RISK FACTORS ASSOCIATED WITH CAESAREAN DELIVERIES AMONG PREGNANT WOMEN AT SIAYA COUNTY REFERRAL HOSPITAL, WESTERN KENYA.

LAWRENCE BABU

A Research Thesis Submitted In Partial Fulfillment For The Requirements For An Award Of Masters In Epidemiology And Biostatistics Degree At The School of Health Sciences Of Jaramogi Oginga Odinga University Of Science And Technology.

DECLARATION

This research project is my original idea and has not been submitted for an award of any degree or academic qualification in any other Institution or University.

Signature……. **Date……...**

Lawrence Babu Adipo

H153/4222/2018

This research project has been submitted for examination with our approval as University supervisors.

Dr. Daniel Onguru (PhD)
School of Health Sciences,
Jaramogi Oginga Odinga University

Signature……. **Date……...**

Dr. David Otieno Odongo, PhD.
Consultant
In-depth Research Services
Institute of Health and Social Work
Nairobi

Signature……. **Date……...**

DEDICATION

This thesis is dedicated to all pregnant women of the reproductive age who develop complications and other adverse pregnancy outcomes after caesarean delivery. With a hope that the findings and recommendations from this work will help the health policymakers in formulating strategies that will help reduce or control the incidences of the caesarean deliveries among the pregnant women in Siaya County and the world at large.

To my beloved dad and mom, thank you for your love and prayers. My siblings, you are a source of strength, joy and love.

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Our Good Lord, it is by your grace and mercy that has enabled me to develop and produce this kind of work. I praise your Name. Amen

To the authors of the past and recent publications, your literatures have been a source of knowledge that shed more light towards development, organization and production of this study. I am deeply grateful for the information provided in your scholarly work.

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ABSTRACT

Recent investments have shown that Caesarean Section (CS) has been on a steady increase for the past 25 years globally and risk factors associated with CS have been documented yet there is little knowledge on the indications of CS in Siaya County Referral Hospital, rural western Kenya. Hence, the objectives of this study were to determine the prevalence of CS in Siaya County Teaching and Referral Hospital, compare the CS rates among the adolescent-young women pregnancies, and adult pregnancies, investigate whether there is an increase in CS rates in Siaya County Teaching and Referral Hospital. Lastly, to investigate on previous CS, parity, hospitalization, HIV/AIDS and antenatal care patterns as the leading risk factors associated with CS delivery among pregnant women in Siaya County Referral Hospital. The study defined cases as caesarean deliveries while virginal births were controls. The research applied unmatched case-control study design (1 caesarean birth vs 2 virginal births) where 417 records of pregnant women were extracted from the Influenza in Pregnancy Cohort Study database stored in encrypted KEMRI-CDC computers. Total population sampling was used to extract all caesarean sections that occurred between 2017 to January 2020. Controls were extracted by convenience sampling. Descriptive analyses of the continuous and categorical variables were done by calculating the means and proportions. For the bivariate analysis, chi-square test was used to compare differences in various exposures of interest. Odds ratios (OR) was calculated to test various exposures for associations with the outcome variable. Exposures with p-Value <0.15 were then included into the multiple logistic regression model using either backward or forward selection process for the calculation of adjusted odds ratios (OR) in which, all exposures with p-value <0.05 were independently associated with the caesarean delivery. This study detected an increase in the trend by proportion of CS from 2017 to January 2020. The results from multivariate analysis indicated that history of hospitalization ($_{a}$OR=2.92; 95% CI 1.14, 6.05, p<0.001), previous caesarean section ($_{a}$OR=2.92; 95% CI 1.14, 6.05; p<0.001) and antenatal care ($_{a}$OR=15.94; 95% CI 1.77, 142.29; p<0.001) increased the risk of caesarean delivery. In conclusion, previous caesarean, history of hospitalization and antennal care patterns were the main reasons leading to caesarean section. Hence, understanding the predictors of caesarean delivery will help the public health experts to adopt interventions that would reduce incidence of CS and the postpartum infectious morbidity caused by caesarean section among pregnant women during CS delivery.

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ACRONYMS AND ABBREVIATIONS

ANC	Antenatal care
BMI	Body mass index
CDC	Centre for Disease Control
CS	Caesarean delivery
DM	Maternal diabetes
ERC	Ethical Review Committee
FSP	Financial Strategic Paper
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome
KDHS	Kenya Demographic and Health Survey
KEMRI	Kenya Medical Research Institute
KNBS	Kenya National Bureau of Statistics
KHIVE	Kenya Human Immunodeficiency Virus Estimates
MDHS	Malawi Demographic Health Survey
MOH	Ministry of Health
PPH	Postpartum hemorrhage
PROM	Premature rupture of membranes
SVD	Spontaneous vaginal delivery
WHO/UNICEF	World Health Organization/ United Nations Children's Fund

OPERATIONAL DEFINITION OF TERMS

Adolescent Girls and Young Women: These girls and women aged between 15-19 and 20-24 years old respectively.

Antepartum: Refers to the period occurring not before the childbirth.

Atopic: Refers to the genetic tendency to develop allergic diseases such as asthma.

Chorioamnionitis: Refers to an inflammation of the fetal membranes (amnion and chorion) due to a bacterial infection.

Hysterectomy: Refers to a surgical operation to remove all or part of the uterus.

Iatrogenic: Refers to illness that is caused by medication or physician

Multigravida: A woman who has been pregnant more than once.

Postpartum: Refers to the period occurring in or being the period following childbirth.

Hysterectomy: Refers to a surgical operation to remove all or part of the uterus.

Postpartum: Refers to the period occurring in or being the period following childbirth.

Primigravida: A woman who is pregnant for the first time.

Primiparous: Mothers who have beared young ones for the first time.

Septicemia Refers to a serious bloodstream infection caused by bacteria elsewhere in the body.

Stenosis: Refers to an abnormal narrowing in a blood vessel or other tubular organ or structure.

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CHAPTER ONE: INTRODUCTION

1.1 Background Information

Caesarean section (CS) is a surgical procedure for delivery of the fetus through incisions made in the mother's abdominal and the uterine walls and it is the most common major operation performed in obstetrics (Yadav *et al.*, 2016) .Caesarean section can be a lifesaving operation (Lavender *et al.*, 2012) and commonly preferred measure of delivery when spontaneous vaginal delivery (SVD) would put the mother or the infant at any risk. However, research has shown that CS is associated with higher maternal morbidity and mortality when compared to vaginal deliveries (Schuitemaker *et al.*, 1997) ,probably because of the adoption of the unnecessary CS. In some settings, it was observed that CS is associated with greater respiratory distress, asphyxia, and other pulmonary infections in infants (MacDorman *et al.*, 2008).

A number of factors are likely to be associated with increasing CS including increased access to modern care services, improved economic status of the population, and change in cultural and social factors and supply induced demand for CS (Haider *et al.*, 2018) .Mothers living in rural areas are more susceptible to have current CS delivery than their urban counterparts (Abebe *et al.*, 2015). This observation may be due to the tendency that rural women are less likely to attend ANC and get prepared for attending skilled delivery service. The chance of undergoing caesarean section would increase as age of the mother increases (Patel *et al.*, 2005). The effect of age could be explained by the possibility of pregnancy complication increment by age. Mothers reported as having pregnancy risk factors like diabetes and hypertension are at higher odds of undergoing CS delivery (Karim *et al.*, 2011).

The average global CS rate has increased by 150% over the past 25 years and is currently at 18.6% with an average rate of increase of 4.4% per year (Ana Pilar Betrán *et al.*, 2016). Of the 18.5 million annual estimated CS deliveries, 3.6% are performed without any medical or surgical indications (Walana *et al.*, 2017). In 1985, the WHO proposed

that CS delivery rates should not exceed 15% of the total births and stated no additional health benefits above this rate.

The average CS rate in the sub-Saharan Africa was estimated to be 10% by the WHO and ranges between 2% to 19% (Cavallaro *et al.*, 2013). In line with the global trend, the CS rates in Kenya are generally on the increase (Lauer *et al.*, 2010) . According to the data (KDHS, 2014), the estimated national CS rate was 14.4% while Nairobi County had 24.9% .Past research (Wanyonyi *et al.*, 2006) showed that CS rates in Nairobi Hospital, The Kenyatta National Hospital and Agha Khan University Hospital were 33%, 30% and 20.4% respectively.

Siaya County contributes about 4.3% (KDHS, 2014) of the national CS rates. Similar trends of increased CS rates have been observed in this rural setting over the past few years. The majority of the households in Siaya County have incomes below the poverty line with the majority of the people being unemployed (Amek *et al.*, 2015). It is an endemic region with high prevalence in Malaria, HIV/AIDS, respiratory infections and skin diseases. Pregnant women become more susceptible to malaria and other infectious diseases and this translates to high rates of morbidity and mortality and other related pregnancy complications for pregnant women (Perrault *et al.*, 2009).

1.2 Statement of Problem

Research has shown that the relative risks of maternal mortality, neonatal respiratory morbidity, hysterectomy, ureter and bladder injury, fetal death, placental previa, and uterine rupture in a future pregnancy are increased with CS compared with SVD (Belizán *et al.*, 2007). It has been suggested that research on health outcomes related to CS and testing of interventions to reduce unnecessary CS are essential (Belizán *et al.*, 2006).

