HOUSEHOLD TYPE OF FUEL AND LOW BIRTH WEIGHT IN NEWBORNS IN ZIMBABWE: FINDINGS FROM THE 2014 MULTIPLE INDICATOR CLUSTER SURVEY

Mr. Tewelde Gebregiorgis Foto

A Thesis Submitted in Partial Fulfillment of the Requirements
for the Degree of Master of Public Health Program in Public Health
College of Public Health Sciences
Chulalongkorn University
Academic Year 2015

ประเภทเชื้อเพลิงในครัวเรือนกับน้ำหนักต่ำกว่าเกณฑ์ในทารกแรกเ
กิดในประเทศซิมบับเว : ผลการวิเคราะห์จากการสำรวจสถานการณ์โ
ดยใช้พหุดัชนีแบบจัดกลุ่ม ปี 2557

นายธีเวลดี เกรบิจิโอกริส โฟโต

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาสาธา
รณสุขศาสตรมหาบัณฑิต
สาขาวิชาสาธารณสุขศาสตร์
วิทยาลัยวิทยาศาสตร์สาธารณสุข จุฬาลงกรณ์มหาวิทยาลัย
ปีการศึกษา 2558

Thesis Title	HOUSEHOLD TYPE OF FUEL AND LOW BIRTH WEIGHT IN NEWBORNS IN ZIMBABWE: FINDINGS FROM THE 2014 MULTIPLE INDICATOR CLUSTER SURVEY
By	Mr. Tewelde Gebregiorgis Foto
Field of Study	Public Health
Thesis Advisor	Robert S. chapman, M.D.

Accepted by the College of Public Health Sciences, Chulalongkorn University in Partial Fulfillment of the Requirements for the Master's Degree

....Dean of the College of Public Health Sciences
(Professor Sathirakorn Pongpanich, Ph.D.)

THESIS COMMITTEE

....Chairman
(Associate Professor Ratana Somrongthong, Ph.D.)

....Thesis Advisor
(Robert S. chapman, M.D.)

....Examiner
(Nutta Taneepanichskul, Ph.D.)

....External Examiner
(Professor Pornpimol Kongtip, Ph.D.)

ธีเวลดี เกรบิจิโอกริส โฟโต : ประเภทเชื้อเพลิงในครัวเรือนกับน้ำหนักต่ำกว่าเกณฑ์ในทารกแรกเกิดในประเทศซิมบับเว : ผลการวิเคราะห์จากการสำรวจสถานการณ์โดยใช้พหุดัชนีแบบจัดกลุ่ม ปี 2557 (HOUSEHOLD TYPE OF FUEL AND LOW BIRTH WEIGHT IN NEWBORNS IN ZIMBABWE: FINDINGS FROM THE 2014 MULTIPLE INDICATOR CLUSTER SURVEY) อ.ที่ปรึกษาวิทยานิพนธ์หลัก: นพ. โรเบิร์ท เอส. แชบเม็น, 85 หน้า.

การศึกษาเกี่ยวกับความสัมพันธ์ระหว่างประเภทการใช้เชื้อเพลิงในครัวเรือนกับน้ำหนักทารกแรกเกิดในประเทสซิมบับเวยังมีจำนวนน้อยและผลการศึกษายังไม่สอดคล้องกัน การศึกษานี้จึงมีวัตถุประสงค์เพื่อศึกษาความสัมพันธ์ระหว่างประเภทการใช้เชื้อเพลิงในครัวเรือนกับน้ำหนักต่ำกว่าเกณฑ์ในทารกแรกเกิด

การวิเคราะห์ข้อมูลทุติยภูมิจากการสำรวจโดยใช้พหุดัชนีแบบจัดกลุ่มของประเทศซิมบับเว ปี พ.ศ. 2557 จากข้อมูลของเด็กแรกเกิดที่เกิดในช่วงสองปีก่อนการสำรวจ จำนวน 3,910 คน พบว่ามีเด็กแรกเกิดเพียง 3,221 คน ที่ได้รับการชั่งน้ำหนักเมื่อแรกเกิด ซึ่งในการวิเคราะห์ความสัมพันธ์ระหว่างประเภทการใช้เชื้อเพลิงในครัวเรือนกับน้ำหนักต่ำกว่าเกณฑ์ในทารกแรกเกิดได้ใช้การวิเคราะห์แบบตัวแปรคู่และการวิเคราะห์แบบหลายตัวแปรร่วมกับการวิเคราะห์การถดถอยโลจิสติก

ผลการวิเคราะห์แบบตัวแปรคู่ พบว่าอัตราส่วนของทารกแรกเกิดที่มีน้ำหนักต่ำกว่าเกณฑ์ในมารดาที่ใช้เชื้อเพลิงชีวมวลในครัวเรือนมีค่าความเสี่ยงสูงกว่ากลุ่มอ้างอิงถึง 1.17 เท่า (OR: 1.17, 95% CI: 0.88, 1.57, P=0.281) หลังจากการปรับตัวแปรทางด้านลักษณะครัวเรือนทางประชากรและสังคม ลักษณะมารดาและลักษณะทารก พบว่ามีความสัมพันธ์ต่ำอย่างไม่มีนัยสำคัญ (OR: 1.17, 95% CI: 0.85, 1.61, P=0.342).
เมื่อนำการรับรู้ของมารดาที่มีต่อขนาดของทารกแรกเกิดมาใช้ในการวิเคราะห์แทนการชั่งน้ำหนักในทารกแรกเกิด พบว่าความสัมพันธ์ระหว่างการใช้ชีวมวลเชื้อเพลิงและน้ำหนักต่ำกว่าเกณฑ์ในทารกแรกเกิด มีความสัมพันธ์อย่างมีนัยสำคัญทางสถิติ (OR: 1.33, 95% CI: 1.04, 1.68, P=0.021).

ความสัมพันธ์ระหว่างการใช้เชื้อเพลิงชีวมวลกับน้ำหนักทารกแรกเกิดไม่มีนัยสำคัญในการวิเคราะห์ใดๆ ในขณะเดียวกันพบความสัมพันธ์อย่างมีนัยสำคัญระหว่างการใช้เชื้อเพลิงชีวมวลกับขนาดของทารกแรกเกิดที่มีขนาดเล็กจากมารดาที่มีการรับรู้เช่นเดียวกับทารกที่ได้รับการชั่งน้ำหนักเมื่อแรกเกิดร่วมกับการรับรู้จดจำขนาดทารกได้ของมารดา พบว่ามีความสัมพันธ์อย่างมีนัยสำคัญกับน้ำหนักของทารกแรกเกิด อย่างไรก็ตามการศึกษาความสัมพันธ์ระหว่างการใช้เชื้อเพลิงชีวมวลกับน้ำหนักต่ำกว่าเกณฑ์ในทารกแรกเกิดในประเทศซิมบับเวเป็นเรื่องที่ไม่ควรละเลยในการศึกษา ถึงแม้ว่าจะไม่มีความสัมพันธ์อย่างมีนัยสำคัญในการศึกษาวิจัยนี้ อย่างไรก็ตามมีความจำเป็นอย่างยิ่งที่จะศึกษาต่อยอดในงานวิจัยนี้ต่อไป

สาขาวิชา สาธารณสุขศาสตร์	ลายมือชื่อนิสิต ....
ปีการศึกษา 2558	ลายมือชื่อ อ.ที่ปรึกษาหลัก ....

5878836453 : MAJOR PUBLIC HEALTH
KEYWORDS: TYPE OF FUEL / LOW BIRTH WEIGHT / ZIMBABWE / MULTIPLE INDICATOR CLUSTER SURVEY 2014

TEWELDE GEBREGIORGIS FOTO: HOUSEHOLD TYPE OF FUEL AND LOW BIRTH WEIGHT IN NEWBORNS IN ZIMBABWE: FINDINGS FROM THE 2014 MULTIPLE INDICATOR CLUSTER SURVEY. ADVISOR: ROBERT S. CHAPMAN, M.D., 85 pp.

There are relatively few studies on the association between type of fuel used in the kitchen and birth weight; and findings are inconsistent. The aim of this study was to further investigate whether there is association between the type of fuel used in a household and low birth weight in newborns.

Secondary data from the Zimbabwe Multiple Indicator Cluster Survey 2014(ZMICS2014) was analyzed. From 3910 children who were born during the two years prior to the survey, only 3221 were weighed at the time of their birth. Bivariate and multivariable logistic regression analyses were used to assess associations between type of fuel in household and low birth weight.

In bivariate analysis, the odds ratio of giving low birth weight baby was 1.17 times higher in the mothers from households that use biomass, (OR: 1.17, 95% CI: 0.88, 1.57, P=0.281) in comparison to the reference group. After adjusting, for household socio-demographic, maternal and fetal characteristics this weak positive, non-significant association persisted, (OR: 1.17, 95% CI: 0.85, 1.61, P=0.342). When women's perception of size of their babies at birth, a variable that exists for most of the children was used instead of the birth weight a statistically significant association was observed between the use of biomass fuel and low birth weight, (OR: 1.33, 95% CI: 1.04, 1.68, P=0.021).

The association between use of biomass fuel and birth weight was not significant in any of the analyses. At the same time, there was a positive, significant association between biomass fuel use and small size of the baby by the mother's perception. Also, among mothers for whom birth weight was available, mother's perception of the baby's size at birth was significantly associated with birth weight. On balance, an association between biomass fuel use and low birth weight in Zimbabwe cannot be ruled out, even though no significant association was observed in this study. Further research is clearly needed on this important topic.

Field of Study: Public Health	Student's Signature ....
Academic Year: 2015	Advisor's Signature ....

ACKNOWLEDGEMENTS

I would like to express my heart-felt gratitude to my thesis advisor, Dr. Robert S. Chapman for his guidance and support during the entire course of my study. I also want to express my thanks to Doctor Abdul Ghaffar Lashari and all Collge of Public Health, Chulalongkorn University who guided me in conducting this study.

I would also want to express my gratitude to Associate Professor Ratana Somrongthong, Ph.D., Nutta Taneepanichskul Ph.D. and my external-examiner Prof. Pornpimol Kongtip, Ph.D. form Mahidol University for their constructive comments.

I would like to thank to all family members and friends who helped me throughout my study time.

I want to thank the MICS UNICEF for allowing me to use the secondary data for my thesis.

My special thanks go to Thailand International Cooperation Agency(TICA) for supporting my scholarship of study.

CONTENTS

Page

Page

LIST OF TABLES

CHAPTER I

INTRODUCTION

1.1 BACKGROUND AND RATIONALE

Birth weight has significant association with future survival chance and wellbeing of a newborn (Ahmed, Zafar, Khan, & Qureshi, 2015). Low birth weight is considered as the single most important predictor of infant mortality, especially of deaths within the first month of life(Demelash, Motbainor, Nigatu, Gashaw, & Melese, 2015) . More than fifty percent of the neonatal deaths occur among those who are weighed below 2500 kilograms. Low birth weight has also been linked with childhood developmental delays as well as metabolic, infectious, and chronic illnesses in future life(Jiang et al., 2015).

Birth weight is the weight of a newly born baby that is measured right after birth. For babies that are born alive, it should be taken within the first hour, if possible. This is because substantial weight loss can happen if the measuring time is delayed. Low birth weight has been defined by the World Health Organization (WHO) as weight at birth of less than 2,500 grams (5.5 pounds) (Wardlaw, 2004). Globally 16 percent, more than 20 million of all the live birth newborns are low birth weight. The incidence of LBW is underestimated since large proportion of births in low income countries take place at home. The incidence in the low-income countries is more than double of the incidence in the middle income countries. (Demelash et al., 2015). In developing countries approximately one out of ten infants dies from a complications related to low birth weight (Abusalah et al., 2012).

The World Bank in its World Development Indicators: Nutrition intake and supplements estimated the Low birth weight in Zimbabwe as 11% of all the live births between the years 2007 and 2013 (WorldBank, 2015). The Zimbabwe Multiple Indicator Cluster Survey 2014(ZMICS 2014) also gathered information about the birth weights of the last live births in the two years preceding the survey. The proportion of low birth babies was gathered from two items in the ZMICS 2014 woman’s questionnaire: 1) the woman’s judgment of the baby’s size at birth (as very small, smaller than average, average, larger than average, very large) and the woman's recall of the baby's weight or the weight as registered on a health card if the baby was weighed at birth. Out of all the live births preceding 2 years the survey 10.1 percent were categorized as low birth weight. The percentage differs among the provinces of the country ranging from 8.6 to 12.4 percent (ZIMSTAT, 2015). In Zimbabwe low birth weight is placed tenth in the rank of causes of mortality. In the WHO data reported in 2014 Low Birth Weight deaths in Zimbabwe reached 6,401 or 5.03% of total deaths. The age adjusted Death Rate is 28.19 per 100,000 of population ranks Zimbabwe number 15 in the world (WorldHealthRanking, 2015).

Many studies showed that the birth weight of a new born is associated with socio-economic, fetal, maternal and environmental factors. A case-control study of Socioeconomic factors and low birth weight, in Mexico City concluded that low socioeconomic level was the most important risk factor for LBW (Torres-Arreola, Constantino-Casas, Flores-Hernández, Villa-Barragán, & Rendón-Macías, 2005) . Another study in Sudan found low educational level of mother was a risk factor for LBW (Elshibly & Schmalisch, 2008). Another study also found an association between living in a deprived neighborhood and Low birth weight (preterm birth and small-for-gestational age) (Vos, Posthumus, Bonsel, Steegers, & Denktaş, 2014).

In a study conducted in North Tanzania low birth weight is associated with adverse perinatal outcomes. The incidence of low birth weight was 10.6%. Multivariate logistic regression showed that pre-eclampsia, eclampsia , chronic hypertension, maternal anemia , smoking during pregnancy , caesarean section delivery, placental abruption, placenta previa, Premature Rupture of Membranes (PROM), maternal underweight, and obesity and female gender of baby were significantly associated with delivery of low birth weight infants. (Mitao et al., 2015). In rural Gambia low birth weight was associated with antepartum hemorrhage and hypertensive pregnancy disorders. In addition to these , primi parity was associated with low birth weight (Jammeh, Sundby, & Vangen, 2011).

The negative impact of smoking on birth weight was identified as early as 1979 when the US Surgeon General concluded that maternal smoking affects birth Weight independently of any other determinant (US Department of Health and Human Services, 1980). The weight of full-term babies born to smoking mothers are less than the average newborn and babies born to heavy smokers are more affected

(Conter, Cortinovis, Rogari, & Riva, 1995; Hardy & Mellits, 1972; Horta, Victora, Menezes, Halpern, & Barros, 1997) cited by (Abbott & Winzer-Serhan, 2012). Environmental tobacco Smoke , passive smoking of pregnant mothers reduces mean birth weight(Leonardi-Bee, Smyth, Britton, & Coleman, 2008). A similar study also concluded nonsmokers exposed women have increased risks of giving birth to infants with lower birth weight (Salmasi, Grady, Jones, & McDonald, 2010).

Smoking during pregnancy is the main etiology of Low birth weight in high income countries. Generally women in Sub-Saharan Africa have very low prevalence of smoking (Pampel, 2008). According to the Zimbabwe MICS 2014 fraction of women in childbearing age (15-49 years) who used any kind of tobacco, smoked or smokeless tobacco products at any time during the preceding one month was 0.7. However, it is estimated that up to 73.9 percent of the households in Zimbabwe use solid fuel for cooking, mainly wood. In urban population use of solid fuels was low about 17 %. However in rural population it was high, 95.8% of the population lived in households that use solid fuels(ZIMSTAT, 2015).

Fetal growth retardation due to cigarette smoking is caused by placental hypoxia due to the presence of carbon monoxide in the smoke. Furthermore, hypoxia depresses metabolic process which leads to disturbance in the amino acid transport system (Sastry, 1991). Polyaromatic hydrocarbons and tobacco smoke from air pollution transferred from mother to fetus through placenta and cause growth retardation (Perera, Jedrychowski, Rauh, & Whyatt, 1999). In the similar way, smoke released from burning of wood exposed by pregnant women caused intrauterine growth retardation by a mechanism similar to smoking (Kourembanas, 2002; Li et al., 2003) . Higher risks for LBW associated with outdoor air pollution have been reported in other settings (Dejmek, Selevan, Benes, Solanský, & Srám, 1999; Yorifuji, Kashima, & Doi, 2015).

A study done in Guatemala, the first report of an association between kitchen fuel use and LBW in humans showed, maternal exposure to biomass fuel during pregnancy can lead to a 63 gram reduction in birth weight of the baby (Boy, Bruce, & Delgado, 2002). Few other studies also showed the associations of maternal exposure to wood fuel and LBW (Ahmed et al., 2015; Mishra, Dai, Smith, & Mika, 2004). However, two studies in India didn’t report any significant relationship between biomass fuel smoke and LBW after adjusting for other related confounding factors such as demographic, nutritional, reproductive, and socioeconomic factors (N, , , & 2014; Wylie et al., 2014). Moreover, In the Sub-Saharan Africa, most of the populations residing in rural and underdeveloped areas have no access to low polluted fuel like natural gas but use high polluted fuel like wood. And the potential effects of these high polluted fuels on birth weight are not well defined. Giving that there are few studies that are done on association between type fuel use and birth weight and some conflicting results, the aim of this study is to determine the risk of LBW and birth weight differences among biomass fuel exposed women during prenatal period in comparison with other fuel sources. Unlike other surveys in developing countries and previous surveys in the country the Zimbabwe MICS 2014 collected relatively high data on birth weight of the children. In the survey 83 percent of the most recent live births within the two years preceding the survey were weighed at birth.

