THE IMPACT OF SOCIO-ECONOMIC AND DEMOGRAPHIC VARIABLES ON MATERNAL HEALTH BEHAVIOR: A STATISTICAL APPROACH

A THESIS SUBMITTED TO THE

CENTRAL DEPARTMENT OF STATISTICS
INSTITUTE OF SCIENCE AND TECHNOLOGY
TRIBHUVAN UNIVERSITY
NEPAL

FOR THE AWARD OF
DOCTOR OF PHILOSOPHY
IN STATISTICS

BY

GAURI SHRESTHA

NOVEMBER, 2014

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RECOMMENDATION

This is to recommend that **GAURI SHRESTHA** has carried out research entitled **"THE IMPACT OF SOCIO-ECONOMIC AND DEMOGRAPHIC VARIABLES ON MATERNAL HEALTH BEHAVIOR: A STATISTICAL APPROACH"** for the award of Doctor of Philosophy (Ph.D.) in **STATISTICS** under my supervision. To my knowledge, this work has not been submitted for any other degree.

She has fulfilled all the requirements laid down by the Institute of Science and Technology (IOST), Tribhuvan University, Kirtipur for the submission of the thesis for the award of Ph.D. Degree.

……..

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Supervisor
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NOVEMBER, 2014

LETTER OF APPROVAL

28 November, 2014

On the recommendation of Prof. Dr. Ganga Shrestha, this Ph.D. thesis submitted by Gauri Shrestha entitled "**THE IMPACT OF SOCIO-ECONOMIC AND DEMOGRAPHIC VARIABLES ON MATERNAL HEALTH BEHAVIOR: A STATISTICAL APPROACH**" is forwarded by Central Department Research Committee (CDRC) to the Dean, IOST, T.U.

……

Prof. Dr. Ram Chandra Singh
Head,
Central Department of Statistics
Tribhuvan University
Kirtipur, Kathmandu
Nepal

DECLEARATION

Thesis entitled **"THE IMPACT OF SOCIO-ECONOMIC AND DEMOGRAPHIC VARIABLES ON MATERNAL HEALTH BEHAVIOR: A STATISTICAL APPROACH"** which is being submitted to the Central Department Of Statistics, Institute of Science and Technology (IOST), Tribhuvan University, Nepal for the award of the degree of Doctor of Philosophy (Ph.D.), is a research work carried out by me under the supervision of Prof. Dr. Ganga Shrestha, Central Department of Statistics, Tribhuvan University.

This research is original and has not been submitted earlier in part or full in this or any other form to any university or institute, here or elsewhere, for the award of any degree.

.....

Gauri Shrestha

ACKNOWLEDGEMENT

I am extremely grateful and deeply indebted to my respected supervisor and teacher, Prof. Dr. Ganga Shrestha for her scholarly supervision and constantly guiding me throughout the research work. Her encouragement, suggestions, cooperation have been extremely fruitful in the outcome of the research.

I am very thankful and obliged to Prof. Dr. Ram Chandra Singh Head, Central Department of Statistics, Tribhuvan University for his valuable suggestion and support during the research work.

I express my cordial thanks to Prof. Dr.Srijan Lal Shrestha, and Prof. Dr. Shankar Prasad Khanal, Central Department of Statistics, Tribhuvan University for spending their valuable time to read throughout the manuscript of my thesis and gave me so many innovative suggestions and invaluable comments.

Similarly, I express my gratitude to Prof. Azaya Bikram Sthapit,, and Associate Prof. Dr. Ram Prasad Khatiwada, Central Department of Statistics, Tribhuvan University for providing me constructive feedback during the pre-submission seminar in Central Department of Statistics.

I am also thankful to all the faculty member of Central Department of Statistics, Prof. Dr. Tika Ram Aryal, Mr. Madhav Bhushal, Mr. Prabhat Upreti and Mr. Santosh Shah for their support and cooperation. My special thanks go to the administrative and support staffs of Central Department of Statistics for facilitating the process smoothly to carry out the research.

I express my indebtedness to the University Grant Commission for allowing the fellowship to enable me to undertake the research work. I also thank to Nepal Academy of Science and Technology for allowing INSA fellowship to research at the Centre for Mathematical Science, Pala Campus, Arunapuram, Kerala, India.

I appreciate the institutional support i have received from the Centre for Mathematical Science, Pala Campus, Arunapuram, Kerala, India. I also thank Emiritus Prof. A.M Mathai who guided me during my stay (Nov, 2010-April, 2011) in Kerala, that helped me to develop the skills and knowledge required to complete my thesis.

I extend my sincere support to the anonymous referees of some journals(in particular, BRAC University Journal, Nepal Journal of Science and Technology, Himalayan Scientific Journal, Journal of Kathmandu Medical College), who kindly reviewed some part of the draft in paper form and offered their valuable comments in course of publication.

I owe to my husband, Mr. Rajesh Kumar Shrestha for his support throughout my career. Without his help, love and encouragement I could not have reached to this level. He's always had great confidence in me, making me believe that I can accomplish any challenging task overcoming the toughest impediments.

My deep and heartfelt appreciation is due to my mother, Mrs. Sabitri Devi Shrestha for her emotional and moral support. I would like to pay my tribute to my father, Late. Mr. Digamber Bhakta Shrestha who would have been one of the happiest person in the world to witness my success. I thank my daughters Grishma Shrestha, Rizma Shrestha and son Rahul Kumar Shrestha for putting up with my negligence towards them , which I couldn't help owing to my occupation with my research work.

Finally, I would like to thank to all well-wishers who directly and indirectly help and encourage me in my research work.

Gauri Shrestha

November, 2014

ABSTRACT

Maternal health care is a crucial part of any health care system. Health care that a woman receives during pregnancy, at the time of child birth and soon after, is important for the survival and well-being of mother and the new born.

The purpose of this study is to investigate the social, economic and demographic factors that affect women use of maternal health care in Nepal. The data used for the study is chosen from the 2006 and 2011Nepal Demographic Health Survey (NDHS). The unit of analysis for both studies is Ever Married Women (EMW) who had at least one live birth in the five year preceding the survey. This study consists of 4182 EMW for 2006 NDHS and 4079 EMW for 2011 NDHS.

For the purpose of this study, three Maternal Health Care Services' (MHCS) were selected as dependent variables. These were place of delivery, assistance during delivery and number of Antenatal Care (ANC) visits. A number of independent variables are taken into account based on scientific literature review of both socio-economic and demographic variables. The independent variables are mixture of categorical and continuous variables.

In order to assess the relationship of social, economic and demographic factors on maternal health care utilization, univariate, bivariate and multivariate analysis were used. In the univariate analysis, descriptive statistics were used to present socio-economic and demographic characteristics of respondents. Bivariate analysis was done by taking each independent variables and calculating proportion of use of all three form of maternal health care services. In a multivariate analysis, Logistic Regression (LR), Multinomial Logistic Regression (MNLR) and Ordinal Logistic Regression (OLR) model were used. LR model was used to analyze the data because the response variable, place of delivery was classified into two categories, In MNLR model, an attempt has been made to quantify the intensity of dependent variable; Assistance during delivery (Y) was coded into three categories: a) assistance during delivery by no one, b) assistance during delivery by unskilled birth attendant, c) assistance during delivery by skilled birth attendant. The 3rdresponse variable is "Number of ANC visits" which takes the three categories: a) no ANC visit b) 1-3 ANC visits (some visits) c) 4 or more visit (adequate visit). To

establish the effect of the identified predictor variables on the response variables "Number of ANC visits", Ordinal Logistic Regression (OLR) model was fitted in the context of the proportional odd model. To use OLR model, proportional odds assumption or the parallel line must be satisfied. The proportional odds model lead to strong assumption that may lead to incorrect interpretation if the assumptions are violated. For 2011 NDHS, the assumption of the parallel line is violated. Therefore Partial Proportional Odds (PPO) mode has been used. This was used to generate the estimates of partial proportional odds ratios across the categories of the outcome variable: (a) none versus some and adequate ANC visits (b) none or some ANC visits versus adequate ANC visits. All the fitted models are screened through various standard model adequacy tests namely residual analysis, goodness of fit, multicollinearity diagnostics. The fitted models are accepted only if they came good over the test.

Education level, wealth index, birth order, was highly significant predictors for the selection of place of delivery for both surveys. Regarding assistance during delivery age, region, wealth index (poorer), birth order, currently working and ANC by provider were found highly significant predictors and education was significant at 5 percent level of significance. But in 2011 NDHS survey only age, region and ANC by provider, wealth index (poorer and middle) were found significant predictors. Similarly age, education level, residence, wealth index and current working were highly significant factors for number of ANC visits but occupation (modern sector) and birth order (three or more) were significant at 5 percent level of significance in 2006 NDHS. For 2011 NDHS, education levels, wealth index, religion, were highly significant predictors for the number of ANC visits.

To increase utilization of health care services and improve maternal health, some crucial steps regarding educating mothers and creating job opportunity for women should be taken. Great attention should be given to those women who are living in rural areas with no education, occupation in agriculture sector and in the low wealth index group.

Keywords: logistic regression; odds ratio; multinomial logistic regression;
proportional odds; partial proportional odds.

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LIST OF ABBREVIATIONS

AHW	Auxiliary Health Worker
AIDS	Acquired Immune Deficiency syndrome
ANC	Antenatal Care
ANM	Auxiliary Nurse Midwife
BEOC	Basic Emergency Obstetric Care
BLR	Binary Logistic Regression
BPP	Birth Preparedness Package
CAC	Comprehensive Abortion Care
CBS	Central Bureau of Statistics
CEOC	Comprehensive Emergency Obstetric Care
DHS	Demographic Health Survey
EMW	Ever Married Women
FCHV	Female Community Health Worker
HH	Household Head
HIV	Human immune Deficiency
ICPD	International Conference on Population Development
MCHW	Maternal and Child Health Worker
MDG	Millennium Development Goal
MHCS	Maternal Health Care Services
MLE	Maximum Likelihood Estimator
MMR	Maternal Mortality Ratio
MOHP	Ministry of Health and Population
NDHS	Nepal Demographic Health Survey
NGO	Non-Government Organization

NSMP	National Safe Motherhood Program
OLR	Ordinal Logistic Regression
PNC	Postnatal Care
PPO	Partial Proportional Odds
PPS	Probability Proportional to Size
PSU	Primary Sampling Unit
SBA	Skilled Birth Attendants
TBA	Traditional Birth Attendant
USBA	Unskilled Skilled Birth Attendants
VDC	Village Development Committee
VHW	Village Health Worker
WHO	World Health Organization

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CHAPTER 1: INTRODUCTION

1.1 Maternal Health in a Global Context

Maternal health care is a crucial part of any health care system. Health care that a woman receives during pregnancy, at the time of child birth and soon after, is important for the survival and well-being of mother and the new born (WHO, 2005). Pregnancy and delivery related causes are among the top ten reasons for death among women of reproductive age in almost all developing countries (Winnikof & Sullivan, 1987). Social Scientist admit that maternal health behavior is an important, complex and neglected field of study in a developing countries, which has only in the late 1980's been recognized as a public health problem (Bosch, 1990). Since the launch of the Safe Motherhood Initiative in 1987, awareness to reproductive health has increased globally and today it is recognized as crucial part of overall health status of women.

Internationally,increasing attention given to maternal health has been concentrated in reducing maternal mortality. The tragedy of not preventing these avoidable or treatable deaths resulted in 536,000 maternal deaths worldwide in 2005 (WHO, 2005). Developing regions accounted for 99 percent (533,000) of these deaths, with sub-Saharan Africa and Southern Asia accounting for 86 percent of them (UN, 2008). Put another way, every minute of each year a woman dies from complications of pregnancy, abortion attempts and childbirth (UNFPA, 2004). Millions more women survive but suffer from illness and disability related to pregnancy and childbirth. Of all the health statistics monitored by the WHO, maternal mortality is the one with large discrepancy between developed and developing countries. At least 35 percent of women in developing countries still receive no ANC, almost 50 percent give birth without skilled attendant and 70percent receive no postpartum care. In contrast, maternal health care is nearly universal in developed countries (WHO, 1998). The important of maternal health care services in reducing maternal mortality and morbidity has received a significant reorganization.

Table 1: Estimate of Maternal Mortality in 2000

Region	MMR per 100,000 live births	Numbers of maternal death	Life time risk of maternal death 1 in
World	400	5,29,000	74
Developed countries	20	25,000	28000
Developing countries	440	5,27,000	61

Source: WHO 2006: Strategic approach to improving maternal and new born survival and health, Department of making pregnancy safer.

Improving maternal health and reducing maternal mortality have been main concerns of several international summits and conferences. It began with the international conference on safe motherhood held in 1987 and continued through International Conference on Population and Development (ICPD) 1994 and again through ICPD+5 (five-year review of the 1994 ICPD) and the Millennium Development Goals (MDG). The first conference ended with a declaration calling for a reduction in maternal mortality at least half by the year 2000. The ICPD set a goal of reducing maternal mortality to one half of the 1990 levels by 2000 and a further one-half reduction by 2015 (UNFPA, 2004). The Millennium Summit in 2000 calls for a 75 percent reduction by 2015 in the maternal mortality ratio from 1990 levels (UN, 2008). However as the deadline approached, these hopes had not been met yet, the world was nowhere near achieving this objective, and it was not even certain that global maternal mortality levels had declined in the past decade to any significant degree (Shiffman, 2003)

World Health Organization (WHO) has summarized three crucial factors underlying maternal deaths Firstly, lack of access and utilization of essential maternal health services. There is a negative association between maternal mortality rates and maternal health care utilization. WHO estimates suggest that 88 to 98 percent of all pregnancy-related deaths are avoidable if all women would have access to effective reproductive health care services (Kunst, 2001). Secondly is the low social status of women in developing countries. The low status of women can limit their access to economic resources and basic education, the impact is that they have limited ability to make decisions, including a decision related to their health and nutrition. Thirdly, too much physical work together with poor diet also contributes to poor maternal health outcomes.

It has been widely acknowledged that the causes of maternal death are consistent around the world. Some 80 percent of maternal deaths are due to direct obstetric complications, such as hemorrhage, sepsis, complications of abortion, pre-

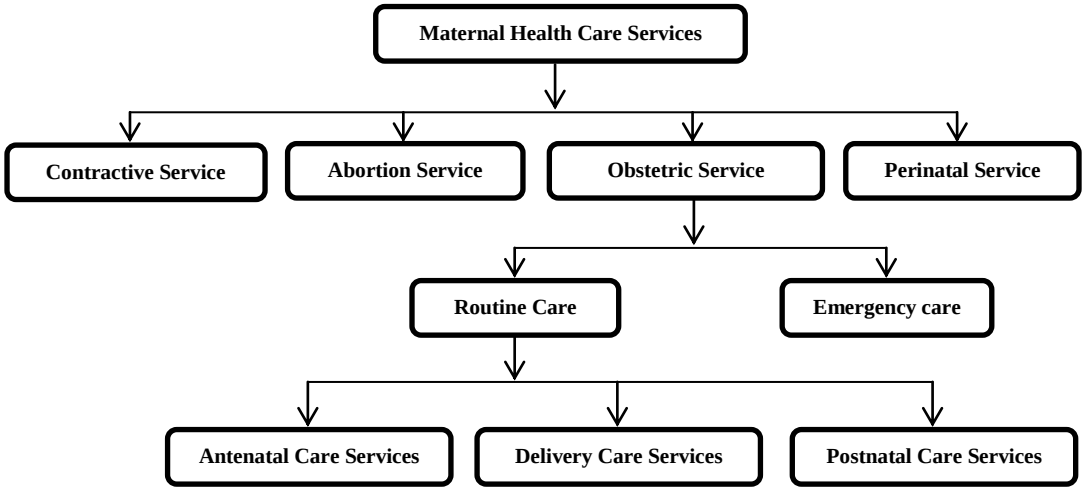
eclampsiaand eclampsia, and prolonged/obstructed labor (UNFPA, 2004). The other 20 percent are due to indirect causes, which generally comprise existing medical conditions that are aggravated by pregnancy or delivery. The indirect causes include anemia, malaria, hepatitis and AIDS. The condition that lead to the death of the mother or that leaves with the severe complications not only have an impact on her but also on the baby, she is carrying. More than a million children loses their mothers each year due to maternal mortality. Evidence show that these children have a 3-10 times higher risk of dying than children who live with both parents within two years after birth (WHO, 2005)

Globally the indicators that are widely used to track maternal health care can be classified into four groups - Contraceptive use, antenatal care (ANC), delivery care and postnatal care (PNC). According to ICPD, maternal health services which is based on the concept of informed choice, should include the following: education on safe motherhood, prenatal/antenatal care that is focused and effective, maternal nutrition programs, adequate delivery assistance and provide for obstetric emergencies, referral services for pregnancy, child birth and abortion complications, postnatal care and family planning (ICPD, 1994).