The identification of risk factors associated with surgical delivery is important to better understand the current CS epidemic. The predictors frequently associated with surgical delivery include race, primiparity (Kac *et al.*, 2007), maternal education (Cesaroni *et al.*, 2008), low stature, high pre-gestational body mass index, antenatal care, and excessive gestational weight gain and pregnancy complications (Seshadri & Mukherjee, 2005).

However, data from Siaya County on the risk factors influencing CS remains sparse. It is important that new evidence is documented regarding the risk factors associated with high CS rate. Therefore, the present study aims to examine the risk factors associated with CS in a representative sample of pregnant women delivering in Siaya County Referral Hospital.

1.3 Objectives

1.3.1 Main Objective

To determine the risk factors associated with caesarean deliveries among pregnant women in Siaya County Referral Hospital, rural western Kenya.

1.3.2 Specific Objectives

i. To estimate the prevalence of caesarean deliveries in Siaya County Referral Hospital, rural western Kenya.
ii. To investigate whether there is a rise in caesarean section at Siaya County Referral Hospital over the years from 2017 to January 2020.
iii. To compare the caesarean rates among the adolescent-young pregnant women and adult pregnancies in Siaya County Referral Hospital, rural western Kenya.
iv. To investigate on previous CS, parity, hospital admission, HIV/AIDS and antenatal care patterns as leading risk factors of caesarean deliveries among pregnant women in Siaya County Referral Hospital, rural western Kenya.

1.4 Research Questions:

i. What is the prevalence of caesarean deliveries in Siaya County Referral Hospital, Siaya County rural western Kenya?
ii. Is there increase in caesarean section at Siaya County Referral Hospital over the years from 2017 to January 2020?
iii. Are the caesarean delivery rates higher among the adolescent and young pregnant women as compared to adult pregnancies in Siaya County Referral Hospital?
iv. Are previous CS, parity, hospital admission, HIV/AIDS and antenatal care patterns the leading predictors of caesarean delivery among the pregnant women in Siaya County Referral Hospital?

1.5 Rationale

Caesarean delivery remains to be the single most important risk factor for postpartum infection, with an estimated 5 to 20 fold increase in incidence (Leth *et al.*, 2009), this results in major financial and health implications for the affected patients and society in general (Conroy *et al.*, 2012). Puerperal infection remains a significant cause of maternal morbidity and mortality both in the developed and developing countries. These risks are undoubtedly higher in developing countries where less attention is paid to sterile techniques and where access to antibiotics may be more restricted (Berg *et al.*, 2003).

Given that CS continues to represent a significant proportion of all births both in the developed and developing countries, the overall health and socioeconomic burden of these infections is substantial. In order to provide better care for the obstetric patients and avoid future endometritis and surgical site infections among the pregnant women in Siaya County, there is need to investigate on the risk factors of the CS among the pregnant women delivering in Siaya County Referral Hospital.

1.6. Significance of the Study

This study seeks to increase knowledge and build evidence to support adoption of interventions that will help reduce or control incidences of CS and the postpartum infectious morbidity in Siaya County and Kenya at large. Findings, conclusions and recommendations drawn from this study will inform public health stakeholders and policymakers on the prevalence and the risk factors of CS in Siaya County and other rural settings in Kenya. The results from this research will be used to strengthen the performance of routinely clinical audits, which can be used to monitor the change of CS rate, improvement of practice and maintain a good quality of care. The results will also emphasize the need for timely and accurate screening of women during obstetric care and, decision to perform caesarean section should be based on clear, compelling and well-supported justifications. This will help limit the risks of CS.

1.7 Scope of the Study

This study focused on the prevalence, trends by proportions in delivery by caesarean section and risk factors associated with caesarean delivery at Siaya County Referral Hospital, Siaya County in rural western Kenya.

1.8 Limitation of the Study

This study has a number of limitations; first, the study was a secondary analysis and therefore did not provide full information concerning the real situation of caesarean section in Siaya. For instance, some important variables such as health insurance, physician incentives were not analyzed. The study was conducted in one facility and this affected the magnitude of the sample size. Home deliveries and deliveries in other health centers also limited the sample determination. Hence our findings have limited comparison with many other current studies. Secondly, the use of unmatched case-control study design did not allow us to estimate the current situation of caesarean delivery in Siaya County. We relied on estimates from other studies for sample size estimation and the use of proportionate stratified random sampling to extract cases and controls across the years might have underestimated or overestimated the effects of the covariates in this study. Third most of the covariates under the controls had missing data and this affected the multivariate analysis. This caused our model to be unstable. Despite these potential limitations, this study has remarkable strengths. This study used data from a well validated maternal- based surveillance registry representative of the pregnant women which enable our results to be generalized to women of reproductive age in Siaya and Kenya as a whole. In addition, our study had enough sample size to determine risk factors associated with caesarean delivery in Siaya County. Lastly our results may help strengthen the performance of routinely clinical audits, which can be used to monitor the change of CS rates. These results will also emphasize the need for timely and accurate screening of women during obstetric care and this will improve good health quality to our pregnant mothers.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter reviews the literature documenting the global, continental and national rate of CS, trends in the CS rates among the adolescent and young pregnant women and the adult pregnancies. The chapter also highlights the relationship between the medical history, the obstetric and nonmedical determinants of caesarean delivery.

2.2 The Prevalence of Caesarean Delivery

Although limited accessibility to CS in some third world countries is of major concern, rapidly increasing overuse of CS constitutes a growing problem in other countries (Althabe *et al.*, 2006). A prospective cohort study within the 2005 WHO global survey on maternal and perinatal health revealed an increased risk of severe maternal and neonatal mobility and mortality with overuse of CS (Villar *et al.*, 2007). The World Health Organization suggested that CS prevalence between 5 and 15% would be the ideal (WHO, 1985) and rates above the 15 % level may indicate an unnecessary and unjustified use of the surgical delivery. According to the most recent estimates, the average global rate of CS is 18.6%, ranging from 6.0% to 27.2% in the least and more developed regions respectively. The highest rates of CS are found in the Latin American countries, Chile presents one of the highest prevalence (45%), followed by the Dominican Republic (31%) and Colombia (27%). Brazil (45.9%) is one of the developing countries with the highest prevalence of CS rates in the world (Wylie & Mirza, 2008). In the Northern America, the highest prevalence of CS was reported in United States (32.8%), and New Zealand (33.4%) in Oceania. In the developed countries in Europe, prevalence of 10% in Switzerland and 14% in Netherlands were observed (WHOSIS, 2009). Iran and Turkey reported the highest prevalence of CS (47.9% and 47.5%, respectively) in the Asian countries (Ana P Betrán *et al.*, 2016)

The average CS rate in the sub-Saharan Africa was estimated to be 10% by the WHO and ranges between 2% to 19% (Harrison & Goldenberg, 2016). In a country like Malawi, the CS rates have doubled in the last decades from 3% in 1992 to 6% (MDHS,

2016). A past study (Naidoo & Moodley, 2009) revealed the CS rates in South Africa was 65% in 2009 based on audit in the private sector. In the Northern Africa, Egypt indicated the highest prevalence 51.8%. In line with the global trend, the CS rates in Kenya are generally on the increase (Lauer *et al*., 2010). According to the data (KDHS, 2014) the estimated national CS rate was 14.4% while Nairobi County had 24.9%. Published data (Wanyonyi *et al.*, 2006) showed CS rates in Nairobi Hospital, The Kenyatta National Hospital and Agha Khan University Hospital had 33%, 30% and 20.4% respectively.

Siaya County contributes about 4.3% (KDHS, 2014) of the national CS rates. Similar trends of increased CS rates have been observed in this rural setting over the past few years. Despite the many strides made in the healthcare services, only 56% (KDHS, 2014) of women in the country deliver in hospitals. According to (MOH, 2014a), prevalence of child bearing (below 25 years) is the highest in the county.

2.3 Comparison of caesarean delivery rates among the adolescent -young pregnancies and adult pregnancies

Adolescent and young pregnant women experience prolonged labor pain caused by slow cervical dilation, small birth canal and this may call for caesarean delivery unlike the natural vaginal delivery. Women in this category are at their peaks of fertility. At this stage pregnancy rates are high as compared to women who have advanced in age. Statistical analysis showed that women in the 27-29 age groups had significantly less chance on average of becoming pregnant as compared to women in the 19-26 years of age (Hall, 2007).

Many previous studies have speculated about the relationship between maternal age and the likelihood of CS. For example, (Ecker *et al.*, 2001) revealed that caesarean delivery rates increased with advancing maternal age (<25 years, 11.6%; >=40 years, 43.1%). This high risk observed among women over the age of 30 could be explained by medical factors, socioeconomic status, parental anxiety, and previous infertility and physician

beliefs, hypertensive disorders and diabetes; these are less common in adolescents and young women (Metello *et al.*, 2008).

Similar results were found in a population-based study conducted in Taiwan where CS rates significantly increased with advancing maternal age after adjusting for maternal complications, and healthcare institution and physician characteristics. Obstetricians are driven to perform more CS for older women in order to prevent potential long-term perineal damage from a vaginal delivery (Lin *et al.*, 2004). These findings were consistent with results obtained from a study in Bangladesh where older mothers aged 25-29 years and 30-49 years were observed to have higher odds of delivery by CS (OR=2.29; CI=1.55-3.38 and OR=2.37; CI=1.47-3.81 respectively) than adolescent mothers aged 15-19 years (Rahman *et al.*, 2018). Past research (Traisrisilp *et al.*, 2015) reported the same findings. In another study, the overall risk of caesarean delivery was significantly observed higher in older parturient women as compared to younger counterparts (Timofeev *et al.*, 2013).