1.2 RESEARCH QUESTION

Is there any association between household type of fuel used for cooking and low birth weight in the newborns in Zimbabwe in the children born 2 years preceding the Zimbabwe Multiple Indicator Cluster survey 2014.

1.3 HYPOTHESIS

1.3.1 STATISTICAL NULL HYPOTHESIS

There is no the association between household types of fuel used for cooking and low birth weight in the newborns in Zimbabwe in the children born 2 years preceding the Zimbabwe Multiple Indicator Cluster survey 2014.

1.3.2 UBORDINATE STATISTICAL NULL HYPOTHESES

As mentioned above, the major purpose of this study was to assess the association of household fuel type with risk of low birth weight. As part of this effort, statistical models were adjusted for a variety of independent variables, as described in the categories given immediately below, and in the conceptual framework.

1. There is no association between household socio-demographic factors and low birth weight in the newborns in Zimbabwe in the children born 2 years preceding the Zimbabwe Multiple Indicator Cluster survey 2014.
2. There is no the association between maternal factors and low birth weight in the newborns in Zimbabwe in the children born 2 years preceding the Zimbabwe Multiple Indicator Cluster survey 2014.
3. There is no association between fetal factors and low birth weight of the newborns in Zimbabwe in the children born 2 years preceding the Zimbabwe Multiple Indicator Cluster survey 2014.

1.4 STUDY OBJECTIVES

1.4.1 GENERAL OBJECTIVE

To find out whether there is a relationship between the main type of fuel used for cooking in a household and low birth weight among the newborns in Zimbabwe in the children born 2 years preceding the Zimbabwe Multiple Indicator Cluster survey 2014.

1.4.2 SPECIFIC PRIMARY OBJECTIVES

To find the association between household main type of fuel used for cooking and low birth weight in the newborns in Zimbabwe in the children born 2 years preceding the Zimbabwe Multiple Indicator Cluster survey 2014.

1.4.3 SPECIFIC SUBORDINATE OBJECTIVES

1. To find the association between household socio-demographic factors and low birth weight in the newborns in Zimbabwe in the children born 2 years preceding the Zimbabwe Multiple Indicator Cluster survey 2014.
2. To find the association between maternal factors and low birth weight in the newborns in Zimbabwe in the children born 2 years preceding the Zimbabwe Multiple Indicator Cluster survey 2014.
3. To find the association between fetal factors and birth weight in the newborns in Zimbabwe in the children born 2 years preceding the Zimbabwe Multiple Indicator Cluster survey 2014.

1.5 CONCEPTUAL FRAME WORK

Independent Variable → **Dependent Variable**

A. Type of fuel used for cooking
1. Biomass fuels vs. Non-biomass
2. Light smoky vs. Higher smoky

B. Household Socio Demographic status
Province
Urban vs. rural residence
Household wealth index quintile
Head of household's educational level
Religion
Mother tongue

C. Maternal factors
Age of the mother
Educational level
Desire to pregnancy
ANC attendance
- Any ANC visit vs. no visit
- Number of ANC visits
- Start of ANC visit
- ANC provider

Iron tablet supplementation
- Any supplementation vs. No
- Duration of supplementation

Folate supplementation
- Any supplementation vs. No
- Duration of supplementation

Malaria prophylaxis intake
- Any intake vs. No
- Frequency of intake

Smoking, ever smoked vs. No
Alcohol drinking habit
- Ever drunk vs. No
- Number of usual drinks

D. Fetal factors
Baby's gender
Birth order
Birth interval/child spacing
Multiple vs. singleton delivery

Birth Weight of a baby

- Low (< 2.5Kg)

- Higher (≥ 2.5Kg)

1.6 OPERATIONAL DEFINITIONS

The operational definitions in this study are usually defined based on the MICS definitions by Zimbabwe National Statistics Agency, 2015.

a. Low birth weight (LBW) refers to the weight of the infants born weighing less than 2500 g, irrespective of the gestational age and the cause of LBW.
b. Higher birth weight refers to the weight of the infants born weighing greater than or equal to 2500 g.
c. Type of fuel use for cooking refers to the type of fuel used mainly for cooking in the households. It is classified in two ways, first as biomass or non-biomass fuels, second as light smoky or higher smoky fuels. In the first way electricity, liquefied petroleum gas (LPG), biogas and kerosene are categorized as non-biomass fuels, and charcoal, wood, saw dust and gel are categorized as biomass fuels. In the second way of classification, electricity, liquefied petroleum gas (LPG) and biogas are light smoky fuels and wood and straw were put in the higher smoky fuels.
d. Province refers to the site of the mother's household in Zimbabwe. It refers to one of the ten provinces of Zimbabwe
e. Residence refers to the location of a household. It is classified as either urban or rural.
f. Household wealth index quintile refers to the economic level of the household. The households were classified as poorest, second, middle, forth and richest. It is a compound indicator of wealth. It is calculated based on information of the ownership of consumer goods, dwelling characteristics, water and sanitation, and other wealth related to a household.
g. Head of household's educational level refers to the highest level of school joined by the head of household. It could be pre-school, primary, secondary or higher level.
h. Religion refers to the religion or faith of the head of the household. In this study it one of the religions in Zimbabwe, it can be Roman Catholic, Protestant, Pentecostal, Apostolic Sect, Other Christian, Islam, Traditional or any other religion.

i. Mother tongue refers to native language of the head of the household. In this study it could be Shona, Ndebele, English or any other type.
j. Having mosquito bed net refers to the presence of at least one mosquito bed net in the household.
k. Age of the mother refers to the completed years at the time of birth of the baby.
l. Educational level of the mother refers to the highest level of school joined by the mother. It could be pre-school or not attended any education, primary, secondary or higher level.
m. Desire to the pregnancy refers whether the mother wanted to get pregnant to the baby.
n. ANC attendance refers to the number of visits by the mother to antenatal care facility. The woman's attendance to at least one time by skilled health professional at the time of her last gestation to a live birth. How many times did the mother get the service? In what age of the pregnancy did she start to visit the ANC center? And who provided the service to her.
o. Iron tablet supplementation refers to the intake of iron supplement by woman with a live birth in her last gestation. It also indicates for how long she took the iron tablet supplementation.
p. Folate supplementation refers to the intake of folate supplement by women with a live birth in her last gestation. It also indicates for how long she took the folate supplementation.
q. Malaria prophylaxis refers the taking of any medicine by the mother in order to prevent her from getting malaria during (any of) her antenatal visit(s) for the pregnancy with the last born child. It also refers to the number of times malaria prophylaxis was taken.
r. Mother smoking refers to if the mother had ever smoked tobacco in her life time.
s. Alcohol drinking habit refers to if the mother had drunk alcohol her life time. It also takes in to account the number of drinks a mother usually drinks.
t. Baby's gender refers to the biological state of being male or female.
u. Birth order or child spacing refers to the order or sequence number among siblings. Categorized as first born, second born, third born, fourth born and so on.

v. Birth interval or child spacing refers to the number of years between the birth dates of the last live born baby and the next older sibling.

w. Number of births per pregnancy refers whether the child is a product of multiple or single pregnancy. It is categorized as single or multiple. Multiple refers to twin or triplet.

CHAPTER II

LITERATURE REVIEW

2.1 BIRTH WEIGHT AND LOW BIRTH WEIGHT

Birth weight is the weight of a newly born baby that is measured immediately after birth. For babies that are born alive, it should be taken within the first hour, if possible. This is because substantial weight loss can happen if the measuring time is delayed. Low birth weight has been defined by the World Health Organization (WHO) as weight at birth of less than 2,500 grams (5.5 pounds) (Wardlaw, 2004).

The most widely accepted perinatal definitions of birth weight are those expressed by the "Committee of Annual Reports and Definitions of Terms in Human Reproduction" of the International Federation of Gynecology and Obstetrics. These terms were adopted by WHO (1982). Commonly the following three terms are used interchangeably to but are not necessarily identical (de Bernabé et al., 2004):

Low birth weight (LBW). This term refers only to infants born weighing 2500 g or less, regardless of gestational age and the cause of LBW.

Three categories of LBW can be distinguished:

1. **Premature or preterm LBW babies** these are babies that are born before 37 complete weeks of gestation or with fewer than 259 days of gestation.
2. **Term LBW babies** these are babies that are, born between 37 and 42 complete weeks of gestation, or between 259 and 293 days of gestation.
3. **Post term LBW babies** are babies that are born after 42 weeks or 294 days of gestation.

2.2 PREVALENCE OF LOW BIRTH WEIGHT

The Global prevalence of low birth weight is 16 percent. More than 20 million of all the live birth newborns are low birth weight. The incidence of LBW is underestimated since large proportion of births in low income countries take place at home. The incidence in the low-income countries is more than double of the incidence in the middle income countries. (Demelash et al., 2015).

Of all the term births in developing countries eleven percent (11 %) are low birth weight. this prevalence is six times more than the prevalence in developed countries (Bergmann, Bergmann, & Dudenhausen, 2008; de Onis, Blössner, & Villar, 1998). In Zimbabwe according to MICS 2014 the prevalence of low birth weight babies in live births is 10.1 percent.

2.3 EFFECT OF LOW BIRTH WEIGHT AND VERY LOW BIRTH WEIGHT

Birth weight is one of the most vital indicators of maternal health and general health position of populations. It is considered the single most important predictor of infant death, particularly of the deaths in the first month of life (Dičkutė et al., 2004). A study in Pakistan found 12.7% premature or LBW or both out of the total deliveries. Congenital problems were observed in 7.3% of the affected neonates. Fifty percent of the premature and low birth weight needed antibiotics with neutral environment and oxygen therapy. Early neonatal deaths in this group of infants was found to be 12% (Ismail, Zaidi, & Maqbool, 2003). Severely preterm and/or very low birth weight neonates may be affected by severe neurological pathologies (6-10% of cases), but they often have minor disabilities (such as distractibility, hyperactivity, learning and social competence disabilities, deficit of motor development) difficult to be early diagnosed, and frequently recognized only at pre-school or school age (Chiarotti et al., 2000).

2.4 HOUSEHOLD SOCIO-DEMOGRAPHIC FACTORS

2.4.1 SOCIO-ECONOMIC LEVEL OF THE FAMILY

Level of income of a family is one of the issues strictly associated with the health condition of populations. It is a well understood fact that low socio-economic level of a family increases the occurrence of LBW(Torres-Arreola et al., 2005).

A systematic review and meta-analysis concluded that adverse pregnancy outcomes (Low Birth weight and others) are associated with living in a deprived neighborhood. The meta-analysis of seven studies included 2,579,032 pregnancies. The study compared the risk of adverse perinatal outcomes in the least and most deprived income quintiles. The odds ratios for adverse perinatal outcomes in the most deprived neighborhood quintiles, compared to the least deprived once were significantly increased. Babies born from mothers in most deprived neighborhoods have 23% higher probability to be preterm and 31% to be small-for-gestational age (Vos et al., 2014).

The association between wealth of families and LBW is also seen in the most developed part of the world. Thought the intensity and pattern differs, a study on socioeconomic Inequalities in LBW in the United States, the United Kingdom, Canada, and Australia concluded socioeconomic gradients in LBW were observed in all the countries(Martinson & Reichman, 2016).

2.4.2 RESIDENCE

Multi-level analysis of the data that was obtained from 2003 and 2008 Demographic and Health Surveys of Ghana showed mothers living in rural areas have higher chance of giving birth to a low birth weight baby. It increases the chance by 43 percent (Kayode et al., 2014).

2.5 MATERNAL FACTORS

2.5.1 MATERNAL AGE

Many studies noted that the incidence of low birth weight increases in the extremes of women's reproductive age. Teen mothers and mothers aged older than 35 have higher probability of delivering low birth weight baby. After adjusting for socio-economic position very young mothers and older mothers, i.e. aged <16 or ≥35 have higher risk of giving birth to a low birth weight baby. (Restrepo-Méndez et al., 2015).

A case control study on risk factors for low birth weight in Bale zone hospitals, South-East Ethiopia: mothers age younger than 20 years at the time of delivery is associated with increased risk of giving birth to a low birth weighted newborn, mat (adjusted odds ratio = 3; 95 %, CI = 1.65–5.73) (Demelash et al., 2015).

2.5.2 ANTENATAL VISITS

A report from Brazil, Sao Paulo state found an association between the number of antenatal visits by a pregnant mother and birth weight of a newborn for that specific pregnancy. Low birth weight and premature delivery incidence was lower in the mothers who have higher frequency of antenatal visits. (Kilsztajn, Rossbach, & Sugahara, 2015).

2.5.3 MATERNAL EDUCATIONAL LEVEL

Demelash et al., 2015, found in Bale zone hospitals, South-East Ethiopia maternal lack of formal education was associeted with giving birth to a low birth weith newborn (AOR = 6; 95 % CI = 1.34–26.90)

2.5.4 TOBACCO SMOKE AND LOW BIRTH WEIGHT

Several studies showed active and passive tobacco smoking of a pregnant mother is associated with the birth weight of a baby. The negative impact of smoking on birth weight was identified as early as 1979 when the US Surgeon General concluded that maternal smoking affects birth Weight independently of any other determinant (US Department of Health and Human Services, 1980). Weight of full-term babies born to smoking mothers ranges from 170 to 250g less than the average newborn and babies born to heavy smokers weigh up to 377g less at birth (Conter et al., 1995; Hardy & Mellits, 1972; Horta et al., 1997) cited by (Abbott & Winzer-Serhan, 2012). A report on environmental tobacco Smoke (ETS) and Fetal Health found exposure of non-smoking pregnant women to ETS reduces mean birth weight(Leonardi-Bee et al., 2008). A similar study concluded, ETS exposed women have increased risks of infants with lower birth weight in addition to other adverse birth outcomes (Salmasi et al., 2010).

Smoking during pregnancy is the main etiology of Low birth weight in high income countries. Generally women in Sub-Saharan Africa have very low prevalence of smoking (Pampel, 2008). Fetal growth retardation due to cigarette smoking is caused by placental hypoxia due to the presence of carbon monoxide in the smoke. Furthermore, hypoxia depresses metabolic process which leads to disturbance in the amino acid transport system (Sastry, 1991). Polyaromatic hydrocarbons and tobacco smoke from air pollution transferred from mother to fetus through placenta and cause growth retardation (Perera et al., 1999).

2.6 FETAL FACTORS

2.6.1 GENDER OF FETUS

In some reports the gender of the fetus has association with birth weight. Females have increased chance of being born low birth weight (Mondal, 1998).

2.6.2 BIRTH ORDER

(Shah, 2010) observed firs born babies (babies that are born from nulliparous mothers) have increased unadjusted risk of low birth weight or small for gestational age. In this study there was no significant association between other birth orders and birth weight.

2.6.3 BIRTH INTERVAL/SPACING

Studies showed that too short and too long birth spacing have a higher risk of giving birth to a low birth weight baby. Shorter than eighteen months or longer than fifty nine months difference was generally associated with adverse perinatal outcomes(Conde-Agudelo, Rosas-Bermúdez, & Kafury-Goeta, 2006).

2.7 COOKING FUEL

For the purpose of cooking and heating more than fifty percent of the world's population and 90% of rural people in the less developed nations is dependent on biomass fuels (e.g. wood, crop residues) and coal. The cooking and heating processes are using open fires or poorly built stoves in less ventilated rooms. This leads to high concentrations of pollutants in the rooms (Bruce, Perez-Padilla, & Albalak, 2002). In sub-Saharan Africa, wood-based fuels account for over 80% of primary energy supply and more than 90% of the population rely on firewood and charcoal (Njenga et al., 2014).

Biomass fuel refers to any plant or animal matter intentionally burnt by human beings. Wood is the most common biomass fuel. Other biomass fuels such as animal dung and crop residuals are also widely used types(de Koning, Smith, & Last, 1985).

In the energy the cleanliness, convenience efficacy and cost increases as people move upward.

