correlates with LBW and PTB. Variables which were significant at P <0.05 in bivariate analysis, and known confounders were considered for the multivariate analysis using a multiple logistic regression mode weighted for survey design. The assessment of CD4 cell count, ART and ARVs during pregnancy was restricted to HIV-infected women. Further, Wald tests using logistic regression model were used to assess whether HIV status modified the effect of correlates found to be significant in the univariate analyses on PTB and LBW

Data were analyzed with STATA 13.1/MP for Windows (Stata Corporation, College Station, TX, USA).

III. Results:

a) Baseline Characteristics:

Overall, 656 mother-infant pairs out of 691 were included in this analysis (94.9% of all mother-infant pairs attending 6 week visits), of whom 55 (8.4%) were HIV-positive. Table 1 shows the characteristics of women in the study. The mean age of mothers was 25 years (95% CI: 24.8-25.8). The mean years of education was 10 (95% CI: 9.7-10.4), 37.3% of women were employed, and 71.4% had household income ≤10,000 Ksh. Fifty percent of women reported more than 1 lifetime sexual partner and 12.7% of women reported intimate partner violence (IPV) during pregnancy.

Overall, 4.0% had a BMI <18.5 kg/m^2 and were classified as underweight and 11.9% had MUAC ≤ 23 cm and were classified as malnourished.

The mean number of pregnancies was 2 (95% CI: 2.1-2.4) per women. All 656 women had one or more pregnancy, 58.0% reported that their most recent pregnancy was intended. Among the 656 births, 93.9% were institutional deliveries (89.6% PTB and 92.1% LBW). Overall, 11.9% of deliveries were via caesarean section. (11.5% PTB and 26.2% LBW) The mean number of ANC visits during pregnancy was 3 (95% CI: 3.5-3.8) and while most (79.4%) received iron supplementation, only 25.9% of women received multivitamins during pregnancy.

Overall, 2.2%, 2.1% and 0.6% of women reported history of TB, sexually transmitted diseases (STDs) and syphilis, respectively. A minority (19.8%) received intermittent preventive treatment (IPT) for malaria and 56.9% were dewormed during pregnancy. Among HIV positive women, 33.3% had CD4 cell count ≤350 cells/ul, 35.9% of women received HAART before pregnancy and 89.4% received other antiretrovirals (ARVs) for PMTCT during pregnancy.

Mean gestational age at birth was 38.4 weeks (95% CI: 38.12-38.67) and mean birthweight was 3.3 kgs (3.2-3.3) (Figure 2, 3). The overall prevalence of LBW was 3.7% (95% CI: 2.6-5.4) while PTB was 20.8% (95% CI: 14.8-28.5). PTB prevalence was 32.1% among HIV-positive mothers versus 19.8% among HIV-negative mothers (p=0.02). LBW prevalence was also higher among HIV-positive mothers compared to those that were HIV-negative (9.8% vs 3.2%, respectively, p=0.005). The mean absolute birth weight was also significantly lower among HIV-positive mothers (3.1 kg vs. 3.3 kg among HIV-positive

vs. HIV-negative, respectively, p=0.01). Similarly, mean gestational age was lower in HIV-positive mothers (37.8 weeks) compared to HIV-negative mothers (38.4 weeks, p=0.08) (Table 5).

b) Correlates of PTB and LBW

Risk factors associated with preterm delivery and low birth weight using univariate analysis are presented in Table 2. Lower family income was associated with PTB (OR=2.8, 95%CI=1.5-5.3, p=0.001) while this was not significant for LBW. Maternal age, and education were not significantly associated with LBW. There was a significant inverse association between LBW and maternal weight (OR=0.9, 95% CI=0.9-0.9, P=0.03).

Though we did not see a significant association between MUAC or deworming with the adverse birth outcomes (PTB, LBW), there were trends for association of these covariates with increased risk of PTB and LBW. An increased risk of LBW was found among HIV-positive mothers compared to mother that were HIV-negative (OR=3.3, 95% CI: 1.4-8.0; P=0.008). A significantly increased risk of PTB was also found among HIV-positive mothers (OR=1.9, 95% CI: 1.08-3.41; P=0.03).

c) Multivariate Analyses of Correlates of PTB and LBW:

After adjustment for maternal HIV infection and weight, HIV infection remained associated with increased risk of LBW (aOR=1.9, 9% CI: 1.1-3.4, P=0.02, Table 3). Maternal weight was not significantly associated with risk of LBW in adjusted analyses.

After adjustment for maternal income, HIV infection was associated with nearly a 3-fold higher likelihood of PTB (aOR=2.7, 95% CI: 1.1-6.3, P=0.03). Mothers with lower income

(≤10,000 Ksh) also had an increased likelihood of PTB in multivariate analysis (aOR=2.7, 95% CI: 1.4-5.0, P=0.002)

Finally, there was no evidence of effect modification by HIV status on correlates of LBW or PTB (Table 4).

IV. Discussion:

In this nationally representative survey of mother-infant pairs attending 6-week immunizations in Kenya, we found that the prevalence of PTB was high and associated with maternal nutritional status and HIV infection. We also found that income was a significant risk factor for PTB and LBW in this population. PTB is a major cause of infant mortality, resulting in more than 50.0% of infant deaths globally and our results provide useful information for MCH planners in settings with high burden of HIV and adverse birth outcomes.[2]

Global estimates of PTB (WHO 2010) and LBW (UNICEF 2004) show varied rates of PTB between countries, with higher rates in sub-Saharan Africa.[1,2] The WHO estimated PTB prevalence in Kenya was 12.3% in 2010 and UNICEF estimates of LBW was 8% in 2012. The WHO estimated PTB rate from national registries or statistical offices and reproductive health surveys. In the WHO study, 37 weeks was used as the cut-off for PTB. Our study determined higher PTB prevalence (20.8%) than WHO estimates. One reason for this discrepancy may be differences in estimating gestational age as the WHO study was restricted to datasets that contained information on gestational age measured by last menstrual period, ultrasound, or clinical assessment and vital status. In our study,

gestational age was abstracted from data on MCH cards, which was self-reported by mothers at the first well child visit. Another reason might be that the majority of women in our study had low income (≤10,000 Ksh 71.4%), which was associated with almost 3-fold increase risk in PTB. It is also possible that mothers with adverse birth outcome were more likely to visit the MCH clinics in the current study. Conversely, because mother-infant pairs in our survey were sampled at 6 weeks of age, this would exclude infants with LBW or PTB who may have died prior to 6 weeks, leading to underestimated LBW or PTB rates.

Our findings of an association between maternal HIV and PTB and LBW are consistent with previous studies that have suggested that HIV influences risk of LBW and PTB.[7,21-23,27,28,33,43] While almost all women used antiretrovirals for PMTCT prophylaxis, not all used HAART. Several studies have noted that HAART in pregnancy, particularly using protease inhibitors is associated with increased risk of PTB and LBW.[22-29] A prospective observational study in Tanzania demonstrated an increased risk of adverse birth outcomes associated with the use of ART during pregnancy.[25] While some studies have found differences in PTB rates based on ART regimen, others have not; in addition, specific ART drugs such as protease-inhibitor based regimen may be more likely to increase risk of PTB than other ART regimens.[26-28] While, a systematic review on use of ART in pregnant HIV-infected women suggests that ART during pregnancy is not associated with an overall increased risk of PTB, it concluded that combination regimens before or early in pregnancy may slightly increase the risk of prematurity.[29] We did not find an association with ART use among HIV-positive women and PTB or LBW, though our population of HIV-positive women was relatively small. Future prospective studies

with larger cohorts will be important to investigate associations between ART and specific regimens and adverse infant outcomes.