Contrary to the previous observations, some studies in Brazil, primiparous adolescent women were generally found to give birth through caesarean delivery (Gama *et al*., 2014). The study reinforced the fact that adolescents are especially susceptible and open to information regarding the safety of caesareans provided during prenatal care. Similarly, CS rates were higher among adolescent women who reported a history of clinical risk and or complications during pregnancy and labor.

2.4 Risk factors associated with caesarean delivery among pregnant women

Several investigations have addressed the increasing global CS rates and its nonmedical determinants. The woman's socioeconomic status, doctor's attitude, type of birth attendant, convenience factors, legal aspects, method of payment, and the woman's expectations and psychological state were the most important nonmedical factors associated with preference for a caesarean (Donati *et al.*, 2003). Demographic variables such maternal age, level of education, occupation have been found to be associated with

the caesarean delivery. A recent report (Diema Konlan *et al.*, 2019) found out that higher education tends to results in lower CS rates. In contrast, a report by WHO (2014), suggested that most women who delivered by CS had a university degree. Similar findings (Hezarjarib & Abbaspoor, 2010) reported that women and their spouse who chose CS delivery were educated in diploma and university level. CS was most common among more educated women, who lived in Eastern China, who had high household income and health insurance, who used antenatal care, and who gave birth at high-level hospital (Klemetti *et al.*, 2010).

In England (Penna & Arulkumaran, 2003) reported on the physicians' incentives for performing CS which include both saving time from prolonged normal vaginal deliveries and making more money at the same time. This signifies that a good number of CS could be decided way before the indication for CS rises. In Bangladesh, it was found that increased utilization of ANC services and deliveries performed in private facilities enhance the chance of CS. Private facilities which are mainly profit driven tend to perform CS without proper indications for this procedure (Islam & Yoshimura, 2015). The study also revealed that the increasing number in private NGOs and clinics, availability and accessibility of maternal and child care services to the general population contributed to the current CS rate (Neuman *et al.*, 2014). A study in China (Hellerstein *et al.*, 2015) confirmed similar results where the country experienced a dramatic increase in the CS rates as a result of increased number of private hospitals, NGOs and clinics . In another study in Brazil (Hopkins, 2000) , 80-90% of the CS rates happened in the private hospitals and clinics.

On another side, past work(Abbaspoor *et al.*, 2014) pointed out that maternal age above 35 years is a significant factor contributing to the rise in CS without medical reasons. This is true since as the mother's age increases, the more the mother is likely to choose CS birth than as she would when young.

Another research (Esamai11 *et al.*) revealed that CS rates are common in infants weighing in 1500-2499 grams as compared to underweight babies may be explained by the fact that smaller fetuses might be more likely to have a malpresentation, to be growth restricted, to be delivered in the context of hypertensive disorders that require preterm delivery, or have another condition requiring CS, such as placental abruption. Antepartum complications such as gestational diabetes eclampsia or pre-eclampsia and pregnancy-induced hypertension were observed in the pregnancies delivered by CS as compared to those with vaginal delivery. This suggests that majority of the CS are performed due to clinical indications.

Elsewhere, recent investment (Abdelraheim *et al.*, 2019) indicated that PROM was associated significantly with high incidence of the caesarean delivery. Women with PROM prior to caesarean section were 7.5 times more likely to have CS than controls. When membrane raptures, the amniotic fluid, which is not sterile, may act as a transport medium by which pathogens may come into contact with the uterine and skin incisions which cause infection (Shrestha *et al.*, 2014). Some other common and important indications for CS include fetal distress, breech presentation, multiple gestations, previous section, parity and CS on the demand (Mukherjee, 2006). CS will be recommended if the mother is carrying multiple pregnancies and the leading baby is in an abnormal position. It was found that higher parity leads to higher rates of CS. This means that CS rates are higher in multiparous women as compared to nulliparous women. Prolonged labor (Gelaw *et al.*, 2017) increases the number of vaginal examinations, which consequently increases the chance of iatrogenic contamination during examination hence creating conditions for CS surgery. These findings were confirmed by other scholars (Krieger *et al.*, 2017). Some authors claim that one of the reasons women undergo unnecessary caesarean sections is lack of information about the possible consequences of this surgery during pregnancy (Kolip & Büchter, 2009) , thus undermining their power of choice (Goodall *et al.*, 2009).

Previous studies in Africa showed that obese women are 87% more likely to have caesarean birth than those who are not (Onubi *et al.*, 2016). A study conducted in Malawi (Nkoka *et al.*, 2019) indicated that maternal obesity is associated with an increased risk of caesarean birth. In another study elsewhere, the risk of caesarean birth was reported to have increased by half in overweight women and two-folds for obese women compared to those with normal BMI. Additionally, maternal obesity is associated with chronic condition and macrosomic births which may result in cephalopelvic disproportion and prompting the need for caesarean birth (Gaudet *et al.*, 2014). In Angola, higher rates of caesarean were observed in women with lower family income and living in a periurban area. The study hypothesized that the poorer and less educated women and lived far from health facilities and had few antenatal care visits and often arrived with complicated conditions which justified delivery through surgery (Nimi *et al.*, 2019).

Another study (Abbaspoor & Momtazpour, 2016) also noted a positive correlation between the average monthly income and CS rate. This means that when income increases, the likelihood of having a CS also increases. A study (Juma *et al.*, 2017) reported similar results from a study conducted in Mama Lucy Kibaki Hospital in Nairobi. They indicated that increased maternal income increases the chances of a mother to have CS delivery. The ability to pay for CS is a major contributing factor since a mother cannot be denied her preferred choice of delivery.

2.5 Summary of Methodology in Literature Review

The choice of the study design for this study was guided by the weakness and strengths drawn from different literature with similar analysis. In Egypt, a study (Abdelraheim *et al.*, 2019) used retrospective case control study design, total population sampling when selecting the cases and simple randomization method when recruiting the control group. This study used multiple logistic regression model to analyse the significance of the association between the explanatory variables (age, parity, prolonged labor among others) and the dependent variable (birth by caesarean section). With these methods in

place, the study reported a number of risk factors associated with increased CS, such as maternal diabetes, emergency delivery, prolonged labor and antenatal care. However, the study had some limitations related to the choice of the design. For instance, the study results were restricted to only cases sampled within the studied hospital and that generalizability may be limited because data was only collected from one site. Another study (D'Orsi *et al*., 2006) elsewhere, used the same methods with systematic sampling procedure when selecting the controls reported significant association between the independent factors and the outcome variable (caesarean section).

This study used unmatched case-control study design. Total sampling technique was used to extract all cases that occurred between 2017 to January 2020. Sampling by Convenience was applied when extracting controls. Multiple logistic regressions method was conducted for determinations of risk factors associated with CS. However, this study analysed different variables as main independent factors against the outcome variable, caesarean section, these include maternal weight, HIV status, maternal age and education level. From the critical analysis of the previous studies, the above mentioned variables were not investigated against caesarean section. For example, Abdelraheim *et al* reported prolonged labour and parity as significant factors associated with caesarean section. Though this study used same methodological and analytical approach with the above previous studies, units of analysis for this study were different.

2.6 Theoretical

This study was anchored by the theory (Leone *et al.*, 2008) where high elective caesarean rates are driven by institutional, socio-economic and community factors. The analyses, based from this framework, showed that women of higher socio-economic background, who had better access to antenatal services are the most likely to undergo a caesarean section. Women who exchange reproductive health information with friends and family are less likely to experience a caesarean section than their counterparts.

2.7 Conceptual Framework

Following the framework suggested by Leone, this study grouped the factors associated with CS delivery into three broad categories. They included, demographic and pregnancy related risk factors, socio-economic factors and obstetric factors. However, this study did not investigate the social network related factors and heath care institutional factors.

Demographic and pregnancy risk factors included maternal age (15-19, 20-24, 25-29, 30-40 years), maternal height (less than 60 inches, and 60 inches and above), and maternal nutritional status (undernourished, normal, and obese), and maternal weight age birth (pounds). The maternal nutritional status was measured by body-mass index (BMI) (categorized according to WHO guidelines) where mothers with BMI less than 18.5 were identified as undernourished, 18.5 to 24.9 as normal, and 25.0 or higher as overweight.

Socio-economic factors consist of maternal education (never attended school, primary, secondary, university or college) and occupation. The obstetric factors included parity, pregnancy-induced hypertension, previous caesarean delivery, antepartum hemorrhage and the number of antenatal care visits (none, 1-2, 3 or more than 3) during pregnancy. See the diagram below.