The utilization of maternal health care is one of the important factors to reduce the incidence of maternal mortality (Mekonnen & Mekonnen, 2003). Studies show that the majority of maternal deaths and disabilities can be prevented through early and timely access to and utilization of quality maternal health care services (Babolola & Fatusi, 2009) United Nations reported recent data of maternal health care from developing countries are as follow: the number of pregnant women who receive at least one antenatal care is approximately 74percent facilities (UNFPA 2004); and skilled health personnel assist nearly 61percent of births in 2006 (UN 2008). Obviously, the data indicates that the government commitment to maternal health care has not reached the levels required to make strong impact on mortality rates. Many existing interventions have been found to be ineffective in preventing maternal deaths. Laws and regulations in many countries sometimes impede health care policies (mostly in specific areas such as sexuality education and access of adolescents to reproductive health information and services).

Improved maternal health outcomes have been associated with utilization of maternal healthcare services (Mekonnen & Mekonnen, 2003; Babolola & Fatusi, 2009). However, many women in developing countries do not have access to Maternal Health Care Services (MHCS) and it is reported that the use of such services remain low in sub-Saharan Africa (Mpembeni, Killewo, Leshabari, Massawe, Jahn, & Mushi, 2007).

Figure 1: The Components of Maternal Health Care Services



Analysis of each of these components would highlight importance to maternal health. Abortion service, Contraceptive service and perinatal service are important components of maternal health service and of the rights afforded to women. These components however, are not discussed in detail in this study as they fall outside the major focus of the study. Emergency care also provides a true reflection of maternal health services but this study does not investigate emergency outcomes. The present study focuses on the routine care component. Under routine care component, only delivery care and antenatal care is included in the research. For the study of delivery care, the place of delivery and assistance during delivery is used. For the study of antenatal care, frequency of antenatal checkup is used.

Like other developing countries, many women experience life threatening complication during pregnancy and child birth and also after child birth in Nepal. The complication of pregnancy or child bearing can be mostly reduced if a woman is healthy and well-nourished before becoming pregnant, if she has a health checkup by medically trained provider during her pregnancy (ANC), if the delivery done at healthy institution (place of delivery) and if a medically trained provider assists during delivery (assistance during delivery). The mother should also be checkup by

health professional especially during 12 hours after delivery and also until six weeks after giving births.

Therefore in the present study, maternal health services is analyzed under three components namely the place of delivery care, the use of trained delivery assistance and use of frequency of antenatal care,. A discussion of the different component of maternal health services which has been found to be reduced maternal morbidities and mortality is provided below.

1.1.1 Antenatal Care

Providing special care for pregnant women in the public health service was not started until 1930's, which was initially introduce in the United Kingdom and Northern Ireland states. It was decided that every pregnant woman should get a regular checkup as an integral part of maternity care. This is one of the important components of maternal health which is now called antenatal care (WHO, 2003).

World Health organization defines antenatal (also called prenatal) as service given to pregnant women by health professionals. Antenatal care is composed of recording medical history, giving assessment of individual needs, giving advice and guidance on pregnancy and delivery (WHO, 2006).

Antenatal Care (ANC) is named as one of the four pillars of the Safe Motherhood Initiatives (WHO, 1994). Routine antenatal visits may raise awareness about the need for care to be taken regarding delivery or give women and their families to familiarize with health facilities that enable them to seek help more effectively during a crisis (Palaniappan, 1995). Other potential benefits of ANC are counseling on the nutrition and healthy pregnancy/ delivery behavior, provide tetanus immunization, malaria prophylaxis, iron and folic tablets, screening for anemia and HIV/AIDS and prevent low birth weight (UNFPA, 2006).

World Health Organization (WHO) estimates suggest 88 to 98 percent of all pregnancy related deaths are avoidable if all women would have access to effective reproductive health services (Kunst, 2001). Therefore antenatal care health services utilization is one of the important factors to reduce the incidence of maternal death. The effectiveness of the health system in developing countries like Nepal is undermined by lack of utilization of existing facilities. Despite the government's serious commitment to deliver health facility to the door step of common people

through innovative approach, the utilization of health services is still far below any acceptable standard. Recent data in Nepal, Maternal Mortality Ratio (MMR)is 286 per 100,000 births (NDHS, 2006). Although MMR appears to have gone down over the past one decade (539 in 1996, 415 in 2000) (UNICEF & WHO, 1996; NPC, 2002), MMR is still high compare to other countries in Asia. Under such circumstances, it becomes vital to identify the factors for non-use of maternal health services.

Coverage of ANC is define as percentage of women who receive antenatal care at least once during pregnancy for reason related to pregnancy (WHO, 1996). Quality of antenatal care is another issue. Accepted indicators of quality antenatal care include: early initiation, number of times ANC visit and medical and educational content of the visit.

Antenatal care is the third indicator towards universal access to reproductive health. Globally 30 percent of women aged 15-40 do not have ANC. 46 percent of those who did not have ANC are in south Asia while 34 percent are in sub-Saharan Africa. This low use of services leads to death and disability due to untreated hypertensive disorders or due to mal-or sub nutrition like iron deficiency anemia (UNICEF, 2010). During pregnancy, the 1st ANC visit should come early in pregnancy, ideally before twelve week. For most women, four visits during pregnancy are appropriate. Women with certain health conditions or pregnancy may need more visits (WHO, 2007). Such care can detect and manage existing disease, recognize and treat complications early, provide information and counseling on sign and symptoms of problems.

Antenatal care is hypothesized to have a positive effect on the likelihood of receiving professional assistance at delivery, in as much as women receiving antenatal care come in contact with health care providers who are likely to encourage them to seek professional assistance at delivery or give birth in a health institution. A complicating factor is that women with pregnancy complications are more likely than other pregnant women both to receive antenatal checkups and to receive professional medical assistance at delivery because of the pregnancy. This study also examines the association between antenatal care by provider and professional assistance at delivery and place of delivery. A vital contribution could be made if attendance at an antenatal service influenced women to select a trained birth attendant.

Retrospective studies in India (Bhatia J, 1993, AnandaLakshmy et. al., 1993, Bloom, Lippeveld, &Wypij, 1999), Ethiopia (Kwast &Liff, 1988), Nigeria (Hartfield, 1980),Senegal (Garenne et al, 1997) found that a lack of antenatal care was an important risk factor for maternal death. Although some of these studies have methodological weakness related to, not controlling for potential confounding factors, the effects were typically very pronounced, suggesting that association is likely to exist.

The rationale for antenatal care is that it is essential to screen a predominantly healthy population to detect early signs of any risk factors for pregnancy related complications and followed by timely intervention. However, focused on ANC has been found to offer the opportunity for early detection and timely treatment of diseases which improves maternal outcomes. For example, detection and treatment of high blood pressure, to prevent eclampsia, has been found to greatly reduce mortality (Macw-Binns et al, 2004). Similarly, improved maternal outcomes have been recorded through the detection and treatment of anaemia (Reynolds, Wong, & Tucker, 2006). The strength of ANC, therefore, lies in its role for early identification of complications; and for providing information on danger signs and how to handle them (Yuster, 1995). Furthermore, opportunities for preventive health services, such as prophylactic treatment of malaria and immunization against neonatal tetanus (Babolola & Fatusi, 2009) are also provided through ANC. Antenatal care also makes it possible to screen for sexually transmitted diseases such as HIV infection, which is known to have taken its toll in much of the developing world. Counseling and education of pregnant women about their own health and that of their children is also an opportunity that can be incorporated.

Regarding utilization of antenatal care services various explanations are given by many authors. Therefore in this study, ANC status is typically characterized by frequency of ANC visits. Number of ANC be highlight on the factors associated with ‘no’, ‘some (1-3)’ and ‘adequate (4 or more)’ antenatal care visits.

1.1.2 Place of Delivery

Unlike the use of antenatal care, the place of delivery, if adequate facilities are provided effectively, has consistently been found to be associated to reduce maternal mortality (Thaddeus & Maine, 1994). The conditions for facilities at birth delivery to

be effective are: first, delivery should be assisted by trained health workers who are able to identify the signs of complications and act appropriately when a problem occurs. Second, Referral facilities should be available to deal with obstetric emergencies once they have been identified, and on arrival at the referral facility patients should be observed promptly and appropriate decisions made to avoid further complications or even death (Thaddeus & Maine, 1994). Moreover, there needs to be a transport system to get women to the facility quickly in order for the service to be effective. However in developing countries, there are a number of factors that can restrain the positive effect of delivery (Griffiths &Stephenson, 2001).

Delivery services, especially emergency obstetric care, are also critical for pregnant women. Emergency care is important if women experience obstructed labor, pregnancy-induced hypertension, eclampsia or severe untreated anemia. Obstructed or prolonged labor is one of the more serious complications that can cause maternal morbidity and death (Kumbi & Isehak, 1999).

This study focuses on the importance of a place of delivery as maternal health services, because delivery at health facilities (government/private hospital/ hospital running by NGOs/ clinics/ centers or other type of health facility) women receive better facilities and assistance than delivery at home. Maternal health analysts also agree that, to substantially reduce both maternal and child deaths, care needs to be scaled up in a continuum, from safe sex and family planning to pregnancy and delivery care (Kerber, Grant-Johnson, Zulfiqur A Bhutta, Starrs, & Lawn, 2007).

The objective of delivery at a health facility is to protect the life and health of the mother and her child by ensuring safe and hygienic condition during deliveries. In this study, place of delivery be highlighted as ‘home delivery’ and institutional delivery. Institutional delivery meaning delivery in health institute which includes all type of facilities in government/ private hospitals/hospital running by NGO’s/clinics/ centers or other health institutions. Delivery at home includes respondent’s home or others (non-health institutions).

1.1.3 Assistance during Delivery

The majority of maternal deaths occur due to unexpected complications, which would require the availability of emergency obstetric care. The presence of skilled birth attendant for all births is the only way to ensure all those with pregnancy

complication to be referred to emergency obstetric care. Skilled Birth Attendants (SBA) during labour, delivery and early postpartum period could reduce an estimated 16 to 33 percent of deaths due to obstructed labour, hemorrhage, sepsis and eclampsia (UNFPA, 2004). A skilled birth attendant is a professionally trained health worker, usually a doctor, midwife or nurse, with the skill to manage a normal labour and delivery, recognize complications early on and perform any essential interventions, start treatment and supervise the referral of mother and baby to the next level of care if necessary (UNFPA, 2004). Most life threatening complication occurs at the time of delivery or immediately postpartum and requires medical intervention, but it is difficult to predict and prevent these complications during antenatal period (McDonagh, 1996). Therefore, to reduce maternal mortality and morbidity, the trend for safe motherhood programs has shifted from primary and secondary prevention to the ensuring of emergency obstetric care and skilled birth attendants (WHO, 1999).

Delivery assistance by SBA is one of the key indicators to reflect the progress towards the Millennium Development Goal of improving maternal health. Globally, the goal is to have 80 percent of all births assisted by SBA by 2005, 85 percent by 2010 and 90 percent by 2015. The agreement set the goal of 40 percent of all births to be assisted by SBA by 2005, with 50 percent coverage by 2010 and 60 percent by 2015 among countries with very high maternal mortality (Stanton et. al., 2006).

In developing countries, many women are still assisted in delivery by either traditional births attendants, relatives or their deliver by themselves. According to a report of UNFPA in 2004, only slightly more than half of all deliveries (56 percent) are assisted by skilled personnel (Abouzahr, 2001). The lowest levels skilled birth attendants at delivery in developing countries are in South Asia (29 percent) and sub-Saharan Africa (37 percent). The highest levels of use of skilled birth attendance are in Latin America and the Caribbean (83 percent) and the Central and Eastern Europe/ Commonwealth of Independent States Regions (94 percent) (AbouZahr & Wardlaw 2001).

Appropriate delivery care is important for the health of both the mother and the new born, especially if there are child birth complications. To reduce the risk of infection and so that any complications can be effectively managed, it is important that mothers

delivery in hygienic setting and in the presence of skilled birth attendants with suitable equipment and supplies.

De Berniset. al., stated that "The proportion of births attended by skilled health personnel was used as one of the important indicators to monitor progress towards the achievement of the millennium development goal of reducing maternal mortality rate". Skilled attendants are able to identify early signs of pregnancy complications and can offer immediate emergency obstetric care leading to reduction in maternal and infant mortality (De Bernis, Sherratt, Abouzahr, & Van Lerberghe, 2003).

In this study, assistance during delivery is characterized as 'by no one', 'by unskilled birth attendants' and 'by skilled birth attendants'. Skilled birth attendants were defined according to WHO definition and included physicians, midwives, nurses, and assistant physicians. Traditional birth attendants were not included in skilled birth attendants. MCH workers/VHW/TBA as unskilled birth attendant and relative/friend/ no help is considered as no utilization of assistance at delivery.

1.2 Maternal Health Context of Nepal

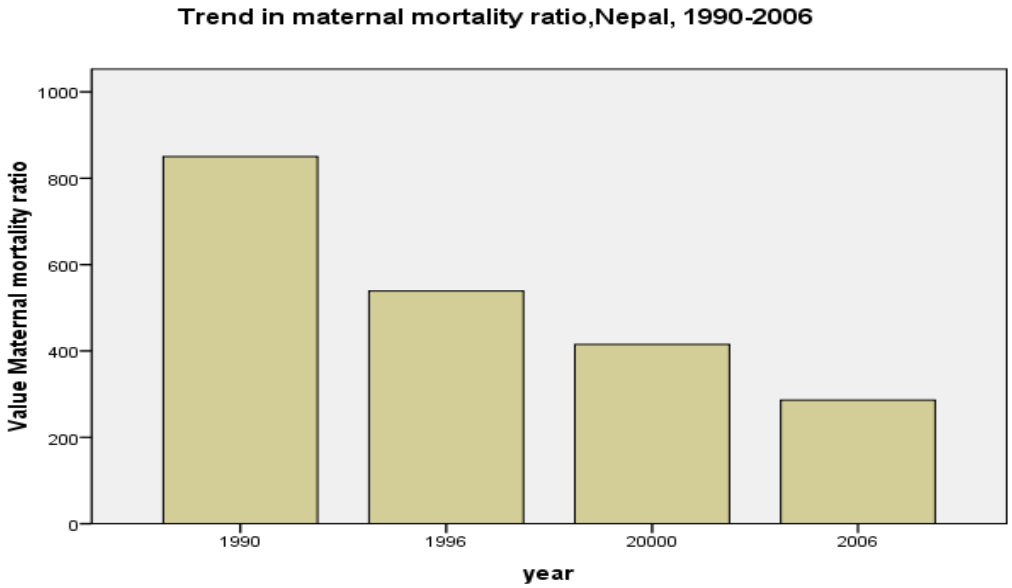
In 1991, National Health Policy was endorsed, then maternal health became a national health priority and several interventions have been implanted in recent years under the National Safe Motherhood Program (NSMP) in Nepal (NFHS, 1990). It stressed reduction of maternal and child mortality through expansion of services. However, use of maternal health services at national level is still low but the government of Nepal aspires to improve maternal health and has developed various strategies to move towards the commitment of Millennium Development Goals (MDG, 2007).

The effectiveness of the health system in developing countries is undermined by lack of utilization of existing facilities. In Nepal, utilization of basic health services has remain poor even though there has been increasing public expenditure on the provision of modern health care. It has been widely known that better use on maternal health care facilities will reduce maternal mortality. Recent data in Nepal showed that maternal mortality ratio (MMR) in this country is 286 deaths per 100,000 live births (NDHS 2006). Under such circumstances, it becomes vital to identify the factors responsible for non-use of maternal health facilities.

It should be highlighted at the outset that data on maternal mortality is highly problematic in Nepal, as measurement of the MMR suffers gravely from under reporting and misclassification, and even household surveys are subject to wide margin of uncertainty due to such issues of variability of the sample, the small number of events and difference in methodology. The base line figure for the MMR itself is conflicting. While the survey based MMR for 1991 for the period of 15-20 years before the survey was 515 deaths per 100,000 live births, another source indicated a figure as high as 850.