We found that maternal weight was inversely associated with LBW, consistent with other studies. Low maternal weight has been associated with cause of early rupture of membranes and intrauterine growth leading to PTB and, as a result LBW. A number of studies have shown increased risk of LBW among underweight (BMI<18.5 kg/m^2) mothers.[14,21,34,46,47] We did not find an association between maternal underweight (BMI<18.5 kg/m^2) and PTB, LBW, despite an association between maternal weight and LBW. Only a few number of women were underweight in this cohort (4.0%) and very few received macronutrient supplementation which might be the reason failing to detect an association. Previous studies have shown that socioeconomic status plays a role in increasing the risk of PTB.[14,48] Our study found an almost 3-fold higher odds of PTB among lower income (≤10,000 Ksh) mothers compared to higher income mothers. This association might be due to medical comorbidities or lack of antenatal/prenatal care among lower income families. Women who receive prenatal care are screened for malnutrition, anemia, STDs and they are also treated for these conditions, which may reduce the risk of PTB. However, we did not find that number of antenatal visits was associated with PTB and most services in public sector clinics in Kenya are provided at no charge. Income and nutrition were independently associated with PTB suggesting that other factors are responsible for the association between income and PTB in this cohort. Studies have found that young or older maternal age is also associated with increased risk of PTB and LBW.[3,44,45] We did not find an age association in this survey. In the current study 73.0% of women were between 21 and 40 years, with fewer

adolescent and older women. There might also be other unmeasured or incompletely ascertained confounders such as parity, education, income, nutritional status and residential location that might have possibly biased the estimates.

Our study had several limitations. We limited evaluation to singleton livebirths and excluded stillbirths. Because evaluation was among 6 week postnatal attendees, the study excluded early neonatal deaths and likely underestimated the true burden of PTB and LBW. The current study also relied mostly on self-reported data raising concerns of bias. Since, the mothers were interviewed after delivery, our study might be limited by recall bias like number of sex partners before/during pregnancy, intimate partner violence before/during pregnancy, intended or unintended pregnancy, antenatal care visits, and weight gain during pregnancy and history of STD. The analysis excludes infants who did not have MCH booklet available (21%) at the time of the survey, who may have been higher risk infants. Because weights were abstracted from MCH booklet, these are not as good as primary weight ascertainment at the time of survey and may vary by facility. The analysis only considers LBW and PTB but not small for gestational age (SGA) or intrauterine growth retardation (IUGR), which may be more informative endpoints. The analysis involves secondary data from a cross-sectional study which limits amount of data/information, time and resources to precisely investigate the relation. Health-conscious women may be more likely to initiate postpartum visits leading to self-selection bias. Also, our analysis includes infants that made it to 6 weeks after birth and therefore they are not representative of all PTB cases. The main strength of the current study was its large sample size and wide coverage nationally throughout Kenya. Use of MCH

booklet to verify the self-reported data was useful to validate data and decrease potential bias and inaccuracy.

We have shown that nutritional and HIV infection and socioeconomic status are risk factors of LBW and PTB. Investigating the risk factors associated with LBW and PTB is useful for planning prevention strategies to reduce infant mortality and provides insights into the mechanisms of PTB and LBW. These data are useful to design effective interventions to reduce infant mortality and morbidity. More research to define role of HIV, ART, and nutrition supplements are needed.