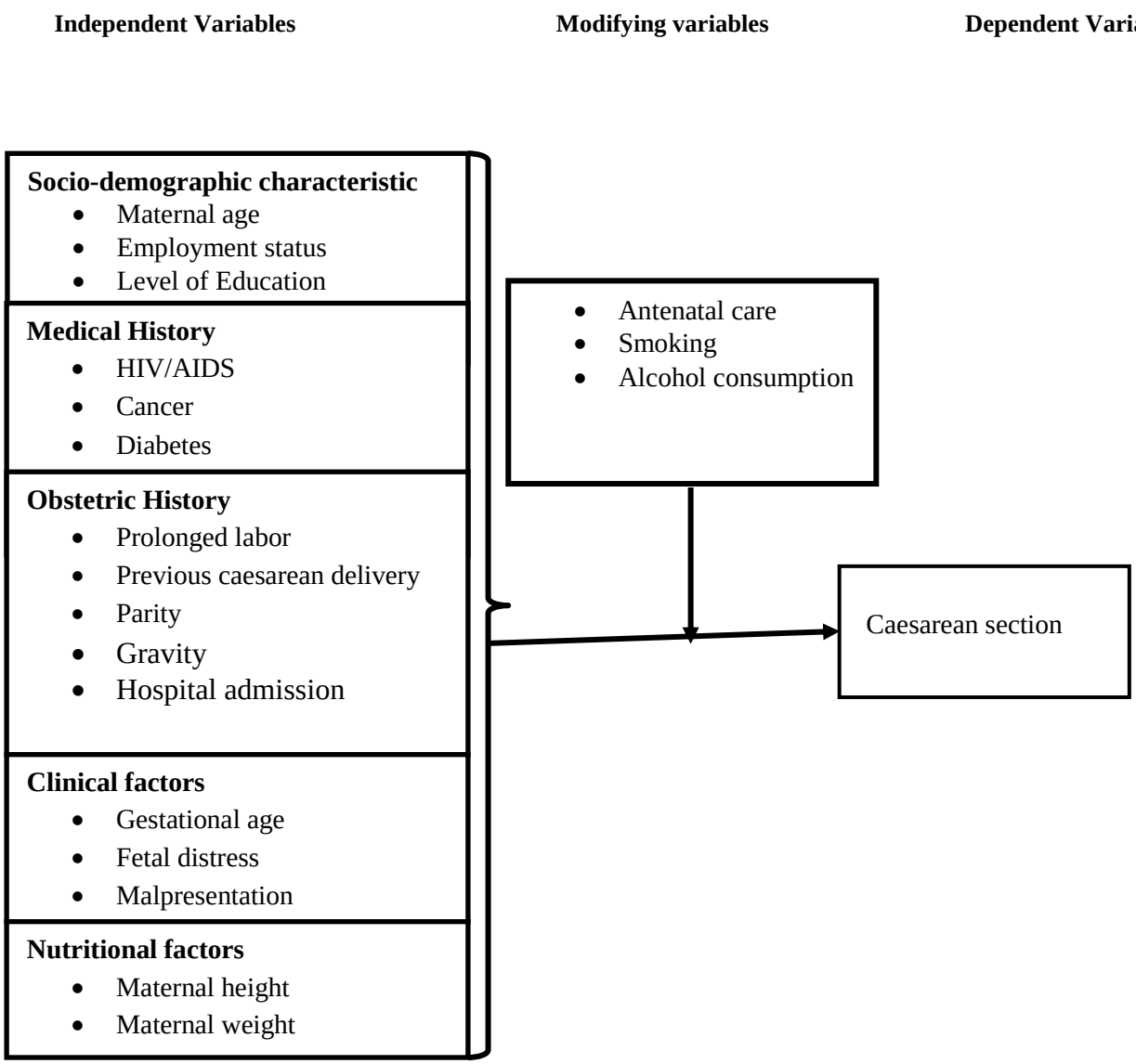

Figure 1: *Factors influencing caesarean section in Siaya County Referral Hospital*

CHAPTER THREE: MATERIALS AND METHODS

3.0 Overview

This chapter describes the research methods that were used to obtain data in this study. This study utilized a previously collected data nested within Influenza in Pregnancy Cohort Study, a maternal surveillance conducted by Kenya Medical Research Institute and the U.S Centers for Disease Control and Prevention since 2015, protocol reference number as CDC/KEMRI SSC 2880.

3.1 Study Site

Influenza in Pregnancy Cohort Study which is the main platform for this study was conducted in two health facilities; Siaya County Referral Hospital and Bondo Sub-County Hospital. However, this study only considered data collected at Siaya County Referral Hospital. The hospital is a high-volume government owned hospital in the outskirts of Siaya Town, Siaya County, in the Nyanza Province of Kenya, northeast to Lake Victoria, western Kenya. The hospital is a large teaching facility with a catchment population of 500,000 persons (MOH, 2014). It has both outpatient and inpatient services with an inpatient capacity of 200 patients. The hospital has quality x-ray facilities and laboratory testing facilities, and referrals are taken from all the surrounding rural clinics and dispensaries, a population approximately 965,103 (KNBS 2017 Projections) from 842,304 (KNBS 2009). Siaya County Referral Hospital has an estimated HIV prevalence of 24%, and is among the facilities most impacted by HIV infection in the county (NASCOP, 2009). Recent statistics show that there are 12 (±2) births per day in the hospital and 10% of the babies were born with low birth weight and nearly 5% were born prematurely (MOH, 2014b).

The facility has the highest reported number of malaria patients (54%), respiratory infections (15%) and diarrheal cases (4%) (FSP, 2017). Challenges faced in the facility include, infrastructure for service delivery, inadequate health personnel amongst others. The above mentioned background features of the hospital and the availability of modern

health care systems make Siaya County Referral Hospital a better site to carry out this research.

3.2 Target Population

The population of interest for this study was pregnant women delivering in the Siaya County Referral Hospital. The study targeted a population of 2040 deliveries from a maternal cohort of pregnant women who delivered between January, 2017 and January 2020. This time frame was suitable since the researcher was certain to get the most recent cases of delivery and sufficient sample size to answer the study objectives.

3.3 Inclusion and Exclusion criteria

3.3.1 Inclusion Criteria

The study population was constituted of pregnant women aged 15-49 years who delivered at Siaya County Referral Hospital. Cases and controls with excessive missing data were excluded. Also, the study excluded foreign nationality, residency in the county for less than six months and multiple pregnancies. Other exclusion criteria included maternal age <15 years, gestational age <28 weeks.

3.3.2 Exclusion Criteria

Cases (caesarean births) and controls (virginal births) with excessive missing data were excluded. Also, the study excluded foreign nationality, residency in the county for less than six months and multiple pregnancies. Other exclusion criteria included maternal age <15 years, gestational age <28 weeks.

3.4 Study Design

This study was nested within Influenza Program that has conducted a maternal surveillance since 2015. This program developed a prospective study design where pregnant women were enrolled and followed up throughout pregnancy and for 12 weeks after delivery. However, this proposed study implemented unmatched case-control study design. This design was chosen because the study intended to investigate exposures associated with an outcome measure in the backward direction. Caesarean deliveries were classified as cases and vaginal deliveries as controls.

3.5 Sample Size Determination

As stated earlier at the overview, this study was embedded into Influenza in Pregnancy Cohort Study as primary data source. This cohort study used proc power for two sample means in SAS 9.3 where data on birth weight from recent locally conducted studies as the outcome measure was used to determine the mean and birth weight in the population. In contrary, this study adopted a different sampling formula suggested by Demidenko, 2008 which is illustrated as:

$$n = (\frac{r+1}{r}) \frac{(\bar{p})(1-\bar{p})(Z_{\beta} + \mathrm{Z}_{\alpha/2})^2}{(\mathrm{p}_1 - p_2)^2}$$

Where;

n= the required sample size in the case group

r = ratio of cases to controls (r=2)

Z_{β} = represents the desired power (typically .84 for 80% power)

$\mathrm{Z}_{\alpha/2}$ = represents the desired level of statistical significance (typically 1.96)

p_1 = the proportion exposed in the cases group (.37). This is obtained from formula suggested by (Fleiss, 2013). The formula is illustrated as:

$$p_{case\exp} = \frac{ORp_{control\exp}}{p_{control\exp}(OR-1)+1} \qquad p_{case\exp} = \frac{2.0(.23)}{(.23)(2.0-1)+1} = \frac{.46}{1.23} = .37$$

OR=Odds ratio (>=2.0) to be detected in the exposure among the controls

p_2 = the proportion exposed in the control group (.23). The study used obstructed labor to determine this prevalence. Obstructed labor is the leading indicator for caesarean section as shown by several studies. This study used prevalence (23%) from the most recent publication (Juma *et al.*, 2017) which revealed obstructed labor as the most predictor of caesarean delivery. This prevalence (23%) from the exposure among the controls ranges proportionally from 15% to 70% as supported by the rule of rates of proportions (Fleiss, 2013).

$\bar{p}$ = the average proportion exposed (.3)

Substituting in the equation, we have;

$$n = 1.5\frac{(.3)(1-.3)(.84+1.96)^2}{(.37-.23)^2} = 126$$

Therefore, n=378, (cases=126, controls=252)

The study added 10% (38) onto the calculated sample size (378) to cater for the incomplete records found during data abstraction. Hence, the final sample size was 417 (cases=139, controls=278).

3.6 Data and Data Sources

For this proposed study, secondary de-identified data was extracted from the Influenza in Pregnancy Cohort Study database stored in encrypted KEMRI-CDC computers. This surveillance has data sets of since 2015. The access to use this data for the study was obtained through a confidentiality agreement between the researcher and the principal investigator. This data used for this research is only available to individuals with the credible academic or research credentials who want to access the data for scientific and or academic research purposes and are willing to commit to handling the data in a manner which is consistent with confidentiality requirements. The data used for this study was obtained from study instruments that were pretested for validity and reliability and this ensured that the findings from this study were generalizable and can used to the broader Kenya population.