According to official data, the ratio for 1990 to 1996s, the MMR stood at around 539 deaths per 100,000 live births. It slowly decreased to 415 in 2000. The most recent available figure is the Nepal Demographic and Health Survey (NDHS) estimation of 281 per 100,000 live births in 2006. For the period of 1996-2006, Nepal reduced its MMR from 539 to 286. Although MMR appears to have gone down over the past one decade (539 in 1996, 415 in 2000; WHO 1996; NPC 2002), MMR is still high compare to other countries in Asia. This figure implies that maternal mortality has always be a long standing problem in this country, where maternal deaths in 2006 were still high; progress in reducing maternal mortality is not as fast as has been expected.

Figure 2: Trend in Maternal Mortality Ratio in Nepal 1990-2006



There has been significant improvement over the past ten years in the proportion of mothers who get antenatal care from skilled birth attendant (Doctor, nurse and midwife), increasing 24 percent in 1991 to 28 percent in 2001, 45 percent in 2006

and 59 percent in 2011(NDHS, 2001; NDHS, 2006; NDHS, 2011). The Nepal maternal health's program recommends at least four ANC visits: at least one visit in the first timester, at least one visit in the second timester and at least two visits in third timester. Data source shows that only 29 percent of mothers meet the recommended schedule (four visits). In the area of maternity care, although women who receive antenatal care are relatively high (75percent in 2006 and 85 percent in 2011) but recommended schedule is still low (29 percent in 2006, 50 percent in 2011). Therefore the present study focuses on the number of ANC visits as maternal health services.

The Policy on Skilled Birth Attendants, endorsed in 2006 by the MOHP, specifically identifies the importance of Skilled Birth Attendants (SBA) at every birth and embodies the government's commitment to training and deploying doctors, nurses, and auxiliary nurse midwives with the required skills across the country. In order to ensure focused and coordinated efforts among various stakeholders involved in safe motherhood and neonatal health programming, the National Safe Motherhood (2002-2007) Program has been revised with wider participation by the government and nongovernmental, national and international institutions. By the end of 2008-2009, the Birth Preparedness Package (BPP) had been rolled out in all 75 districts. Similarly, a maternity incentive scheme was adopted in 2005 to encourage women to use health facilities for maternity care and improve access to maternity care services (MOHP, 2011). The health care services that a woman receives during pregnancy, childbirth, and the immediate postnatal period are important for the survival and well-being of both the mother and the child. The 2011 NDHS collected information on the extent to which women in Nepal receive care during each of these stages. The findings can be used to identify subgroups of women at increased risk of mortality because of non-use of maternal health services and to assist in the planning of appropriate improvements in services.

Improvements in maternal health services have been key in reducing the country's MMR. The National Safe Motherhood Program has made significant progress in terms of development of policies and protocols as well as expansion of the role of service providers such as staff nurses and auxiliary nurse midwives. The National Safe Motherhood Program is a priority for the government of Nepal's Health Sector Strategy, which works toward meeting the Tenth Five-year Poverty Reduction Strategy and health sector targets set out in the Millennium Development Goals

(MDGs). The target for maternal health is to reduce the MMR by three-quarters between 1990 and 2015 (MDG, 2007).

According to Nepal Demographic Health Survey (NDHS) 2006, three in four (75 percent) pregnant women receive antenatal care, about 57 percent of mothers who receive antenatal care reported that they were informed the sign of pregnancy complications (NDHS, 2006). Similarly according to NDHS 2011, half of women had an ANC visit by their four month of pregnancy as recommended. This is substantial improvement from only 28 percent in 2006(NDHS, 2011).

Analysis of the Nepal Demographic and Health Survey (NDHS) 2011 shows substantial differences in the maternal health services use within the country. According to 2011 NDHS, 52 percent of women went for the adequate ANC visits. However, adequate antenatal care is lower in the rural residence (52 percent) compared with the urban residence (63 percent). Though antenatal care received by women is much higher 85 percent but only 35 percent of babies were delivered by doctors or nurses or midwives and only 39 percent of the births occurred at health institutions. With this report, it is clear that Nepal has a long way to go to meet the MDG target of 60 percent births attended by skilled personnel (NDHS 2011).

In the area of maternity care, although women who received antenatal care are relatively high, official data shows that the utilization of delivery services at modern health care is still low. It has been reported that during 2006, only 18 percent of live births in five years preceding the survey were delivered at a formal health facility: 13 percent of births were delivered in a public sector health facility, 4 percent in a non-government facility and less than one percent in a private health facility. The coverage is vary across the ecological region, being lowest in the mountains (6 percent), high in the hills (21 percent) and moderately high (17 percent) in the Terai (NDHS 2011).

In Nepal, the percentage of births taking place in a health facility has more than doubled in last five years (9 percent in 2001, 18 percent in 2006 and 39 percent in 2011). Even though the rate of birth taking place in a health facility has increased, still three out of five (61 percent) births take place at home (NDHS,2001; NDHS 2006; NDHS, 2011). This fact is a serious obstacle to reduce maternal mortality as women get less facility at home than in a health facility. Therefore it is safer to deliver at a health facility than at home.

A professional delivery care, such as assistance by a skilled birth attendant (doctor, nurse or midwife) at delivery is a key to reduce maternal mortality (Brouwere & Lerberghe, 2001). In Nepal, most of maternal deaths occur because the delivery is not assisted by skilled birth attendant. Approximately 35 percent of births in the five years preceding the survey were attended by SBA's. The coverage of births by skilled birth attendants vary across the residence of Nepal from 64 percent in urban compared with 26 percent of births in rural areas (NDHS, 2011).

Reports show that more maternal deaths are due to absence of adequate number of place of delivery and skilled assistance. So, regarding the maternal health services mentioned above, this study focuses on the importance of place of delivery in maternal health services, because women delivery undergoing at health facilities (government/private, hospital/hospital running by NGO's/clinics/centers or other type of health facility) receive better facilities and assistance than women who have delivery at home. Maternal health analysts also agree that, to substantially reduce both maternal and child deaths, care needs to be scaled up in a continuum, from safe sex and family planning to pregnancy and delivery care (Kerber et. al., 2007).

1.3 Maternal Health Services Delivery System in Nepal

Of all the reproductive health programs, the maternal care or safe motherhood has been the main focus in the recent years. The safe motherhood initiative (1987) was adopted globally as the strategy to reduce maternal mortality. This goal was later adopted by the National Government and by other international conferences including the International Conference on Population and Development (ICPD) in Cairo in 1994 and the fourth world conference in Beijing in 1995.

As in many countries His Majesty's Government of Nepal (HMG/N) had established a Safe Motherhood task force in 1994 to improve the health status of women during pregnancy and childbirth. In 1998, the National Safe Motherhood Plan (1994-1997) addressed maternal mortality as one of the major public health problems among women of childbearing age. Since, then government has given high priority to the Safe Motherhood program to reduce maternal deaths and disabilities. The objective of this policy is to initiate and promote policy and programmatic research activities at improving maternal health service and ultimately the health of women (MOH, 1996)

A National Health Policy (NHP) was developed in 1991 to address the health of the nation. It addresses delivery of health care services as well as information and administrative issues. Its prime objective is to approach health care at the district level as the first step. The policy emphasizes community involvement, encourages participation of the private sectors and national and international NGO's. The 8th health plan (1992-1997), the 9th health plan (1997-2002) and the long-term health plan (2002-2017) have been developed, all in keeping up with the objective of the National Health Plan. The government of Nepal is currently in the process of defining the function and standard design of level of health facilities. At present, all levels of facilities have maternal services as an integral component with standard design for birthing centers, Basic Emergency Obstetric Care (BEOC), Comprehensive Emergency Obstetric Care (CEOC), Comprehensive Abortion Care (CAC) have already been defined.

Table 2: Government Health Facilities in Nepal

Level	Quantity	Facilities
National Hospitals	4	All have CEOC and maternity department
Regional & sub regional Hospitals	4	All have CEOC and maternity department
Zonal Hospital	8	All have CEOC and maternity department
District Hospital	65	13 have CEOC & 38 have BEOC. All provide ANC, delivery and PNC.
Primary Health Care Centers (PHCCs)	168	42 have BEOC. All provide ANC, delivery and PNC.
Health Post (HP)	696	All provide ANC, PNC and some have birthing center
Sub Health Post (SHP)	3129	Providing ANC and PNC.

In terms of maternal health care, the services provided by the government are available at various levels in Nepal. The primary level for maternity services consists of sub-health posts, health posts and primary health centers. Health posts and sub-health posts are the main providers of maternal health services in rural areas. At sub-health posts, maternity services are provided by maternal and child health (MCH) workers. The MCH workers are also expected to support trained traditional birth attendants (TBA) and female community health volunteers (FCHV). At the health posts, auxiliary nurse midwives (ANM) provide integrated preventive, promotive and curative services. These services include antenatal and postnatal care. Primary health centers also provide both, preventive and curative services. Indoor beds are available for maternity emergencies. A medical doctor, a staff nurse, a health assistant, two auxiliary health workers, two ANMs, a laboratory assistant, and a village health worker are available at primary health centers (CBS, 1998).

District level hospitals and regional and zonal hospitals are the main institutions at the secondary level for maternity services. Problems that cannot be handled at health posts are referred to district level hospitals. Central level hospitals serve as the providers for tertiary level maternity services. The majority of women in Nepal reside in rural areas where only basic services are available at health posts and sub-health posts. Some services are provided by trained traditional birth attendants and female community health volunteers (CBS, 1997).

In summary, there are several dimensions of the maternal health problems in Nepal. The government has made several efforts to improve the health of the mother; however, MMR in Nepal is still high. The current low utilization of maternal care services at primary health care level has negatively affected health status of women and contributed to high maternal mortality and morbidity. For this reason, it is important to investigate factors affecting the utilization of maternal health care services in Nepal. This crucial issue needs to be accorded a national priority.

1.4 Rationale of the Research

The circumstances of women's lives are important to their health and well-being and should be included in any discussion of maternal health. Although men, women, and children in developing countries live under socioeconomic conditions that are associated with ill health, in the developing world, most women of reproductive age are also mothers; therefore, the terms "women's health" and "maternal health" are used interchangeably.

Women's health in developing countries typically implies reproductive health as well as a woman's capacity to produce and take care of her children. On the basis of NDHS findings, three key indicators - maternal mortality, maternal nutritional status, and low birth weight are used as outcome variables to describe the overall health status and condition of mothers in developing countries. Because of the limited range of indictors of women's health, maternal mortality dominates as a key indicator. At the same time, however, more women survive childbirth but continue to live with morbidities that are not measured. It is for this reason that it is important to explore the context of women's lives. (Leslie, 1991; Tinker, 2000)

Socio-economic and, demographic factors are important in their potential to interact with or mediate direct determinants of maternal health. Using DHS data, it is possible to measure factors at all two levels (Socio-economical and Demographical) along with three indicators of maternal health (Frequency of ANC visits, place of delivery and Assistance during delivery).

Empirical studies of maternal health services have often found that use of services is most strongly correlated with demographic and social economic characteristics than with health beliefs (Fielder, 1981). Appropriate maternal health care including ANC and delivery care is essential to the prevention and management of complication of pregnancy and childbirth and to avert adverse outcomes (Magadi, Madise, & Rodrigues, 2000).

In Nepal, only a few studies have been undertaken concerning factors that influence the utilization of maternal health services. Some of the studies mentioned in the text also acknowledged that maternal death could have been avoided largely with appropriate care (Okonofua, Abejide, &Makanjuola, 1992) (Hieau, Hanenberg, Vinh, & Sokal, 1999).

This study on the impact of socio-economic and demographic variables on maternal health behavior is therefore needed for two reasons. Firstly, over the last two decades, there have been investments in the public health system in Nepal with an emphasis on increasing the availability of maternal and child health services and encouraging women to obtain adequate health care during pregnancy and delivery. However, the MMR has not yet dropped appreciably and the strategies so far put forward have not brought the desired results yet. Presumably, socio-economic and demographic factors do play a role in the utilization of maternal health care services.

Secondly, underutilization of maternal health care service by pregnant women in Nepal put them at greatest risk. The utilization requires voluntary participation; however, there are multitude factors make women most likely not to utilize health care. In Nepal, 75 percent of ever married women attended antenatal care but only 29 percent of the mother meet recommended schedule (four visits). Yet only 18 percent of births were subsequently delivered in health institution(NDHS 2006). Similarly, 85 percent of ever married women attended antenatal care but only 52 percent of the

mother meet recommended schedule and only 39 percent were delivered in health institution (NDHS 2011).

This is an important research area because it is reported that deaths of women due to pregnancy related causes account for the majority of deaths that occur to adult female population. Researchers are interested in maternal health because of its influence on maternal mortality, as an indicator of the success of maternal health programs and as an explanation for sex differentials in mortality. Research has shown that adequate use of antenatal and delivery services can reduce maternal deaths by 10 to 45 percent, especially in the developing countries where maternal mortality is highest (WHO, 1997). The study seeks to identify factors that influence the use of various maternal health care services in Nepal. There is inadequate information at present regarding the level of utilization of maternal health services. Similarly, the factors that affect the utilization of the services have not been identified and are poorly understood.

The study is useful for Nepal because if the factors influencing maternal health service use are established, appropriate strategies can be devised to enhance the use of maternal care services in the country. That way, maternal morbidity and mortality could be reduced. The concern with prevention of early death, hence a prolonged healthy life for women is part of the International Safe Motherhood Initiative of 1987, which Nepal endorsed. Furthermore, the Cairo International Conference on Population and Development (ICPD) of 1994 placed a lot of emphasis on reproductive health, of which safe motherhood is a component. Nepal has adopted the plan of action on reproductive health. The government recognizes the right of access to appropriate health care services that will enable women to go safely through pregnancy and childbirth and provide couples with the best chance of having a healthy infant.

1.5 Objectives of the Research

The general objective of this study is to analyze factors associated with the utilization of health care services, which influence the use of maternal health care services in Nepal. The general objective can be translated into the following specific objectives

- To describe the utilization of maternal health care services specifically antenatal and delivery services.

- To estimate the effect of socio-economic and demographic factors on utilization of institutional delivery.
- To estimate the effect of socio-economic and demographic factors on utilization of assistance during delivery.
- To estimate the effect of socio- economic and demographic factors on utilization of number of ANC visit
- To estimate the probabilities of institutional delivery using some selected independent variables.

1.6 Limitation of the Research

Since the NDHS data do not have information on access to health services and cost associate with use of services, we were unable to control for supply factors such as proximate of health facilities or presence of profession providers. Furthermore, the utilization of maternal health services influenced by physical availability of services, distance or time to health facility, transportation in services and respondent's beliefs concerning health care practices, which have not been covered.

Further the analysis did not take into account factors related to complications during the current pregnancy and difficulties encountered during previous childbirth which may influence the decision about preferred place of delivery.

CHAPTER 2: LITERATURE REVIEW

This chapter presents a critical review of the literature on impact of socio-economic and demographic variables on maternal health service utilization. Relevant studies in both developing and developed countries are reviewed which particularly emphasize on the findings and methodological issue in developing countries. This review of previous literature focuses on peer reviewed articles and will include reports from population based cross sectional surveys and cohort studies of maternal health and their determinants. The review of the determinants focuses on non-clinical factors, covering socio-economic and demographic factors. First the title and abstract of the paper was examined and then full texts of relevant articles were subsequently retrieved for further assessment. In the process, many study reports and research papers utilizing statistical models in this area have been reviewed. In addition books, reports, statistics in Nepal and other countries reporting national wide studies were also included.

Studies have pointed out that the utilization of maternal health services is a complex behavioral phenomenon. Empirical studies of preventive and curative services have often found that use of health services is related to the availability, quality and cost of the services, that will undoubtedly influence on individual's decision. Other factors, such as the social structure, health belief and personal characteristics of the users and the community are also determining factors. (Anderson & Newman, 1973; Kroeger, 1983; Becker, Peters, Gray, Gultiano, & Blake, 1993; Sarin, 1997)

The health behavior model proposed by Anderson (1995) is composition of three main set of characteristics namely predisposing, enabling and need. The predisposing include demographic factors (age, sex, number of children, residence etc.) and social characteristic (education, religion, wealth index etc.). The enabling characteristics are those that may promote the use of the health care facility which include knowledge of and access to modern health care. The third set of characteristic (need) includes perception of the severity of an illness and is therefore stimulus to utilize health care services. Regarding Anderson's behavior health model, people must consider the problem, understand about health threatening situation and make decision on behavior change (Anderson R, 1995).