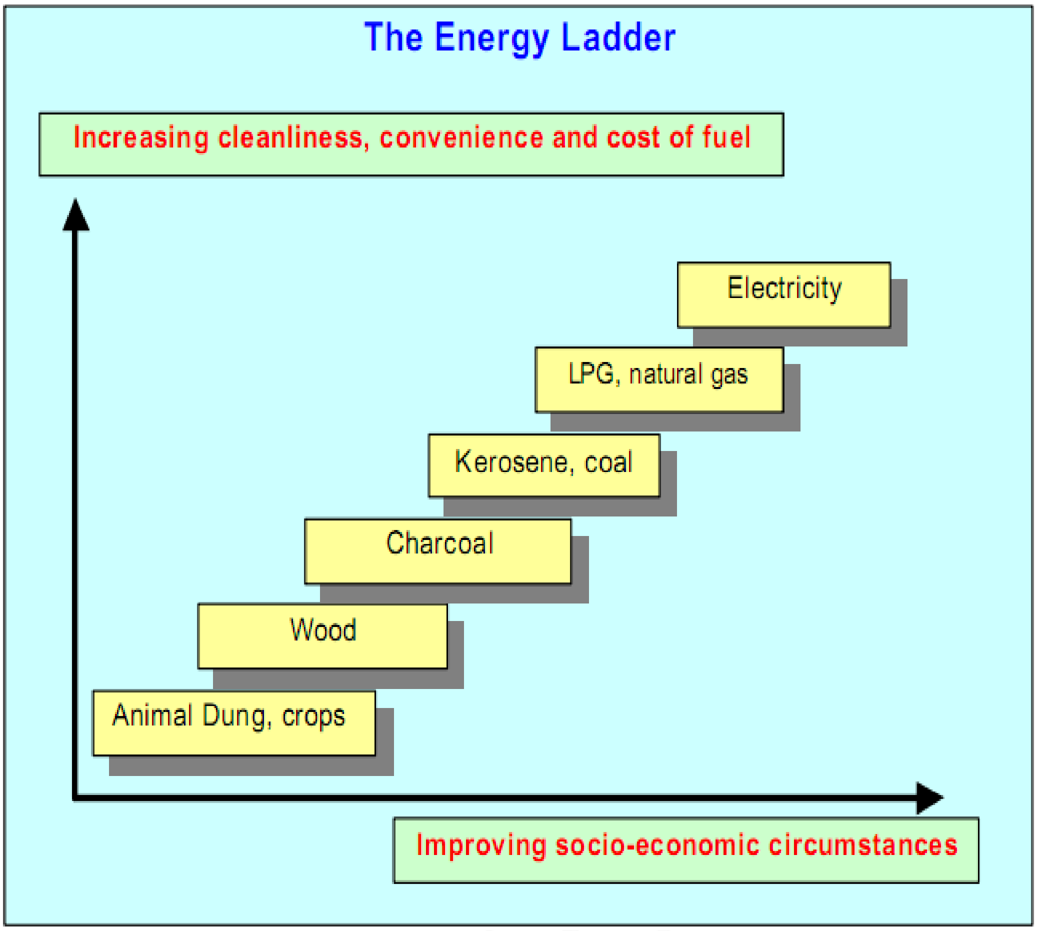

Figure 1 (Smith et al., 1994).

Indoor air pollution is one of the top ten causes of disease and death in the world. Based on WHO reports in the less developed world pollutions from biomass fuel cause 1.6 million premature deaths annually(Fitzgerald et al., 2012).

2.7.1 BIOMASS FUEL AND BIRTH WEIGHT

A study done in Guatemala, the first report of an association between kitchen fuel use and LBW in humans showed, maternal exposure to biomass fuel during pregnancy can lead to a 63 gram reduction in birth weight of the baby (Boy et al., 2002). Few other studies also showed the associations of maternal exposure to wood fuel and LBW (Ahmed et al., 2015; Mishra et al., 2004).

However, two studies in India didn’t report any significant relationship between biomass fuel smoke and LBW after adjusting for other related confounding factors such as demographic, nutritional, reproductive, and socioeconomic factors. Before adjustment women who use wood for cooking gave birth babies that were on average 112 grams lighter (95% CI -170.1, -54.6) when compared to women who use gas for cooking. However after adjusting for the confounding factors this association was no more significant (Wylie et al., 2014). (N et al., 2014), a cross-sectional study also did not found significant association between type of fuel use and birth weight of a new born.

As in most parts of the Sub-Saharan Africa, in Zimbabwe most of the populations residing in rural and underdeveloped areas have no access to low polluted fuel like natural gas but use high polluted fuel like wood. The Zimbabwe Multiple Indicator Cluster Survey found 73.9 percent of the households depend on solid fuel for cooking. The potential effects of these high polluted fuels on birth weight are not well defined. Giving that there are few studies that are done on association between type fuel use and birth weight and some conflicting results, the aim of this study is to determine the risk of LBW and birth weight differences among biomass fuel exposed women during prenatal period in comparison with other fuel sources. Unlike other surveys in developing countries and previous surveys in the country the Zimbabwe MICS 2014 collected relatively high data on birth weight of the children. In the survey 83 percent of the most recent live births

CHAPTER III

METHODOLOGY

This study used secondary data from the Zimbabwe Multiple Indicator Cluster Survey that was conducted in 2014 by the Zimbabwe National Statistics Agency as part of the global MICS programme. UNICEF coordinated the technical and financial support of the survey. The data sets for the secondary study were obtained by requesting the official website of UNICEF that deals with global MICS, http://mics.unicef.org/surveys.

3.1 STUDY DESIGN

The study design of this research is analysis of a secondary data of Zimbabwe MICS 2014. The primary data was collected through a nationwide cross-sectional cluster survey.

3.2 STUDY AREA

A nationally representative data was collected from urban and rural areas of the ten provinces of the Zimbabwe.

3.3 STUDY POPULATION

The study population of this study is the most recent born children whose age was less than 2 years at the time of the Zimbabwe MICS 2014 and their mothers.

3.4 SAMPLING TECHNIQUE

In the 2014 Zimbabwe MICS a two-stage, stratified sampling was used for the selection of the survey samples. Except in one province, Bulawayo in all the nine provinces urban and rural areas were defined as the sampling strata. In all provinces, the primary sampling units (clusters) were distributed to the urban and rural domains proportionally to the number of urban and rural households in each province. The first stage of the sampling was selection of census enumeration areas/clusters and second stage was selection of households. Using systematic random sampling 25 households were selected from each cluster.

3.5 SAMPLE SIZE

The sample size for the 2014 Zimbabwe MICS was 17, 068 households. The total number of household clusters was 683. However one cluster was not covered due to the relocation of the households that were affected by flooding. Therefore 17, 068 households from 682 clusters were enumerated. Among the 17,068 households, there were 3,913 last live-born children within the preceding two years of the 2014 Zimbabwe MICS. During the constructing of analysis data set, three children missed the ID variable that was used for merging data file. These were excluded from this study. From the remaining 3910, only 3221 were weighed at the time of the birth. Therefore 3221 last live born children and their mothers were the sample size of this study. For further details see result section 4.1.1.

3.6. MEASUREMENT TOOLS

In the 2014 Zimbabwe MICS 4 questionnaire were used. These questionnaires were adapted and customized from standard MICS5 questionnaires. All questionnaires were translated from English to two main vernacular languages in Zimbabwe, i.e. Shona and Ndebele.

The questionnaires are

1. **A household questionnaire** which was used to collect basic demographic information on all de jure household members (usual residents), the household, and the dwelling.
2. **A Woman's questionnaire** which was administered to all women in childbearing age (15 to 49 year).
3. **A Man's questionnaire** for the 15 to 54 year age group was administered in every third household selected.
4. **The under-five questionnaire** was administered to mothers (or primary caregivers) of children under 5 years of age living in the households.

This study used data that were collected by the first two types of questionnaires, the household questionnaire and the woman's questionnaire. Main type of fuel in household and household socio-demographic characteristics were collected by the household questionnaire and the woman characteristics fetal characteristics were collected by the woman's questionnaire.

3.7 DATA COLLECTION

In February 2014 20 days Training for the fieldwork was conducted. Training included presentations on interviewing techniques and the contents of the questionnaires. Mock interviews were conducted among trainees to gain practice in asking questions.

The data were collected by 29 mobile teams; each team comprised a team leader, a measurer, four to five interviewers and a driver. Teams were supported by provincial and national supervisors.

In the 2014 Zimbabwe MICS Eight SPSS data files were produced, (households, household members, mosquito nets in households, women in reproductive age (15-49 years of age), birth history, maternal mortality, mothers or primary caretakers of children under the age of five, men (15-49 years of age)). All these data sets were obtained from UNICEF, http://mics.unicef.org/surveys. This study used three out of these eight data files, the household, women in reproductive age and the birth history data files. The latter two files were derived from answers in the women's questionnaire.

3.8 INCLUSION AND EXCLUSION CRITERIA

- All most recent born children whose ages were less than 2 years at the time of survey and their mothers were included in this study.
- Children, whose ID variable for merging purpose could not be created, were excluded from this study.

3.9 DATA MANAGEMENT AND DATA ANALYSIS

The data management work started by merging the different data files. The three data files that contain the variables of interest for this study were, the household data file, the women in reproductive age (15-49 years of age) data file and the birth history data file. The household data file comes from the household questionnaire and the latter two data files, the women's file and the birth history file both come from the women's questionnaire. Most of the independent variables and the dependent variable were available in the data set of women in reproductive age (15-49 years of age). Therefore it was used as an initial/starting data set by taking the women whose last live born babies were within the last two years of the ZMICS 2014.

Other data sets with variables of interest were merged to it. The main independent variable, types of fuel used for cooking and other socio-demographic variables of interest were in the household data file. Since, in the MICS data files, a unique ID variable for merging different data files was not provided; the cluster number and household number were used to create the merging ID variable for the two data sets. The fetal characteristics of the children were obtained from the birth history data set. To merge the birth history data set to the previously merged two data sets the cluster number, household number, woman's line number in the household and child's birth year and month were used to create the merging ID variable. Twins and triplets in the birth history data set shared the same merging ID variable. To include only the last live born twin or triplet manual cleaning was done before the birth history data set was merged to the main analytical data set. All the data sets merging process, data cleaning and creating new variables, and descriptive statistics of the study were done in SPSS 22.

Bivariate data analysis was done by logistic regression to identify the relationship between dependent and independent variables, assessing one independent variable at a time. Multivariable analysis was done in two steps. In the first step, variables that showed association with low birth weight at a p-value less than or equal to 0.2 in the bivariate analysis were selected for first step multivariable logistic regression. In the second step of multivariable logistic regression only independent variables with p-value less than or equal to 0.2 in the first step of multivariable analysis were included, for final analysis to adjust for the association between type of fuel used in a household and low birth weight. Odds ratios were accompanied by p-values and 95% confidence interval (CI). P-values less than 0.05 were considered as statistically significant level for results of analysis.

All the inferential statistics, bivariate and multivariable logistic regression analyses were done in STATA version 12. The main reason, the inferential part of this study was done in STATA is to consider the clustering nature of the survey design and the women's sample weight that was introduced in the survey. SPSS cannot address both, the clustering nature of the data and individual weights simultaneously. Therefore, by using the STATA survey commands both these effects were accounted and a nationally representative result was analyzed from the ZMICS 2014.

3.10 ETHICAL CONSIDERATION

This study received ethical approval from the Ethics Review Committee for Research Involving Human Research Subjects, Health Science Group, Chulalongkorn University, COA No.199/2016.

CHAPTER IV
RESULTS

4.1 DESCRIPTIVE STATISTICS

In the 2014 ZMICS a total of 3913 women, whose last live born children were within the preceding two years of the survey were interviewed. The analysis data file for this study was constructed by merging variables from three different data files, namely the data file for women in reproductive age (15-49 years of age), the data file of household information and the data file for birth history of children from the women in reproductive age. A unique ID variable, which was needed to merge variables form the different data files into the analysis data set was not found for 3 pairs of children and mothers, and they were excluded from further analysis of this study.

4.1.1 BIRTH WEIGHT

Out of the 3910 babies 3221, 82.4 percent were weighed at the time of birth. 2950, 91.6 percent of the weighed babies were weighed 2500g or more at the time of birth and 271, 8.4 percent were weighed below 2500g. 689, 17.6 percent of the babies were not weighed at the time of birth, Table 1. These babies were excluded in all the analyses in which birth weight was considered.

Table1 Distribution of birth weight in Kg of the children who were born within the two years preceding the ZMICS

Birth Weight in Kg	Frequency	Percent	Percent of weighed
≥ 2.5	2950	75.4	91.6
< 2.5(low)	271	6.9	8.4
Total weighed	3221	82.4	**100.0**
Not weighed or weight was not filled	689	17.6	
Total	**3910**	**100.0**	

4.1.2 TYPE OF FUEL IN HOUSEHOLDS

Table 2 shows the distribution of the main type of fuel for cooking in the households of 3216 weighed last live born children in the preceding two years of the ZMICS2014 by low or higher birth weight, when the type of fuels are categorized as biomass or non-biomass fuels. 32141, 67% of the households use biomass fuel as their main cooking energy. 8.6 % of the children who were born to mothers from households that use biomass fuels and 8.1 percent from the non- biomass fuel users were low birth weight at the time of their birth.

Table 2 biomass and non-biomass distribution of the main type of fuel for cooking in the households of the last live born children in the preceding two years of the ZMICS2014 by low or higher birth weight

			Birth weight in Kg		
			≥ 2.5	**< 2.5 (low)**	**Total**
	Non-biomass	N	988	87	1075
		%	91.9%	8.1%	100.0%
	Biomass	N	1957	184	2141
		%	91.4%	8.6%	100.0%
Total		**N**	**2945**	**271**	**3216**
		%	**91.6%**	**8.4%**	**100.0%**

Table 3, shows the distribution of the main types of fuel for cooking in the households of 3201 weighed last live born children in the preceding two years of the ZMICS2014 by low or higher birth weight, when the type of fuels are categorized as light smoky or higher smoky fuels. 8.8 % of the babies that was born to mothers that belong to households that use higher smoky fuels as their main cooking energy were weighed below 2500g at the time of their birth.

Table 3 distribution of the main type of fuel for cooking in smoke levels in the households of the last live born children in the preceding two years of the ZMICS2014 by low or higher birth weight

			Birth weight in Kg		
			≥ 2.5	**< 2.5 (low)**	**Total**
	light smoky	N	923	77	1000
		%	92.3%	7.7%	100.0%
	Higher Smoky	N	2008	193	2201
		%	91.2%	8.8%	100.0%
Total		**N**	**2931**	**270**	**3201**
		%	**91.6%**	**8.4%**	**100.0%**

4.1.3 HOUSEHOLD SOCIO DEMOGRAPHIC STATUS

Table 4 shows the distribution of socio-demographic characteristic of the households of the mothers and their last live born children in the preceding two years of the ZMICS2014 by low or higher birth weight. Overall, 8.4 percent of the 3221 children that were weighed at the time of birth were below 2.5Kg.

The proportion of children that were weighed below 2.5Kg was slightly higher in rural households than in urban households. 8.6 percent of the children from rural residences and 8.1 percent from urban were weighed below 2.5Kg. The proportion of children that were weighed below 2.5Kg among the households that were headed by men and women with different educational levels showed small differences. It was slightly higher in the group that was headed with the highest level of education, with a proportion of 9.7 percent Table 4.

Based on the availability of different assets the households that were sampled in the ZMICS2014 were given scores and they were ranked in to five wealth categories, from the poorest through richest. Though, it was not big difference from the other wealth quintile groups the proportion of children that were weighed below 2.5Kg was marginally higher in the poorest quintile. The fourth group had the lowest proportion, 7.4 percent children that were weighed below 2.5Kg, Table 4.

During the ZMICS2014 primary data collection, mother tongue of each of the visited households was asked to the person who was responsible to responding the household questionnaire. The women and their children that are interest of this study are dominantly from the Shona language speakers. The rest belong to Ndebele and other languages. The proportion of children that were weighed below 2.5Kg at the time of birth was 8.1, 9.3 and 10 percent in the Shona, Ndebele and other languages speakers headed households respectively, Table 6.

Around one third of the households of the women and their children that were included in this study own at least one mosquito net. The proportion of children that were weighed less than 2.5Kg at the time of their birth is higher in the households that do not possess at least on mosquito net. It was about 9 percent on those who do possess and 7.4 percent on those who do not, Table 4.

The proportion of children that were weighed below 2.5Kg at the time of birth among the ten provinces of Zimbabwe ranges from 5.4 percent in Mashonaland Central Province to about 11 percent in Matabeleland South Province Appendix A.

Majority of the women and their children that were included in this study belong to households headed by followers of Christianity. The rest are form households that are headed by people without religion or other non-Christians. The proportion of children that were weighed below 2.5Kg at the time of birth is slightly higher in the group of households that are headed by other religions. The other religions group comprises, household heads that worship Traditional religion, Islam and other religions that were not specified on the primary data entry, Appendix A.