This study used birth data from 2017 to January 2020 and was linked with the socio-demographic characteristics of the study participants enrolled in the main cohort. The study extracted all the caesarean cases from the database and dropped records with exclusion criteria for case definition. The choice to use total population sampling for selecting cases is because this total population is suited to situations where the number of cases being investigated is relatively small and rare to get (Etikan *et al.*, 2016). This study extracted 139 mothers who underwent delivery through caesarean section. On the other hand, the controls were extracted by convenience. The 278 most recent records

from vaginal deliveries of the total 2040 deliveries were used as controls for analysis in this study.

This study utilized 43 units of the data previously collected from the large perspective cohort study. These units were collected from the demographic, obstetric history, medical history, clinical and nutritional data from the main platform-database. The demographic data included age, education level and employment status. The researcher also extracted data on HIV status, history of diabetes from the medical history. Weight and height were the nutritional information to be extracted from the database. In addition, gestational age at delivery, first pregnancy, antenatal care visits, and duration of labor, fetal distress, malpresentation, parity and previous CS are among the factors that were investigated in this study. The unique study individual identifier was used as a linkage to all the required data sets.

3.7 Data Processing

3.7.1 Data Management

The raw data from the maternal surveillance database was imported into R- software for cleaning and manipulation. The processed data was then stored in password locked computer for analysis.

3.7.2 Data Analysis

Statistical analyses were performed in R- software version 3.6. Descriptive analyses of the continuous and categorical variables were done by calculating the means and proportions respectively. For the bivariate analysis, chi-square test was used to compare differences in various exposures of interest. Odds ratios (OR) were calculated to test various exposures for associations with the outcome variable. Exposures with p-Value <0.15(the standard probability for stepwise regression) were included into the multiple logistic regression model using either backward or forward selection process for the calculation of adjusted odds ratios (OR) in which ,all exposures with p-value <0.05 were considered to be independently associated with the caesarean delivery.

3.8 Ethical Consideration

The research project was built upon an existing protocol CDC/KEMRI SSC 2880 which was reviewed and approved by the Ethical Review Committee of the Kenya Medical Research Institute (KEMRI) and the Institutional Review Board of the U.S Centre for Disease Control and Prevention (CDC). This enhanced project was then reviewed and approved by Institutional Review Board of Jaramogi Oginga Odinga University of Science and Technology (JOOUST). Confidentiality of the data was maintained strictly to ensure privacy.

CHAPTER FOUR: RESULTS AND FINDINGS

4.1 Socioeconomic and Demographic Characteristics of Study Participants

This study analyzed 417 records of pregnant mothers who delivered at Siaya County Referral Hospital between January 2017 and January 2020. Of the 417 records, cases and controls were 139 (33.3%), 278 (66.7%) respectively. The mean age of the women was 27.0 (±5.4) years with the oldest mother being 41.2 years and youngest 15.5 years old. Majority 250 (60.0%) of these mothers were above 25 years old. The adolescent mothers were 30 (7.2%). Table 1 presents the demographic characteristics of the study population.

Table 1: *Demographic Characteristics of the Study Participants*

Demographic Variables	**All N=417**	**Caesarean Section N=139**	**Vaginal Delivery N=278**
	n (%), Mean±SD	**n(%), Mean±S.D**	**n (%), Mean±S.D**
Maternal age	27.02±5.30	26.0±5.37	26.04±5.26
Age category			
< 20 years	30 (7.20)	12 (8.63)	18 (6.48)
20-24 years	137 (32.80)	46(33.09)	91 (32.73)
>=25 years	250 (60.00)	81 (58.28)	169 (60.79)
Marital Status			
Single	31 (7.43)	17 (12.23)	14 (5.04)
Married	382 (91.61)	120 (86.33)	262 (94.24)
Widowed	4 (0.96)	2 (1.44)	2 (0.72)
Education level			
Never attended school	2 (0.48)	1 (0.72)	1 (0.36)
Primary	203 (48.68)	60 (43.17)	143 (51.44)
Secondary	151 (36.21)	46 (33.09)	105 (37.77)
University	61 (14.63)	32 (23.02)	29 (10.43)
Occupation			
Farmer	22 (5.28)	5 (3.60)	17 (6.12)
Home maker	142 (34.05)	34 (24.46)	108 (38.85)
Business woman	223 (53.48)	90 (64.75)	133 (47.84)
Employed	30 (7.19)	10 (7.19)	20 (7.19)

S.D Standard deviation

Most of the women in this study were married 382 (91.61%) while 4 (1%) had lost their husbands. Only 31 (7.43%) were single. The highest 203 (48.68%) number of these mothers had primary education while those who had secondary education were 151

(36.21%). Mothers with university education were only 61 (14.63%). However, 2 (0.48%) of them did not attend school. More than half 223 (53.48%) of the mothers were business women, a small percentage 30 (7.19%) were employed. More than a quarter 142 (34.05%) of them were neither employed nor had any business to do. Of the 417 mothers, 22 (5.28%) were farmers.

4.2 Objective 1: The prevalence of caesarean section

This study did not analyse the prevalence of the caesarean section given the nature of the study design. The case-control studies are limited to estimating the prevalence of an outcome. In this study, 33.3% of caesarean section was reported. However, this is an overestimate of the caesarean births in Siaya County. Hence not the true reflection of the current situation in Siaya County Referral Hospital.

4.3 Objective 3: Trends in delivery by caesarean section at Siaya County Referral Hospital

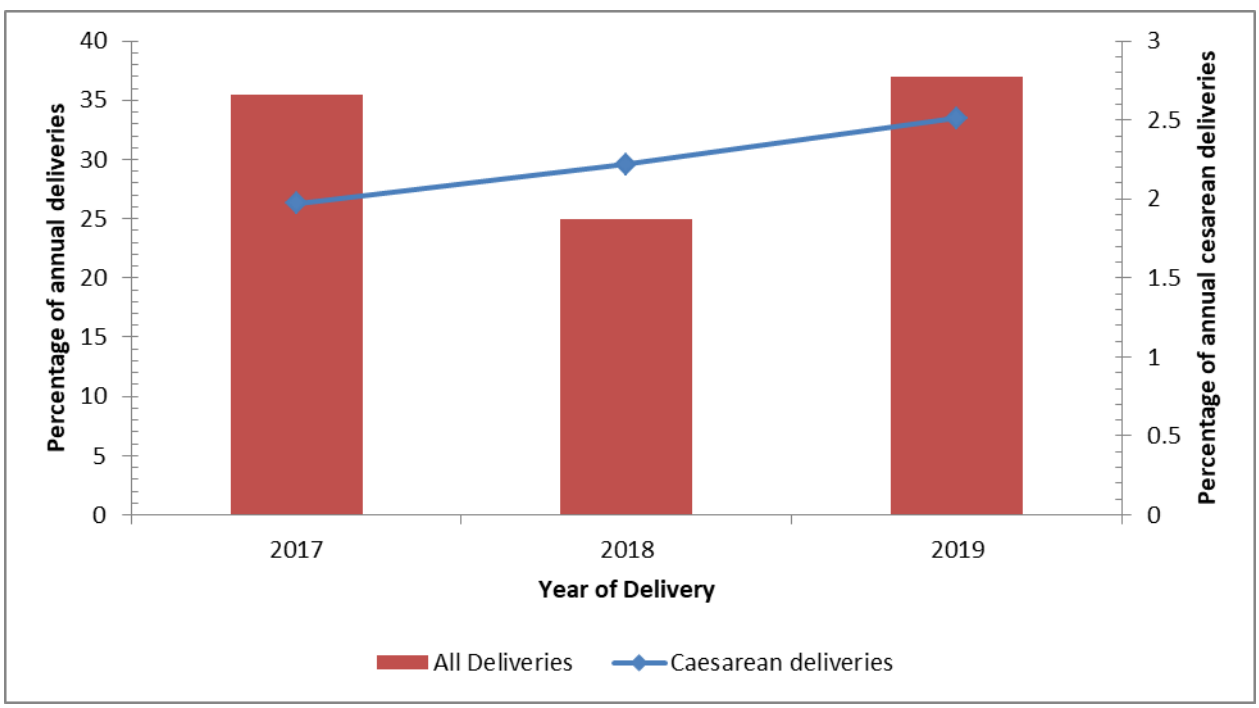

Figure 2: *Trends of delivery by Caesarean Section*

This analysis did not include 2020 deliveries in the graph to avoid selection bias

This study used proportions to explore the trends of delivery across the years and results indicated that the majority of the mothers delivered in the year 2017 (35.5%) with the least deliveries experienced in 2018 (24.95%). The number of deliveries dropped slightly in 2018 and increased drastically in 2019 (37.03%). When trends of delivery by caesarean were explored, this study reports a consistent increase in CS deliveries across the years. An increase from 1.97% of all deliveries in 2017 to 2.51% in 2019. However, a test of association between CS and year of delivery did not report significant difference (*p=0.08*).

4.4 Objective 3: Association between maternal age and CS at Siaya County Referral Hospital

Delivery by caesarean section has been associated with various factors. This study compared the relationship between maternal age and caesarean section. Overall, 139 (33.3%) delivered by caesarean section. Higher proportion of mothers who delivered by caesarean was reported among those aged 25 years and above as compared to the adolescent and young women (58.28% vs 8.63%, 58.28% vs 33.09) respectively. However, bivariate model of maternal age indicated that younger women (OR=0.76; 95% CI 0.33, 1.71) and older mothers (OR=0.71; 95% CI 0.32, 1.54) were less likely to deliver by CS as compared to adolescent mothers (Table 2).