There has been considerable debate in the literature as to whether the mere provision of health services will lead to increase utilization? (Magadi, Madise, & Rodrigues, 2000; Obermeyer M, 1993; Becker et al, 1993) Provision of services may not be enough, as people will not make use of the available services if they do not have the perceived need to use them. Therefore, it has been argued that utilization of health services is affected not only by access but also by demand for services. People must be made aware of the importance and benefits of using such kind of services. Hence even after controlling for the availability of resources, some women are more likely to use maternal health services than others. This suggests that characteristics of health services may not be the only explanatory factors. Therefore the present study will examine the impact of socio-economic and demographic characteristics to explain why some women are more likely to use maternal health services during pregnancy while others are not. Hence this study will examine the socio-economic and demographic characteristic while controlling the accessibility factor.

The Millennium Development Goal also focused on improving maternal health with a target of reducing maternal mortality ratio by three quarters between 1990 and 2015, an annual reduction of 5.4 percent (Wagstaff & Claeson, 2004). Progress towards these goals, however is surprisingly low and insufficient, especially in Nepal for various reasons. Hence identification of factors which impact the low utilization of maternal health care services is pivotal in formulating evidence based policy so that it will reduce MMR fast. Different factors affect utilization of maternal health care services. Socio-economic and demographic factors are among those strong factors that influence individual personality. The details are described in the following sections.

2.1 Socio-Economic Factors

Socio economic factors have great influence on maternal health care services use. The socio economic status of an individual and her household determines her economic ability to do so (Stephenson & Tsui, 2002). The literature is paying increasing attention to the issue of women's status because empirical research worldwide consistently finds that variables related to women's status are negatively correlated with fertility, maternal health and mortality (Sen & Batiwala, 2000). There is a general consensus that women's status has is an important determinant of

reproductive behavior and maternal health, especially in place where the status of women varies considerably as in case of Nepal. Socio-economic factors have been shown to be a greater importance than demographic factors in influencing maternal health service utilization. Although demographic factors may shape a women's desire to make use of maternal health service, the socio-economic status of an individual and her household determines economy ability to do so (Stephenson &Tsui, 2002).

In a study from Nepal, household economic status in particular was found to be an important factor associated with utilization of maternal health care services. This can be explained by the ability to pay for services by economically well off groups but the fact that there was a significant relationship after controlling for other factors like place of residence suggested that the richest groups differ from their poor counterparts by more than just dispensable income (Gubhaju, 2001).

The mechanism through which education operates to affect the decision to use health services is not well understood. However it has been hypothesized that education affects individuals by introducing them to a new modern culture (Caldwell, 1979). Education affects women's knowledge and knowledge itself produce the change of women's behavior that relates to utilization of maternal health care services (Hogan, Berhanu, & Hailermariam, 1999). Many studies pointed out the influence of education on utilization of maternal health services (Obermeyer M., 1993; Bhatia & Cleland, 1995; Bloom, Wypij, & Gupta, 2001; Elo, 1992; Anson, 2004). Research in developing country has consistently shown education to be strongly and significantly associated with utilization of maternal health services (Govindasany & Ramesh, 1997; Kamal, 2009; Munsur, Aia, & Kawahara, 2010). Niraula (1994) also reported that women who had attended school for a few years are more likely to use the health services than women without schooling (Niraula, 1994). According to Celik and Hotchkiss (2002), education of women to significant predictor of greater utilization of health services (Celik & Hotchikiss, 2002).

Chakraborty et. al. (2003) examined the factors associated with the use of maternal health services in the Bangladesh on the basis of data from a survey of maternal morbidity in Bangladesh. The results from both the bivariate and multivariate analysis confirmed the importance of mother's education and in explaining the utilization of the maternal health services. It showed that women with sec/higher education are

almost 0.8 percent (95% CI=1.12-3.04) likely to delivery at health institute as maternal health services compared to no education. In this study, Women from families in good economic condition are more likely to delivery at health institute. However, the positive impact of higher economic status on health care use was not found to be statistically significant (OR=0.025, 95% CI=0.67-1.57) (Chakraborty, Islam, Chowdhury, Bari, &Akhter, 2003).

In another study, Becker and colleagues (Becker et al., 1993) using logistic regression model found mother's education to be the most consistent and important determinant of the use of child and maternal health services. Similar study conducted using EDHS data of 2005, by the Ethiopian Society of Population Studies (2008), indicated female education retains a net effect on maternal health service use, independent of other women's background characteristics, households, socioeconomic status and access to health care services (EDHS, 2005).

Some researchers however question the strong independent effect of education on maternal health service utilization. They argue that other factors such as place of residence, husband's education level, socio-economic status etc. interact to dilute this strong association (Raghupathy, 1996; Gage &Calixte, 2006). Magadiet. al. (2000) found no evidence association between maternal education and use of maternal health services after controlling other variables. Authors found bivariate relationship between maternal education and use of maternal health services but the relation disappeared in the multivariate analysis (Magadi, Madise, & Rodrigues, 2000). Another consistent finding, Rosenzweiz and Schultz (1982) reported that education of mother to be less significant to use maternal health services.

Some studies also revealed that effect of education may not be constant across all level of education. In a study in Thailand, Raghupathy (1996) reported that among the three schooling categories- Primary, secondary and higher education. Secondary education was found the most likely predictor of utilization of maternal health services (Raghupathy, 1996).

Contradictly, Shiffman (2000) suggested that higher wealth index is not a necessary condition for maternal mortality reduction (Shiffman J, 2000). Similarly, Shariff and Singh (2000) revealed that wealth index was not a significant determinant of the maternal health service utilization (Shariff & Singh, 2000). Surprisingly in many

developing countries women are less likely to use maternal health services from the health services, even when they are provided free of charge (Rahmann et. al., 2000; Sesia, 1996)

Letamo, G and Serai, D investigated individual and household factors associated with non-use of maternal health services in Botswana. The study investigated whether the women had an institutional delivery, had a prenatal checkup and had a qualified delivery assistant. Data for the study were derived from the 1996 Botswana Family Health Survey (BFHS). Descriptive statistics and logistic regression were used for evaluating the relationship between a group of predictor variables and probability for non-use of certain health care services. In this study, urban-rural status of women displayed significance effects on pattern of non-use of maternal health services, even after controlling for age, parity, education and socio economic status. Rural women were more than twice likely to have a non-institutional delivery and no antenatal check-up as compared to urban women (OR=2.06, 95%CI=1.85-2.30)(Latemo, 2003).

Economic status has recently been described by using Demographic Health Survey Data to classify women into quintile group according to household wealth. Wealth is measured by means of an asset score that is based on principle component analysis on more than forty asset variables: durable consumer goods, housing facilities and housing materials, hence wealth index is to be found as an important indicator of access to health care services. Wealth index of the household as a determinant of use of maternal health service is also important, since it reflects the ability of the household to pay for the cost that are associated with using maternal health services(Gwatkm, Rutslen, & Johnson, 2000).

Many studies reported that increased income positively affects utilization of health care services (Elo, 1992; Chakraborty, Islam, Chowdhury, Bari, &Akhter, 2003). Women from poor wealth index may have difficulty in paying for household cost and are less likely to use maternal health services. (Gabrysch & Campbell, 2009) Studies also indicate that women, whose husband has higher status occupation, are more likely to use maternal health services. This is because such occupation is usually associated with greater wealth, making it easier to bear the cost of health care. A study in Nepal has shown that women are less likely to use maternal health services, when they do not have personal control over finance (Gage & Calixte, 2006; Fruta &

Salways, 2006). It suggests that an interaction between autonomy and family wealth index produces maternal health service utilization.

Women's economic opportunity in providing for the family measured by their involvement in gainful or paid employment, type of occupation and status of work also affects their health and health seeking behavior. This might empower women and they will have increased control over income and on decision making concerning their health. As a result they will have increased health seeking behavior leading to improved maternal health (Gill, Pande, & Malhotra, 2007).

It is generally assume that when women are employed and earn cash for their work, they are less dependent on their husband and financial ability to pay for services. However it must be pointed out that for a large population in developing countries, employment does not always involve cash income or women have no control over their own earning (Fruta & Salways, 2006). This is also the case in Nepal where the majority of women are employed in the agricultural sector as unpaid worker.

Another study in Nepal, Sharma et. al. (2007) revealed that non-working women are better than working women. In the context of developing countries, women's work is largely poverty induced and is likely to have a negative impact on utilization of maternal health services (Sharma, Sawangde, & Sinirassamme, 2007). Although employment in general case increase the women's awareness to the outside world. Studies have presented mixed result in the association between employment and maternal health service utilization. In some region of the world, it has been found that non-working women are more likely to use maternal health services than earning women (Kamal, 2009).Some studies also indicated that women engaged in low grade occupations are less likely to use maternal health. On the other hand employment may also pose physical exhaustion and in some cases employed women may not have the time to go to health services this may have a negative effect on use of the services (Gubhaju, 2001; Gill, Pande, & Malhotra, 2007).

Bloom,S; Lippeveld, T; and Wypij, D., 2001 investigated that does ANC make difference to safe delivery?, study in urban Uttar Pradesh. They introduced a new measure for antenatal care utilization, comprised of 20 input component covering care content and visit frequency, weights for each component reflect its relative importance to better maternal and child health, and were derived from a survey of international

researchers. This composite measure for ANC utilization was studied in a probability sample of 300 low to middle income Varanasi, Uttar Pradesh, India. Results showed that demarcating women's ANC status based on simple indicators – two or more visit less make a large amount of variation in care received. After controlling the relevant socio- demographic and maternity history factors, women with a relatively high level of care (at the 75th percentile of the score) had an estimated odds of using trained assistance at delivery that was almost four times higher than women with a low level of care (at the 25th percentile of the score) (OR=3.97, 95% CI=1.96-8.10). Similar results were obtained for women delivery in health facility versus at home. This strong positive association between level of care obtained during pregnancy and the use of safe delivery care may explained why ANC could also be associated with reduced maternal mortality.

2.2 Demographic Factors

Various studies in the literature indicate an association between factors such as age, religion, Parity, residence to utilization maternal health services (Chakraborty et. all, 2003; Babolola & Fatusi, 2009; Ideako, Onah, & Iloabachie, 2006; Idris, Gwarzo, &Shehu, 2006; Awusi, Anyanwu, & Okeleke, 2009).

Utilization of maternal health services is highly influenced by maternal age. Magadiet. al., (2000) also identified the significant association between maternal age and maternal health services. There is however some debate on women's age regarding use of maternal health services. Some studies found positive correlation with older age (Gerlter, Rahaman, & Fiefer, 1993; Glei & Goldman, 2003; Burgard, 2004; Reynolds, Wong, & Tucker, 2006). Possible explanation for high use of maternal health services by older women may be the fact that women in this cohort are generally more experienced and knowledgeable about health care services. While other found a curvilinear relationship (Gage A., 1998). A negative relationship between the utilization of health care and age of women was found in a study in Central Nepal (Niraula, 1994). The young women were more likely to seek maternal health services than old ones. This result is consistent with the finding in a Comparative Analysis of the use of maternal health services between teen ages and older mothers in Sub-Sahara Africa (Magadi, Agwanda, & Obare, 2007). Another study in Nepal revealed that women over the age 35 are less likely to utilize antenatal

care service but more likely to utilize delivery and postnatal health care (Sharma, Sawangde, & Sinirassamme, 2007).

Many studies found that the residence of mother correlates significantly with their use of maternal health services (Obermeyer & Potter, 1991; Mekonnen, 2003; Magadi, Madise, & Rodrigues, 2000). Bhatia and Cleland (1995) also revealed that urban rural differential in the health service utilization and argued that urban rural residence is also an indicator of geographical proximity to service (Bhatia & Cleland, 1995). Large differences in the utilization of maternal health services among many regions were found in a study conducted by Elo (1992) in Peru (Elo, 1992). Contrary to above finding, Mondal (1997) found that the place of residence did not emerge as a significant factor in explaining the difference in service utilization after controlling all other variables (Mondal, 1997). This result is consistent with the finding of Celik and Hotchkiss (2000) that urban/rural living status of women did not emerge as statistically significant role on maternal health service utilization after controlling other variables (Celik & Hotchikiss, 2002). In short, residence of women was significantly associated with the use of maternal health services.

Parity, the number of children ever born, is strongly associated with utilization of maternal health services. There are many studies that have investigated the relationship between the number of living children of a mother and use of maternal health care services (Magadi, Madise, & Rodrigues, 2000; Mekonnen, 2003; Anson, 2004; Rehmann et. al. 1997; Celerik & Cleland 2000). Studies show that low parity women are consistently more likely to use maternal health services than high parity group (Bell, Siam, Curtis, & Silvia, 2003). High parity women are less likely to use maternal health services due to great confidence and cumulative experience. More-ever, having a large number of children may cause resource constraints, which has been found to be negative associated with maternal health service utilization (Chakraborty, Islam, Chowdhury, Bari, & Akhter, 2003; Wong, Popkin, Guilkey, & Akin, 1987). Similarly, among women with more surviving at the time of their pregnancy were less likely to use maternal health services than among others (Bloom, Wypij, & Gupta, 2001). Contradict, the number of living children and maternal health services was reported as a positive association in a study about care seeking behavior in Bangladesh by Rahmann et.al., 1997. The author argued that women with high

parity understand the high risk of pregnancy related complication and are more likely to go for maternal health care services (Rahman et. al., 1997).

In summary, the strong influence of women's education on the utilization of maternal health care services is consistent with findings from other studies. Women's education may also act as a proxy variable of a number of background variables representing women's higher socioeconomic status, thus enabling her to seek proper medical care whenever she perceives it necessary. Many Studies also showed that women in households with the lowest wealth index are less likely to seek maternal health care services than women in households with middle wealth quintile. The probability of seeking health care services is higher among women at the household with the highest wealth index. A study in over 50 countries showed that on average more than 80 percent of births were attended for the richest women compared with only 34 percent of the poorest women (Gill, Pande, & Malhotra, 2007). Most studies use approximations for the household living standard, because survey data do not include full information on household income and/or expenses. These approximate indicators differ by study and can include the occupation of the pregnant women, her husband's education level and his occupation, the ownership of durable goods, and household amenities such as water source and toilet facility.

Studies indicate that religion is negatively associated with the use of some maternal healthcare services but shows no significant difference for others. The place of residence is an important factor affecting maternal healthcare services utilization. Urban women were more likely to receive assistance of health professional than rural women. In general rural women are less likely to give birth in health facility than their urban counterparts. The importance of place of residence in determining women's use of maternal health care can be explained through the availability of health facilities. It is undeniable that generally, medical facilities are more ready accessible in urban than in rural areas. In addition, urban women tend to be more educated and therefore, have greater knowledge about the benefits of maternal health care.

As a result of the contextual differences in women's employment, studies have presented mixed results in the association between employment and maternal healthcare services utilization. Several studies have found a positive association between maternal healthcare services use and women's formal employment

suggesting that the capacity to earn could contribute to maternal healthcare services utilization through empowerment. On the other hand, in some regions, it has also been found that non-employed women are more likely to use some maternal healthcare services than earning women. In the context of developing countries, women's work is largely poverty induced and is likely to have a negative impact on utilization of maternal health services (Sharma, Sawangde, & Sinirassamme, 2007).

Even though many studies have been conducted at different parts of the world to establish the quantitative association between use of maternal health services and socio economic factors, such studies have been very few in Nepal.

2.3 Statistical Methods in Associating MHCS and Predictors

The statistical tools employed ranges from simple descriptive statistics to inferential statistics and statistical modeling. The objective is to evaluate whether there is association between use of maternal health services such as place of delivery, assistance during delivery and frequency of ANC visits with socio-economic and demographic factors. The commonly used technique is multiple regression analysis. The use of appropriate statistical tools for associating use of maternal health services with predictors depends upon nature of study designs used in studies. In order to model nonlinearity between the response and explanatory variables, logistic regression model has been often used. Logistic regression model has been extensively used since it has dichotomous variable as response variable. In dichotomous response variable, odd ratios are computed through logistic regression modeling. If the response variable has more than two categories, multinomial logistic regression has been used. Similarly, if the response variable has more than two categories and in order form, ordinal logistic regression has been used. Even though many studies have been conducted to establish the quantitative association between use of maternal health services and socio economic factors by using logistic regression model, few studies have been used multinomial and order logistic regression model.

Elo (1992) using logistic regression model finds positive and significant associations between antenatal care use and several living standard indicators including the husband's education level and his occupation, the use of piped water and ownership of several household durables (Elo, 1992).

The study conducted by Becker and his friends, use several indicators to estimate logistic regression model but only find a significant association with the husband's education level and the ownership of a radio or television (Becker et. al., 1993).

McCaw-Binns and his friends also using logistic regression model report positive associations between antenatal care use and the occupation of the woman and of the main wage earner in the household (McCaw-Binnas & Ashley, 1995).