Table 4 distribution of socio-demographic characteristic of the households of the last live born children in the preceding two years of the ZMICS2014 by low or higher birth weight

			Birth weight in Kg		Total
			≥ 2.5	< 2.5	
Area of residence	Urban	N	1060	94	1154
		%	91.9%	8.1%	100%
	Rural	N	1890	177	2067
		%	91.4%	8.6%	100%
Total		**N**	**2950**	**271**	**3221**
		%	**91.6%**	**8.4%**	**100%**
Education level of household head	None	N	143	13	156
		%	91.7%	8.3%	100.0%
	Primary	N	870	81	951
		%	91.5%	8.5%	100.0%
	Secondary	N	1615	142	1757
		%	91.9%	8.1%	100.0%
	Higher	N	318	34	352
		%	90.3%	9.7%	100.0%
Total		**N**	**2946**	**270**	**3216**
		%	**91.6%**	**8.4%**	**100.0%**
Wealth index quintile of Household	Poorest	N	493	53	546
		%	90.3%	9.7%	100.0%
	Second	N	546	44	590
		%	92.5%	7.5%	100.0%
	Middle	N	479	50	529
		%	90.5%	9.5%	100.0%
	Fourth	N	786	63	849
		%	92.6%	7.4%	100.0%
	Richest	N	646	61	707
		%	91.4%	8.6%	100.0%
Total		**N**	**2950**	**271**	**3221**
		%	**91.6%**	**8.4%**	**100.0%**
Mother tongue of Head of Household	Shona	N	2249	197	2446
		%	91.9%	8.1%	100.0%
	Ndebele	N	466	48	514
		%	90.7%	9.3%	100.0%
	Other language	N	235	26	261
		%	90.0%	10.0%	100.0%
At least one Mosquito net possession	NO	N	1914	188	2102
		%	91.1%	8.9%	100.0%
	Yes	N	1036	83	1119
		%	92.6%	7.4%	100.0%
Total		**N**	**2950**	**271**	**3221**
		%	**91.6%**	**8.4%**	**100.0%**

4.1.4 MATERNAL CHARACTERISTICS

Table 5 displays distribution of the characteristics of the mothers of the last live born children in the preceding two years of the ZMICS2014 by low or higher birth weight. Based on their age the mothers were categorized into three groups, below 20, 20-34, and above 34 years old. Majority of the mothers that were eligible for this study fall in the 20 – 34 age group. The proportion of children that were weighed below 2.5Kg at the time of birth was low (7.4%) in this age group, and it was high in both the extreme age groups with little difference between them, Table 5.

In this study the educational status of the mothers of interest was classified in to 4 categories. Majority of the women attended either primary or secondary schools. Few mothers attended higher educational level and fewer mothers fall to the group with pre-school or no-education. The proportion of children that were weighed below 2.5Kg at the time of their birth is least (6.2%) in the group of mothers with the highest level of education. However, it was highest (8.9%) in the group of mothers with high school educational level.

In the primary data collection all the mothers, whose last live born child was within the two preceding years of the ZMICS2014 were inquired whether they wanted the last regency. Majority of the mothers had wanted the pregnancy. The proportion of children that were weighed below 2.5Kg at the time of birth was exactly the same in the groups, Table 6.

Table 5 distribution of the characteristics of the mothers of the last live born children in the preceding two years of the ZMICS2014 by low or higher birth weight

			Birth weight in Kg		Total
			≥ 2.5	< 2.5 (low)	
Mother's age at birth	<20	N	522	64	586
		%	89.1%	10.9%	100%
	20-34	N	2102	168	2270
		%	92.6%	7.4%	100%
	35+	N	326	39	365
		%	89.3%	10.7%	100%
Total		**N**	**2950**	**271**	**3221**
		%	**91.6%**	**8.4%**	100%
Educational level of the mother	No education or preschool	N	27	2	29
		%	93.1%	6.9%	100%
	Primary	N	771	65	836
		%	92.2%	7.8%	100%
	Secondary	N	1954	191	2145
		%	91.1%	8.9%	100%
	Higher	N	198	13	211
		%	93.8%	6.2%	100%
Total		**N**	**2950**	**271**	**3221**
		%	**91.6%**	**8.4%**	100%
Desire to the last pregnancy	Yes	N	2038	187	2225
		%	91.60%	8.40%	100
	No	N	912	84	996
		%	91.60%	8.40%	100%
Total		**N**	**2950**	**271**	**3221**
		%	**91.60%**	**8.40%**	**100%**

From the 3221 mothers whose children were weighed at the time of birth only 45 had never visits at least once to an ANC service center. The proportion of children that were weighed below 2.5Kg at the time of birth was more than 11 percent in the group of mothers who had never visited, Table 6.

Table 6 distribution of ANC visits of the mothers of the last live born children in the preceding two years of the ZMICS2014 by low or higher birth weight

ANC Visit at least once			**Birth weight in Kg**		
			≥ 2.5	**< 2.5 (low)**	**Total**
	No	N	40	5	45
		%	88.9%	11.1%	100.0%
	Yes	N	2910	266	3176
		%	91.6%	8.4%	100.0%
Total		**N**	**2950**	**271**	**3221**
		%	**91.6%**	**8.4%**	**100.0%**

The mean number of ANC visits in the mothers of the last live born children with in the preceding two years of the ZMICS2014 was 5. The mean starting time for an ANC visit in these mothers was 5th month of the pregnancy. To avoid missing data in this variable, mothers who had never visited to ANC were coded as if they went to an ANC center at a 10th month of the pregnancy, table 7.

Table 7 Distribution of number of ANC visits and start of ANC visits by the age of pregnancy of the mothers of the last live born children with in the 2 preceding years of the ZMICS2014

	N	**Min**	**Max**	**Mean**	**Std. Deviation**
Number of ANC visits	3876	0	60	4.98	3.052
Moth of start of ANC visits by age of pregnancy	3910	.23	10.00	4.8020	1.98537

Table 8 shows the distribution of Iron and folate supplementation intake of the mothers of the last live born children in the preceding two years of the ZMICS2014 by low or higher birth weight. 400 from the 3218 others did not take any iron tablet supplementation during the pregnancy period of their last live born child. 978 out of these mothers also did not take folate supplementation. The proportion of children that weighed below 2.5Kg at the time of birth is higher in the group of mothers who did not take. The mothers were further grouped in to five groups, according to the duration of iron and folate intake.

Table 8 distribution of Iron and folate supplementation and malaria prophylaxis intake of the mothers of the last live born children in the preceding two years of the ZMICS2014 by low or higher birth weight

			Birth weight in Kg		Total
			≥ 2.5	< 2.5	
Iron tablets intake	No	N	356	44	400
		%	89.0%	11.0%	100%
	Yes	N	2593	225	2818
		%	92.0%	8.0%	100%
Total		**N**	**2949**	**269**	**3218**
		%	**91.6%**	**8.4%**	100%
Duration iron tablets taken	No intake	N	357	46	403
		%	88.6%	11.4%	100%
	Less than 1 month	N	282	34	316
		%	89.2%	10.8%	100%
	One to two months	N	423	31	454
		%	93.2%	6.8%	100%
	Two to three months	N	403	46	449
		%	89.8%	10.2%	100%
	Three months or more	N	1481	114	1595
		%	92.9%	7.1%	100%
Duration folate tablets taken	No intake	N	901	89	990
		%	91.0%	9.0%	100%
	Less than 1 month	N	248	30	278
		%	89.2%	10.8%	100%
	One to two months	N	310	25	335
		%	92.5%	7.5%	100%
	Two to three months	N	326	34	360
		%	90.6%	9.4%	100%
	Three months or more	N	1158	93	1251
		%	92.6%	7.4%	100%
Total		**N**	**2943**	**271**	**3214**
		%	**91.6%**	**8.4%**	100%

Table 9 shows the distribution malaria prophylaxis intake of the mothers of the last live born children in the preceding two years of the ZMICS2014 by low or higher birth weight. Only 1163 mothers took fansidar to prevent malaria attack during their pregnancy.

Table 9 distribution of and malaria prophylaxis intake and frequency of malaria prophylaxis intake of the mothers of the last live born children in the preceding two years of the ZMICS2014 by low or higher birth weight

			Birth weight in Kg		**Total**
			≥ 2.5	**< 2.5**	
Malaria prophylaxis taken	No	N	1865	177	2042
		%	91.3%	8.7%	100.00%
	Yes	N	1070	93	1163
		%	92.0%	8.0%	100%
Total		**N**	**2935**	**270**	**3205**
		%	**91.6%**	**8.4%**	100%
Number of times Malaria prophylaxis	0	N	2173	203	2376
		%	91.5%	8.5%	100%
	1	N	407	34	441
		%	92.3%	7.7%	100%
	2	N	184	17	201
		%	91.5%	8.5%	100%
	3	N	129	12	141
		%	91.5%	8.5%	100%
	> 3	N	47	3	50
		%	94.0%	6.0%	100%
Total		**N**	**2940**	**269**	**3209**
		%	**91.6%**	**8.4%**	100%

Table 10 displays the distribution of smoking and alcohol drinking habits of the mothers of the last live born children in the preceding two years of the ZMICS2014 by low or higher birth weight. Very small proportion of the mothers had ever smoked cigarettes. Only 50 out of 3220 mothers reported that they had ever smoked a smoke producing cigarette. Form these mothers, 487 said that they had ever tried at least one drink in their life time.

Table 10 Distribution of smoking and alcohol drinking habits of the mothers of the last live born children in the preceding two years of the ZMICS2014 by low or higher birth weight

			Birth weight in Kg		
			≥ 2.5	< 2.5 (low)	Total
mother ever smoked	No	N	2902	268	3170
		%	91.5%	8.5%	100.0%
	Yes	N	47	3	50
		%	94.0%	6.0%	100.0%
Total		N	**2949**	**271**	**3220**
		%	**91.6%**	**8.4%**	**100.0%**
Mother ever drunk	No	N	2499	230	2729
		%	91.6%	8.4%	100.0%
	Yes	N	447	40	487
		%	91.8%	8.2%	100.0%
Total		**N**	**2946**	**270**	**3216**
		%	**91.6%**	**8.4%**	**100.0%**
number of drinks usually consumed	0	N	2904	266	3170
		%	.9	8.4%	100.0%
	1 to 4	N	25	4	29
		%	86.2%	13.8%	100.0%
	more than 5	N	20	1	21
		%	95.2%	4.8%	100.0%
Total		**N**	**2949**	**271**	**3220**
		%	**91.6%**	**8.4%**	**100.0%**

4.1.5 FETAL CHARACTERISTICS

Table 11 shows the distribution of the characteristics of the last live born children in the preceding two years of the ZMICS2014 by low or higher birth weight. The number of males and the females was almost equal in the sample. The proportion of children who were weighed below 2.5Kg at the time of birth was 9.3 percent in the females where as it was 7.5 percent in the males. First born children, when it is compared to the other groups of birth order, has a higher proportion of children who were weighed below 2.5Kg at the time of birth. The children of interest of this study were also categorized according to their previous birth interval (the number of years between the birth dates of the children and their preceding siblings). When compared to the other groups the percent of children who were weighed below 2.5Kg at the time of birth is higher in the first group, i.e. previous birth interval less than two years. Out of the 3221 weighed babies, 56 were delivery of multiple pregnancies. As this study is dealing with only the last live born children from a mother in reproductive age, the twin siblings of these 56 children were not included in this study. About 54 percent of the twin children were weighed below 2.5Kg at the time of birth.

Table 11 distribution of the characteristics of the last live born children in the preceding two years of the ZMICS2014 by low or higher birth weight

			Birth weight in Kg		
			≥ 2.5	**< 2.5 (low)**	**Total**
Gender	Female	N	1470	151	1621
		%	90.7%	9.3%	100.0%
	Male	N	1480	120	1600
		%	92.5%	7.5%	100.0%
Total		**N**	**2950**	**271**	**3221**
		%	**91.6%**	**8.4%**	**100.0%**
Birth order	1	N	856	103	959
		%	89.3%	10.7%	100%
	2-3	N	1354	101	1455
		%	93.1%	6.9%	100.0%
	4-6	N	673	62	735
		%	91.6%	8.4%	100%
	7+	N	67	5	72
		%	93.1%	6.9%	100%
Total		**N**	**2950**	**271**	**3221**
		%	**91.6%**	**8.4%**	**100%**
Previous birth interval	<2 years	N	1040	122	1162
		%	89.5%	10.5%	100%
	2 years	N	498	31	529
		%	94.1%	5.9%	100%
	3 years	N	478	29	507
		%	94.3%	5.7%	100%
	4+ years	N	934	89	1023
		%	91.3%	8.7%	100%
Total		**N**	**2950**	**271**	**3221**
		%	**91.6%**	**8.4%**	**100%**
Multiple birth	No	N	2924	241	3165
		%	92.4%	7.6%	100.0%
	Yes	N	26	30	56
		%	46.4%	53.6%	100%
Total		**N**	**2950**	**271**	**3221**
		%	**91.6%**	**8.4%**	**100 %**

4.2 BIVARIATE ANALYSIS

4.2.1 TYPES OF FUEL AND LOW BIRTH WEIGHT

The fuels used in the households of the mothers and children were classified in two ways. First according whether they were biomass or non-biomass, second according to the level of smoke they produce when they are burned. On the first way of classification, the association of fuel with low birth weight was analyzed by using the mothers from the households that use non-biomass fuel as a reference group. The use of biomass fuel was weakly associated with low birth weight. The odds ratio of giving low birth weight baby was 1.17 times higher in the mothers from households that use non-biomass fuel as their main type cooking energy source, (OR: 1.173, 95% CI: 0.877, 1.569, p=0.281), table 12.

Table 12 the relationship of biomass and non-biomass fuels in households of mothers of the last live born children in the preceding two years of the ZMICS2014 with Low birth weight, a bivariate analysis

	OR	**t**	**95% CI**		**P**
Non-biomass fuel	1				
biomass fuel	1.173	1.08	0.877	1.569	0.281

Table 13 also shows the association of low birth weight and the types of fuels, when the fuels are categorized in to two according to the level of smoke they produce at the time of burning. Low smoky fuels, Electric, Liquefied Petroleum Gas (LPG) and biogas, and the smoky fuels are kerosene, charcoal, wood and straw. In bivariate analysis of showing the association between these fuel types and low birth weight, the odds ratio of giving birth to a low birth weight baby is 1.24 times higher in the mothers from households that usually cook using the smoky fuels. (OR: 1.236, 95% CI: 0.911, 1.675, p=0.173).

Table 13 the relationship of low smoky and smoky fuels in households of mothers of the last live born children in the preceding two years of the ZMICS2014 with Low birth weight, a bivariate analysis

low birth weight	**OR**	**t**	**95% CI**		**P**
Light smoky fuels*	1				
smoky fuels**	1.236	1.37	0.911	1.675	0.173

* = Electric, Liquefied Petroleum Gas(LPG)and biogas

**= kerosene, charcoal, wood and straw

4.2.2 HOUSEHOLD SOCIO-DEMOGRAPHIC CHARACTERISTICS

Table 14 shows the bivariate analysis of the relationship of the household socio-demographic characteristics of the mothers of the last live born children in the preceding two years of the ZMICS2014 with Low birth weight. Household characteristics such as province, residence area (urban or rural), educational level of head of the households, wealth index quintile, religious faith of the head of the household, mother tongue of the head of the head of the household and availability of at least one mosquito net in the household were considered. Bivariate logistic regression was done to see if there is significant difference in odds ratio of giving a low birth weight baby between the mothers from different subgroups of the household characteristics. Out of all the household characteristics only availability of at least one mosquito net in a household seems slightly associated with a lower risk of giving birth of a low birth weight baby. Mothers from households that had at least one mosquito net have 0.84 times odds ratio of giving birth to a low birth weight baby when compared to mothers from households that don’t, (OR: 0.84, 95% CI: 0.64, 105) of with a p-value of 0.122. The mosquito ownership characteristic is the only household factor that was carried on to the multivariable logistic regression.

Table 14 , the relationship of the household characteristics of the mothers of the last live born children in the preceding two years of the ZMICS2014 with Low birth weight, a bivariate analysis

	OR	**t**	**95%CI**		**P**
Residence					
urban	1				
rural	1.129	0.85	0.854	1.493	0.395
Educational level of HHH					0.759*
no education	1				
primary	0.939	-0.18	0.473	1.864	0.857
secondary	0.883	-0.36	0.447	1.746	0.72
Higher	1.164	0.39	0.537	2.522	0.700
Wealth index quintile					0.550*
Poorest	1				
Second	0.794	-1.08	0.521	1.209	0.282
Middle	1.041	0.19	0.693	1.563	0.847
Fourth	0.788	-1.2	0.534	1.164	0.231
Richest	0.909	-0.47	0.613	1.348	0.635
Mother tongue of Head of HH					0.609*
Shona	1				
Ndebele	1.165	0.89	0.831	1.633	0.376
Other language	1.148	0.62	0.740	1.781	0.536
Having mosquito net at least 1					
No	1				
YES	0.778	-1.77	0.588	1.028	0.078
Province					0.243*
Religion of HHH ¥					0.889*

¥ HHH = Head of household

4.2.2 MATERNAL CHARACTERISTICS

15 shows a bivariate analysis of the relationship of the maternal characteristics of the last live born children in the preceding two years of the ZMICS2014 with Low birth weight. According to their age at the time of giving birth to the children the mothers were categorized in to three groups, mothers who were below the age of 30 years, 20 to 34 years and 35 years and above. In the bivariate logistic regression, the latter two age groups of mothers were compared to the teen aged mothers. The second group of mothers has a reduced risk of giving birth to a low birth weight baby, the odds ratio of giving low birth weight baby in this age group was 0.68 times the odds

ratio in of the in the comparison group, (OR: 0.68, 95% CI: 0.48, 0.98). This was statistically significant at a p-value of 0.029. While the oldest age group of mothers didn't show any significant difference in the chance of giving birth of low birth weight babies.