Table 2: *Maternal Age Associated with caesarean section*

Predictor	All N=417	C-Section N=139	Vaginal Delivery N=278	Crude Odds Ratio	p-Value
	n (%)	n(%)	n (%)		
Age category					
< 20 years	61 (14.63)	14 (16.91)	47 (16.91)	Ref	
20-24 years	134 (32.13)	51 (36.69)	83 (29.86)	0.76 (0.33,1.71)	0.5
>=25 years	222 (53.24)	74 (53.24)	148 (53.24)	0.71 (0.32,1.54)	0.39

4.5 Objective 4: Predictors of caesarean section

Table 3: *Bivariate analysis: demographic, socio-economic, medical history, obstetric, clinical and nutritional variables by caesarean section.*

Independent Variables	All N=417	C-Section N=139	Vaginal Delivery N=278	Crude Odds Ratio	p-Value
	n (%)	n (%)	n (%)		
Marital Status					
Single	31 (7.45)	17 (12.32)	14 (5.04)	Ref	
Married	381 (90.35)	119 (86.23)	262 (94.24)	0.37 (0.18,0.78)	0.01
Widowed	5 (1.20)	3 (1.45)	2 (0.72)	0.82 (0.10,6.62)	0.85
Education level					
Never attended school	2 (0.48)	1 (0.72)	1 (0.36)	Ref	
Primary	203 (48.68)	60 (42.75)	143 (51.44)	0.41 (0.03,6.70)	0.53
Secondary	151 (36.31)	46 (33.33)	105 (37.77)	0.44 (0.03,7.16)	0.56
University	61 (14.63)	32 (23.19)	29 (10.43)	1.10 (0.07,18.46)	0.95
Occupation					
Farmer	22 (5.29)	5 (3.62)	17 (6.12)	Ref	
Home maker	142 (34.13)	34 (24.64)	108 (38.85)	1.07 (0.37,3.12)	0.9
Business woman	223 (53.37)	90 (64.49)	133 (47.84)	2.28 (0.81,6.39)	0.12
Employed	30 (7.21)	10 (7.25)	20 (7.19)	1.7 (0.48,5.95)	0.41
Maternal height (centimetres)					
Smaller than average	16 (3.85)	9 (6.52)	7 (2.52)	Ref	
Average and above	401 (96.15)	130 (93.48)	271 (97.48)	0.37 (0.13, 1.02)	0.05
Maternal nutritional status					
Undernourished	16 (3.85)	6 (4.35)	10 (3.60)	Ref	
Normal	242 (57.93)	70 (50.00)	172 (61.87)	0.67 (0.23,1.91)	0.45
Overweight	118 (28.37)	43 (31.16)	75 (26.98)	0.96 (0.32,2.81)	0.93
Obesity	41 (9.86)	20 (14.49)	21 (7.55)	1.59 (0.49,5.18)	0.44
Size of the baby					
Larger than average	1 (0.24)	1 (0.72)	0	N/A	N/A
Average	401 (96.15)	130 (93.48)	271 (97.48)	0.42 (0.15, 1.17)	0.1
Smaller than average	15 (3.61)	8 (5.80)	7 (2.52)	Ref	
HIV Status	85 (20.43)	24 (17.39)	61 (21.94)	0.74 (0.44,1.26)	0.28
Diabetes	0				
Vaginal bleeding	1 (0.24)	1	1 (0.72)	N/A	
Other chronic complications	12 (2.88)	4 (2.90)	8 (2.88)	1.01 (0.30,3.41)	0.99
Gestational weeks					
<37 weeks	35 (8.41)	17 (12.32)	18 (6.47)	Ref	
37-39 weeks	189 (45.19)	55 (39.13)	134 (48.20)	0.43 (0.20,0.89)	0.02
40-41 weeks	131 (31.49)	38 (27.54)	93 (33.45)	0.43 (0.20,0.93)	0.03
>41 weeks	62 (14.90)	29 (21.01)	33 (11.87)	0.93 (0.41,2.13)	0.87
Fetal distress	26 (6.25)	26 (18.84)	0	N/A	
Mal presentation	8 (1.92)	8 (5.80)	0	N/A	
Pre-eclampsia or eclampsia	1 (0.24)	1 (0.72)	0	N/A	
Premature membrane rapture	0	0	0	N/A	
Maternal parity					
Primaparous	207 (49.76)	84 (60.87)	123 (44.24)	Ref	
Multiparous	210 (50.24)	55 (39.13)	155 (55.76)	0.51 (0.34,0.77)	<0.001
Gravidity					
Primigravida	74 (17.79)	38 (27.54)	36 (12.95)	Ref	
Multigravida	343 (82.21)	101 (72.46)	242 (87.05)	0.39 (0.23,0.65)	<0.001
Prolonged labour	38 (9.13)	38 (27.54)	0	N/A	
Previous caesarean section	52 (12.50)	45 (32.61)	7 (2.52)	18.73 (8.16, 42.98)	<0.001
Anthemorrage	3 (0.72)	2 (1.45)	1 (0.36)	4.07 (0.37,45.32)	0.25
Smoking	0	0	0	N/A	
Alcohol	3 (0.72)	0	3 (1.08)	N/A	
ANC Visits					
1-2 visits	394 (94.47)	138 (99.28)	256 (92.09)	11.77 (1.57,88.28)	0.02
3+ visits	23 (5.53)	1 (0.72)	22 (7.91)	Ref	
History of hospitalization	15 (3.61)	9 (6.52)	6 (2.16)	3.16 (1.10,9.07)	0.03
Maternal preference	16 (3.85)	16 (11.59)	0	N/A	N/A

To better understand the predictors of caesarean section, this study analyzed the independent factors using two models, bivariate and multivariate logistic models. Table 3 and Table 4 present the results from the bivariate and multivariate logistic regressions respectively. Bivariate analysis of the demographic variables indicated that married or widowed mothers were less likely to deliver by caesarean section (OR=0.37; 95% CI 0.33, 1.71, OR=0.71; 95% CI 0.32, 1.54) respectively Table 3. In terms of education, mothers with primary (OR=0.41; 95% CI 0.03, 6.70) or secondary education (OR=0.44; 95% CI 0.03, 7.16) were less likely to give birth through caesarean as compared to those who never attended school. On the other hand, mothers who had university education (OR=1.10; 95% CI 0.07, 18.46) were reported to have increased odds of delivering through caesarean as compared to those who never attended school, though the effect was not statistically significant (*p>0.05*) (Table 2).Employment status was associated with increased odds of delivering by caesarean section, such that mothers who had a business (OR=2.28; 95% CI 0.81, 6.39) , employed (OR=1.70; 95% CI 0.48, 5.95) or home maker (OR=1.07; 95% CI 0.37, 3.12) were more likely to deliver by caesarean as compared to those who were farmers (Table 2). With regard to nutritional factors, mothers who were average or higher in height were less likely to deliver by caesarean section (OR=0.37; 95% CI 0.13, 1.02). Similarly, mothers who were normal in weight (OR=0.67; 95% CI 0.23, 1.91) or overweight mothers (OR=0.96; 95% CI 0.32, 2.81) were less likely to deliver by caesarean. However, obese mothers (OR=1.59; 95% CI 0.49, 5.18) had higher odds of delivering through caesarean (Table 2). Baby weight was associated with lower odds of delivering by caesarean section such that mothers who gave birth to average babies (OR=0.42; 95% CI 0.15, 1.17) were less likely to deliver by caesarean. Further, with respect to medically related complications, this study reports that HIV positive mothers (OR=0.74; 95% CI 0.44, 1.26) were less likely to deliver by caesarean as compared to those who were negative. Mothers with other chronic complications such Tuberculosis or Asthma were more likely to deliver by caesarean section (OR=1.01; 95% CI 0.30, 3.41). With respect to obstetric factors, multiparous mothers (OR=0.51; 95% CI 0.34, 0.77) were less likely to deliver through caesarean

section as compared to primaparous mothers. Similarly, this study reports that multigravida mothers (OR=0.39; 95% CI 0.23, 0.65) were less likely to delivery by caesarean than primigravida mothers. In relation to clinical factors, mothers aged between 37-39 weeks gestation (OR=0.43; 95% CI 0.20, 0.89), 40-41 weeks (OR=0.43; 95% CI 0.20, 0.93) or above 41 weeks gestation (OR=0.93; 95% CI 0.41, 2.13) were less likely to deliver by caesarean than preterm mothers. Other significant predictors were previous caesarean section and the number of ANC visits and bleeding complications, such that mothers who had a previous caesarean section (OR=18.73; 95% CI 8.16, 42.98) had higher odds of delivery by caesarean than those who did not have; mothers who had at least two antenatal visits (OR=11.77; 95% CI 1.57, 88.28) had increased odds of giving birth through caesarean than those who had more than three visits. Finally, this study reveals that mothers who reported any history of hospitalization during pregnancy were more likely to deliver by caesarean section (OR=3.16; 95% CI 1.10, 9.07) (Table 3).