A study carried out in urban Uttar Pradesh India was studied in a probability sample of 300 low to middle income women who had given birth within the last three years. Logistic regression were conducted to examine the effect of antenatal care utilization on the likelihood of using safe delivery care, a factor known to decrease maternal mortality. Results showed that demarcating women's antenatal care status based on a simple indicator –two or more visits verses less masked a large amount of variation in care received. After controlling for relevant socio demographic and maternity factors, women with a relatively high level of care (at the 75^{th} percentile of score) had an estimated odds using trained assistance at delivery that was almost four times higher than women with low level of care (at the 25^{th} percentile of care) (OR=3.97, 95% CI=1.96-8.10). Similar results were obtained for women delivering in a health facility versus at home (Shelah & Theo, 1999).

A study in Nepal investigated to establish the relative importance of service access and quality on utilization of preventive health services in the western and middle hill region of Nepal. In order to estimate the effects of services access and quality on uptake of services, multilevel logistic regression was used. Multi-level was required because data are available at three levels of aggregation: health post, cluster and household and individuals (Aitken & Longford, 1986). After adjustment for access and for socio-economic characteristic of families and communities, a very pronounced relationship between overall structural quality of nearest health post and service uptake persisted (Acharya & Cleland, 2000). Another study from Nepal using logistic regression model showed that household economic status in particular was found to be an important factor associated with utilization of maternal health care services. This can be explained by the ability to pay for services by economically well off groups but the fact that there was a significant relationship after controlling for other factors like place of residence suggests that the richest groups differ from their

poor counterparts by more than just dispensable income (Matsumura & Gubhaju, 2001).

A study carried out in Botswana to investigate individual and household factors associated with non-use of maternal health services. Descriptive statistics and logistic regression were used for evaluating the relationship between a group of predictors and the probability for non-use of maternal health care services while controlling for other variables in the model. Using result from logistic regression analysis, it can be observed that low parity women less likely to use maternal health services. Another consistent finding is that women with low education level, those residing in areas and those with low socio-economic status were less likely to use maternal health services (Latemo, 2003).

A study conducted by Chakraborty and his friends is made to examine the factors associated with the use of maternal health services in Bangladesh on the basis of data from a survey of maternal morbidity conducted by the Bangladesh Institute of Research for Promotion of Essential and Reproductive Health and Technologies (BIRPERHT). Multiple logistic regression model has been used to estimate predisposing and enabling factors. The results from both the bivariate and multivariate analysis confirmed the importance of mother's education in explaining the utilization of maternal health care services. Women's age, number of previous pregnancies and access to health facilities do not have significant on the use of maternal health services (Chakraborty, Islam, Chowdhury, Bari, & Akhter, 2003).

A study conducted by Thind and his friends is made to examine the determinants of home, private and public sector utilization for a delivery in a Western state of India. Multinomial logistic regression analyses was conducted to assess the association of predisposing, enabling and need factors on use of home, public or private sector for delivery. Results showed that, majority delivered at home (n=559, 37%); with private and public facility deliveries accounting for 32 percent (n=493) and 31 percent (n=454) respectively. For the choice set of home delivery versus public facility, women with higher birth order and those living in rural areas had greater odds of delivering at home, while increasing maternal age, greater media exposure, and more than three antenatal visits were associated with greater odds of delivery in a public facility. Maternal and paternal education, scheduled caste/tribe status, and media

exposure were statistically significant predictors of the choice of public versus private facility delivery (Thind, Mohini, & Banerjee, 2008).

A study in Nigeria, aimed at modeling a categorical response i.e., pregnancy outcome in terms of some predictors. An ordinal logistic regression model was used as a tool to model the three major factors viz., environmental (previous cesareans, service availability), behavioral (antenatal care, diseases) and demographic (maternal age, marital status and weight) that affected the outcomes of pregnancies (live birth, stillbirth and abortion). The fit, of the model was illustrated with data obtained from records of 100 patients at Ijebu-Ode, State Hospital in Nigeria. The tested model showed good fit and performed differently depending on categorization of outcome, adequacy in relation to assumptions, goodness of fit and parsimony. Result showed that weight and diseases increase the likelihood of favoring a higher category i.e., (live birth), while medical service availability, marital status age, antenatal and previous cesareans reduce the likelihood/chance of having stillbirth (Adeleke & Adepoju, 2010).

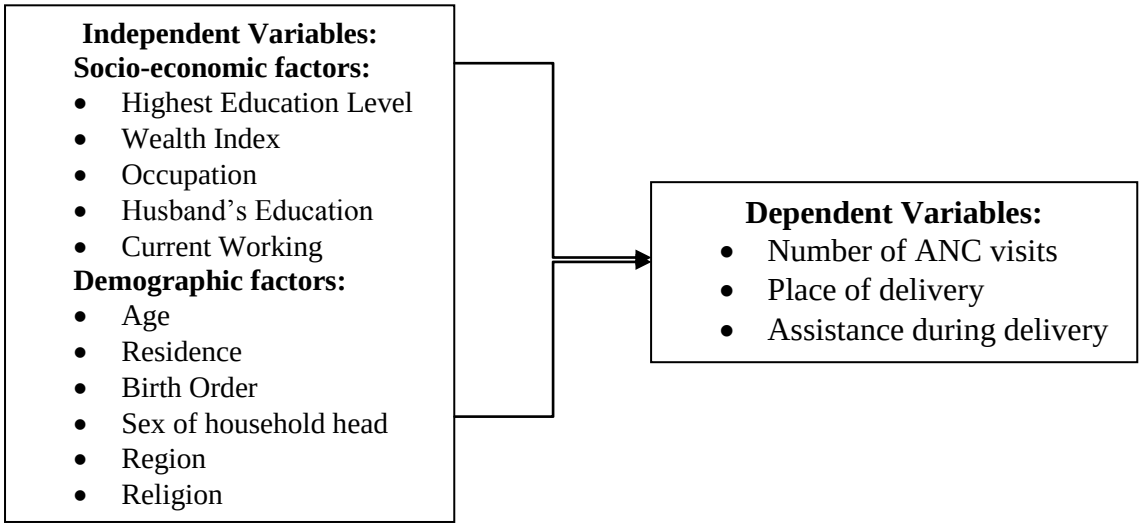
To summarize, this brief literature review in methods to establish the quantitative association between use of maternal health services and socio-economic and demographic factors, most of the studies have restricted in using logistic regression model. Most of the studies have restricted in using simple descriptive measures. Moreover, the use of statistical modeling and the tools in the analysis have been scare.

2.4 Conceptual Framework

The conceptual frame work takes into consideration that for the maternal health care services, the decision to use maternal health services is often perceived as one of the individual choice. The forgoing literature review has demonstrated that most studies found a significant relationship between the availability and accessibility of health service with increased utilization of the health service. However studies have also demonstrated that there are difference in utilization, even in communities that have similar availability and accessibility of maternal health services. Reviews of literature suggest that in developing countries the use of health service can be explained from two perspectives: socio-economic and demographic explanation.

The frame work is not designed to test any formal theory of maternal health seeking behavior. Nevertheless, each of the independent variable selected for inclusion in the study is based on a review of the existing literature on the subject and the availability of information in the NDHS 2006 and NDHS 2011. The accessibility of the health facilities will be used as control variable.

Figure 3: Conceptual Framework of the Study MHCS



The conceptual frame work describe socio-economic and demographic characteristic (independent variables) that may have an impact on the level of maternal health services.

2.5 Research Questions

The present research on impact of socio-economic and demographic variables on maternal health has attempted to address the following research questions:

a. How do Socio economic characteristic such as education, wealth index, occupation, currently working status, husband's education impact the maternal health services?

b. How do demographic characteristic such as age, religion, region, sex of household head and residence impact the maternal health services?

CHAPTER 3: METHODOLOGY

The objective of this study is to examine the impact of socio- economic and demographic Variables on the maternal health care service utilization of women in Nepal using data from a secondary source. Maternal health is conceptualized as a comprehensive component consisting socio-economic and demographic inputs. Data source and operationalization of dependent variable and independent variable, and method of data analysis will be discussed in this chapter.

3.1 Data

The data for this study is chosen from the Demographic Health Survey (DHS), 2006 and 2011 of Nepal. The 2006 Nepal Demography Health Survey (NDHS) is third comprehensive survey conducted in Nepal as part of the world wide DHS project. The data set is nationally representative cross sectional survey designed to provide information on topics related to fertility levels and determinants, family planning, fertility preferences, infant, child, adult and maternal mortality, maternal and child health, nutrition, knowledge of HIV/AIDS and women's empowerment. The survey was conducted to determine on the respondent's backgrounds characteristics (age, education, religion etc.); reproductive history, knowledge and use of family planning methods; antenatal and delivery care; breast feeding; vaccinations and health of children under age of three, marriage, fertility preferences, husband's background; and respondent's work.

The NDHS 2006 used the sampling frame provided by the list of census enumeration areas with population and household information from the 2001 population census of Nepal. Each of 75 districts in Nepal is subdivided five administrative divisions; village development committees (VDC's), and each VDC's into wards. The primary sampling unit (PSU) for the 2006 NDHS is a ward, sub ward or group of wards in rural areas, and sub ward in urban areas. The sample for the survey is based on two stages stratified, nationally representative sample of households. At the 1st stage of sampling 260 PSU's (82 in urban areas and 178 in rural areas) were selected using systematic samplings with probability proportional to size (PPS). A complete household listing operation was then carried out in all the selected PSU's to provide a sampling frame for the 2nd stage selection of households. At the 2nd stage of sampling

systematic samples of about 30 households per PSU on average in urban areas and about 36 households per PSU on average in rural areas were selected in all regions, in order to provide statistically reliable estimates of key demographic and health variables.

Similarly, the 2011 Nepal Demography Health Survey (NDHS) is the fourth comprehensive survey conducted in Nepal as part of the world wide DHS project. The survey includes topics on fertility levels and determinants, family planning, fertility preferences, childhood mortality, children and women's nutritional status, utilization of maternal and child health services, knowledge of HIV/AIDS and STI, women's empowerment and for the first time, information on women facing different type of domestic violence. The survey also represents the anemia status of women age 15-49 years. A total of 12,826 women age 15-49 years were identified as eligible for the individual interviewed.

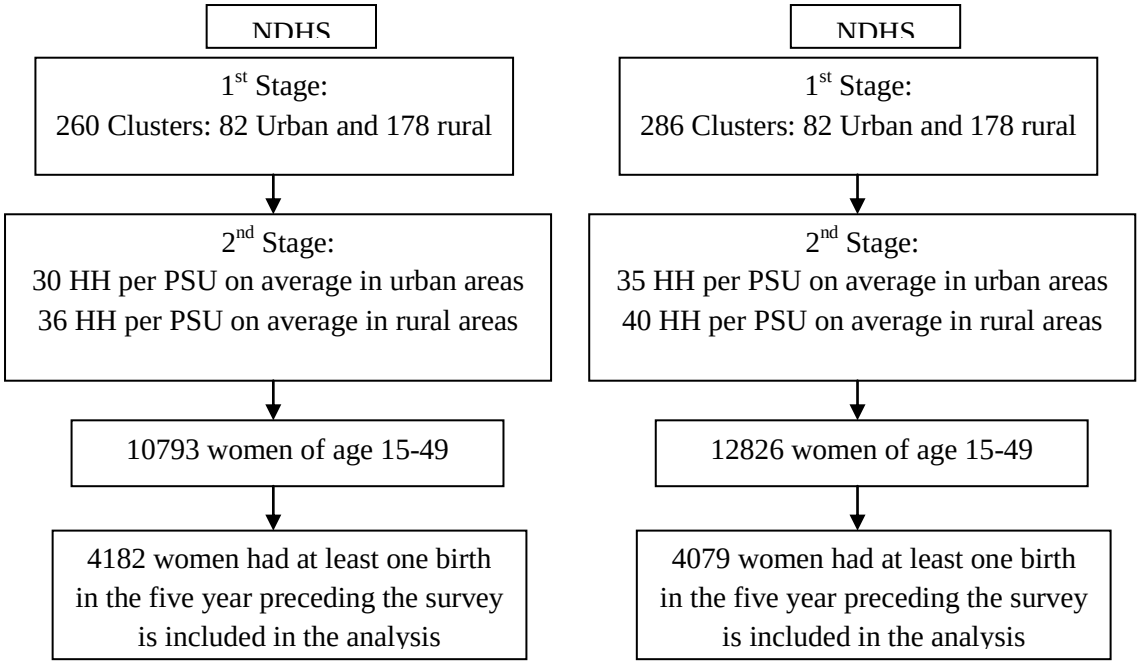
The 2011 NDHS use the list of enumeration areas with population and household information developed by the Central Bureau of Statistics (CBS) for 2001 population census. The long gap between the 2001 population census and the fielding of 2011 NDHS necessitated an updating of the sampling frame to take into account not only population growth but also mass internal and external migration due to the ten years political conflict in the country. Samples were selected independently in each stratum through a two stage selection process. The primary sampling unit (PSU) for the 2011NDHS is a ward, sub ward or group of wards in rural areas, and sub ward in urban areas. The sample for the survey is based on two stages stratified, nationally representative sample of households. At the 1st stage of sampling 286 PSU's (92 in urban areas and 194 in rural areas) were selected with probability proportional to size (PPS). A complete household listing operation was then carried out in all the selected PSU's to provide a sampling frame for the 2nd stage selection of households. At the 2nd stage of sampling systematic samples of about 35 households per PSU on average in urban areas and about 40 households per PSU on average in rural areas were randomly selected in all regions, in order to provide statistically reliable estimates of key demographic and health variables.

The unit of analysis for both studies is Ever Married Women (EMW) who had at least one live birth in the five year preceding the survey. For those EMW, who had more

than one birth, only utilization behavior of maternal health services associated with most recent pregnancy within five years was considered, so the sample of this study consists of 4182 EMW for 2006 NDHS and 4079 EMW for 2011 NDHS. The sample was selected with the rationale that mothers would most accurately be able to recall the utilization behavior of their pregnancy that occurred within the past years. Since the sample drawn was a nationally representative sample, result from the study can be inferred to the national situation regarding MHCS issues in Nepal.

Permission to use the data was obtained from ORC MACRO, the agency which provided technical support for the survey through MEASURE DHS Project. The entire raw data set obtained for NDHS 2006 and 2011 is freely available for all interested researcher at the ORC MACRO website address: http://www.macro.int.com. The data set was downloaded from ORC MACRO website. The following flow chart shows the data generation process.

Figure 4: Flow Chart of Data Generation Process for NDHS 2006 and NDHS 2011



3.2 Variable Description

3.2.1 Dependent Variables

For the purpose of this study, three Maternal Health Care Services' (MHCS) were selected as dependent variables. These dependent variables were created from questionnaires included in the maternal health component of the DHS questionnaire. These include frequency of ANC visits, place of delivery and assistance during

delivery. As noted in the literature review, majority of maternal deaths and disabilities occur around the time of delivery. For this reason, Delivery care (represented by place of delivery and assistance during delivery) was selected as dependent variable. Antenatal care was selected as dependent variable, since its importance as proxy to the early detection of complication has been demonstrated in the literature.

This study used two indicators of delivery care and one indicator of antenatal care as dependent variable. Antenatal care is more beneficial in preventing adverse pregnancy outcomes when it is sought early in the pregnancy and continued through to delivery. Health professional recommended that the 1st ANC visit should occur within the 1st three month of pregnancy and continued on a monthly basis through the 28 week pregnancy and up to 36 weeks (or until birth). More ANC visits should be able to identify women at risk for obstetric care complications and offer appropriate care or referrals. The WHO recommended 4 or more ANC visits as optimum number of visits for those with uncomplicated pregnancy therefore, the frequency of ANC visits is taken as indicator of antenatal care and categorized into three levels as no ANC visit, some visit (1-3 visits) and adequate visit (4 or more visits). This classification was used to assess use of services in most analysis using DHS (Mpembeni, Killewo, Leshabari, Massawe, John, & Mushi, 2007). As an indicator of delivery care, the study accessed place of delivery and assistance during delivery. The place of delivery was collapsed to create a dichotomous variable on the basis of whether the woman delivery at health institution or home. Next indicator assistance during delivery is categorized into three levels as assistance during delivery by no one, by unskilled birth attendant and skilled birth attendant (SBA).