V. Figures and Tables

Figure 1. Flow Diagram of Sample Selection

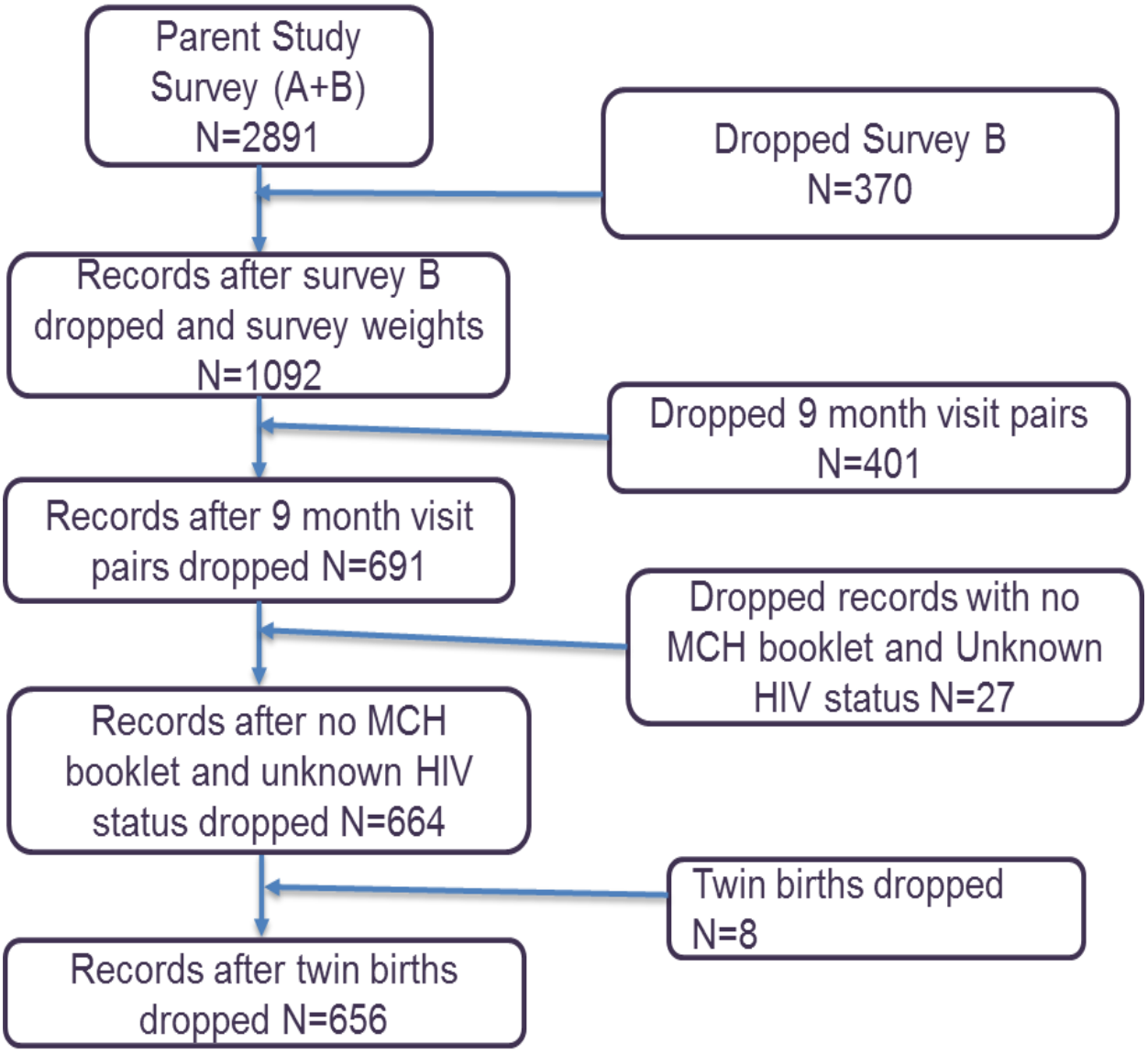


Table 1: Characteristics of mother-infant pairs with documented birth data

Characteristics	% or Mean N=656	95% CI
Sociodemographic		
Age		
Years, Mean	25.29	24.80-25.78
>24 years (adult)	49.86	45.69-54.03
≤24 years (young adult)	29.73	26.23-33.48
<21 years (adolescent)	20.41	17.02-24.27
Education		
Years, Mean	10.03	9.68-10.37
None	4.22	2.57-6.84
Primary	43.24	39.14-47.55
Secondary/Higher	52.54	47.89-57.14
Employed	37.28	32.79-42.00
Income ≤10,000 Ksh	71.37	64.38-77.48
Untreated water	37.80	32.41-43.52
Firewood use	35.49	28.39-43.29
Partner characteristics		
Married	89.64	87.11-91.72
Lifetime # partners >1	49.85	44.29-55.41
Intimate partner violence	12.72	9.83-16.31
Obstetric history		
Prior pregnancies, Mean	2.22	2.09-2.36
Prior live births, Mean	2.82	2.66-2.99
Prior stillbirths ≥1	3.28	2.01-5.32
Prior miscarriages ≥1	10.88	8.85-13.32
Current pregnancy intended	58.00	52.41-63.39

Characteristics	% or Mean N=656	95% CI
Maternal Nutrition		
Maternal weight (kg), Mean	61.18	60.28-62.08
Maternal height (cm), Mean	160.04	158.82-161.26
Maternal MUAC, MUAC ≤23 (cm)	11.95	7.92-17.64
Maternal BMI <18.5 kg/m^2 (underweight)	4.01	2.34-6.77
Maternal medical history		
TB history	2.19	1.36-3.52
STD history	2.05	1.12-3.73
Syphilis	0.56	0.17-1.79
Maternal antenatal and labor care		
Number of ANC visits, Mean	3.62	3.48-3.76
Nutritional supplementation, Yes	0.77	0.34-1.74
Multivitamins	25.89	19.10-34.08
Iron supplementation, Yes	79.41	71.93-85.30
Malaria prophylaxis (IPT)	19.76	14.31-26.64
Deworming	56.90	45.90-67.25
Home delivery	6.04	4.05-8.92
Cesarean section	11.97	9.31-15.27
Maternal HIV		
HIV infected	8.37	6.03-11.50
CD4 count ≤350 cells/ml	33.26	17.32-54.24
HAART before pregnancy	35.90	23.29 – 50.80
ARV during pregnancy	89.38	68.67-97.00

Table 2: Baseline Characteristics with univariate analysis

Characteristics	LBW % or Mean (95% CI) N= 31	No LBW % or mean (95% CI) N=625	OR (95% CI)	p-value	PTB % or Mean (95% CI) N= 136	No PTB % or Mean (95% CI) N= 520	OR (95% CI)	p-value
Sociodemographic								
Age								
>24 years	39.00 (25.42-54.52)	50.28 (45.95-54.61)	ref		42.24 (34.56-50.32)	51.86 (47.21-56.47)	ref	
≤24 years (young adult)	32.84 (20.64-47.91)	29.61 (26.02-33.47)	1.43 (0.71-2.91)	0.32	35.61 (27.51-44.65)	28.19 (24.49-32.21)	1.55 (0.99-2.43)	0.06
<21 years (adolescent)	28.16 (15.21-46.14)	20.11 (16.65-24.08)	1.80 (0.75-4.35)	0.2	22.14 (16.31-29.33)	19.95 (16.27-24.23)	1.36 (0.88-2.11)	0.16
Education								
None	8.90 (2.18-29.75)	4.04 (2.41-6.71)	ref		5.05 (2.41-10.31)	4.00 (2.20-7.30)	ref	
Primary	59.93 (41.51-75.92)	42.6 (38.35-46.96)	0.64 (0.14-2.94)	0.6	47.46 (37.56-57.56)	42.14 (37.62-46.79)	0.89 (0.3-2.59)	0.8
Secondary/Higher	31.21 (16.62-50.81)	53.36 (48.71-57.96)	0.27 (0.05-1.35)	0.1	47.49 (37.87-57.31)	53.86 (48.85-58.81)	0.70 (0.25-1.90)	0.49
Employed	34.97 (18.77-55.58)	37.37 (32.75-42.23)	0.90 (0.38-2.16)	0.8	39.04 (29.79-49.16)	36.81 (32.01-41.88)	1.10 (0.71-1.71)	0.67
Income ≤10,000 Ksh	69.92 (46.31-86.24)	71.42 (64.24-77.67)	0.93 (0.33-2.62)	0.89	85.51 (76.5-91.45)	67.60 (60.11-74.30)	2.83 (1.51-5.31)	0.001*
Untreated water	49.05 (31.46-66.88)	37.37 (31.85-43.24)	1.61 (0.75-3.51)	0.22	41.02 (31.11-51.72)	36.96 (31.13-43.21)	1.19 (0.71-1.91)	0.47
Firewood use	35.07 (17.53-57.86)	35.50 (28.32-43.41)	0.98 (0.39-2.51)	0.97	36.61 (21.71-54.62)	35.19 (28.00-43.13)	1.06 (0.51-2.26)	0.9