When this study controlled for potential confounders such as employment status, maternal nutrition, gravidity, previous caesarean, history of hospitalization, ANC visits and anthemorrage in the multivariable model, delivery by caesarean was more likely among mothers who had private business ($_{a}$OR=1.97; 95% CI 0.57, 6.73), but the effect was not statistically significant (*p=0.28*). However, obesity was associated with lower odds with caesarean after adjusting for other covariates ($_{a}$OR=0.85; 95% CI 0.21, 3.38) (Table 4).

Table 4: *Multivariate analysis: demographic, socio-economic, medical history, obstetric, clinical and nutritional variables associated with caesarean section.*

Independent Variables	Crude Odds Ratio	Adjusted Odds Ratio[a]	p-Value
Occupation			
Farmer	Ref†	Ref	
Home maker	1.07 (0.37,3.12)	0.80 (0.22,2.87)	0.73
Business woman	2.28 (0.81,6.39)	1.97 (0.57,6.73)	0.28
Employed	1.7 (0.48,5.95)	0.71 (0.15,3.25)	0.66
Maternal nutritional status			
Undernourished	Ref	Ref	
Normal	0.67 (0.23,1.91)	0.45 (0.14,1.49)	0.19
Overweight	0.96 (0.32,2.81)	0.60 (0.17,2.04)	0.41
Obesity	1.59 (0.49,5.18)	0.85 (0.21,3.38)	0.82
Gravidity			
Primigravida	Ref	Ref	
Multigravida	0.39 (0.23,0.65)	0.20 (0.11,0.33)	<0.001
Previous caesarean section	18.73 (8.16, 42.98)	15.07 (6.59, 34.48)	<0.001
Anthemorrage	4.07 (0.37,45.32)	8.59 (0.72,101.70)	0.09
ANC Visits			
1-2 visits	11.77 (1.57,88.28)	15.94 (1.77,142.29)	0.02
3+ visits	Ref	Ref	
History of hospitalization	3.16 (1.10,9.07)	2.92 (1.14,6.05)	<0.001

† Reference groups: Model included variables that were significant at p=.25

In addition, multigravida mothers (OR=0.39; 95% CI 0.23, 0.65) remained significantly less likely to delivery by caesarean than primigravida mothers (OR=0.20; 95% CI 0.11, 0.33; $p<0.001$). Previous caesarean remained significant predictor of caesarean after adjusting for other covariates ($p<0.001$). Such mothers who had a previous caesarean section are more likely to have another caesarean delivery than the other counterparts ($_{a}$OR=15.07; 95% CI 6.59, 34.48) (Table 4). Also, this study reports that mothers who had bleeding complications during pregnancy were more likely to have caesarean delivery than those without bleeding ($_{a}$OR=8.59; 95% CI 0.72, 101.70) though the effect was not statistically significant ($p=0.09$). Finally, the number of ANC visits ($p=0.02$) and history of hospitalization ($p<0.001$) remained significant predictors at the multivariate level, such that mothers who visited the clinic at least twice for ANC were more likely to deliver by caesarean section as compared to mothers who had at least four visits during pregnancy ($_{a}$OR=15.94; 95% CI 1.77, 142.29) and mothers who were

admitted in the hospital during pregnancy due to complications were more likely to deliver by caesarean section than those without hospitalization ($_{a}$OR=2.92; 95% CI 1.14, 6.05) (Table 4).

CHAPTER FIVE: DISCUSSIONS

5.0 Discussion

The main aim of this study was to explore trends by proportions in delivery by caesarean section and to determine the risk factors associated with caesarean section among the pregnant women at Siaya County Referral Hospital over the years from 2017 to January 2020. Several studies have linked demographic, socio-economic factors, obstetric, clinical and nutritional factors with caesarean section. These studies have noted increased trends of caesarean section over the past years. For instance, a study in Bangladesh (Rahman *et al.*, 2018) reported an increase of caesarean from 3% of all deliveries in 2000 to 24% in 2014. In the same line, findings from this study reported increased caesarean section from 3.1% of all deliveries in 2015 to 8.9% in 2019.

In Bangladesh, according to the study findings, maternal age was found to have a positive relationship with caesarean delivery (Rahman *et al.*, 2018). Older mothers aged 25-29 years and 30-49 years were observed to have higher odds of delivery by CS (OR=2.29; CI=1.55-3.38 and OR=2.37; CI=1.47-3.81 respectively) than adolescent mothers aged 15-19 years. Risks of delivery complications such as prolonged labor lasting more than 20 hours, excessive bleeding and dysfunctional labor that require medical attention increased with maternal age. This is in contrast with the present results from this study where younger mothers aged 20-24 years and older mothers aged 25 years and above were less likely to have caesarean section as compared to adolescent mothers (OR=0.76; CI=0.33-1.71 and OR=0.76; CI=0.32-1.54 respectively). However, these findings are consistent with previous results observed in Brazil where primiparous adolescent women were generally found to give birth by caesarean delivery (Gama *et al*., 2014). Adolescents have been shown to susceptible and open to information regarding the safety of caesarean provided during prenatal care. Also, adolescent mothers develop some clinical risks and or complications during pregnancy and labor.

In this study, as well as previous studies in other countries (Klemetti *et al.*, 2010) , (Hezarjarib & Abbaspoor, 2010) it has been shown that mothers who have higher education are more likely to have caesarean delivery as compared to those who did not

have a university degree (OR=1.10; CI=0.07-18.46). However, a recent report (Diema Konlan *et al.*, 2019) indicated different findings where higher education was associated with lower rates of caesarean section. Highly educated mothers have the knowledge of the benefits that come with caesarean delivery. It has been showed that a planned caesarean section lowers the risks of birth injuries such as asphyxia to the baby and some maternal risk benefits such as avoidance of labour pain.

This study found out that history of previous caesarean section is a significant predictor of having caesarean delivery both at the bivariate and multivariate level. Mothers who had previous caesarean section in their previous delivery were more likely to delivery by caesarean than mothers who have never undergone caesarean delivery. Similar findings were demonstrated by other scholars (Mukherjee *et al.,* 2006). Caesarean section has been associated with increased risks of placental previa or placental abruption in the future pregnancies factors that put the mother at a risk of having another caesarean delivery.

Others scholars Gelaw *et al.*, 2017 in their study detected a positive association between higher parity with caesarean section. They found out that higher CS rates in multiparous women as compared to nulliparous women. However, these findings are not in line with results presented in this study. We found out that mothers with higher parity were less likely to go for caesarean delivery as compared to primaparous mothers. Studies have shown that primaparous mothers prefer caesarean delivery to vaginal so as to maintain their beauty-this is important for some men as they do not like the form of women's genitalia to change ; with caesarean the genital system is kept constant unlike vaginal delivery which causes the form of pelvic and genitalia to change (Khatony *et al.*, 2019). Also, this study has shown that gravidity is significantly associated with caesarean birth and that multigravida mothers are less likely to undergo caesarean delivery as compared to primigravida.

This study observed significant association between the numbers of antenatal care visits with caesarean section. Pregnant mothers who visited the clinic at least four times for

their routine medical checks were less likely to be subjected to caesarean as compared to pregnant mothers who went to the clinic at least two times. Proper ANC checks help to detect pregnancy complications such hypertension, pregnancy diabetes which may predispose the mothers at risk to caesarean section. A previous study in Bangladesh did not detect similar results; they found that increased utilization of ANC services enhanced the chance of CS. Frequent visits during the pregnancy period indicates the extent of use of antenatal care services by the mothers that could have influenced patients who prefer medical intervention to have caesarean delivery Rahman *et al.*,2018.

As with previous findings Karima Martin *et al*., 2018, this study found an increased risk of caesarean birth with history of hospitalization. Mothers who presented severe acute respiratory symptoms and other pregnancy related complications that required hospital admissions were more likely to undergo caesarean section. Duration of hospitalization has been linked with increased depression among pregnant mothers. It has been shown that pregnant women with depression are more likely to develop high-risk health behaviour such smoking, poor nutrition which have been linked with caesarean delivery.

From this study it is demonstrated that obese mothers at the bivariate level are more likely to undergo caesarean delivery as compared to those with normal BMI. These findings are confirmed by previous studies in Africa Onubi *et al.,* 2016 who showed that obese women are 87% more likely to have caesarean birth than those who are not. Elsewhere in Malawi, Nkoka *et al.,* 2019 confirmed that maternal obesity is associated with increased risk of caesarean birth. Obesity is associated with increased risk of almost all pregnancy complications. Some of the examples include: gestational hypertension, preeclampsia, gestational diabetes mellitus and higher incidence of congenital defects all occur more frequently in obese women than in women with normal BMI. These pregnancy complications as a result of obesity put the mother at a risk of having caesarean delivery.

CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusion

The current study showed that there is an upward trend in the proportion of mothers delivering through CS. The study did not detect any significant difference between maternal and caesarean section. From this study, the leading causes of CS were previous caesarean, history of hospitalization, gravidity and ANC visits.

6.2 Recommendations

In order to reduce or avoid unnecessary CS from occurring, it is suggested that better antenatal services be provided to reduce number of hospitalized cases due to health or pregnancy complicated issues or unhealthy eating behaviors. Appropriate training of hospital stuff with skills is important to offer careful and justified trail of labour to reduce repeated CS. Future studies should develop better research design for effective sample size determination that will estimate the prevalence of caesarean section in Siaya County. There is need to investigate on HIV/AIDS as a potential indicator of caesarean delivery in Siaya being one of the endemic regions of HIV/AIDS in Kenya.