Table 3: Description of Dependent Variables

Variable id	Variables	Description
1	Place of delivery	The variable is a dichotomous variable indicating whether the place of delivery was at home or health institution. The health institution includes all type of facilities in government/ private hospitals/hospital running by NGO's/clinics/ centers or other health institutions. Delivery at home includes respondent's home or others(non-health institutions)
2	Assistance during delivery	This is trichotomous variable indicating the type of assistance received during delivery. Assistance received from a doctor, nurse/midwife is considered as skilled birth attendant. MCH workers/VHW/TBA as unskilled birth attendant and relative/friend/ no help is considered as no utilization of assistance at delivery.
3	Number of ANC visits	In the primary survey, the variable "Number of ANC visits" was recorded as 1,2,3,4,5until 12, which was the last number. In this

Variable id	Variables	Description
		study, the variable is classified as No ANC visit-0, 1-3 ANC visits-1 and 4 or more ANC-2, to meet the WHO standard and national recommendation of at least 4 ANC visits.

3.2.2 Independent Variables

A number of independent variables are taken into account based on scientific literature review of both socio-economic and demographic variables. The independent variables are mixture of categorical and continuous variables and basic description are presented in Table 4. It also presents the information on how the variables are recoded.

Table 4: Description of Independent Variables

No.	Variable	Option	Recoded
	Current age of respondent(X_1)	15-49 years	
1	Region(X_2)	1-Eastern 2-Central 3-Western 4-Mid western 5-Far western	4,5=0 1,3=1 2=2
2	Residence(X_3)	1=Urban 2=Rural	2=0 1=1
3	Education level(X_4)	0=No education 1=Primary 2=Secondary 3=Higher	0=0 1=1 2,3=2
4	Religion(X_5)	1=Hindu 2=Buddhist 3=Muslim 4=Kirant 5=Christian 6=Others	1=0 2-6=1
5	Sex of household head(X_6)	1=Male 2=Female	2=0 1=1
6	Wealth index(X_7)	1=Poorest 2=Poorer 3=Middle 4=Richer 5=Richest	1=0 2=1 3=2 4=3 5=4
7	Birth in last five years	1 to 5	1=0 2=1 ≥3=2
8	Respondent currently working	0=No 1=Yes	

No.	Variable	Option	Recoded
9	Husband's education	0=no education 1,2,…,13, 14 class	0=0 1-10=1 11-14=2
10	Occupation	0=Not working 1=Prof;Tech; Managerial 2=Clerical 3=Sales 4=Agri. self employed 5=Agri. employee 6=Household and domestic 7=Services 8=Skilled manual 9=Unskilled manual 98=Don't know	0=0 4,5,6,9=1 1,2,3,7,8=2
11	ANC by provider	1=Doctor 2=Nurse/ Midwife 3=Health assistance 4=MCH worker 5=TBA 6=VHW 7=Others 8=FCHV 9=No one	9=0 3-8=1 1-2=2

Age

Women aged from 15-49 were chosen to take part in a survey. For this study, age of the respondent is continuous variable. Age will be determined as complete years of the respondent at the time of interview.

Region

The region of residence will be used as an indicator for availability of services. Region not only locates in different geographical areas but it also reflects difference in socio-economic context. The more developed the regions, the more coverage of health services and less developed adverse health outcomes they have. Nepal is divided into five development regions. They are Far western development region, Mid-western development region, Western development region, Central development region and East development region. Based on statistics provided by the department of health services, the five development region are categorized as region of scare facilities (Mid-western and Far western), region with moderate facilities (Easter and Western) and region with adequate facilities (Central).

Residence

This variable is used as a proxy indicator for the accessibility and availability of maternal health services. Services are more accessible for women residing in household of urban areas compared to rural areas. This is a dichotomous variable (urban and rural), according to where the woman was living at the time of the survey. It was coded as 0 for rural and 1 for urban.

Education Level

The education variable measured the level of education that a woman has completed. The variable has been re categorized as no education, primary, secondary and higher. The rationale for such a categorization is that the number of women who have completed secondary or higher level of education is considerably small to be treated as separate categories, therefore secondary and higher education level is merged.

Religion

The impact of religion in maternal health care services utilization lies in the fact that it plays a significant role in shaping, beliefs, norms and values that relate to child birth and utilization of maternal health services. This variable categorized the religion of the respondent. There are six categories (Hindu, Buddhist, Muslim, Kirant, Christian and others) in NDHS 2006 and NDHS 2011. It is recoded into binary variable as Hindu and others. The rationale for such categorization is that the majority of women in Nepal are Hindu (87 percent) (NDHS 2006) and rests are merged into other category similarly for 2011 NDHS, 85 percent women are Hindu and rest are merged into other category.

Sex of Household Head

It is classified as male or female. Based on the answer from the usual residents of the household on who the household head is.

Wealth Index

The wealth index variable needs further explanation. It is a composite variable created from the number of variables. Information on the wealth index was based on the data collected in the household questionnaire included questions concerning the household's ownership of the number of consumer items such as television and car;

dwelling characteristics such as flooring material; type of drinking water sources; toilet facilities and other characteristics that are related to wealth status. Each household, for which information collected, is assigned a weight factor score generated through principal component analysis. The resulting asset scores are standardized in relation to a standard normal distribution with a mean zero and standard deviation one. These standard scores are then used to create the break points that define wealth index as poorest, poor, middle, richer and richest.

Birth in Last Five Years

This variable measured the number of births in last five years. The variable has been re categorized as one birth, two births and 3 or more births in last five years.

Respondent Current Working

The variable measure whether the women is employed in any type of work aside from her own housework. The definition of employed used here is very broad as it include all forms of women labor force participation formal and informal work, work inside and outside the home and work for payment in cash, payment in kind or no earning. This is dichotomous variable. If the respondent is employed, the response is coded as yes and if the respondent is not working, the response is coded as no.

Occupation

Occupation of the woman is further narrowly defined. The variable is classified into 9 categories as not working, technical; management, clerical, sales, agri.-self-employed, household & domestic, skilled manual and unskilled manual. This was recoded into three distinct groups as, not working, agricultural sector and modern sector to avoid overlap. The informal type of work with no cash earning such as agriculture, household and domestic work and unskilled manual are separates from a modern sector occupation. Such type of occupation is most likely associated with higher autonomy and status compared to informal work. Woman who are not working are grouped as not working. Woman working in agricultural sector, domestic work and unskilled manual are grouped as agriculture sector and the third group modern sector includes woman working as profession, managerial, technical, clerical and skilled manual work.

Husband's Education

The husband's education measure the number of years of education that the respondent's husband attained. It is categorized as no education, 1,2..., 14. This was recoded into three distinct groups as, no education, below SLC, above SLC.

ANC by Provider

ANC by provider is further narrowly defined. The variable is classified into nine categories as doctor, nurse/midwife, health assistance, Maternal Child Health (MCH) worker, Traditional Birth Attendant (TBA), Village Health Worker (VHW), others, Female Child Health Workers (FCHV) and no one. This was recoded into three distinct groups as, ANC by no one, ANC by informal sources and ANC by SBA. ANC by health assistance, MCH, TBA, VHW, others, FCHV are grouped as informal sources and third group ANC by SBA includes doctor, nurse/midwife.

3.3 Method of Analysis

In analyzing data, univariate, bi-variate and multivariate analysis were employed. In the univariate analysis, descriptive statistics were used to present socio-economic and demographic characteristics of respondents. Frequency and percentage was used to describe the data. Bivariate analysis was done by taking each independent variables and calculating proportion of use of place of delivery, assistance during delivery and number of ANC visits. Bar charts were subsequently created to aid visual appreciation on socio-economic and demographic variables and utilization pattern across the place of residence. Cross tabulation was employed and Chi-square statistic was used to determine the association between formal health care use and socio-economic and demographic factors. The level of significance, p, is the probability of rejecting the hypothesis one wants to test when it is true. If the p-value is found to be less than 0.05, then the statistical relationship between the variables is taken to be significant and this means that there exists a relationship between the variables.

The Chi-square statistics test is given by

$$\chi^2 = \sum_{i=1}^{r}\sum_{j=1}^{c}\frac{(o_{ij} - e_{ij})^2}{e_{ij}} \qquad (1)$$

Where χ^2= Chi square

I=1,2,…r

J= 1,2,…c

o_{ij}= Observed frequency

e_{ij} = Expected frequency

r= the number of categories of independent variables

c = the number of categories of dependent variables.

The chi square test in the bivariate analysis does not consider confounding effects therefore multivariate statistical method used in the analysis.

For building of suitable statistical models, various types of models were explored and different measure of models adequacy test were applied to verify the suitability reliability and validity of the fitted models. In this research,logistic regression model, multinomial logit model and Ordinal logistic regression model were used to assess the influence of socio-economic and demographic characteristics of individuals on use of maternal health care services.

The use of health service is a discrete event, a person either uses or not. Therefore there is a dichotomy of 'use' verses 'non-use'. Given this type of dependent variable, the logistic regression model may be the most appropriate technique of analysis. For logistic regression, the dependent variable of the study is place of delivery (Y) which is taken to be binary one. Consider $Y_i = 1$, if the i^{th} respondent's delivery in a health facility and $Y_i = 0$, if the i^{th} respondent's delivery at home. The health facility includes all type of facilities in Government/Private hospital/hospitals running by NGO's/Clinics/Centers or other health facility. Delivery at home includes respondent's home or others (non-health-facility). The method is used to analyze the net effect of each of the independent variables on women's place of delivery while controlling for the other independent variables. The ten independent variables are divided into two groups: socio-economic and demographic variables. Demographic variable includes current age of mother, birth in last five years, residence, sex of household head, region and religion. Socio-economic variable includes education level, wealth index, occupation of women and husband's education.

In Multinomial Logistic Regression (MNLR) model, an attempt has been made to quantify the intensity of dependent variable, Assistance during delivery (Y) was coded into three categories (Assistance during delivery by no one, assistance during

delivery by unskilled birth attendant, assistance during delivery by skilled birth attendant). In MNLR Model one of the categories of the outcome variable was designed as the reference category and each of the other level has compared with the reference category. Separate odds ratios are determined for all independent variables for each category of the outcome variable with the comparison of dependent variable.

Though MNLR model is one of the statistical methods that can be used when dealing with dependent variable more than two levels and for our data set this model will work but the result lack parsimony and the essence of order present in the dependent variable was lost. Since the dependent variable "Number of ANC visit" is polychotomous in nature. Hence Ordinal Logistic Regression(OLR) model was considered as suitable method.

The detail of the multivariate statistical technique (Logistic regression model, Multinomial Logistic Regression, ordinal logistic regression model used for the analysis of data are briefly provided below.

3.3.1 Logistic Regression Model

Logistic regression analysis was used to analyze the data because the response variable, place of delivery was classified into two categories delivery at health institution and delivery at home. This model was chosen as the most suitable method because of its computation ease and desirable statistical properties. Logistic regression model is less restrictive than linear regression model. It does not assume a linear relationship between the dependent and independent variables. The independent variables need not be interval, normally distributed, nor linearly related, nor of equal variance within each group. The only assumptions of logistic regression are that the resulting logit transformation is linear, the response variable is dichotomous and that the resultant logarithmic curve does not include outliers. The categories (groups) must be mutually exclusive and exhaustive; a case can only be in one group and every case must be a member of one of the groups. Larger samples are needed than for linear regression because maximum likelihood coefficients are large sample estimates. A minimum of 50 cases per predictor is recommended.

Let $Y_i = \begin{cases} 1\ if the delivery is a the alth institute \\ 0, otherwise \end{cases}$ (2)

Logistic regression extended to model with multiple explanatory variables (X). The model for $\pi_i = P(Y_i = 1)$ probability that $Y_i = 1$ and $1 - \pi_i = P(Y_i = 0)$ probability that $Y_i=0$ at values $X = (X_1, X_2, \ldots X_k)$ of k predict ands and the subscript i denote i^{th} individual and the model assumed is

$$\pi_i = \frac{\exp\left(\beta_0 + \sum_{j=1}^{k} \beta_j X_{ij}\right)}{1 + \exp\left(\beta_0 + \sum_{j=1}^{k} \beta_j X_{ij}\right)}$$

$$\pi_i = \frac{1}{1 + e^{-(\beta_0 + \sum_{j=1}^{k} \beta_j X_j)}}$$

And

$$1 - \pi_i = \frac{e^{-(\beta_0 + \sum_{j=1}^{k} \beta_j X_j)}}{1 + e^{-(\beta_0 + \sum_{j=1}^{k} \beta_j X_j)}}$$

Therefore

$$\frac{\pi_i}{1 - \pi_i} = e^{\beta_0 + \sum_{j=1}^{k} \beta_j X_j} \qquad (3)$$

Then logit or log odds of having $Y_i = 1$ is modeled as a linear function of the explanatory variables, that is

$$ln \frac{\pi_i}{1 - \pi_i} = \beta_0 + \sum_{j=1}^{k} \beta_j X_{ij} \qquad (4)$$

Where X_j , (j =1, 2, ...*k*) are explanatory variables.

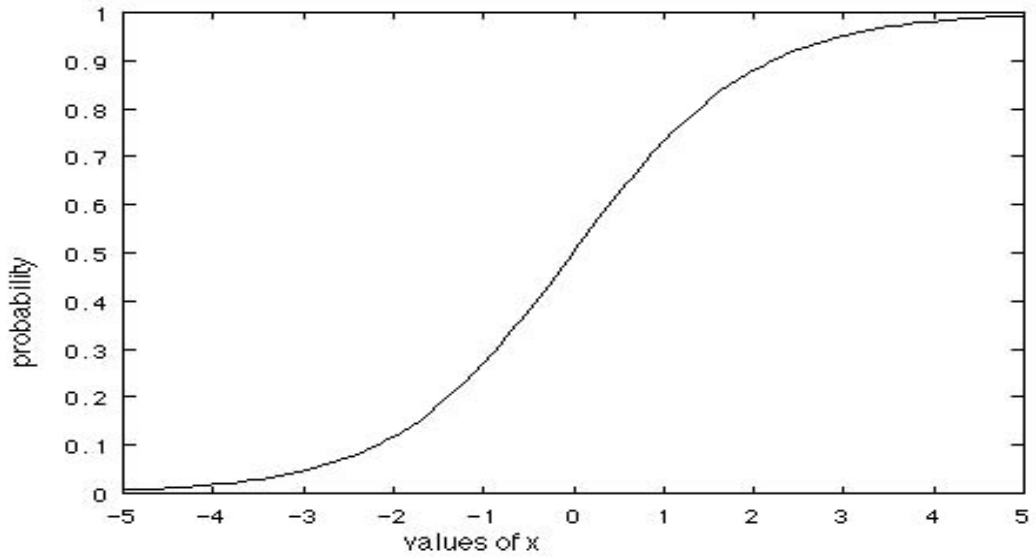
$0 \leq \pi_i \leq 1$,

j = 0, 1, 2, k,

i = 1, 2… n.

Note that π_i is a conditional probability of the form $P(Y_i=1/X_1, X_2, \ldots X_k)$. That is, it is assumed that "Success" is more or less likely depending on combination of values of predictor variables. It is also known as the logit transformation of π_i and analysis described here is sometimes known as logit analysis. The logit transformation above is beneficial in many ways. It is similar to a linear regression model since logit(Y) has linear parameters. This transformation is bounded between 0 and 1 and represented by logistic curve as shown in Figure 5.

Figure 5: Logistic Curve



The parameters that must be estimated from the available data are constant β_0 and the logistic regression coefficients β_j. Because of nature of the model, estimation is based on the maximum likelihood principle (method) rather than on the least square principle.