Characteristics	LBW % or Mean (95% CI) N= 31	No LBW % or mean (95% CI) N=625	OR (95% CI)	p-value	PTB % or Mean (95% CI) N= 136	No PTB % or Mean (95% CI) N= 520	OR (95% CI)	p-value
Partner characteristics								
Married	87.13 (71.07-94.91)	89.73 (87.04-91.92)	0.77 (0.26-2.32)	0.65	90.88 (83.95-94.99)	89.31 (86.37-91.68)	1.19 (0.58-2.45)	0.63
Lifetime # partners >1	58.67 (38.98-75.93)	49.52 (43.95-55.09)	1.45 (0.66-3.15)	0.35	41.42 (30.41-53.36)	52.07 (46.26-57.82)	0.65 (0.39-1.11)	0.1
Intimate partner violence	16.19 (6.71-34.21)	12.59 (9.69-16.21)	1.34 (0.51-3.61)	0.56	14.41 (7.89-24.87)	12.28 (9.25-16.13)	1.20 (0.57-2.53)	0.6
Obstetric history								
Prior pregnancies ≥1	2.15 (1.58-2.72)	2.23 (2.09-2.36)	0.96 (0.73-1.27)	0.8	2.44 (2.15-2.72)	2.17 (2.01-2.32)	1.12 (0.98-1.28)	0.1
Prior live births ≥1	2.92 (2.18-3.66)	2.82 (2.66-2.98)	1.05 (0.74-1.51)	0.8	2.80 (2.55-3.05)	2.83 (2.63-3.03)	0.99 (0.83-1.17)	0.86
Prior stillbirths ≥1	0.14 (-0.81-0.37)	0.04 (0.02-0.06)	1.87 (0.74-4.74)	0.18	0.04 (0.01-0.07)	0.05 (0.02-0.07)	0.88 (0.48-1.62)	0.67
Prior miscarriages ≥1	0.13 (-0.03-0.29)	0.16 (0.12-0.21)	0.90 (0.45-1.81)	0.8	0.18 (0.11-0.26)	0.15 (0.10-0.21)	1.09 (0.81-1.40)	0.5
Current pregnancy intended	47.97 (31.39-65.01)	58.39 (52.71-63.86)	0.66 (0.32-1.33)	0.24	62.37 (49.85-73.43)	56.87 (51-62.55)	1.26 (0.73-2.17)	0.41
Maternal Nutrition								
Maternal weight, mean	57.22 (53.88-60.56)	61.33 (60.42-62.24)	0.95 (0.91-0.99)	0.03*	60.50 (58.80-62.20)	61.40 (60.41-62.35)	0.99 (0.97-1.01)	0.4
Maternal height, mean	158.37 (154.64-162.11)	160.10 (158.86-161.35)	0.98 (0.93-1.03)	0.36	160.05 (158.53-161.56)	160.04 (158.65-161.42)	1.00 (0.98-1.03)	0.99
Maternal MUAC ≤23 (cm)	23.62 (11.24-43.03)	11.50 (7.51-17.31)	2.38 (0.91-6.25)	0.08	6.09 (2.81-12.74)	13.49 (8.96-19.82)	0.55 (0.21-1.21)	0.1
Maternal BMI <18.5 kg/m^2 (underweight)	2.51 (0.37-14.98)	4.06 (2.35-6.94)	0.61 (0.08-4.58)	0.63	5.11 (1.66-14.67)	3.72 (2.17-6.29)	1.39 (0.43-4.54)	0.58

Characteristics	LBW % or Mean (95% CI) N= 31	No LBW % or mean (95% CI) N=625	OR (95% CI)	p-value	PTB % or Mean (95% CI) N= 136	No PTB % or Mean (95% CI) N= 520	OR (95% CI)	p-value
Maternal medical history								
TB history	6.85 (1.7-23.36)	2.01 (1.18-3.41)	3.59 (0.74-17.45)	0.11	3.28 (1.45-7.26)	1.9 (1.03-3.5)	1.75 (0.6-5.14)	0.3
STD history	0	2.13 (1.16-3.9)	0		3.12 (1.2-7.78)	1.77 (0.8-3.84)	1.8 (0.5-6.4)	0.4
Syphilis	0	0.58 (0.2-1.86)	0		0	0.71 (0.22-2.26)	0	
Maternal antenatal and labor care								
Number of ANC visits, Mean	3.74 (3.13-4.36)	3.62 (3.47-3.76)	1.07 (0.79-1.45)	0.67	3.49 (3.26-3.71)	3.66 (3.51-3.81)	0.9 (0.80-1.04)	0.17
Nutritional supplementation	0	0.80 (0.35-1.80)	0		0.57 (0.08-4.09)	0.82 (0.33-2.01)	0.69 (0.08-6.25)	0.74
Iron supplementation	89.95 (66.12-97.62)	79.02 (71.59-84.92)	2.38 (0.58-9.78)	0.23	84.45 (70.11-92.64)	78.01 (69.95-84.38)	1.50 (0.65-3.62)	0.33
Malaria prophylaxis	19.42 (14.10-26.22)	28.39 (14.22-48.67)	1.61 (0.74-3.65)	0.22	23.62 (14.54-35.98)	18.74 (12.97-26.32)	1.30 (0.69-2.59)	0.38
Deworming	76.20 (48.8-91.48)	56.14 (45.35-66.38)	2.50 (0.88-7.10)	0.08	72.34 (51.41-86.6)	52.89 (41.55-63.93)	2.33 (0.90-6.01)	0.08
Home delivery	7.89 (2.66-21.2)	5.97 (3.97-8.88)	1.35 (0.43-4.26)	0.6	10.43 (4.90-20.79)	4.89 (3.15-7.50)	2.26 (0.91-5.63)	0.08
Cesarean section	26.24 (11.47-49.42)	11.42 (8.75-14.77)	2.76 (0.95-8.04)	0.06	11.46 (7.11-17.98)	12.1 (9.01-16.08)	0.94 (0.50-1.77)	0.85
Maternal HIV								
HIV infected	22.06 (10.47-40.65)	7.84 (5.61-10.85)	3.33 (1.38-8.012)	0.008*	12.93 (8.78-18.63)	7.17 (4.7-10.75)	1.91 (1.08-3.41)	0.03*
CD4 count** ≤350 cells/ml	0	36.86 (19.81-57.97)	0		36.08 (13.05-67.99)	31.97 (14.61-56.35)	1.2 (0.25-5.67)	0.8
HAART before pregnancy**	16.00 (6.14-35.69)	2.50 (1.41-4.42)	5.64 (0.68-46.7)	0.1	5.78 (2.51-12.77)	2.28 (1.25-4.11)	1.70 (0.41-7.44)	0.4
ARV during pregnancy**	100.00	88.81 (67.16-96.85)	0		86.87 (41.19-98.43)	90.42 (64.14-98.03)	0.70 (0.04-11.47)	0.8

****The assessment of CD4 cell count, HAART and antiretroviral therapy (ARV) during pregnancy was restricted to HIV-infected women.**

Table 3: Multivariate analysis

Low Birth Weight

Characteristics	aOR (95% CI)	P-Value
Maternal weight	0.99 (0.97-1.01)	0.4
Mother HIV-infected	1.90 (1.10-3.40)	0.02

Preterm Birth

Characteristics	aOR (95% CI)	P-Value
Income ≤10,000 Ksh	2.69 (1.44-5.04)	0.002
Mother HIV infected	2.65 (1.11-6.34)	0.03

Table 4: Effect modification by maternal HIV status

Characteristics	Low Birth Weight		
	HIV Positive, OR (95% CI)	HIV Negative, OR (95% CI)	P-Value (interaction)
Maternal weight	0.99 (0.93-1.06)	0.93 (0.88-0.98)	0.249
Characteristics	**Preterm**		
	HIV Positive, OR (95% CI)	**HIV Negative, OR (95% CI)**	**P-Value (interaction)**
Income (10,000 Ksh)	2.93 (0.43-19.84)	0.29 (0.14-0.62)	0.09