Educational level of the mothers was also a factor that was considered to contribute in the risk of giving birth to a low birth weight babies. Mothers were categorized in to four educational levels, mothers with no education, mothers who reached to primary, secondary or higher levels. In the bivariate logistic regression the three groups of mothers with education were compared separately to the mothers with no education. There were no significant differences in the odds ratio of giving birth to low birth weight babies, table 15.

Table 15, the relationship of the maternal characteristics (mother's age and education) of the mothers of the last live born children in the preceding two years of the ZMICS2014 with Low birth weight, a bivariate analysis

	OR	t	95% CI		P-value
Mother's age at the time of birth					0.034
<20	1				
20-34	0.681	-2.19	0.482	0.961	0.029
35+	1.011	0.05	0.623	1.642	0.964
Educational level of the mother					
No education	1				
Primary	1.254	0.28	0.256	6.139	0.779
Secondary	1.396	0.42	0.290	6.717	0.677
Higher	0.964	-0.04	0.182	5.089	0.965

Data on whether the pregnancy that led to the last live born child was wanted also was considered in the analyses. On the bivariate analysis in comparing the chances of giving birth to low birth weight baby between the mothers who wanted the pregnancy and mothers who didn't showed no significant difference, table 16.

Mothers who attended to any antenatal care services were compared to mothers who didn't receive any antenatal care during their last pregnancy time. No significant difference on the odds ratio of giving birth to a low birth weight baby was observed between these two groups of mothers. However when the number of antennal visits was considered, mothers with higher number of visits tend to have a lower risk of giving low birth weight babies, (OR: 0.96, 95% CI: 0.91, 1.01), with a p-value of 0.133. Starting antenatal visits by the age of pregnancy was also analyzed;

mothers who start the antenatal visits in a later gestational age were with at a relatively lower risk of giving a low birth weight baby, (OR: 0.95, 95% CI: 0.88, 1.02), with a p-value of 0.143, table 17. Mothers got the ANC cervices from different health professionals, doctors, nurses/midwives or traditional birth attendants. There was no significant difference on the odds of giving birth to a low birth weight baby when who provided the antenatal care was compared to those who did not get the series, table 16.

Table 16 , the relationship of the maternal characteristics(desire to the pregnancy and ANC) of the mothers of the last live born children in the preceding two years of the ZMICS2014 with Low birth weight, a bivariate analysis

	OR	**t**	**95% CI**		**P-value**
Pregnancy wanted					
No	1				
Yes	1.013	0.08	0.747	1.373	0.933
ANC received					
No	1				
Yes	0.704	-0.72	0.270	1.836	0.473
Number of ANC visits					
	0.960	-1.5	0.911	1.013	0.133
Start of ANC visit					
	0.945	-1.47	0.876	1.019	0.143
ANC PROVIDER					
No ANC visits	1				
Doctor	0.889	-0.54	0.580	1.363	0.589
Nurse/Midwife	0.738	-1.11	0.433	1.260	0.265
CHW/TBA* or others	1.105	0.09	0.116	10.558	0.931

**CHW=Community Health Worker, TBA=Traditional Birth Attendant*

In the bivariate analysis, Iron tablets intake during pregnancy was significantly associated with a lower risk of giving birth to a low birth weight baby. Mothers who took iron during their gestation time have lower risk of giving birth to a low birth weight baby, the odds ratio of giving birth to a low birth weight baby in mothers who took iron tablet during their pregnancy period is 0.69 times when compared to mothers who didn’t take any iron tablet supplementation, (OR: 0.69, 95% CI: 0.49, 0.92) with a p-value of 0.039. Duration of iron tablet intake during the pregnancy time was also inversely associated with a risk of low birth weight. As the duration of iron intake increased the risk of giving birth to a low birth weight baby decreased, (OR:

0.89, 95% CI: 0.82, 0.97), with a p-value of 0.01. However, folate tablet intake and duration of folate tablet intake were not associated with chance of giving birth to low birth weight babies, table 17.

Other maternal factors such as, taking malaria prophylaxis, number of times malaria prophylaxis taken, mothers' ever smoked cigarette, mothers' ever drunken alcohol and number of usual alcohol drinks were taken in to account in the bivariate analysis. However, none of these factors was significantly associated with the mothers' odds ratios of giving birth to a low birth weight baby, table 17.

Table 17 , the relationship of the maternal characteristics, intake of supplementary-prophylactic tablets and habits of the mothers of the last live born children in the preceding two years of the ZMICS2014 with Low birth weight, a bivariate analysis

	OR	**t**	**95% CI**		**P**
iron intake during pregnancy					
No	1				
Yes	0.693	-2.07	0.489	0.982	0.039
Duration iron tablets taken	0.893	-2.58	0.819	0.973	0.010
Folate intake during pregnancy					
No	1				
Yes	0.946	-0.38	0.706	1.267	0.707
Duration folate tablets taken	0.958	-1.14	0.889	1.032	0.255
malaria prophylaxis taken					
No					
Yes	0.983	-0.12	0.745	1.298	0.905
Number of times Malaria prophylaxis	0.983	-0.24	0.848	1.138	0.814
Mother ever smoked					
No	1				
Yes	0.924	-0.12	0.266	3.207	0.901
Mother ever drunk					
No	1				
Yes	0.969	-0.16	0.655	1.435	0.876
Number of drinks usually consumed	0.981	-0.06	0.534	1.802	0.951

4.2.4 FETAL CHARACTERISTICS

Table 18 shows the bivariate analysis of the relationship of the fetal characteristics of the last live born children in the preceding two years of the ZMICS2014 with Low birth weight. Baby gender with was slightly associated with low birth weight. When male babies are compared with female babies they tend to have a lowered risk of becoming low birth weight. The odds ratio of becoming low birth weight baby in males is 0.83 times when compared to females, (OR: 0.83, 95% CI: 0.63, 1.09), with a p-value of 0.176.

In the bivariate analysis of birth order and low birth weight, first born babies were considered as a reference group to the group of 2^{nd} or 3^{rd} born babies, 4^{th}-6^{th} born babies, and 7^{th} or above born babies. The 2nd or 3^{rd} born babies have lowered risk of becoming a low birth weight baby, (OR: 0.65, 95% CI: 0.47, 0.89) when compared to the first born babies, with a p-value of 0.008. The other two groups seem to have a lower chance of becoming low birth weight baby, but not statistically significant, table 18.

Previous birth interval, the number of years between the last born baby and the previous sibling, was also considered in the bivariate analysis. In the bivariate analysis babies with previous birth interval less than two years were considered as a reference group. Group of babies with previous birth interval of 3 or 4 years have a lower chance of becoming low birth weight. The odds ratio of becoming a low birth weight baby in both groups is 0.53 times the odds ratio in the group of babies whose birth interval is less than two years. The other group of babies with 4 or more years of spacing with previous sibling showed a non-significant decreased risk of becoming low birth weight babies, table 18.

Becoming a twin or triplet baby is highly positively associated with becoming low birth weight. Twin babies when they are compared to single born babies have an odds ratio of 14.28 times becoming a low birth weight, (OR: 14.28, 95% CI: 8.24, 24.73), with a p-value of less than 0.001.

Table 18 the relationship of the fetal characteristics of the last live born children in the preceding two years of the ZMICS2014 with Low birth weight, a bivariate analysis

	t	OR	95%CI		P
Baby Gender					
Female		1			
male	-1.35	0.828	0.629	1.089	0.176
Birth Order					0.066*
1		1			
2--3	-2.64	0.646	0.467	0.894	0.008
4--6	-1.03	0.821	0.564	1.194	0.301
7+	-0.9	0.646	0.249	1.678	0.369
Interval in years					0.007*
< 2		1			
2	-2.8	0.533	0.343	0.829	0.005
3	-2.75	0.529	0.336	0.834	0.006
4+	-1.26	0.813	0.590	1.122	0.207
Twin					
single		1			
Twin(Multiple birth)	9.5	14.277	8.243	24.729	<0.001

4.3 MULTIVARABLE ANALYSIS

Table 19 shows the first step multivariable logistic regression of the association between low birth weight(less than 2.5Kg) and the types of fuels in the households. The types of fuels were grouped as biomass or non-biomass. To adjust for the possibly associated factors of birth weight, all the variables that had p-value less than 0.2 in the bivariate analysis were carried to the multivariable logistic regression. Type of fuel and other eleven adjusting independent variables were tested in this analysis. In this multivariable logistic regression babies born to mothers from households that use biomass fuels as their main cooking energy had an odds of 1.16 times higher of low birth weight when they are compared to the babies that are born to the mothers from households that use non-biomass fuels, (OR: 1.17, 95% CI: 0.85, 1.61). However this was not statistically significant with p-value of 0.342.

Table 20 shows a similar model of multivariable logistic regression as table 18, with the exception that the types of fuels in the households are grouped in the level of smoke they produce while burning. In this model the fuels are grouped in to light smoky fuels (Electric, Liquefied Petroleum Gas, and biogas) and higher smoky fuels (kerosene, charcoal, wood and straw). The odds of becoming low birth weight babies is 1.21 times higher in the babies born to mothers from households that mainly use higher smoky fuels in comparison with the babies that were born to mothers from households that use less smoky fuels.

Table 19 first step multivariable logistic regression analysis, association between low birth weight and household type of fuel (biomass and non-biomass) and other adjusting independent variables.

low birth weight	OR	t	95% CI		P
A. TYPE FUEL					
biomass fuel	1.169	0.95	0.847	1.614	0.342
B. HOUSEHOLD SOCIO-DEMOGRAPHI CHARACTERISTICS					
having at least 1 mosquito bed net	0.776	-1.66	0.575	1.047	0.096
C.MATERNAL CHARACTERISTICS					
Mother's age					0.078*
<20	1				
20-34	0.887	-0.55	0.577	1.362	0.583
35+	1.547	1.33	0.812	2.948	0.184
ANC received[$]	0.699	-0.67	0.245	1.989	0.501
Number of ANC visits	0.888	-2.76	0.817	0.966	0.006
Start of ANC visit	0.831	-3.53	0.750	0.921	<0.001
Iron intake during pregnancy	1.072	0.27	0.641	1.792	0.790
Duration iron tablets taken	0.840	-2.59	0.737	0.959	0.010
D.FETAL CHARACTERISTICS					
male gender	0.813	-1.43	0.611	1.081	0.155
Twin(Multiple birth)	21.603	9.72	11.611	40.194	<0.001
birth interval in years					0.056*
< 2	1				
2	0.554	-1.86	0.297	1.034	0.063
3	0.527	-1.88	0.270	1.029	0.061
4+	0.890	-0.4	0.505	1.569	0.687
Birth Order					0.403*
1	1				
2--3	0.823	-0.65	0.458	1.480	0.514
4--6	0.724	-0.93	0.366	1.433	0.353
7+	0.362	-1.63	0.106	1.232	0.104

[$]=This variable was retained in order to sharpen the model estimate for timing of ANC even though the p-value of this variable was > 0.2

* P-value for the variable as a whole

Table 20 first step multivariable logistic regression analysis, association between low birth weight and household type of fuel (light smoky and higher smoky) and other adjusting independent variables.

low birth weight	OR	t	95% CI		P
A. TYPE FUEL					
higher smoky	1.209	1.12	0.867	1.687	0.263
B. HOUSEHOLD SOCIO-DEMOGRAPHI ARACTERISTICS					
having at least 1 mosquito bed net	0.7650676	-1.75	0.567	1.033	0.080
C.MATERNAL CHARACTERISTICS					
Mother's age					
<20	1				0.100*
20-34	0.890	-0.54	0.580	1.365	0.592
35+	1.512	1.26	0.793	2.885	0.209
ANC received[$]	0.688	-0.71	0.243	1.949	0.481
Number of ANC visits	0.890	-2.71	0.817	0.968	0.007
Start of ANC visit	0.830	-3.52	0.748	0.921	K0.001
Iron intake during pregnancy	1.061	0.22	0.633	1.776	0.823
Duration iron tablets taken	0.840	-2.59	0.737	0.959	0.010
D.FETAL CHARACTERISTICS					
male	0.818	-1.38	0.615	1.089	0.169
Twin(Multiple birth)	21.317	9.72	11.491	39.54 3	<0.001
birth interval in years					0.061*
< 2	1				
2	0.558	-1.85	0.300	1.038	0.065
3	0.536	-1.83	0.274	1.047	0.068
4+	0.897	-0.38	0.509	1.580	0.706
Birth Order					0.4136
1	1				
2--3	0.811	-0.7	0.451	1.459	0.484
4--6	0.725	-0.92	0.366	1.435	0.355
7+	0.363	-1.62	0.107	1.235	0.105

[$]=This variable was retained in order to sharpen the model estimate for timing of ANC even though the p-value of this variable was > 0.2

* P-value for the variable as a whole

Table 21 shows step two multivariable logistic regressions of the association between low birth weight(less than 2.5Kg) and the types of fuels in the households. In this model only the independent variables that were associated with low birth weight with a p-value less than 0.2 in the previous multivariable logistic regression were included. The association of the variables, iron intake during pregnancy and birth orders, with low birth weight was attenuated when these variables were carried in to the first step multivariable logistic regressions. Both of them scored p-values greater than 0.2, therefore they were excluded from the subsequent multivariable logistic regression. In the subsequent multivariable logistic regression, the babies born to mothers from households that use biomass fuels had odds of 1.10 of becoming low birth weight when compared to babies born to mothers from households that use non-biomass fuels, (OR: 1.10, 95% CI: 0.80, 1.52, p=0.52).

Table 22 is similar to table 20, except that the types of fuels were grouped according to the level of smoke they produce at the time of burning. In the multivariable logistic regression the odds of becoming a low birth weight baby in the babies that were born from the mothers from households that use higher smoky fuels was 1.14 times higher when compared to the odds of the babies who were born to the mothers from households that use light smoky fuels, (OR: 1.18, 95% CI: 0.82, 1.59, p=0.42).

Table 21 Second step multivariable logistic regression analysis of association between household type of fuel (biomass and non-biomass) and low birth weight(less than 2.5kg), with independent variables less than 0.2 p-values

low birth weight	**OR**	**t**		**P**	**95% CI**
A. TYPE FUEL					
biomass fuel	1.104	0.61	0.804	1.515	0.540
B. HOUSEHOLD SOCIO-DEMOGRAPHI CHARACTERISTICS					
having at least 1 mosquito bed net	0.781	-1.62	0.579	1.053	0.105
C.MATERNAL CHARACTERISTICS					
Mother's age					0.181*
<20	1				
20-34	0.798	-1.07	0.526	1.209	0.286
35+	1.185	0.56	0.652	2.155	0.578
ANC received $	0.722	-0.63	0.261	1.995	0.529
Number of ANC visits	0.889	-2.77	0.819	0.966	0.006
Start of ANC visit	0.829	-3.6	0.749	0.918	<0.001
Duration iron tablets taken	0.850	-3.19	0.768	0.939	0.001
D.FETAL CHARACTERISTICS					
male	0.808	-1.47	0.608	1.075	0.143
Twin(Multiple birth)	19.326	9.96	10.777	34.656	<0.001
birth interval in years					0.004*
< 2	1				
2	0.487	-2.86	0.297	0.798	0.004
3	0.455	-2.98	0.271	0.764	0.003
4+	0.796	-1.14	0.539	1.177	0.253

$=This variable was retained in order to sharpen the model estimate for timing of ANC even though the p-value of this variable was > 0.2

* P-value for the variable as a whole

Table 22 Second step multivariable logistic regression analysis of association between household type of fuel (light smoky and higher smoky) and low birth weight(less than 2.5kg), with independent variables less than 0.2 p-values

low birth weight	**OR**	**t**	**95% CI**		**P**
A. TYPE FUEL					
higher smoky	1.143	0.8	0.823	1.587	0.424
B. HOUSEHOLD SOCIO-DEMOGRAPHI HARACTERISTICS					
having at least 1 mosquito bed net	0.770	-1.71	0.571	1.040	0.088
C.MATERNAL CHARACTERISTICS					
Mother's age					0.209
<20	1				
20-34	0.800	-1.06	0.528	1.210	0.29
35+	1.165	0.5	0.639	2.123	0.618
ANC received$	0.703	-0.68	0.256	1.935	0.495
Number of ANC visits	0.891	-2.73	0.819	0.968	0.007
Start of ANC visit	0.827	-3.6	0.746	0.918	<0.001
Duration iron tablets taken	0.848	-3.23	0.767	0.937	0.001
D.FETAL CHARACTERISTICS					
male	0.814	-1.42	0.612	1.083	0.157
Twin(Multiple birth)	19.162	9.95	10.701	34.312	<0.001
birth interval in years					0.004*
< 2	1				
2	0.486	-2.87	0.297	0.797	0.004
3	0.460	-2.94	0.274	0.772	0.003
4+	0.796	-1.15	0.538	1.177	0.252

$=This variable was retained in order to sharpen the model estimate for timing of ANC even though the p-value of this variable was > 0.2

* P-value for the variable as a whole

CHAPTER V
DISCUSSION

5.1 TYPE OF FUEL USED IN THE HOUSEHOLD

This study, using bivariate and multivariable logistic regression, tried to see the association of the use of biomass fuels or higher smoky fuels in a household and low birth weight. In both levels of analysis, slight association of biomass or higher smoky fuels use with low birth weight was observed. The odds ratio of giving birth to a low birth weight baby was higher in the mothers from households that use biomass fuels or higher smoky fuels in comparison to their respective reference groups. However these associations were not statistically significant.