Place of delivery as the outcome of interest, delivery at health facility equals outcome of one and a delivery at home equal an outcome of zero. As mention previously, the probability that Y=1 given $X_1, X_2,\ldots X_k$ equal $\pi(x_i)$ and $P(Y=0/X_1, X_2,..X_k)= 1- \pi(x_i)$ Thus when a delivery at a health facility, there individual contribution to health facility is $\pi(x_i)$ and when delivery at home, their individual contribution to the likelihood function is $1- \pi(x_i)$. Thus an expression for any individual contribution to the likelihood function is given by

$$L(\beta_j) = \prod_{i=1}^{n} P(Y_i|X_1, X_2, X_3 \ldots . X_k)$$

$$= \prod_{i=1}^{n}\left[\frac{e^{\beta_0+\sum_{j=1}^{k}\beta_j X_j}}{1+e^{\beta_0+\sum_{j=1}^{k}\beta_j X_j}}\right]^{Y_i} \prod_{i=1}^{n}\left[\frac{1}{1+e^{\beta_0+\sum_{j=1}^{k}\beta_j X_j}}\right]^{1-Y_i} \quad (5)$$

Note that Y is the 0/1 outcome for the i^{th} case and $X_{i1}, X_{i2},\ldots X_{ik}$ are the value of the predictor variables for the i^{th} case based on a sample of n cases. The principle of maximum likelihood states that we use as our estimate of β the value which maximizes the expression in L. However, it is easier mathematically to work with the log of equation L. Therefore, the log likelihood is defined as

$$LL(\beta_j) = LnL(\beta_0\beta_1\beta_2 \ldots \beta_k) =$$

$$\sum_{i=1}^{n} Y_i(\beta_0 + \beta_1 X_1 + \cdots + \beta_k X_k) - \sum_{i=1}^{n} \ln\{1 + \exp(\beta_0 + \beta_1 X_1 + \cdots \beta_k X_k)\} \qquad (6)$$

Using the method of calculus, a set of values for β_0 and the β_j can be calculated that maximize L and the resulting values are known as maximum likelihood estimates (MLE's). However, the general approach involves establishing initial guesses for the unknown parameters and then continuously adjusting these estimates until the maximum value of L is found. Here we use a very effective and well known Newton-Raphson iterative method to solve the equations, which is known as iteratively weighted least square algorithm. In brief, this iterative procedure for maximizing L(β) works with a linear approximation of the derivative of L(β) with respect to β_0, β_1, ..., β_k and an initial estimate of β_0, β_1, ..., β_k is obtained . From there an updated estimate of β_0, β_1,…, β_k is obtained. Iteration continues until a convergence criterion is reached.

Once the particular logistic regression model has been fitted, we begin the process of model assessment. Assuming that we are preliminarily satisfied with the final model (model contains variables in their correct functional form). Then several standard measures of model adequacy tests have been considered in order to examine how well the fitted models match the observed data. These measures are presented in the following sections.

3.3.1.1 Log Likelihood Statistics

The overall fit of the model is assessed using the log likelihood (LL) statistics. In this analysis rather than reporting log likelihood itself, the value is multiplied by -2. (-2LL, which has an approximately chi square distribution). At the final stage -2LL should be less than the value when only constant is included in the model (lower value of -2LL indicates that the model is predicated the outcome variable more accurately). Log likelihood test, also called likelihood ratio test based on -2LL(deviance).

The likelihood ratio test looks at the model chi-square (chi square difference) by subtracting deviance (-2LL) for the final (full) model from deviance for the intercept-only model. The degrees of freedom in this test equal the number of terms in the model minus 1 (for the constant). This is the same as the difference in the number of

terms between the two models, since the null model has only one term. Model chi-square measures the improvement in fit that the explanatory variables make compared to the null model. The likelihood ratio test is thus a test of the overall model. The overall test statistic for likelihood ratio test is given as,

$$\text{Likelihood ratio} = G2 = -2\{LL_{null} - LL_k\} \quad (7)$$

Where, L_{null} is the likelihood of the null model and L_k is the likelihood of the model comprising k predictors.

Under the global null hypothesis, H_0: $\beta_1 = \beta_2 = ... = \beta_k = 0$ the likelihood ratio test statistic, G^2, follows a chi-square distribution with k degrees of freedom and measures how well the independent variable affect the outcome or response variable (Hosmer and Lemeshow, 2000).

3.3.1.2 Hosmer- Lemeshow Test

The goodness of fit (the degree of closeness of the model-predicted value to the corresponding observed value) is useful for applying to the regression model. The Hosmer-Lemeshow goodness of fit statistics (Hosmer & Lemeshow, 2000) proposes a Pearson's statistic to compare the observed and fitted counts for the partition. Let g denote the number of groups, n_k is the number observations in the k^{th} group, O_k is the sum of Y's value for the k^{th} group and $\bar{\pi}_k$ is the average of the ordered π for k^{th} group then their statistic equals

$$\tau = \sum_{k=1}^{g} \frac{(O_k - n_k' \bar{\pi}_k)^2}{n_k' \bar{\pi}_k (1 - \bar{\pi}_k)} \quad (8)$$

This test is also called chi-square test. It is more reliable than the traditional chi - square test (Agresti, 1990). In general, the Hosmer-Lemeshow goodness of fit test divides subject into deciles based on predicted probabilities and computes a chi square from observed and expected frequencies. Under the null hypothesis, the distribution of the statistic τ is well approximated by the chi-square distribution with g-2 degree of freedom. To support the model, a significance value greater than .05 is needed that is if p-value for the Hosmer-Lemeshow goodness of fit test is greater than 0.05, we will not reject the null hypothesis that there is no difference between observed and model predicted values, implying that the model estimates are adequate to fit the data at an acceptable level.

3.3.1.3 Test for Individual Predictors

To determine the significance of the predictor variables we can use either the Wald statistic or the likelihood ratio test. The Wald statistic is an alternative test which is commonly used to test the significance of individual logistic regression coefficients for each predictor variable (that is, to test the null hypothesis in logistic regression that a particular logit (effect) coefficient is zero).The Wald test approximates the likelihood ratio test, but with the advantage that it only requires estimating one model.

The Wald statistic is defined as

$$W = \frac{\hat{\beta}_i^{\,2}}{\{S.E(\hat{\beta}_i)\}^2} \qquad (9)$$

Which has a chi-square distribution, where β_i hat stands for estimated regression coefficient and S.E(β_i) hat stands for standard error of β_i. It tells us whether the β coefficient is significantly different from zero. If the coefficient is significantly deferent from zero then we can assume that the predictor is making significant contribution to the prediction of outcome (Y). Wald statistics are easy to calculate but their reliability is questionable, particularly for small samples. For data that produce large estimates of the coefficient, the standard error is often inflated, resulting in a lower value of the Wald statistic, and therefore the explanatory variable may be incorrectly assumed to be unimportant in the model. Likelihood ratio tests are generally considered to be superior (Agresti, 2007).

3.3.1.4 Nagelkerke R^2

Coefficient of determination (R^2)is the proportion of the variation in the dependent variable that can be explained by predictors in the model. While coefficient of determination (R^2) is a very valuable measure of how well linear regression model fits, it is less useful in logistic regression. As logistic regression is not a linear model, we can't calculate R^2 directly as for linear regression model. However, test like -2log likelihood gives the pseudo R^2 (Nagelkerke R^2) statistics which are based on comparing the likelihood of the current model to the null model (without any predictors).A large pseudo R^2 indicate that more of the variation is explained by the model, from a minimum of 0 to maximum of 1. It should also be noted that pseudo R^2values tend to be very low for logistic regression model, much lower than for linear

regression model. This is because we are trying to predict the outcome where as the model only given us the probability of outcomes.

$$R_N^2 = \frac{1-e^{\wedge\frac{-2}{n}\{LLnew-LLbase\}}}{1-e^{\left\{\frac{2LLbase}{n}\right\}}} (10)$$

Where LL(new) is log likelihood of the model contains all the predictors in the model.

LL(base) is log likelihood of null model with just the constant.

3.3.1.5 Residual Analysis

Residual analysis is a principle tool for accessing how well a model fit the observed data. The analysis is identical with the analysis arising from linear models. For linear models, the usual residual is normally distributed and homoscedastic but it is not true in nonlinear models such as logistic regression model. Residual analysis for logistic regression is complicated by the fact that the errors are not normally distributed. The deviance residuals provide information about the fit of individual cases, or more to the point, the contribution of a case to the (overall) deviance. Residual should be checked for outliers and influential. The main propose of examining residual in logistic regression is (i) to isolate point for which the model fits properly. (ii) To isolate points that exerts an undue influence on the model.

Leverage values is a term used in connection with regression analysis and, in particular, in analyses aimed at identifying those observations which have a large effect on the outcome of fitting regression models. Leverage points are those observations, if any, made at outlying values of the predictor variables such that the lack of neighboring observations means that the fitted regression model will pass close to that particular observation. Leverage statistics should be lie between 0(the case has no influence whatsoever)and 1(the case exerts complete influence over the model), tell us about whether certain cases are welding undue influence over model.

Influential values are points that have exerted excessive influence on the regression coefficient estimates. Influential measures can be used to identify cases that are highly influential on the logistic regression estimates. An influential point affects the statistical significance as well as the strength and direction of the association between a response variable and predictor variables. The two common measures of the influence of an observation are Cook's distance and DFBETAS.

Cook's distance is a measure of the influence of an observation(available in both OLS and logistic regression). DFBETA which is a standardized version of Cook's statistics, tell us something of the influence of certain cases. For each parameter estimate, a DFBETAS diagnostic is calculated for each observation. This is the standardized difference in the parameter estimate due to deleting the observation, and it can be used to assess the effect of an individual observation on each estimated parameter of the fitted model. These measures are useful for detecting observations that are causing instability in the selected coefficients.

To detect outliers and influential cases that have a substantial impact on the fitted logistic regression model is examined through appropriate graphical methods.

3.3.1.6 Collinearity Analysis

We know that multicollinearity can affect the parameters of the regression model. The multicollinearity was measured by tolerance statistics and variance inflation factor (VIF). The VIF measures the strength of inter relationship among the independent variables. Tolerance $=1 - R^2$, where R^2 is the square of multiple correlation. We can obtain tolerance and variance inflated factor (VIF) by simply running a regression analysis using same predictor and outcome. Mernard (Menard, 1995) suggests that a tolerance value less than 0.1 almost certainly indicates a serious collinearity problem. The corresponding VIF is 1/tolerance. Variance inflation measures the inflation in variance of the parameters estimated due to collinearity between dependent variable and other variables. If VIF exceeds 10, then it is the indication of the presence of multicollinearity (Field, 2005).

3.3.1.7 Interpreting the Fitting Logistic Regression

We may interpret the result from a logistic regression at different ways. First each term in the equation represent contribution to estimated log odds. Thus, for each one unit increase (decrease) in X_j's there is predict and to be an increase (decrease) of β_j units in the log odds in favor of Y=1. Also if all predictors are set equal to zero, the predict and log odds in favor of Y=1 would be the constant term.

More critical to the interpretation of likelihood ratio is the value of exp (β), which is an indicator of the change odds resulting from a unit change in a predictor. The odds of an event occurring are defined as the probability of an event occurring divided by the probability of none occurring. In this study P(event) is the probability of delivery

at health facility and P(no event) is the probability of not delivery at health facility. Therefore,

$$odds = \frac{P(event)}{P(noevent)} \quad (11)$$

In order to calculate the proportionate change in odds, divide the odds after a unit change in the predictor by the odds before changes, that is

$$\Delta odd = \frac{oddsaftertheunitchangeinpredictor}{originalodds}$$

This proportionate change in odds is exp(β), so we can interpret exp(β) in terms of the change in odds. Thus, each one unit increase in X_{ij}, the predicted odds is increased by a factor of exp (β). If the value is greater than 1, then it indicates that as the predictor increases, the odds of the outcome increases. If the value is less than 1 then as the predictor increases, the odds of the outcome decrease.

3.3.1.8 Predicted Probabilities for Selected variables

The results can be expressed in terms of probabilities by use of logistic function with substituted, the equation become

$$P(Y = 1|X_1, X_2, \dots X_k) = \frac{e^{\beta_0 + \sum_{j=1}^{k} \beta_j X_j}}{1 + e^{\beta_0 + \sum_{j=1}^{k} \beta_j X_j}} \quad (12)$$

Predicted probabilities for place of delivery at health institute, another logistic regression was fitted with some selected variables (highest education level, wealth index and place of residence). It is displayed by graph.

3.3.2 Multinomial Logit Model

The Multinomial Logistic Regression (MNLR) model used is generally effective when the dependent variable is composed of polychotomous categories having multiple choices. This model can be understood as a simple extension of logistic regression that allows each category of an unordered response variable to be compared to an arbitrary reference category providing a number of logit regression models (Hosmer & Lemeshow 2000). A binary logistic regression model compares one dichotomy, whereas the multinomial logistic regression model compares a number of dichotomies. This procedure outputs a number of logistic regression models that make specific comparisons of the response categories. When there are j

categories of the response variable, the model consists of j-1 logit equations which are fit simultaneously.

MNLR model is equivalent to the simultaneous estimation of multiple logit where each of the categories is compared to one selected base category. But if we would estimate them separately, we would loss information, as each logit would be estimated on a different sample (selected category plus base category, with allother categories omitted from analyses). To avoid that, we use multinomial logistic regression model.

The assumptions for MNLR model are that the independent variables may either be numerical or categorical. The dependent variable has to be categorized into three or more groups. The data do not need to have a normal distribution, no linear relationship and no equality of variance. To run MNLR model, the minimum sample size required is 15-20 cases per independent variable.

For multinomial model, First of all, the multinomial distribution is reviewed. Consider a random variable Yi that may take one of several discrete values, which we indexed 1, 2, …,j. In this study, the response variable is "Assistance during delivery" and it takes the values 'Assistance by no one', 'Assistance by unskilled birth attendant(USBA)' and 'Assistance by skilled birth attendant(SBA)', which are indexed 1, 2 and 3.

Let,

$$\pi_{ij} = \Pr(Y_i = j) \tag{13}$$

Denote the probability that the i^{th} response fall in the j^{th} category. In this study, π_{i1} is the probability that the i^{th} respondent is 'Assistance during delivery by no one', π_{i2} is the probability that the i^{th} respondent is 'Assistance during delivery by USBA' and π_{i3} is the probability that the i^{th} respondent is 'Assistance during delivery by SBA'. Assuming that, the response categories are mutually exclusive and exhaustive.

Let n_i denote the number of cases in the i^{th} group and let Y_{ij} denote the number of responses from the i^{th} group that fall in the j^{th} category with observed value y_{ij}. Here $n_i$is the number of women in the i^{th} group. In this study, we could work with the 4182 records in the individual data file of 2006 and 4097 of 2011 respectively. Let y_{i1} be 1 if the i^{th} woman is assistance during delivery by no one and 0 otherwise. Similarly, y_{i2} be 1 if the i^{th} woman is assistance during delivery by unskilled birth attendant and 0

otherwise, y_{i3} be 1 if the i^{th} woman is assistance during delivery by skilled birth attendant and 0 otherwise.

The distribution of the count Y_{ij} given the total n_i is given by the multinomial distribution.

$$\Pr(Y_{i1} = y_{i1,\ldots\ldots\ldots\ldots}, Y_{ij} = y_{ij}) = \binom{n_i}{y_{i1}, y_{i2}, \ldots y_{ij}} \pi_{i1}^{y_{i1}} \ldots\ldots\ldots \pi_{ij}^{y_{ij}} \quad (14)$$

The special case when j=2 that is we have only two response categories is the binomial distribution. To verify this fact, equate $y_{i1}=y_i$ then $y_{i2}= n_i-y_i$and $\pi_{i1}=\pi_i$ and $\pi_{i2}=1-\pi_i$.

We now consider models for the probabilitiesπ_{ij}. In practice we would like to consider model where probabilities depend on a vector X_i of covariates associated with the i^{th} individual or groups. Perhaps the simplest approach to multinomial data is to nominate one of the response categories as a baseline or reference cell, calculate log odds of the other categories relative to the base line, and then let the log odds be a linear function of predictors.

Typically, we pick the last category as a base line and calculate the odds that a member of group i fall in category j as opposed to the base line as $\frac{\pi_{i1}}{\pi_{ij}}$. In our study, we could look at the odds of being 'assistance by SBA' rather than 'assistance by no one and odds of using 'assistance by USBA rather than 'assistance by no one'.

The j-1 multinomial logit equation contrasts each of categories j-1 with category j, whereas the single logistic regression equation is a contrast between successive and failure.

Since we need only j-1 equations to describe a variable with j response categories and that is really make no difference which category we pick as the reference cellbecause we can convert from one formulation to another. In our study J=3 categories, we contrast category 1 versus 3 and 2 versus 3. The missing contrast between categories 1 and 2 can easily be obtained in terms of the other two. Since

$$\ln\frac{\pi_{i1}}{\pi_{i2}} = ln\frac{\pi_{i1}}{\pi_{i3}} - ln\frac{\pi_{12}}{\pi_{i3}} \quad (15)$$

Since there are 4182 individuals in the data set of 2006 NDHS and 4079 in the data set of 2011, number from i= 1 to n. If the outcome for individual i is in category 1, then we let yi1 be equal to 1 otherwise yi1 is equal to zero. We similarly create outcome variables y_{i2}, and y_{i3} to indicate whether the outcome is in category 2 or category 3.

$$Y_{ij} = \begin{cases} 1, if the individual f all in category\ j \\ 0, otherwise. \end{cases} \quad (16)$$

Where, j=1,2,3, and

Let $$\pi_{ij} = \Pr(Y_{ij} = j|X) \quad (17)$$

Denote the probability that Y_{ij}= j

Assuming that the response categories are mutually exclusive then we can write,

$$\sum_{j=1}^{3} \pi_{ij} = 1 \quad (18)$$

We now consider model for π_{ij}, in particular, I would like to consider model where their probabilities depend on a vector X_k of covariates associated with the i^{th} individuals.

$$ln\frac{\pi_{ij}}{\pi_{i1}} = ln\frac{P(Y_{ij} = j|X)}{P(Y_{i1} = 1|X)}$$

$$= \alpha_j + \sum_{k=1}^{g} \beta_{jk} X_k \quad (19)$$

Where j= 2, 3, and α_j is a constant

$\beta_{jk}$is the regression coefficient for j=2,3 and

X_k(k=1, 2, …, g) are explanatory variables.