Figure 2: Prevalence of Low Birth Weight and Preterm Birth

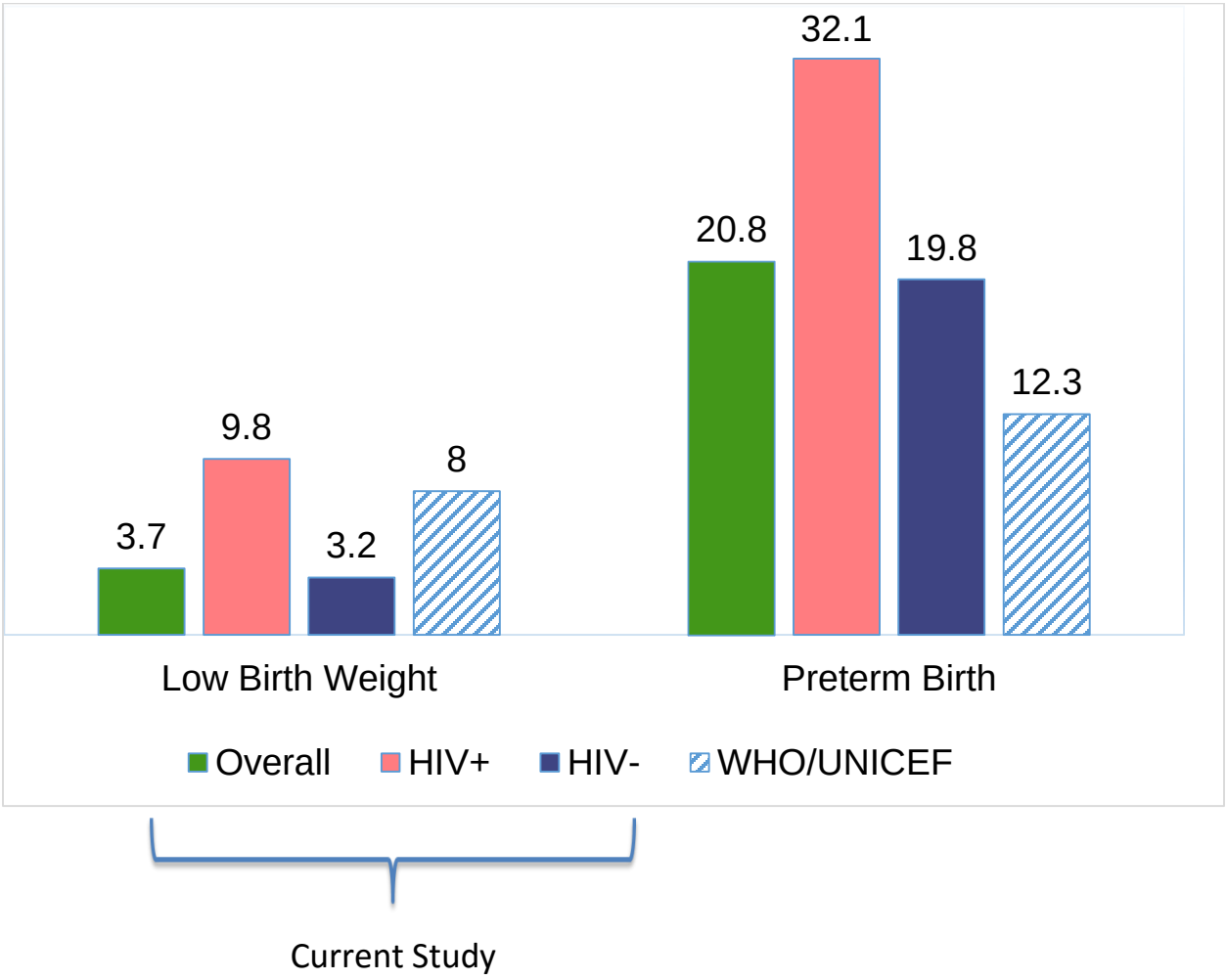


Table 5: Mean birth weight and gestational age between HIV + and HIV -

Characteristics	HIV Positive Mean (95% CI) N= 55	HIV Negative Mean (95% CI) N= 601	P-Value
Infant Birth Weight	3.10 (2.94 – 3.23)	3.30 (3.22 – 3.33)	0.01
Infant Gestational Age	37.84 (37.14 – 38.55)	38.44 (38.17 – 38.71)	0.08