Relatively few studies have assessed the association between maternal exposure to smoke from cooking fuels and birth weight of the baby. (Boy et al., 2002), observed a lower mean birth weight of babies that were born to mothers who usually cook in using wood in an open fire. A secondary data analysis of the 2006/07 Pakistan Demographic Health Survey(DHS) showed, use of biomass in households were associated with low birth weight (Ahmed et al., 2015). A similar study from the 1999 Zimbabwe DHS concluded, cooking using high polluting fuels might be a cause for reduced weight of babies at birth (Mishra et al., 2004). Several other studies also showed association of smoke producing fuels with low birth weight (Amegah, Jaakkola, Quansah, Norgbe, & Dzodzomenyo, 2012; Demelash et al., 2015; Sreeramareddy, Shidhaye, & Sathiakumar, 2011). A study conducted in Central East India, after adjusting for other confounders showed no significant association of wood fuel and low birth weight (Wylie et al., 2014). A cross-sectional survey conducted in one of the villages of India, did not find any association of type of fuel and low birth weight. As it is stated in the conclusion of the study, the reason for the that the study had not seen the association of type of fuel and low birth weight could probably be the small sample size used in the study (N et al., 2014).

5.2 HOUSEHOLD SOCIO-DEMOGRAPHIC FACTORS

Province, urban or rural residence, Educational level of head of household, wealth index quintile, religion of head of household, mother tongue of head of household and at least one mosquito net ownership of the household were the household socio-demographic independent variables that were analyzed adjust the effect of type of fuel used in households on low birth weight or baby size. In the bivariate analysis except the ownership of at least one mosquito net, all the household socio-demographic factors did not show any association with low birth weight. Therefore, it was the only variable that was carried on for further multivariable logistic regression. Babies born to mothers from households that own at least one mosquito net tend to have a lower risk of becoming low birth weight. In the further steps of multivariable logistic regression this variable continued to have slight association with decreased lower risk of low birth weight with nearly statically significant p-values. This might mean owning of mosquito net in a household leads to lower risk of malaria and anemia during pregnancy and eventually to lower risk of low birth weight (Gamble, Ekwaru, Garner, & Ter Kuile, 2007; ter Kuile et al., 2003).

In this study the effect of urban rural residence was one of the first factors that was considered for adjustment. However, there was no significant effect of residence on the outcome variable. Therefore, as all the other variables which did not show significant association with low birth weight, it was not further included in the multivariable logistic regression. For this reason the rest other analyses were done without considering the rural and urban residence differences. Thought, some other studies (Martinson & Reichman, 2016; Torres-Arreola et al., 2005)suggest socio-economic variables affect the general health of the population and the pregnancy outcomes, in this study no significant difference of low birth weight proportion was observed on the five wealth index levels of the households. Other factors that belong to the heads of the households, such as level of education, mother tongue, and religion were assessed and no significant associations were observed between these factors and low birth weight.

5.3. MATERNAL FACTORS

In the bivariate analysis, maternal age between 20-34 years, higher number of ANC visits, starting ANC visits at latter age of pregnancy, taking iron tablets during pregnancy and taking iron tablets for higher duration were maternal factors that were associated with lower risk of giving birth to a low birth weight baby. These factors and the variable ANC attendance were taken to the multiple logistic regressions to adjust the effect of type of fuel on low birth weight. In the final multivariable logistic regression higher number of ANC visits, starting ANC visits at latter age of regency and taking iron tablets for higher duration continued to be significantly associated with decreased risk of giving birth to a low birth weight baby, with p-values less than 0.05. A report from Brazil, Sao Paulo state found an association between the number of antenatal visits by a pregnant mother and birth weight of a newborn for that specific pregnancy. Low birth weight and premature delivery incidence was lower in the mothers who have higher frequency of antenatal visits (Kilsztajn et al., 2015).

5.4 FETAL FACTORS

Being a twin baby or having less than two years difference with previous sibling were factors that were highly associated with higher risk of low birth weight in the multivariable logistic regression. Studies showed that too short and too long birth spacing have a higher risk of giving birth to a low birth weight baby (Conde-Agudelo et al., 2006). Being a female baby was slightly associated with increased risk of becoming low birth weight. Some studies reveled that females have increased chance of being born low birth weight (Mondal, 1998). Studies showed that too short and too long birth spacing have a higher risk of giving birth to a low birth weight baby.

As mentioned in the background section, birth weight was sometimes taken from the health card, and sometimes from the mother's recall. The former were on average somewhat larger than the latter (p=0.095). When source of birth weight was entered into multivariable models, there were no appreciable differences in magnitude or p-value of the associations between fuel type and low birth weight from the associations reported in the previous chapter (data not shown).

As the title shows, this thesis concentrates on birth weight. Mother's perception of newborn size was also measured in this MICS survey. The mother's perception of size of baby is highly associated with the actual weight of the babies in Kilograms, when it is analyzed in the babies that were weighed, see appendix B. In separate multivariable logistic regression models, the birth weight variable was replaced by baby size at birth by mothers' perception, which was available for 3904 observations (99.8% coverage). Results of these separate analyses are shown in the appendix. The babies that were perceived to have below average or very small size were grouped as small sized babies. Based on these separate analyses, children born to mothers from the household that use biomass fuels or higher smoky fuels had higher odds, 1.33 and 1.32 times respectively, of being low sized babies at birth in comparison with the respective reference groups. These associations were statistically significant, see appendix B. This observation suggests that biomass fuel use could conceivably be a risk factor for low birth weight in Zimbabwe as a whole, even though no significant association was observed in the current study. Further research on the overall effect of biomass fuel on birth weight in Zimbabwe, and on the extent to which mother's perception of birth size can be considered a surrogate for birth weight, is clearly needed.

5.5 CONCLUSION

Babies born to mothers from households that use biomass fuel or higher smoky fuels as their main cooking energy tend to have slight higher risk of becoming low birth weight when they are compared to mothers from households that usually cook using non-biomass fuel or light smoky fuels. Being a mother form a household that uses biomass fuels or higher smoky fuels as a main type of cooking is significantly associated with giving birth to a small sized baby.

Higher Number of ANC visits, starting the ANC attendance at late age of pregnancy, taking iron tablets during pregnancy to increased duration, are the factors that might help mothers to reduce the risk of giving birth to a low birth weight baby.

Single pregnancy, child spacing 2 to 3 years are factors that lower the risk of giving birth to a low birth weight baby.

5.6 RECOMMENDATIONS

Based on the findings the following recommendations can be forwarded,

- Avoiding maternal exposure to smokes from biomass fuel or smokes from high polluting fuels during pregnancy might help to reduce the risk of low birth weight.
- Pregnant mothers should be advised to visit antenatal care more frequently and to take iron tablet supplementation to a longer duration.
- It is advisable for parents to wait 2 to 3 years before giving birth to a next sibling.
- Further research is needed to confirm the effect of types of fuel on birth weight.

5.7 STRENGTHS AND LIMITATION

Having a representative sample and analyzing it using the STATA survey set command to consider the clustering effect of the design and women's sample weights can help to give a representative image of the whole country. On the other hand missing data on birth weight and other variables are some of the disadvantages relying on secondary data. In addition to these, the 2014 Zimbabwe MICS didn't collect data on the some important variables that can contribute to the birth weight of a newborn. Data on height of the mother and maternal illnesses during pregnancy such pre-eclampsia and eclampsia, anemia, and malaria and maternal weight gain were not collected on the survey. Premature delivery of baby, which is one of the main factors that are associated with low birth weight also lacks in this study. Data on Environmental tobacco smoking exposure of mothers was not enough to consider that variable in the analysis.

5.8 BENEFITS

As in most of the Sub-Saharan Africa region, most of the Zimbabwe populations residing in rural and underdeveloped areas have not access to low polluted fuel like natural gas but use high polluted fuel like wood. The results of this study could contribute to the knowledge of the risk of low birth weight in households that use biomass fuel. The result can also be used as a stimulating factor to the bodies that are interested in developing less polluted stoves in the region.

REFERENCES

Abbott, L. C., & Winzer-Serhan, U. H. (2012). Smoking during pregnancy: lessons learned from epidemiological studies and experimental studies using animal models. *Critical reviews in toxicology, 42*(4), 279-303.

Abusalah, A., Gavana, M., Haidich, A.-B., Smyrnakis, E., Papadakis, N., Papanikolaou, A., & Benos, A. (2012). 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 and child health journal, 16*(8), 1718-1727.

Ahmed, Z., Zafar, M., Khan, N. A., & Qureshi, M. S. (2015). Exposure to biomass fuel and low child birth weight–Findings of Pakistan Demographic and Health Survey 2006–2007. *International Journal of Health System and Disaster Management, 3*(5), 19.

Amegah, A. K., Jaakkola, J., Quansah, R., Norgbe, G. K., & Dzodzomenyo, M. (2012). Cooking fuel choices and garbage burning practices as determinants of birth weight: a cross-sectional study in Accra, Ghana. *Environ Health, 11*(1), 78.

Bergmann, R., Bergmann, K., & Dudenhausen, J. (2008). Undernutrition and growth restriction in pregnancy.

Boy, E., Bruce, N., & Delgado, H. (2002). Birth weight and exposure to kitchen wood smoke during pregnancy in rural Guatemala. *Environmental Health Perspectives, 110*(1), 109.

Bruce, N., Perez-Padilla, R., & Albalak, R. (2002). The health effects of indoor air pollution exposure in developing countries. *Geneva: World Health Organization, 11*.

Chiarotti, F., Castignani, A., Puopolo, M., Menniti-Ippolito, F., Minniti, D. S. E., & Di Paolo, A. (2000). [Effects of socio-environmental factors on neurocognitive performance in premature or low-birth weight preschoolers]. *Annali dell'Istituto superiore di sanita, 37*(4), 553-559.

Conde-Agudelo, A., Rosas-Bermúdez, A., & Kafury-Goeta, A. C. (2006). Birth spacing and risk of adverse perinatal outcomes: a meta-analysis. *Jama, 295*(15), 1809-1823.

Conter, V., Cortinovis, I., Rogari, P., & Riva, L. (1995). Weight growth in infants born to mothers who smoked during pregnancy. *Bmj, 310*(6982), 768-771.

de Bernabé, J. V., Soriano, T., Albaladejo, R., Juarranz, M., Calle, M. a. E., Martínez, D., & Domínguez-Rojas, V. (2004). Risk factors for low birth weight: a review. *European Journal of Obstetrics & Gynecology and Reproductive Biology, 116*(1), 3-15.

de Koning, H. W., Smith, K., & Last, J. (1985). Biomass fuel combustion and health. *Bulletin of the World Health Organization, 63*(1), 11.

de Onis, M., Blössner, M., & Villar, J. (1998). Levels and patterns of intrauterine growth retardation in developing countries. *European journal of clinical nutrition, 52*, S5-15.

Dejmek, J., Selevan, S. G., Benes, I., Solanský, I., & Srám, R. J. (1999). Fetal growth and maternal exposure to particulate matter during pregnancy. *Environmental Health Perspectives, 107*(6), 475.

Demelash, H., Motbainor, A., Nigatu, D., Gashaw, K., & Melese, A. (2015). Risk factors for low birth weight in Bale zone hospitals, South-East Ethiopia: a case–control study. *BMC pregnancy and childbirth, 15*(1), 1.

Dičkutė, J., Padaiga, Ž., Grabauskas, V., Nadišauskienė, R. J., Basys, V., & Gaižaukienė, A. (2004). Maternal socio-economic factors and the risk of low birth weight in Lithuania. *Medicina (Kaunas), 40*(5), 475-482.

Elshibly, E. M., & Schmalisch, G. (2008). The effect of maternal anthropometric characteristics and social factors on gestational age and birth weight in Sudanese newborn infants. *BMC public health, 8*(1), 244.

Fitzgerald, C., Aguilar-Villalobos, M., Eppler, A. R., Dorner, S. C., Rathbun, S. L., & Naeher, L. P. (2012). Testing the effectiveness of two improved cookstove interventions in the Santiago de Chuco Province of Peru. *Science of the total environment, 420*, 54-64.

Gamble, C., Ekwaru, P. J., Garner, P., & Ter Kuile, F. O. (2007). Insecticide-treated nets for the prevention of malaria in pregnancy: a systematic review of randomised controlled trials. *PLoS Med, 4*(3), e107.

Hardy, J., & Mellits, E. D. (1972). Does maternal smoking during pregnancy have a long-term effect on the child? *The Lancet, 300*(7791), 1332-1336.

Horta, B. L., Victora, C. G., Menezes, A. M., Halpern, R., & Barros, F. C. (1997). Low birthweight, preterm births and intrauterine growth retardation in relation to maternal smoking. *Paediatric and perinatal epidemiology, 11*(2), 140-151.

Ismail, M., Zaidi, K., & Maqbool, S. (2003). Premature and low birth weight neonates and their management at neonatology unit of Shaikh Zayed Hospital Lahore. *Pakistan Journal of Medical Research, 42*(2), 54-57.

Jammeh, A., Sundby, J., & Vangen, S. (2011). Maternal and obstetric risk factors for low birth weight and preterm birth in rural Gambia: a hospital-based study of 1579 deliveries. *Open Journal of Obstetrics and Gynecology, 1*(03), 94.

Jiang, M., Qiu, J., Zhou, M., He, X., Cui, H., Lerro, C., . . . Zhang, H. (2015). Exposure to cooking fuels and birth weight in Lanzhou, China: a birth cohort study. *BMC public health, 15*(1), 1.

Kayode, G. A., Amoakoh-Coleman, M., Agyepong, I. A., Ansah, E., Grobbee, D. E., & Klipstein-Grobusch, K. (2014). Contextual risk factors for low birth weight: a multilevel analysis. *PloS one, 9*(10), e109333.

Kilsztajn, S., Rossbach, A., & Sugahara, M. (2015). [Prenatal care low birth weight and prematurity in SÃ£ o Paulo State 2000]. *RevistaÂ de Saude Publica/Journal of Public Health, 37*(3), 303-310.

Kourembanas, S. (2002). Hypoxia and carbon monoxide in the vasculature. *Antioxidants and Redox Signaling, 4*(2), 291-299.

Leonardi-Bee, J., Smyth, A., Britton, J., & Coleman, T. (2008). Environmental tobacco smoke and fetal health: systematic review and meta-analysis. *Archives of Disease in Childhood-Fetal and Neonatal Edition, 93*(5), F351-F361.

Li, N., Sioutas, C., Cho, A., Schmitz, D., Misra, C., Sempf, J., . . . Nel, A. (2003). Ultrafine particulate pollutants induce oxidative stress and mitochondrial damage. *Environmental Health Perspectives, 111*(4), 455.

Martinson, M. L., & Reichman, N. E. (2016). Socioeconomic Inequalities in Low Birth Weight in the United States, the United Kingdom, Canada, and Australia. *American Journal of Public Health*(0), e1-e7.

Mishra, V., Dai, X., Smith, K. R., & Mika, L. (2004). Maternal exposure to biomass smoke and reduced birth weight in Zimbabwe. *Annals of epidemiology, 14*(10), 740-747.

Mitao, M., Philemon, R., Obure, J., Mmbaga, B. T., Msuya, S., & Mahande, M. J. (2015). Risk factors and adverse perinatal outcome associated with low birth weight in Northern Tanzania: a registry-based retrospective cohort study. *Asian Pacific Journal of Reproduction*.

Mondal, B. (1998). Low birth weight in relation to sex of baby, maternal age and parity: a hospital based study on Tangsa tribe from Arunachal Pradesh. *Journal of the Indian Medical Association, 96*(12), 362-364.

N, D., , K. B., , A. M., & , P. S. (2014). Indoor Air Pollution and Low Birth Weight- A Cross-Sectional

Study *IOSR Journal of Nursing and Health Science, 3*(4), 6.