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APPENDICES

Appendix I: Ethical Approval

KENYA MEDICAL RESEARCH INSTITUTE

P.O. Box 54840-00200, NAIROBI, Kenya
Tel (254) (020) 2722541, 2713349, 0722-205901, 0733-400003; Fax: (254) (020) 2720030
E-mail: director@kemri.org info@kemri.org Website:www.kemri.org

KEMRI/RES/7/3/1 **February 10, 2015**

TO: **MEREDITH McMORROW,**
PRINCIPAL INVESTIGATOR

THROUGH: **DR. STEPHEN MUNGA**
THE DIRECTOR, CGHR,
KISUMU

Dear Sir,

RE: SSC PROTOCOL NO. 2880 (*RESUBMISSION OF INITIAL SUBMISSION*): COHORT STUDY OF INFLUENZA-ASSOCIATED ILLNESS IN PREGNANT WOMEN IN WESTERN KENYA-(*VERSION 1.2 DATED 2ND FEBRUARY, 2014*)

Reference is made to your letter dated February 2, 2015. The KEMRI Scientific and Ethics Review Unit (SERU) acknowledge receipt of the revised protocol on 4th February, 2015.

This is to inform you that the Committee notes that the issue raised at the 232nd meeting of 21st October, 2014 is adequately addressed.

Consequently, the study is granted approval for implementation effective this **February 10, 2015**. Please note that authorization to conduct this study will automatically expire on **February 9, 2016.** If you plan to continue with data collection or analysis beyond this date, please submit an application for continuing approval to the SERU by **December 29, 2015**.

Any unanticipated problems resulting from the implementation of this protocol should be brought to the attention of the SERU. You are also required to submit any proposed changes to this protocol to SERU prior to initiation and advise the SERU when the study is completed or discontinued.

You may embark on the study.

Yours faithfully,

EAB

PROF. ELIZABETH BUKUSI,
ACTING SECRETARY,
KEMRI/ETHICS REVIEW COMMITTEE

KENYA MEDICAL RESEARCH INSTITUTE

P.O. Box 54840-00200, NAIROBI, Kenya
Tel: (254) 2722541, 2713349, 0722-205901,0733-400003, Fax: (254) (020) 2720030
Email: director@kemri.org, info@kemri.org, Website. www.kemri.org

KEMRI/RES/7/3/1 **January 31, 2020**

TO: **NANCY OTIENO**
PRINCIPAL INVESTIGATOR

THROUGH: **THE DIRECTOR, CGHR**
KISUMU

FORWARDED
DIRECTOR - CGHR

Dear Madam,

RE: **SSC PROTOCOL NO. 2880 (*REQUEST FOR ANNUAL RENEWAL WITH PROTOCOL DEVIATION REPORT*): COHORT STUDY OF INFLUENZA-ASSOCIATED ILLNESS IN PREGNANT WOMEN IN WESTERN KENYA**

Thank you for the continuing review report for the period **February 10, 2019 to January 20, 2020.**

The Committee noted that a protocol deviation form has been submitted as the request for annual renewal was done after the date of submission required. Measures taken to address deviation are adequate.

This is to inform you that the expedited review team of the KEMRI Scientific and Ethics Review Unit (SERU) was of the informed opinion that the progress made during the reported period is satisfactory. The study has therefore been granted **approval**.

This approval is valid from **February 10, 2020** for a period of **one (1) year**. Please note that authorization to conduct this study will automatically expire on **February 09, 2021**. If you plan to continue data collection or analysis beyond this date, please submit an application for continuation approval by **December 29, 2020.**

You are required to submit any amendments to this protocol and other information pertinent to human participation in this study to the SERU for review prior to initiation. You may continue with the study.

Yours faithfully,

for **ENOCK KEBENEI**
ACTING HEAD
KEMRI SCIENTIFIC AND ETHICS REVIEW UNIT

KENYA MEDICAL RESEARCH INSTITUTE

Centre for Global Health Research, P.O. Box 1578-40100, KISUMU-KENYA
Tel: (254) (057) 22923/24, Email: cvbcr@kisian.mimcom.net Website: www.kemri.org

27th February 2020

To
The Director,
School of Graduate Studies,
Jaramogi Oginga Odinga University of Science and Technology,
P.O Box Private Bag,
Bondo.

FORWARDED
DIRECTOR - CGHR

Through;
The Director,
CGHR, KEMRI
Kisumu

RE: THESIS DATA AND SUPERVISION – LAWRENCE BABU H153/4222/2018

This is to confirm that the above named MSc student at Jaramogi Oginga Odinga University, School of Health Sciences, and Department of Public Health will be collecting data within the Kenya Medical Research Institute – Division of Global Health Protection (DGHP) - Influenza program.

His data collection will be supported by SSC protocol #2880 where I am the Principal Investigator. I hereby confirm that the student is cleared to collect his thesis data within the ongoing project, and that I will provide the necessary supervision as the lead investigator.

Nancy A. Otieno
Senior Research Officer – Deputy Branch Chief
Division of Global Health Protection
KEMRI – Centre for Global Health Research
P.O. Box 1578 Kisumu-40100 Kenya
Tel: +254-57-2022902/59/83 Ext: 413
Cell: +254-717881475
E-mail: NOtieno@kemricdc.org or nancyotieno@gmail.com

Appendix II : Sample Research Quidde

FACTORS ASSOCIATED WITH CAESAREAN SECTIONS AMONG PREGNANT WOMEN DELIVERING AT SIAYA COUNTY REFERAL HOSPITAL, RURAL WESTERN KENYA

Participant ID Number: ___ ___ ___ ___ ___

Date of collection: DD/MMM/YYYY ___ ___ ___ ___ ___

Delivery mode: ❑ Spontaneous Vaginal Delivery (Normal) ❑ C-Section

Socio Demographics Information

1. Date of Birth: DD/MMM/YYYY ___ ___ ___ ___ ___
2. *Age:* ___ ___ *years* .
3. Marital status: ❑Single ❑Married ❑Widowed ❑Other
4. Subject's Education level: ❑ Never attended school
   ❑ Primary
   ❑ Secondary
   ❑ University/College
5. Subject's Occupation: ❑ Farmer
   ❑ Business woman
   ❑ Fisherman/Fish monger
   ❑ Homemaker
   ❑ Salaried worker
   ❑ Other Specify:
   _____

A. Obstetric History

1. Is this the subject's first pregnancy? ❑Yes ❑ No ❑Don't Know

2. If yes to B.1, SKIP to question B.6. If no, how many previous pregnancies has she had – regardless of outcome? __ __

3. How many previous pregnancies resulted in a live birth? __ __

4. How many stillbirths (death after 28 weeks gestation, 0 days gestation) has she had? __ __

5. How many miscarriages (fetal loss before 28 weeks gestation) has she had? __ __

6. Has this woman had multiples (e.g. twins or triplets)? ❑Yes ❑ No

7. Gestation age at delivery __ __weeks

8. Maternal height at delivery __ __cm

9. Maternal weight at delivery __ __kg

From ANC Card:

10. Total number of antenatal visits made during this pregnancy including this visit? __ __

Prior Pregnancies:

11. Has the patient ever been told by a clinician that they have had any of the following pregnancy-related complications (for any prior pregnancy)?

a. Previous caesarean delivery? ❑Yes ❑ No ❑Don't Know

b. Fetal distress? ❑Yes ❑ No ❑Don't Know

c. Pregnancy-induced hypertension? ❑Yes ❑ No ❑Don't Know

d. Malpresentation? ❑Yes ❑ No ❑Don't Know

e. Gestational Diabetes ❑Yes ❑ No ❑Don't Know

f. Premature labor? ❑Yes ❑ No ❑Don't Know

g. Prolonged labor? ❑Yes ❑ No ❑Don't Know

h. Other? _____

C. Medical History

1. Has the patient had any of the following medical conditions?

a. Tuberculosis or on TB treatment ❑Yes ❑ No ❑Don't Know

b. Asthma ❑Yes ❑ No ❑Don't Know

e. Diabetes (high blood sugar) ***not gestational related*** ❑Yes ❑ No ❑Don't Know

d. Cancer ❑Yes ❑ No ❑Don't Know

e. Malnutrition ❑Yes ❑ No ❑Don't Know

f. Hypertension (high blood pressure) ***not gestational related*** ❑Yes ❑ No ❑Don't Know

g. HIV Status : ❑HIV-infected ❑ NOT HIV-infected ❑Don't Know

2. a. Malaria Results? ❑Positive ❑ Negative ❑Invalid

b. Malaria drugs given? ❑Ye ❑ No ❑Don't Know

c. Vaccinated against malaria? ❑Yes ❑ No ❑Don't Know

If yes to 2.c above, please specify the vaccine for admission: _____

3. Smoked cigarettes during this pregnancy? ❑Yes ❑ No ❑Don't Know

4. Drunk alcohol one month before or during this pregnancy? ❑Yes ❑ No ❑Don't Know

5. During this pregnancy, was the patient ever admitted to the hospital for something other than childbirth? ❑Yes ❑ No

If yes to C.5, please specify reason for admission:

_____

6. Has the patient been ill during this pregnancy? ❑Yes ❑ No ❑Don't Know

D: Completion and verification

Researcher Signature: _____ Date: DD/MMM/YYYY