Figure 2: Histogram of Gestational Age in Weeks

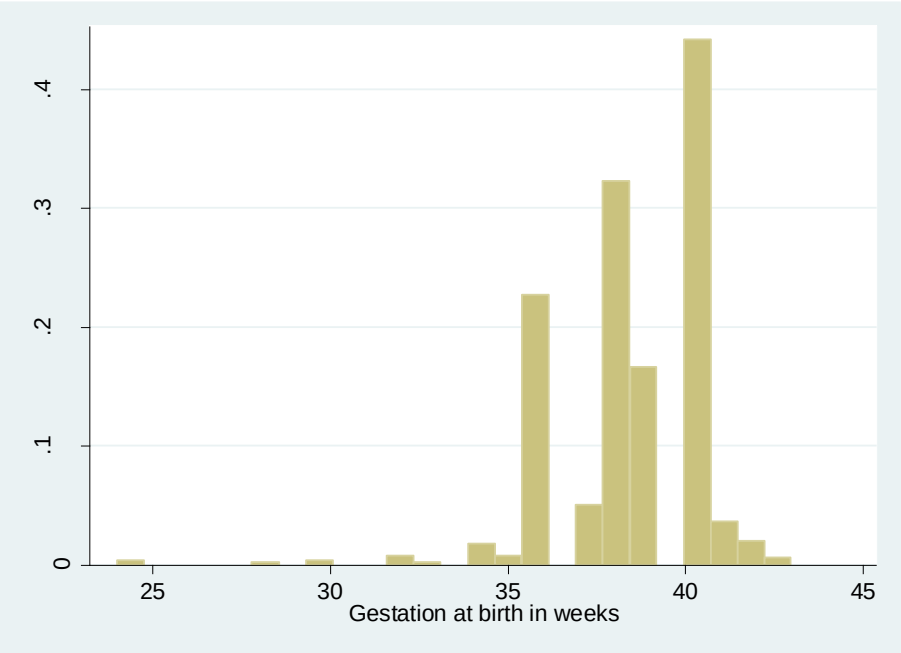
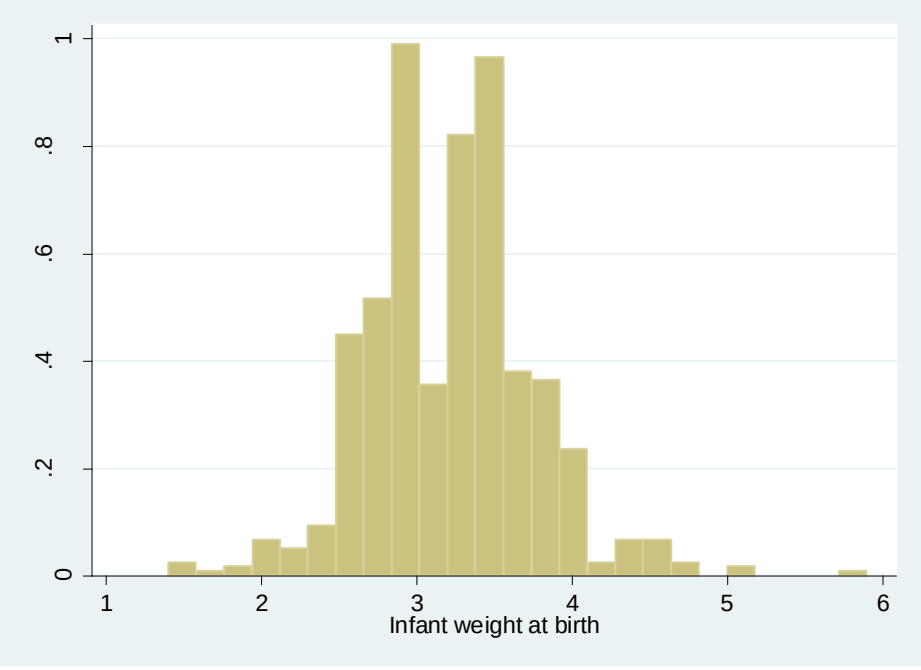
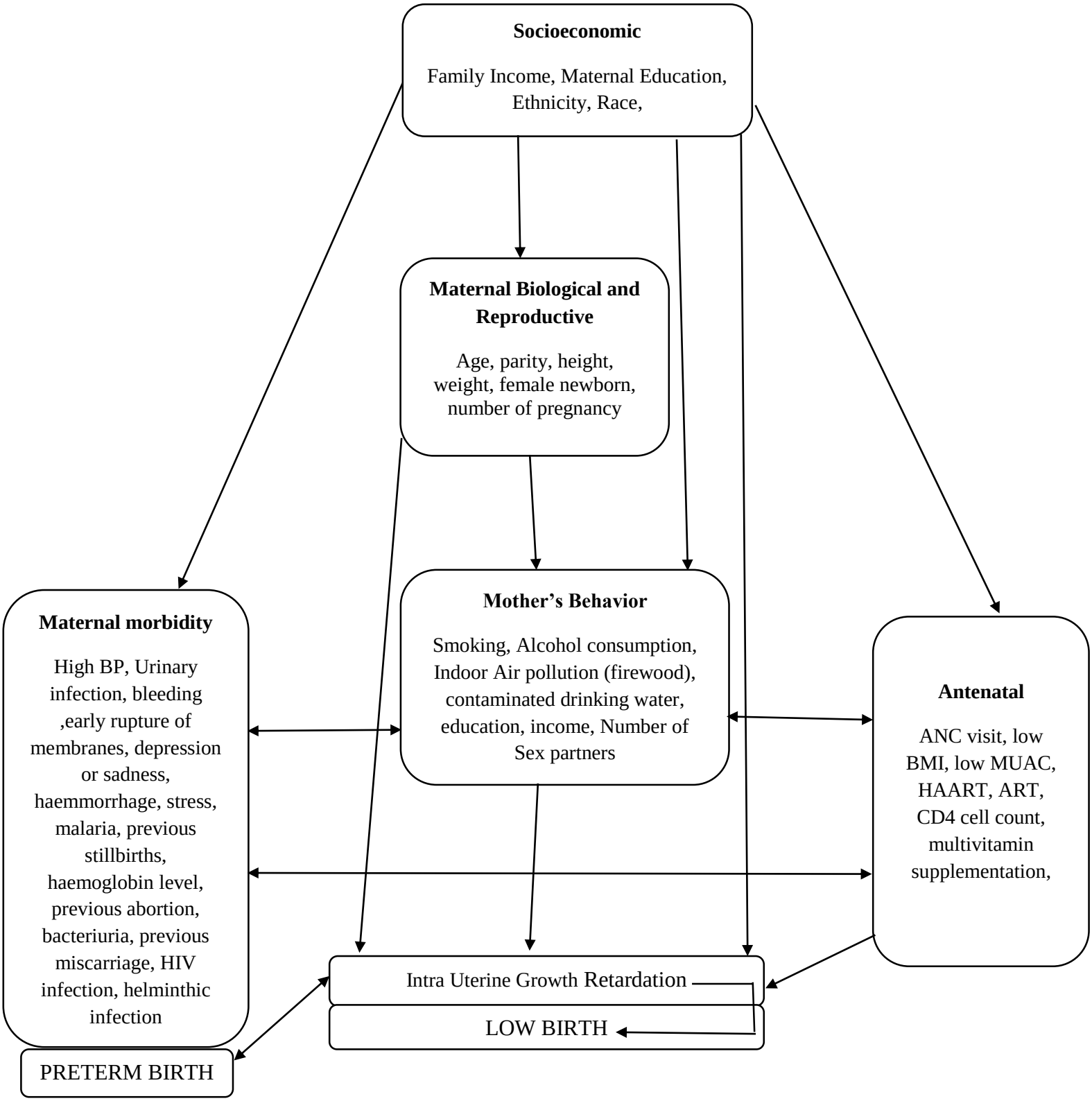


Figure 3: Histogram of Birth Weight in Gram



VI. Conceptual Model:



VII. Reference:

1. United Nations Children's Fund and World Health Organization: **Low Birthweight: Country, regional and global estimates.** UNICEF, New York, 2004
2. **Born too soon: the global action report on preterm birth**: World Health Organization 2012
3. Caroline H D Fall, Harshpal Singh Sachdev, Clive Osmond, Maria Clara Restrepo-Mendez, Cesar Victora, Reynaldo Martorell, Aryeh D Stein, Shikha Sinha, Nikhil Tandon, Linda Adair, Isabelita Bas, Shane Norris, Linda M Richter, and the COHORTS investigators: **Association between maternal age at childbirth and child and adult outcomes in the off spring: a prospective study in five low-income and middle-income countries (COHORTS collaboration)** Lancet Glob Health 2015, 3: e366–7
4. Hendler I, Goldenberg RL, Mercer BM, Iams JD, Meis PJ, Moawad AH, MacPherson CA, Caritis SN, Miodovnik M, Menard KM, Thurnau GR, Sorokin Y: **The Preterm Prediction Study: association between maternal body mass index and spontaneous and indicated preterm birth.** Am J Obstet Gynecol. 2005 Mar, **192**(3):882-6.
5. da Silva AA, Simões VM, Barbieri MA, Bettiol H, Lamy-Filho F, Coimbra LC, et al: **Young maternal age and preterm birth.** Paediatr Perinat Epidemiol. 2003, **17**(4):332–9.
6. Krymko H, Bashiri A, Smolin A, Sheiner E, Bar-David J, Shoham-Vardi I, et al: **Risk factors for recurrent preterm delivery.** Eur J Obstet Gynecol Reprod Biol. 2004,**113**(2):160–3
7. Bekana Kebede, Gashaw Andargie, Abebaw Gebeyehu: **Birth outcome and correlates of low birth weight and preterm delivery among infants born to HIV-infected women in public hospitals of Northwest Ethiopia**. Vol.5, No.7A4, 25-34 (2013)
8. Goldenberg Robert L, Culhane Jennifer F, Iams Jay D, Romero Roberto: **Epidemiology and causes of preterm birth.** The Lancet, 2008, Vol.371(9606), pp.75-84
9. Copper RL, Goldenberg RL, Das A, et al: **The preterm prediction study: maternal stress is associated with spontaneous preterm birth at less than thirty-five weeks gestation.** Am J Obstet Gynecol 1996, 175: 1286–92.
10. Lobel M, Dunkerl-Schetter C, Scrimshaw SC: **Prenatal maternal stress and prematurity: a prospective study of socioeconomically disadvantaged women.** Health Psychol 1992, 11: 32–40.
11. Y Neggers, RL Goldenberg: **Some thoughts on body mass index, micronutrient intakes and pregnancy outcome.** J Nutr, 133 (2003), pp. 1737S–1740S