Njenga, M., Karanja, N., Karlsson, H., Jamnadass, R., Iiyama, M., Kithinji, J., & Sundberg, C. (2014). Additional cooking fuel supply and reduced global warming potential from recycling charcoal dust into charcoal briquette in Kenya. *Journal of Cleaner Production, 81*, 81-88.

Pampel, F. (2008). Tobacco use in sub-Sahara Africa: estimates from the demographic health surveys. *Social science & medicine, 66*(8), 1772-1783.

Perera, F. P., Jedrychowski, W., Rauh, V., & Whyatt, R. M. (1999). Molecular epidemiologic research on the effects of environmental pollutants on the fetus. *Environmental Health Perspectives, 107*(Suppl 3), 451.

Restrepo-Méndez, M. C., Lawlor, D. A., Horta, B. L., Matijasevich, A., Santos, I. S., Menezes, A., . . . Victora, C. G. (2015). The Association of Maternal Age with

Birthweight and Gestational Age: A Cross-Cohort Comparison. *Paediatric and perinatal epidemiology, 29*(1), 31-40.

Salmasi, G., Grady, R., Jones, J., & McDonald, S. D. (2010). Environmental tobacco smoke exposure and perinatal outcomes: a systematic review and meta-analyses. *Acta obstetricia et gynecologica Scandinavica, 89*(4), 423-441.

Sastry, B. (1991). Placental toxicology: tobacco smoke, abused drugs, multiple chemical interactions, and placental function. *Reproduction, Fertility and Development, 3*(4), 355-372.

Shah, P. S. (2010). Parity and low birth weight and preterm birth: a systematic review and meta-analyses. *Acta obstetricia et gynecologica Scandinavica, 89*(7), 862-875.

Sreeramareddy, C. T., Shidhaye, R. R., & Sathiakumar, N. (2011). Association between biomass fuel use and maternal report of child size at birth-an analysis of 2005-06 India Demographic Health Survey data. *BMC public health, 11*(1), 403.

ter Kuile, F. O., Terlouw, D. J., Kariuki, S. K., Phillips-Howard, P. A., Mirel, L. B., Hawley, W. A., . . . Lal, A. A. (2003). Impact of permethrin-treated bed nets on malaria, anemia, and growth in infants in an area of intense perennial malaria transmission in western Kenya. *The American Journal of Tropical Medicine and Hygiene, 68*(4 suppl), 68-77.

Torres-Arreola, L. P., Constantino-Casas, P., Flores-Hernández, S., Villa-Barragán, J. P., & Rendón-Macías, E. (2005). Socioeconomic factors and low birth weight in Mexico. *BMC public health, 5*(1), 20.

US Department of Health and Human Services. (1980). The health consequences of smoking for women: a report of the Surgeon General (pp. 1–359).

Vos, A. A., Posthumus, A. G., Bonsel, G. J., Steegers, E. A., & Denktaş, S. (2014). Deprived neighborhoods and adverse perinatal outcome: a systematic review and meta-analysis. *Acta obstetricia et gynecologica Scandinavica, 93*(8), 727-740.

Wardlaw, T. M. (2004). *Low Birthweight: Country, regional and global estimates*: UNICEF.

WorldBank. (2015). Development Indicators: Nutrition intake and supplements

WorldHealthRanking. (2015). Health Profile Zimbabwe

Wylie, B. J., Coull, B. A., Hamer, D. H., Singh, M. P., Jack, D., Yeboah-Antwi, K., . . . MacLeod, W. B. (2014). Impact of biomass fuels on pregnancy outcomes in central East India. *Environ Health, 13*(1), 1.

Yorifuji, T., Kashima, S., & Doi, H. (2015). Outdoor air pollution and term low birth weight in Japan. *Environment international, 74*, 106-111.

ZIMSTAT. (2015). zimbabwe multiple indicator cluster survey 2014.

APPENDIX

SECTION A

Distribution of provinces and religion of the head of the households of the last live born children in the preceding two years of the ZMICS2014 by low or higher birth weight

			Birth weight in Kg		
			≥ 2.5	**< 2.5**	**Total**
Province	Bulawayo	N	232	20	252
		%	92.1%	7.9%	100.0%
	Manicaland	N	312	28	340
		%	91.8%	8.2%	100.0%
	Mashonaland Central	N	295	17	312
		%	94.6%	5.4%	100.0%
	Mashonaland East	N	288	34	322
		%	89.4%	10.6%	100.0%
	Mashonaland West	N	311	35	346
		%	89.9%	10.1%	100.0%
	Matabeleland North	N	233	24	257
		%	90.7%	9.3%	100.0%
	Matabeleland South	N	207	25	232
		%	89.2%	10.8%	100.0%
	Midlands	N	310	21	331
		%	93.7%	6.3%	100.0%
	Masvingo	N	304	29	333
		%	91.3%	8.7%	100.0%
	Harare	N	458	38	496
		%	92.3%	7.7%	100.0%
Total		**N**	**2950**	**271**	**3221**
		%	**91.6%**	**8.4%**	**100.0%**
Religion of head of Household	Roman Catholic	N	222	17	239
		%	92.9%	7.1%	100.0%
	Protestant	N	438	45	483
		%	90.7%	9.3%	100.0%
	Pentecostal	N	456	45	501
		%	91.0%	9.0%	100.0%
	Apostolic Sect	N	995	87	1082
		%	92.0%	8.0%	100.0%
	Other Christians	N	154	12	166
		%	92.8%	7.2%	100.0%
	No Religion	N	523	46	569
		%	91.9%	8.1%	100.0%
	Other religions	N	162	19	181
		%	89.5%	10.5%	100.0%
Total		**N**	**2950**	**271**	**3221**
		%	**91.6%**	**8.4%**	**100.0%**

The relationship provinces and religion of the head of the households the mothers of the last live born children in the preceding two years of the ZMICS2014 with Low birth weight, a bivariate analysis

	OR	t	95%CI		P
Province					
Bulawayo	1				
Manicaland	1.111	0.35	0.615	2.008	0.726
Mashonaland Central	0.711	-1.03	0.371	1.362	0.303
Mashonaland East	1.447	1.24	0.805	2.599	0.217
Mashonaland West	1.324	0.87	0.703	2.497	0.384
Matabeleland North	1.278	0.78	0.688	2.376	0.437
Matabeleland South	1.400	1.09	0.762	2.571	0.277
Midlands	0.801	-0.69	0.428	1.502	0.489
Masvingo	1.172	0.48	0.612	2.247	0.631
Harare	0.918	-0.29	0.515	1.638	0.773
Religion of Head of HH					
Roman Catholic	1				
Protestant	1.214	0.6	0.643	2.290	0.548
Pentecostal	1.115	0.35	0.601	2.068	0.73
Apostolic Sect	1.050	0.16	0.584	1.886	0.87
Other Christians	0.859	-0.36	0.377	1.955	0.717
No Religion	1.104	0.32	0.601	2.025	0.75
Other religion	1.490	1.05	0.707	3.139	0.294

SECTION B

comparison of mothers' perception of babies and weight in kg of the babies, in the babies that were weighted at the time of birth, one way ANOVA

Mothers perception of size	Frequency	Mean weight in Kg	SD
1 Very large	216	3.635	.508
2 Larger than average	865	3.428	.452
3 Average	1720	3.081	.420
4 Smaller than average	308	2.562	.445
5 Very small	110	2.114	.534
Total	**3219**	**3.128**	**.551**

P<0.001

Multivariable logistic regression analysis of association between household type of fuel (biomass and non-biomass) and small baby size at birth, with adjusting independent variables that have less than 0.2 p-values in the first step multivariable logistic regression

baby's size	OR	t	95% CI		p
A. TYPE FUEL					
biomass fuel	1.326	2.32	1.044	1.683	0.021
B. HOUSEHOLD SOCIO-DEMOGRAPHI CHARACTERISTICS					
having at least 1 mosquito bed net	0.816	-1.87	0.660	1.010	0.061
C.MATERNAL CHARACTERISTICS					
Mother's age					0.858*
<20	1				
20-34	0.926	-0.55	0.702	1.220	0.583
35+	0.940	-0.27	0.600	1.472	0.786
ANC received[$]	1.144	0.46	0.644	2.032	0.647
Number of ANC visits	0.897	-3.59	0.845	0.952	<0.001
Start of ANC visit by	0.916	-2.37	0.853	0.985	0.018
Duration iron tablets taken	0.904	-2.86	0.843	0.969	0.004
D.FETAL CHARACTERISTICS					
Baby Gender male	0.649	-4.24	0.531	0.793	<0.001
Twin(Multiple birth)	6.037	6.25	3.431	10.621	<0.001
birth interval in years					0.037*
< 2	1				
2	0.711	-2.17	0.523	0.968	0.030
3	0.610	-2.78	0.430	0.865	0.006
4+	0.773	-1.76	0.580	1.031	0.079

[$]=This variable was retained in order to sharpen the model estimate for timing of ANC even though the p-value of this variable was > 0.2

* P-value for the variable as a whole

Multivariable logistic regression analysis of association between household type of fuel (light smoky and higher smoky) and small baby size at birth, with adjusting independent variables that have less than 0.2 p-values in the first step multivariable logistic regression

baby's size	**OR**	**t**	**95% CI**		**p**
A. TYPE FUEL					
higher smoky	1.319	2.19	1.029	1.691	0.029
B. HOUSEHOLD SOCIO-DEMOGRAPHI CHARACTERISTICS					
having at least 1 mosquito bed net	0.812	-1.91	0.656	1.005	0.056
C.MATERNAL CHARACTERISTICS					
Mother's age					0.834*
<20	1				
20-34	0.919	-0.6	0.697	1.211	0.547
35+	0.925	-0.34	0.589	1.453	0.736
ANC received	1	0.39	0.631	1.993	0.696
Number of ANC visits	0.896	-3.6	0.843	0.951	<0.001
Start of ANC visit	0.912	-2.47	0.848	0.981	0.014
Duration iron tablets taken	0.905	-2.83	0.844	0.970	0.005
D.FETAL CHARACTERISTICS					
Baby Gender male	0.653	-4.19	0.535	0.797	<0.001
Twin(Multiple birth)	6.013	6.27	3.429	10.545	<0.001
birth interval in years					0.040*
< 2	1				
2	0.714	-2.14	0.524	0.972	0.033
3	0.611	-2.76	0.430	0.868	0.006
4+	0.773	-1.75	0.579	1.031	0.080

SECTION C

MULTIPLE INDICATOR CLUSTER SURVEYS (MICS)

The Multiple Indicator Cluster Survey (MICS) is a household survey programme developed by UNICEF in the mid 90's to assist countries in filling data gaps for monitoring the situation of children and women. Since its conception, the surveys of MICS have been conducted in series of rounds in different countries. The Zimbabwe MICS 2014 was part of the fifth round (MICS5). Detailed information about MICS, the final report of the Zimbabwe MICS 2014 and the survey questionnaires are available in the official website of the survey, http://mics.unicef.org/surveys. As it is mentioned in measurement tools section of this study, the Zimbabwe MICS 2014 used 4 questionnaires. Parts of the household and the Woman's questionnaire (questions that were used to construct the dependent and independent variables in this study) are included in this appendix.

PART OF THE ZIMBABWE MICS 2014 QUESTIONNAIRES

MICS **PART OF THE HOUSEHOLD QUESTIONNAIRE**

Zimbabwe MICS 2014 Questionnaires

HOUSEHOLD INFORMATION PANEL	
HH1. Cluster number and Number ___ ___ ___	**HH2**. Household number:
HH3. Interviewer's name and number: Name ________________________ ___ ___	**HH4**. Supervisor's name and number: Name_________________________
HH5. Day / Month / Year of interview: ___ ___ /___ ___ / 2 0 1 ___	**HH7**. *Province* ___ ___
HH6. Area: Urban.. Rural..	
HH8. Is the household selected for Questionnaire for Men? Yes ....1 No.............2	

GOOD ………….! MY NAME IS …………………………. AND I AM WORKING FOR THE ZIMBABWE NATIONAL STATISTICS AGENCY (ZIMSTAT). WE ARE WORKING ON A NATIONWIDE SURVEY CONCERNED WITH THE SITUATION OF CHILDREN, FAMILIES AND HOUSEHOLDS. YOUR HOUSEHOLD WAS SELECTED FOR THE SURVEY. FIRSTLY, I WOULD LIKE TO SPEAK WITH A KNOWLEDGEABLE ADULT MEMBER OF THE HOUSEHOLD FOR ABOUT 35 MINUTES AND LATER ON WOMEN (AND MEN) AS WELL AS MOTHERS OR PRIMARY CARE GIVERS OF CHILDREN IN THE HOUSEHOLD. WE WOULD VERY MUCH APPRECIATE YOUR PARTICIPATION IN THIS SURVEY. ALL THE INFORMATION WE OBTAIN WILL REMAIN STRICTLY CONFIDENTIAL AND YOUR ANSWERS WILL NEVER BE IDENTIFIED. MAY I START NOW? IF PERMISSION IS GIVEN, BEGIN THE INTERVIEW.

☐ *Yes, permission is given* ⇨ *Go to HH18 to record the time and then begin the interview.*

☐ *No, permission is not given* ⇨ *Circle 04 in HH9. Discuss this result with your supervisor.*

EDUCATION	*For household members age* **5 and above**						**ED**
ED1. *Line number*	**ED2.** *Name and age*		**ED3.** HAS (*name*) EVER ATTENDED SCHOOL OR PRE-SCHOOL? 1 Yes 2 No ⇘		**ED4A.** WHAT IS THE HIGHEST LEVEL OF SCHOOL (*name*) HAS ATTENDED? Level: 0 Preschool 1 Primary 2 Secondary 3 Higher 8 DK *If level=0, skip to ED5*		**ED4B.** WHAT IS THE HIGHEST GRADE (*name*) COMPLETED AT THIS LEVEL? Grade: 98 DK *If the first grade at this level is not completed, enter "00".*
Line	Name	Age	Yes	No	level		Grade
01		___ ___	1	2	1 2 3 8		___ ___
02		___ ___	1	2	1 2 3 8		___ ___
….							

HOUSEHOLD CHARACTERISTICS

HC1A. WHAT IS THE RELIGION OF THE HEAD OF THIS HOUSEHOLD?	*Religion 1* .... 1 *Religion 2* .... 2 *Religion 3* .... 3 Other religion (*specify*) __________ 6 No religion.......... 7	
HC1B. WHAT IS THE MOTHER TONGUE/NATIVE LANGUAGE OF THE HEAD OF THIS HOUSEHOLD?	*Language 1* .... 1 *Language 2* .... 2 *Language 3* .... 3 Other language (*specify*) __________ 6	
HC1C. TO WHAT ETHNIC GROUP DOES THE HEAD OF THIS HOUSEHOLD BELONG?	*Ethnic group 1* .... 1 *Ethnic group 2* .... 2 *Ethnic group 3* .... 3 Other ethnic group (*specify*) __________ 6	
HC2. HOW MANY ROOMS IN THIS HOUSEHOLD ARE USED FOR SLEEPING?	Number of rooms.......... __ __	
HC3. *Main material of the dwelling floor.* *Record observation.*	Natural floor Earth / Sand .... 11 Dung.......... 12 Rudimentary floor Wood planks.......... 21 Palm / Bamboo.......... 22 Finished floor Parquet or polished wood.......... 31 Vinyl or asphalt strips .... 32 Ceramic tiles.......... 33 Cement .... 34 Carpet.......... 35 Other (*specify*) __________ 96	
HC4. *Main material of the roof.* *Record observation.*	Natural roofing No Roof.......... 11 Thatch / Palm leaf .... 12 Sod .... 13 Rudimentary roofing Rustic mat.......... 21 Palm / Bamboo.......... 22 Wood planks.......... 23 Cardboard.......... 24 Finished roofing Metal / Tin.......... 31 Wood.......... 32 Calamine / Cement fibre .... 33 Ceramic tiles.......... 34 Cement .... 35 Roofing shingles.......... 36	

	Other (*specify*) ________________________ 96	
HC5. *Main material of the exterior walls.* *Record observation.*	Natural walls No walls .... 11 Cane / Palm / Trunks .... 12 Dirt .... 13 Rudimentary walls Bamboo with mud .... 21 Stone with mud .... 22 Uncovered adobe... 23 Plywood... 24 Cardboard.. 25 Reused wood .... 26 Finished walls Cement .... 31 Stone with lime / cement .... 32 Bricks .... 33 Cement blocks... 34 Covered adobe... 35 Wood planks / shingles .... 36 Other (*specify*) ________________________ 96	
HC6. WHAT TYPE OF FUEL DOES YOUR HOUSEHOLD <u>MAINLY</u> USE FOR COOKING?	Electricity .... 01 Liquefied Petroleum Gas (LPG) .... 02 Natural gas.. 03 Biogas.. 04 Kerosene.. 05 Coal / Lignite .... 06 Charcoal... 07 Wood .... 08 Straw / Shrubs / Grass .... 09 Animal dung .... 10 Agricultural crop residue .... 11 Sawdust……………………………………..12 Gel……………………………………………..13 No food cooked in household .... 95 Other (*specify*) ________________________ 96	01 ⇨ HC8 02 ⇨ HC8 03 ⇨ HC8 04 ⇨ HC8 05 ⇨ HC8