12. RL Goldenberg, T Tamura: **Prepregnancy weight and pregnancy outcome.** JAMA, 275 (1996), pp. 1127–1128
13. Passini Renato, Cecatti Jose, Lajos Giuliane, Tedesco Ricardo, Nomura Marcelo, Dias Tabata, Haddad Samira, Rehder Patricia, Pacagnella Rodolfo, Costa Maria, Sousa, Maria. Brazilian Multicentre Study on Preterm Birth (EMIP): **Prevalence and Factors Associated with Spontaneous Preterm Birth**. PLoS One, Oct 2014, Vol.9(10), p.e109069
14. Meis Paul J, Michielutte Robert, Peters Tim J, Wells H.Bradley, Sands R.Evan, Coles E.C, Johns K.A: **Factors associated with preterm birth in Cardiff, Wales: I. Univariable and multivariable analysis.** American Journal of Obstetrics and Gynecology, 1995, Vol.173(2), pp.590-596
15. Martius Joachim A, Steck Thomas, Oehler Martin K, Wulf Karl-H: **Risk factors associated with preterm (<37+0 weeks) and early preterm birth (<32+0 weeks): univariate and multivariate analysis of 106 345 singleton births from the 1994 statewide perinatal survey of Bavaria.** European Journal of Obstetrics and Gynecology, 1998, Vol.80(2), pp.183-189
16. Kalanda B. F, Verhoeff F. H, Chimsuku L, Harper G, Brabin B. J: **Adverse Birth Outcomes in a Malarious Area Epidemiology and Infection.** 1 June 2006, Vol.134(3), pp.659-666
17. Shah R, Mullany LC, Darmstadt Gl, Mannan I, Rahman SM, Talukder Rr, Applegate Ja, Begum N, Mitra D, El Arifeen S, Baqui Ah: **Incidence and risk factors of preterm birth in a rural Bangladeshi cohort**. BMC Pediatrics 2014, 14:112 doi:10.1186/1471-2431-14-112
18. Broek R, Jean-Baptiste Rachel, Neilson James: **Factors Associated with Preterm, Early Preterm and Late Preterm Birth in Malawi**. PLoS One, Mar 2014, Vol.9(3)
19. Kruger, H S: **Maternal anthropometry and pregnancy outcomes: a proposal for the monitoring of pregnancy weight gain in outpatient clinics in South Africa** Curationis 2005, Vol.28(4), pp.40-9
20. UNAIDS, **Joint United Nations Programme on HIV/AIDS (UNAIDS). The Gap Report. 2014;** ISBN 978-92-9253-062-4. UNAIDS/JC2656 (English original, July 2014, updated September 2014) **http://www.unaids.org/en/media/unaids/contentassets/documents/unaidspublication/2014/UNAIDS_Gap_rep ort_en.pdf**
21. Yu L., Li W.Y., Chen R.Y., Tang Z.R., Pang J., Gui X.Z., Meng X.N. and Zhang F.J. (2012): **Pregnancy out- comes and risk factors for low birth weight and preterm delivery among HIV-infected pregnant women in Guang- xi, China.** Chinese Medical Journal, 125, 403-409.

22. Chen, J. (2009): **Risk factors for adverse pregnancy out- comes among HIV infected women in Gaborone, Botswana.** 16th Conference on Retroviruses and Opportunistic Infections, Montreal, 2009.
23. Machado E.S.H.C., Costa T.T., et al. (2009): **Pregnancy outcome in women infected with HIV-1 receiving com- bination antiretroviral therapy before versus after conception.** Sex Transm Infect. 2009 Apr; 85(2): 82–87.
24. Townsend Cl, Cortina-Borja M, Peckham CS, Tookey PA: **Antiretroviral therapy and premature delivery in diagnosed HIV-infected women in the United Kingdom and Ireland.** Aids, 2007 May 11, Vol.21(8), pp.1019-1026
25. Nan Li, Mary Mwanyika Sando, Donna Spiegelman, Ellen Hertzmark, Enju Liu, David Sando, Lameck Machumi, Guerino Chalamilla, and Wafaie Fawzi: **Antiretroviral Therapy in Relation to Birth Outcomes among HIV-infected Women: A Cohort Study.** The Journal of Infectious Disease 2015: jiv389v1-jiv389.
26. Cotter Amanda M, Garcia Adolfo Gonzalez, Duthely M Lunthita, Luke, Barbara, O'Sullivan Mary J: **Is antiretroviral therapy during pregnancy associated with an increased risk of preterm delivery, low birth weight, or stillbirth?** J Infect Dis. (2006) 193 (9): 1195-1201. doi: 10.1086/503045
27. Thorne C, Patel D, Newell Ml: **Increased risk of adverse pregnancy outcomes in HIV-infected women treated with highly active antiretroviral therapy in Europe.** Aids, 2004 Nov 19, Vol.18(17), pp.2337-2339
28. Powis Km, Kitch D, Ogwu A, Hughes MD, Lockman S, Leidner J, van Widenfelt E, Moffat C, Moyo S, Makhema J, Essex M, Shapiro Rl: **Increased Risk of Preterm Delivery Among HIV-Infected Women Randomized to Protease Versus Nucleoside Reverse Transcriptase Inhibitor-Based HAART During Pregnancy** Journal Of Infectious Diseases, 2011 Aug 15, Vol.204(4), pp.506-514
29. Kourtis AP, Schmid Ch, Jamieson Dj, Lau J: **Use of antiretroviral therapy in pregnant HIV-infected women and the risk of premature delivery: a meta-analysis.** Aids, 2007 Mar 12, Vol.21(5), pp.607-615
30. Maliye C, Taywade M, Gupta S, Deshmukh P, Garg B, P2-445**: Maternal risk factors associated with low birth weight in Wardha, India.** Journal of Epidemiology and Community Health August 2011, Vol.65(Suppl 1), p.A344
31. Chaves C, Coutinho E, Nelas P, Duarte J, Araujo L, PP.65: **Study of Factors Associated with Low Birth Weight.** Archives of Disease in Childhood - Fetal and Neonatal Edition April 2013, Vol.98(Suppl 1), p.A99
32. Muchemi Onesmus Maina, Echoka Elizabeth, Makokha Anselimo: **Factors associated with low birth weight among neonates born at Olkalou district hospital, central region, Kenya.** Pan African Medical Journal, 26 February 2015, Vol.20

33. Dreyfuss Michele, Spiegelman Donna, Hunter David: **Determinants of low birth weight among HIV-infected pregnant women in Tanzania**. The American Journal of Clinical Nutrition, Dec 2001, Vol.74(6), pp.814-826
34. Han Zhen, Mulla Sohail, Beyene Joseph, Liao Grace, Mcdonald Sarah D: **Maternal underweight and the risk of preterm birth and low birth weight: a systematic review and meta-analyses.** International Journal of Epidemiology, 2011, Vol. 40(1), pp.65-101
35. Abusalah A1, Gavana M, Haidich AB, Smyrnakis E, Papadakis N, Papanikolaou A, Benos A: **Low birth weight and prenatal exposure to indoor pollution from tobacco smoke and wood fuel smoke: a matched case-control study in Gaza Strip**. Maternal Child Health J. 2012 Nov;16(8):1718-27. doi: 10.1007/s10995-011-0851-4.
36. WHO Library Cataloguing-in-Publication Data: **Indoor air pollution from solid fuels and risk of low birth weight and stillbirth.** Report from a symposium held at the Annual Conference of the International Society for Environmental Epidemiology (ISEE), September 2005, Johannesburg. World Health Organization. ISBN 978 92 4 150573 5 (NLM classification: WA 900)
37. Pope Daniel P, Mishra Vinod, Thompson Lisa, Siddiqui Amna Rehana, Rehfuess Eva A, Weber Martin, Bruce Nigel G: **Risk of Low Birth Weight and Stillbirth Associated With Indoor Air Pollution From Solid Fuel Use in Developing Countries.** Epidemiologic Reviews, 2010, Vol. 32(1), pp.70-81
38. Ruckart PZ, Bove FJ, Maslia M. **Evaluation of contaminated drinking water and preterm birth, small for gestational age, and birth weight at Marine Corps Base Camp Lejeune, North Carolina: a cross-sectional study**. Environmental Health. 2014;13:99. doi:10.1186/1476-069X-13-99.
39. World Health Organization: **Global Database on Body Mass Index**. Retrieved from http://apps.who.int/bmi/index.jsp?introPage=intro_3.html
40. Tang Alice M., Dong Kimberly, Deitchler Megan, Chung Mei, Maalouf-Manasseh, Zeina; Alison Tumilowicz, Alison; Wanke, Christine. 2013. **Use of Cutoffs for Mid-Upper Arm Circumference (MUAC) as an Indicator or Predictor of Nutritional and Health Related Outcomes in Adolescents and Adults: A Systematic Review**. Washington, DC: FHI 360/FANTA
41. Doherty M, Ford N, Vitoria M, Weiler G, Hirnschall G. **The 2013 WHO guidelines for Antiretroviral therapy: evidence-based recommendations to face new epidemic realities.** Current Opinion in HIV and AIDS 2013; 8(6): 528-34.
42. Gian Petraglia, Carlo Di Renzo, Irene Giardina, Alessia Rosati, Graziano Clerici, Michela Torricelli, Felice. **Maternal risk factors for preterm birth: a country-based population analysis.** European Journal of Obstetrics & Gynecology and Reproductive Biology 159 (2011) 342-346.

43. Rachel M. Zack, Jenna Golan, Said Aboud, Gernard Msamanga, Donna Spiegelman, and Wafaie Fawzi. **"Risk Factors for Preterm Birth among HIV-Infected Tanzanian Women: A Prospective Study,"** Obstetrics and Gynecology International, vol. 2014, Article ID 261689, 9 pages, 2014. doi:10.1155/2014/261689
44. Schempf, A., Branum, A., Lukacs, S., & Schoendorf, K. (2007). **Maternal age and parity-associated risks of preterm birth: Differences by race/ethnicity**. Paediatric and Perinatal Epidemiology, 21(1), 34-43.
45. Fraser AM, Brockert JE, Ward RH. **Association of young maternal age with adverse reproductive outcomes**. New England Journal of Medicine 1995; 332:1113–1117
46. Britto RPdA, Florêncio TMT, Benedito Silva AA, Sesso R, Cavalcante JC, Sawaya AL (2013**). Influence of Maternal Height and Weight on Low Birth Weight: A Cross-Sectional Study in Poor Communities of Northeastern Brazil.** PLoS ONE 8(11): e80159. doi:10.1371/journal.pone.0080159
47. Wieslaw Maciej Kanadys. **Maternal underweight and pregnancy outcome: prospective cohort study**. Obstetrics and Gynecology Clinic, Specialist Medical Center Czechow in Lublin Archives of Perinatal Medicine 13(3), 23-26, 200
48. Luo Z-C, Wilkins R, Kramer MS, for the Fetal and Infant Health Study Group of the Canadian Perinatal Surveillance System. Effect of neighbourhood income and maternal education on birth outcomes: a population-based study. CMAJ : Canadian Medical Association Journal. 2006; 174(10):1415-1420. doi:10.1503/cmaj.051096.
49. Polyzos NP, Polyzos IP, Mauri D, Tzioras S, Tsappi M, et al. (2009) Effect of periodontal disease treatment during pregnancy on preterm birth incidence: a meta-analysis of randomised trials. Am J Obstet Gynecol 200(3): 225–32. doi: 10.1016/j.ajog.2008.09.020

VIII. Appendix I.

Variable Label	Role	Variable name	Variable Type
Age	Exposure	agecat24	Categorical (Ordinal)
Employment	Exposure	employ3	Dichotomous
Education	Exposure	educat1	Categorical (Ordinal)
Marital Status	Exposure	married01	Dichotomous
Income	Exposure	income	Categorical
Number of Sex partners	Exposure	sexpartners1	Categorical
Number of Pregnancy	Exposure	pregcat	Categorical
Number of Still Birth	Exposure	stillbirthcat	Categorical
Number of Live Birth	Exposure	livebirths births	Categorical
Number of Miscarriage	Exposure	miscarriagecat	Categorical
Number of Living Children	Exposure	livechildren	Categorical
Number of ANC visits	Exposure	ANC	Categorical
Infant Sex	Exposure	infsex	
Intimate Partner Violence	Exposure	IPV	Dichotomous
Nutritional Supplement during pregnancy	Exposure	nutritionsupp	Dichotomous
Maternal MUAC	Exposure	mmuac1	Categorical
Maternal BMI	Exposure	BMI	Categorical
Maternal Weight	Exposure	mweight	Continuous
Maternal Height	Exposure	mheight	Continuous
Birthing Location	Exposure	birthloc	Dichotomous
Intermittent Preventive Therapy for Malaria	Exposure	IPT	Dichotomous

Type of Pregnancy	Exposure	preg1	Dichotomous
Type of Cooking fuel	Exposure	fuel1	Dichotomous
Drinking Water Treatment	Exposure	treat	Dichotomous
History of TB	Exposure	tbever	Dichotomous
Maternal HIV status	Exposure	momhiv	Dichotomous
HAART before Pregnancy	Exposure	haartstartpreg01	Dichotomous
CD4 cell count	Exposure	cd4count_350	Categorical
History of Syphilis	Exposure	syphilis	Dichotomous
Deworming during pregnancy	Exposure	deworm01	Dichotomous
Multivitamin during pregnancy	Exposure	multivit1	Dichotomous
ARV during pregnancy	Exposure	Arvspreg	Dichotomous
History of STD	Exposure	stdever	Dichotomous
Iron tablet during pregnancy	Exposure	iron	Dichotomous
Type of Delivery	Exposure	delivery	Dichotomous
Low Birth Weight	Outcome	LBW	Dichotomous
Preterm Birth	Outcome	Preterm	Dichotomous