		95 ⇨ HC8
HC7. IS THE COOKING USUALLY DONE IN THE HOUSE, IN A SEPARATE BUILDING, OR OUTDOORS? *If 'In the house', probe*: IS IT DONE IN A SEPARATE ROOM USED AS A KITCHEN?	In the house In a separate room used as kitchen .... 1 Elsewhere in the house .... 2 In a separate building... 3 Outdoors .... 4 Other (*specify*) _________________________ 6	
HC8. DOES YOUR HOUSEHOLD HAVE: [A] ELECTRICITY? [B] A RADIO? [C] A TELEVISION? [D] A NON-MOBILE TELEPHONE? [E] A REFRIGERATOR? [F] *Country Specific Items (Add as necessary)*	Yes No Electricity .... 1 2 Radio .... 1 2 Television .... 1 2 Non-mobile telephone .... 1 2 Refrigerator... 1 2 *Country Specific Item* 1 2	
HC9. DOES ANY MEMBER OF YOUR HOUSEHOLD OWN: [A] A WATCH? [B] A MOBILE TELEPHONE? [C] A BICYCLE? [D] A MOTORCYCLE OR SCOOTER? [E] AN ANIMAL-DRAWN CART? [F] A CAR OR TRUCK? [G] A BOAT WITH A MOTOR? [H] *Country Specific Items (Add as necessary)*	Yes No Watch.. 1 2 Mobile telephone .... 1 2 Bicycle.. 1 2 Motorcycle / Scooter .... 1 2 Animal-drawn cart................................ 1 2 Car / Truck.. 1 2 Boat with motor .... 1 2 *Country Specific Item* 1 2	

HC10. DO YOU OR SOMEONE LIVING IN THIS HOUSEHOLD OWN THIS DWELLING? *If "No", then ask:* DO YOU RENT THIS DWELLING FROM SOMEONE NOT LIVING IN THIS HOUSEHOLD? *If "Rented from someone else", circle "2". For other responses, circle "6".*	Own .... 1 Rent .... 2 Other *(specify)*______________ 6	
HC11. DOES ANY MEMBER OF THIS HOUSEHOLD OWN ANY LAND THAT CAN BE USED FOR AGRICULTURE?	Yes.......... 1 No 2	2⇨ HC13
HC12. HOW MANY HECTARES OF AGRICULTURAL LAND DO MEMBERS OF THIS HOUSEHOLD OWN? *If less than 1, record "00". If 95 or more, record "95". If unknown, record "98".*	Hectares .... ___ ___	
HC13. DOES THIS HOUSEHOLD OWN ANY LIVESTOCK, HERDS, OTHER FARM ANIMALS, OR POULTRY?	Yes.......... 1 No 2	2⇨ HC 15
HC14. HOW MANY OF THE FOLLOWING ANIMALS DOES THIS HOUSEHOLD HAVE? [A] CATTLE, MILK COWS, OR BULLS? [B] HORSES, DONKEYS, OR MULES? [C] GOATS? [D] SHEEP? [E] CHICKENS? [F] PIGS? [G] *Country Specific Additions (Add as necessary)* *If none, record "00". If 95 or more, record "95". If unknown, record "98".*	Cattle, milk cows, or bulls .... ___ ___ Horses, donkeys, or mules .... ___ ___ Goats.......... ___ ___ Sheep .... ___ ___ Chickens .... ___ ___ Pigs .... ___ ___ *Country Specific Addition*.......... ___ ___	

HC15. DOES ANY MEMBER OF THIS HOUSEHOLD HAVE A BANK ACCOUNT?	Yes .... 1 No 2	
INSECTICIDE TREATED NETS		**TN**
TN1. DOES YOUR HOUSEHOLD HAVE ANY MOSQUITO NETS THAT CAN BE USED WHILE SLEEPING?	Yes .... 1 No 2	2⇨ Next Module
TN2. HOW MANY MOSQUITO NETS DOES YOUR HOUSEHOLD HAVE?	Number of nets .... ___ ___	

PART OF THE QUESTIONNAIRE FOR INDIVIDUAL WOMEN

Zimbabwe MICS Questionnaires

WOMAN'S INFORMATION PANEL	
This questionnaire is to be administered to all women age 15 through 49 (see List of Household Members, column HL7). A separate questionnaire should be used for each eligible woman.	
WM1. Cluster number: ___ ___ ___	**WM2**. Household number: ___ ___
WM3. Woman's name: Name______________	**WM4**. Woman's line number: ___ ___
WM5. Interviewer's name and number: Name______________	**WM6**. Day / Month / Year of interview: ___ ___ /___ ___ / 2 0 1 ___

GOOD …………! MY NAME IS ………………………… AND I AM WORKING FOR THE ZIMBABWE NATIONAL TATISTICS AGENCY (ZIMSTAT). WE ARE WORKING ON A NATIONWIDE SURVEY CONCERNED WITH THE SITUATION OF CHILDREN, FAMILIES AND HOUSEHOLDS. YOUR HOUSEHOLD WAS SELECTED FOR THE SURVEY. NOW I WOULD LIKE TO TALK TO YOU MORE ABOUT YOUR HEALTH AND OTHER TOPICS. THIS INTERVIEW WILL TAKE ABOUT 50 MINUTES. WE WOULD VERY MUCH APPRECIATE YOUR PARTICIPATION IN THIS SURVEY. ALL THE INFORMATION WE OBTAIN WILL REMAIN STRICTLY CONFIDENTIAL AND YOUR ANSWERS WILL NEVER BE IDENTIFIED.	*If greeting at the beginning of the household questionnaire has already been read to this woman, then read the following:* NOW I WOULD LIKE TO TALK TO YOU MORE ABOUT YOUR HEALTH AND OTHER TOPICS. THIS INTERVIEW WILL TAKE ABOUT ***30*** MINUTES. AGAIN, ALL THE INFORMATION WE OBTAIN WILL REMAIN STRICTLY CONFIDENTIAL AND ANONYMOUS.
MAY I START NOW? ☐ *Yes, permission is given* ⇨ *Go to WM10 to record the time and then begin the interview.* ☐ *No, permission is not given* ⇨ *Circle "03" in WM7. Discuss this result with your supervisor.*	

WB1. IN WHAT MONTH AND YEAR WERE YOU BORN?	Date of birth Month.. DK month .... Year .... DK year...	
WB2. HOW OLD ARE YOU? *Probe:* HOW OLD WERE YOU AT YOUR LAST BIRTHDAY? *Compare and correct WB1 and/or WB2 if inconsistent.*	Age (in completed years)	
WB3. HAVE YOU EVER ATTENDED SCHOOL OR PRESCHOOL?	Yes .... No..	 2⇨WB7
WB4. WHAT IS THE HIGHEST LEVEL OF SCHOOL YOU ATTENDED?	Preschool... Primary.. Secondary.. Higher..	0⇨WB7
WB5. WHAT IS THE HIGHEST GRADE YOU COMPLETED AT THAT LEVEL? *If the first grade at this level is not completed, enter "00".*	Grade...	

CM1. NOW I WOULD LIKE TO ASK ABOUT ALL THE BIRTHS YOU HAVE HAD DURING YOUR LIFE. HAVE YOU EVER GIVEN BIRTH?	Yes .... No..	 2⇨CM8
CM4. DO YOU HAVE ANY SONS OR DAUGHTERS TO WHOM YOU HAVE GIVEN BIRTH WHO ARE NOW LIVING WITH YOU?	Yes .... No..	 2⇨CM6
CM5. HOW MANY SONS LIVE WITH YOU? HOW MANY DAUGHTERS LIVE WITH YOU? *If none, record "00".*	Sons at home .... Daughters at home..........................	
CM6. DO YOU HAVE ANY SONS OR DAUGHTERS TO WHOM YOU HAVE GIVEN BIRTH WHO ARE ALIVE BUT DO NOT LIVE WITH YOU?	Yes .... No..	 2⇨CM8
CM7. HOW MANY SONS ARE ALIVE BUT DO NOT LIVE WITH YOU? HOW MANY DAUGHTERS ARE ALIVE BUT DO NOT LIVE WITH YOU? *If none, record "00".*	Sons elsewhere .... Daughters elsewhere	
CM8. HAVE YOU EVER GIVEN BIRTH TO A BOY OR GIRL WHO WAS BORN ALIVE BUT LATER DIED? *If "No" probe by asking:* I MEAN, TO A CHILD WHO EVER BREATHED OR CRIED OR SHOWED OTHER SIGNS OF LIFE – EVEN IF HE OR SHE LIVED ONLY A FEW MINUTES OR HOURS?	Yes .... No..	 2⇨CM10
CM9. HOW MANY BOYS HAVE DIED? HOW MANY GIRLS HAVE DIED? *If none, record "00".*	Boys dead....................................... Girls dead	
CM10. *Sum answers to CM5, CM7, and CM9.*	Sum	

CM12. OF THESE (*total number in CM10*) BIRTHS YOU HAVE HAD, WHEN DID YOU DELIVER THE LAST ONE (EVEN IF HE OR SHE HAS DIED)?

Month and year must be recorded.

Date of last birth

Month ....

Year ....__

CM13. *Check CM12: Last birth occurred within the last 2 years, that is, since (month of interview) in* ***2012***
(if the month of interview and the month of birth are the same, and the year of birth is ***2011****, consider this as a birth within the last 2 years).*

☐ *No live birth in last 2 years.* ⇨ *Go to* ILLNESS SYMPTOMS *Module.*

☐ *One or more live births in last 2 years.* ⇨ *Ask for the name of the last-born child.*

*Name of last-born child*_______________________

If child has died, take special care when referring to this child by name in the following modules.

Continue with Next Module.

SUMMARY OF BIRTH HISTORY		
BH1	Line number of the baby	______
BH2	Was the baby twin or single	1single 2 multiple
BH3	What was the gender of the baby	1 boy 2 girl
BH4	What is the birth day of the baby	Year ______ month ____

DESIRE FOR LAST BIRTH		
This module is to be administered to all women with a live birth in the 2 years preceding the date of interview. *Record name of last-born child from CM13 here ______________________.* *Use this child's name in the following questions, where indicated.*		
DB1. WHEN YOU GOT PREGNANT WITH (*name*), DID YOU WANT TO GET PREGNANT AT THAT TIME?	Yes .... 1 No 2	1⇨Next Module

MATERNAL AND NEWBORN HEALTH

This module is to be administered to all women with a live birth in the 2 years preceding the date of interview.
Record name of last-born child from CM13 here ____________________.
Use this child's name in the following questions, where indicated.

MN1. DID YOU SEE ANYONE FOR ANTENATAL CARE DURING YOUR PREGNANCY WITH (*name*)?	Yes ..... 1 No 2	2⇨MN5
MN2. WHOM DID YOU SEE? *Probe:* ANYONE ELSE? *Probe for the type of person seen and circle all answers given.*	Health professional: Doctor ..... A Nurse / Midwife ..... B ***Auxiliary midwife*** ..... C Other person Traditional birth attendant ..... F Community health worker ..... G Other (*specify*)____________________ X	
MN2A. HOW MANY WEEKS OR MONTHS PREGNANT WERE YOU WHEN YOU FIRST RECEIVED ANTENATAL CARE FOR THIS PREGNANCY? *Record the answer as stated by respondent.*	Weeks ..... 1 __ __ Months ..... 2 0 __ DK 998	
MN3. HOW MANY TIMES DID YOU RECEIVE ANTENATAL CARE DURING THIS PREGNANCY? *Probe to identify the number of times antenatal care was received. If a range is given, record the minimum number of times antenatal care received.*	Number of times ..... __ __ DK 98	
MN4A. DID YOU TAKE ANY IRON TABLETS DURING YOUR PREGNANCY WITH (NAME)? SHOW IRON TABLET	Yes ..... 1 No ..... 2 DK 8	2 ⇨ N4E 8⇨MN4E

MN4B. FOR HOW LONG DID YOU TAKE THE IRON TABLETS?	Less than 1 month .... 1 One to two months .... 2 Two to three months .... 3 Three months or more .... 4 DK 8	
MN4E. DID YOU TAKE ANY FOLATE ABLETS DURING YOUR PREGNANCY WITH (NAME)?	Yes .... 1 No .... 2 DK.. 8	2⇨MN5
MN4F. FOR HOW LONG DID YOU TAKE THE FOLATE TABLETS?	Less than 1 month .... 1 One to two months .... 2 Two to three months................................ 3 Three months or more .... 4 DK 8	
MN12. *Check MN1 for presence of antenatal care during this pregnancy:* ☐ *Yes, antenatal care received.* ⇨ *Continue with MN13.* ☐ *No antenatal care received* ⇨ *Go to MN17.*		
MN13. DURING (ANY OF) YOUR ANTENATAL VISIT(S) FOR THE PREGNANCY WITH (*name*), DID YOU TAKE ANY MEDICINE IN ORDER TO PREVENT YOU FROM GETTING MALARIA?	Yes .... 1 No .... 2 DK 8	2⇨MN17 8⇨MN17
MN14. WHICH MEDICINES DID YOU TAKE TO PREVENT MALARIA? *Circle all medicines taken. If type of medicine is not determined, show typical anti-malarial to respondent.*	SP / Fansidar .... A Chloroquine .... B Other (*specify*)___________________________ X DK .... Z	
MN15. *Check MN14 for medicine taken:* ☐ *SP / Fansidar taken.* ⇨ *Continue with MN16.* ☐ *SP / Fansidar not taken.* ⇨ *Go to MN17.*		
MN16. DURING YOUR PREGNANCY WITH (*name*), HOW MANY TIMES DID YOU TAKE SP/ FANSIDAR IN TOTAL?	Number of times .... __ __ DK 98	

PLEASE INCLUDE ALL THAT YOU OBTAINED EITHER DURING AN ANTENATAL CARE VISIT, DURING A VISIT TO A HEALTH FACILITY OR FROM ANOTHER SOURCE?		
MN20. WHEN (*name*) WAS BORN, WAS HE/SHE VERY LARGE, LARGER THAN AVERAGE, AVERAGE, SMALLER THAN AVERAGE, OR VERY SMALL?	Very large .... 1 Larger than average .... 2 Average .... 3 Smaller than average .... 4 Very small .... 5 DK 8	
MN21. WAS (*name*) WEIGHED AT BIRTH?	Yes .... 1 No .... 2 DK 8	 2⇨MN23 8⇨MN23
MN22. HOW MUCH DID (*name*) WEIGH? *If a card is available, record weight from card.*	From card.... 1 (kg) __ . __ __ __ From recall.... 2 (kg) __ . __ __ __ DK 99998	

TOBACCO AND ALCOHOL USE		TA
TA1. HAVE YOU EVER TRIED CIGARETTE SMOKING, EVEN ONE OR TWO PUFFS?	Yes .... No	 2⇨TA6
TA3. DO YOU CURRENTLY SMOKE CIGARETTES?	Yes .... No	 2⇨TA6
TA4. IN THE LAST 24 HOURS, HOW MANY CIGARETTES DID YOU SMOKE?	Number of cigarettes..............................	
TA14. NOW I WOULD LIKE TO ASK YOU SOME QUESTIONS ABOUT DRINKING ALCOHOL. HAVE YOU EVER DRUNK ALCOHOL?	Yes .... No	 2⇨Next Module
TA15. WE COUNT ONE DRINK OF ALCOHOL AS ONE CAN OR BOTTLE OF BEER, ONE GLASS OF WINE, OR ONE SHOT OF COGNAC, VODKA, WHISKEY OR RUM. HOW OLD WERE YOU WHEN YOU HAD YOUR FIRST DRINK OF ALCOHOL, OTHER THAN A FEW SIPS?	Never had one drink of alcohol............ Age..	00⇨Next Module
TA16. DURING THE LAST ONE MONTH, ON HOW MANY DAYS DID YOU HAVE AT LEAST ONE DRINK OF ALCOHOL? *If respondent did not drink, circle "00".* *If less than 10 days, record the number of days.* *If 10 days or more but less than a month, circle "10".* *If "every day" or "almost every day", circle "30".*	Did not have one drink in last one month.. Number of days.. 10 days or more but less than a month.. Every day / Almost every day..............	00⇨Next Module
TA17. IN THE LAST ONE MONTH, ON THE DAYS THAT YOU DRANK ALCOHOL, HOW MANY DRINKS DID YOU USUALLY HAVE PER DAY?	Number of drinks	

VITA

Mr. Tewelde Gebregiorgis Foto was born on 18th August, 1984 in Ghinda, Eritrea. He graduated in Bachelor of Science in Public Health from Asmara College of Health Sciences, Eritrea in 2010.

Publication

Foto, G., Chapman, S., Ghaffar A. Risk Factors of Low Birth Weight: Findings from the Zimbabwe 2014 Multiple Indicator Cluster Survey. Journal of Health Research, (accepted to publish).