The MNLR model may also be written in terms of probability π_{ij} rather than odds.

$$\pi_{ij} = \frac{e^{\alpha_j + \sum_{k=1}^{g} \beta_{jk} X_k}}{1 + e^{\alpha_j + \sum_{k=1}^{g} \beta_{jk} X_k}} \quad (20)$$

Estimation of the parameters of this MNLR model is done by, what is known as iteratively reweighted least square, which is identical to the logarithm of fisher

scoring or Newton- Raphsons, and lead to maximum likelihood estimates as shown by McCullagh and Nelder(1989).

Once the particular MNLR model has been fitted, we begin the process of model assessment. Model-fit statistics interpreted is much the same way as for a standard logistic regression model. First step in the process is the overall model evaluations. The likelihood ratio scores and Wald test were examined to determine the improvement of MNLR model over the intercept model (also called null model).The overall goodness of fit of the estimated model is judged by deviance and Pearson's chi square as in logistic regression model. Non-significant p values suggest that the estimated model fit well to the MNLR model.

We can't calculate R^2 directly as for linear regression model. However, test like -2log likelihood gives the pseudo R^2 (Nagelkerke R^2) statistics which are based on comparing the likelihood of the current model to the null model (without any predictors).A large pseudo R^2 indicate that more of the variation is explained by the model, from a minimum of 0 to maximum of 1. It should also be noted that pseudo R^2 values tend to be very low for multinomial logistic regression model, much lower than for linear regression model. This is because we are trying to predict the outcome where as the model only given us the probability of outcomes.

$$R_N^2 = \frac{1-e^{\wedge\frac{-2}{n}\{LLnew-LLbase\}}}{1-e^{\left\{\frac{2LLbase}{n}\right\}}} \qquad (21)$$

Where LL(new) is log likelihood of the model contains all the predictors in the model.

LL(base) is log likelihood of null model with just the constant.

A more useful measure to assess the utility of MNLR model is classification accuracy, which compare predicted group membership based on the MNLR model to the actual known group membership, which is the value of the response variable. The benchmark that will use to characterize, a MNLR model as useful is a 25 percent improvement over the rate of accuracy achievable by chance alone. The estimate of by chance accuracy that will use is the proportional accuracy rate, computed by summing the squared percentage of case in each group. Greater the classification accuracy than a proportional by chance accuracy suggest that the estimated model fit well to the MNLR model.

Multicollinearity in the multinomial logistic regression solution is detected by examining the standard errors for the b coefficients. A standard error larger than 2.0 indicates numerical problems, such as multicollinearity among the independent variables, zero cells for a dummy-coded independent variable because all of the subjects have the same value for the variable, and 'complete separation' whereby the two groups in the dependent event variable can be perfectly separated by scores on one of the independent variables. Analyses that indicate numerical problems should not be interpreted.

3.3.3 Ordinal Logit Regression Model

In previous section "assistance during delivery" as a response variable which takes the three categories: a) assistance during delivery by no one b) assistance during delivery by unskilled birth attendant (USBA) and c) assistance during delivery by skilled birth attendant(SBA). For this MNLR model have been applied which would allowed the identification of the each of the selected predictor variable on assistance during delivery, controlling for the effect of other predictor variables. MNLR model is one of the statistical methods that can be used when dealing with categorical dependent variable with more than two categories. In this study, the response variable is "Number of ANC visits" which takes the three categories: a) no ANC visit b) 1-3 ANC visits (some visits)and c) 4 or more visit (adequate visit). To establish the effect of the identified predictor variables on the response variables "Number of ANC visits", ordinal logistic regression (OLR) model was fitted in the context of the proportional odd model.

When choosing an ordered model, it is important to decide which type of comparison (cumulative, stage or adjacent) makes the more sense. In this study we choose cumulative ordinal logit model originally proposed by Walker and Duncan (Walker and Duncan1967). Cumulative approach compare the probability of being at or below a certain point to the probability of being that point i.e.$(\frac{pr(Y\leq j|X)}{pr(Y>j|X)})$ and the response variable with J categories is split into J-1 logit equations. In this study, a three categories outcome will have two binary logit equations based on the following comparisons: none versus (1-3 ANC visits, 4 or more ANC visits), none or 1-3 ANC visit versus (4 or more ANC visits). The traditional model within a cumulative approach is the proportional odds model.

One of the assumption underlying ordinal logit regression model is that the coefficient that describe the relationship between say lowest verses all higher categories of the response variable are the same as those that describe the relationship between the next lowest category and all higher categories. This is called the proportional odds assumption or the parallel regression assumption. The intercept (or cut point) is the only coefficient that changes across logit equations, which allow the researcher to present a single set of coefficient for each variable just as one would in binary logit. It allows for a more parsimonious model and presentation of output and ensures the ordinality in the dependent variable. The proportional odds model lead to strong assumption that may lead to incorrect interpretation if the assumptions are violated (Ananth & Kleinbium, 1997).

The proportional odds model is the most commonly used logit model of ordinal response variable McCullagh, proposed the proportional odds model as a means of analyzing ordinal response variable within a logistic frame work (McCullagh, 1980).The equation for the proportional odds model is

$$\log\left(\frac{pr(Y \leq j|X)}{pr(Y > j|X)}\right) = \alpha_j - X\beta, \quad 1 \leq j < J \tag{22}$$

Where

J is a category,

X is a vector of independent variables,

α_j is a cut point (thresh hold),

$\beta$is a vector of logit coefficients.

The negative sign on a vector of logit coefficients facilitates an OLS regression type interpretation of the coefficients. A positive coefficient indicates that a unit increase in X leads to a higher level of Y. The probability for any given outcome category (j) in the proportional model is

$$\Pr(Y = j|X) = \begin{cases} F(\alpha_1 - X\beta) j = 1 \\ F(\alpha_j - X\beta) - F(\alpha_{j-1} - X\beta) \quad 1 < j \leq J-1 \\ 1 - F(\alpha_{j-1} - X\beta) j = J \end{cases} \tag{23}$$

Where F is the logistic cumulative density function (cdf),

X is a vector of independent variable,

α is a cut point (thresh hold),

β is a vector of logitcoefficient.

And j is the category and its corresponding logit equation (Long J. S., 1997; Powers & YU, 2000) as in case of binary logit, the proportional odds model is nonlinear in the probability but linear in the log of odds (or logit). For an outcome with three categories, the proportional odds model estimate two binary logit models simultaneously with the following marginal probabilities for each category

$$P_1 = \Pr(Y = 1)$$

$$P_2 = \Pr(Y \leq 2) - \Pr(Y = 1)$$

$$P_3 = 1 - \Pr(Y \leq 2)$$

After the analysis, a model fitted was assessed using the Brant test of proportionality (Brant, 1990). Brant test has important implications for hypothesized estimates, which may, determines the extent of parallelism with the first and second cut off points of the dependent variable, i.e., the lowest versus all higher categories of the response variable is same as those that describe the relationship between the next lowest category and all higher categories. Such that equality may be assumed among the coefficients of the variables remaining in the final model, implying a common odds ratio (OR) for both cut off points. Violating the proportionality assumption, results in biased estimates, which may have important implications for hypothesis testing. In such cases, the proportionality constraints should be completely relaxed and then Partial Proportional Odds (PPO) model is used (McCullagh & Nelder, 1989).

Once the particular OLR model has been fitted, we begin the process of model assessment. Model-fit statistics interpreted is much the same way as for a standard logistic regression model. First step in the process is the overall model evaluations. The likelihood ratio scores and Wald test were examined to determine the improvement of OLR model over the intercept model (also called null model).

The overall goodness of fit of the estimated model is judge by deviance and Pearson's chi square. Deviance can be regarded as a measure of lack of fit between model and data. Generally, larger the deviance, poorer fit to the data. The null hypothesis states

that the observed data are consistent with the fitted model. Non-significant p values suggest that the estimated model fit well to the OLR model.

In this study, McFadden's, the ratio of the likelihoods suggests the level of improvement over the intercept model that is model without predictors offered by the full model that is the model with predictors.

$$R_M^2 = 1 - \frac{-2LL(Full\ model)}{-2LL\ (base)} \tag{24}$$

However this statistics measure is limited that never reaches as its theoretical maximum of 1. Therefore Negelkerke suggest the following amendment (Negelkerk's R^2).

$$R_N^2 = \frac{R_{CS}^2}{1 - e^{\left\{\frac{2LLbase}{n}\right\}}} \tag{25}$$

For 2011 NDHS, the assumption of the parallel line is violated; it would need different model to describe the relationship between response variable and predictors. A common practice is to go ahead and use the model anyway which can lead to incorrect, incomplete or misleading result. Another option is to use a non-ordinal alternative such as MNLR model but it has more parameters than the parallel model (There are two coefficients for each explanatory variable instead of only one) and its interpretation is not simple. Another simple and valid approach to analyze data is to dichotomize the ordinal response variable by means of several cutoff points and use separate Binary Logistic Regression (BLR) model for each dichotomous response variable (Bender & Grouven, 1998). But this procedure should be avoided if possible because of the loss in statistical power and reduce the generality of loss in analytical solution (Gemeroff, 2005)

Hence, a legal alternative is to develop a Partial Proportional Odds (PPO) model. This was used to generate the estimates of partial proportional odds ratios across the categories of the outcome variable:(a) none versus some and adequate ANC visits (b) none or some ANC visits versus adequate ANC visits. The PPO model works well in situations where the proportionality or parallel slopes assumption of ordinal logistic regression is violated (William, 2006). This assumption was assessed during the preliminary analysis.

For an ordinal dependent variable with J categories, the PPO model (Williams 2006) can be written as

$$P(Y_i > j) = \frac{e^{\alpha_j + X_i\beta_j}}{1 + e^{\alpha_j + X_i\beta_j}} \qquad (26)$$

Here dependent variable has 3 possible values; the PPO model will have 2 sets of coefficients. Two equations are estimated simultaneously. A PPO model will estimate as many coefficients as a multinomial logit model does. It gives results that are very similar to what we get with the series of binary logistic regressions such as we presented earlier and can be interpreted the same way. The OLR model(Proportional Odds model) is a special case of the PPO model, where the betas are the same for each j.

The main problem with PPO model or a MNLR model is that it generated many more parameters than an OLR model does. This is because, with these methods, all variables are free from the proportional odds constraint, even though the assumption may only be violated by one or a few of them. With a partial proportional odds model, however, it is possible to relax the parallel lines/proportional odds assumption only for those variables where it is violated.

In between these two PPO and OLR model, is the Partial Proportional Odds (PPO) model with constraint. It is also called restricted partial proportional odds model. With the restricted PPO model, a key enhancement is that some of the beta coefficients are the same for all values of j, while others can differ. For example, in the following PPO model the betas for X_1 and X_2 are constrained to be the same across values of J but the betas for X_3 are not:

$$P(Y_i > j) = \frac{e^{\alpha_j + X_{1i}\beta_1 + X_{2i}\beta_2 + X_{3i}\beta_{3j}}}{1 + e^{\alpha_j + X_{1i}\beta_1 + X_{2i}\beta_2 + X_{3i}\beta_{3j}}} \ , j = 1,2,3 \qquad (27)$$

Empirically, the restricted PPO model can work very well, providing a substantially better fit to the data than the OLR model does while at the same time being much more parsimonious than other alternatives. However, the interpretation and justification for the PPO model is less straightforward than it is for the OLR model. The “gologit2” with auto fit option command was used in STATA to fit the restricted PPO model, which relax the parallel line constraint for those variables where it is violated.

It goes through an iterative process. First, it estimates a totally unconstrained model, the same model as the PPO model. It then does a series of Wald tests on each variable individually to see whether its coefficients differ across equations, e.g. whether the variable meets the parallel lines assumption. If the Wald test is statistically insignificant for one or more variables, the variable with the least significant value on the Wald test is constrained to have equal effects across equations. The model is then re-estimated with constraints, and the process is repeated until there is no more variables that meet the parallel lines assumption. A global Wald test is then done of the final model with constraints versus the original unconstrained model; a statistically insignificant test value indicates that the final model does not violate the parallel lines assumption.

There are several other issues to be aware of with the restricted PPO model. First, it probably works best when relatively few of the variables in the model violate the proportional odds assumption. If several variables violate the assumption, then the restricted PPO model offers little in the way of parsimony and more widely known techniques such as MNLR model may be superior.

Peterson & Harrell(1990) presented an equivalent parameterization of the restricted PPO model, called the Gamma parameterization. The Gamma parameterization can be used for alternative statistical test for violation of assumption. It is more theory based model selection. Here γ coefficient represents deviation from proportionality. If the Gammas for a variable are all 0, the variable meets the proportional odds assumption (Peterson & Harrell, 1990).

There are several advantages to the γ parameterization: It is consistent with other publish research. It provides an alternative way of understanding the parallel line assumption. If the gamma for all variables is zero, the parallel line assumption is satisfied. By examining the gammas, it can better pinpoint where assumptions are been violated.

3.4 Computer Software

Data analysis and subsequent model building is carried out with the help of several statistical computer software packages such as Microsoft Excel, Statistical Package for the Social Science (SPSS) for windows and STATA.

CHAPTER 4: RESULTS AND DISCUSSION

It has been discussed earlier that the respondent's choice of maternal healthcare services is influenced by her socio- economic and demographic characteristics. Descriptive, bivariate, logistic regression, multinomial logistic regression and ordinal logistic regression analysis are used to analyze the impact of socio-economic and demographic variables on maternal healthcare service utilization. This chapter will examine, by means of a bivariate analysis the relationships between the dimensions of maternal health care (Place of Delivery (POD), Assistance During Delivery (ADD) and number of ANC visits) and the independent variables, representing education (both the respondent's and her husband's), age, region, religion, wealth index, place of residence, birth in last five years, sex of household head, currently working status, occupation, and ANC by provider. Before the results of the bivariate analysis are discussed, the descriptive statistics of each variable mentioned above would be examined.

4.1 Descriptive Analysis of 2006 NDHS

An examination of the descriptive statistics of a variable is important for identifying and summarizing the characteristics of the sample or population with respect to the variable. Almost most of the variables in the NDHS 2006 are nominal and ordinal variables. Some of the variables have to be recoded and classified as categorical variables as appropriate. The descriptive statistics provides percentage of maternal healthcare service utilization status of mothers.

4.1.1 Descriptive Analysis of the Dependent Variables

Utilization pattern for place of delivery, assistance during delivery and number of times ANC visits is presented in Table 5. From the total sample, only 19 percent of the women gave birth at health institution. Majority of women were delivered in home. The distribution was uneven between the urban and rural women where only 12 percent of the rural women delivered at health institution while 41percent of the urban women were delivered in health institution.

Similarly while looking at pattern of assistance during delivery 20percent of the women gave birth with assistance from a skilled birth attendant, this includes doctors,

nurses and midwives. The distribution was uneven between the urban and rural women where only 13percent of rural women delivered with skilled birth attendant while 44percent of the urban women were assisted during delivery by a skilled birth attendant. In rural area, 78percent of women gave birth from unskilled birth attendant.

As shown in Table 5, 28 percent of women in Nepal never visit ANC and only 29 percent of women attended adequate antenatal care visits during pregnancy. The distribution was uneven between the urban and rural women where only 24 percent of rural women attended adequate ANC visits while 47 percent of the urban women were attended adequate ANC visits.

Table 5: Distribution of Use of POD, ADD and Number of ANC Visits in the Sample Data of Nepal, NDHS 2006

Variables	Description	Total		Urban		Rural	
		Freq.	percent	Freq.	percent	Freq.	percent
Place of delivery	At home	3390	81.1	583	58.6	2807	88.1
	At health institute	792	18.9	412	41.4	380	11.9
Assistance during delivery	By no one	316	7.6	32	3.2	284	8.9
	By unskilled birth attendant	3015	72.1	525	52.8	2490	78.1
	By skilled birth attendant	851	20.3	438	44.0	413	13.0
Number of ANC visits	No ANC visits	1161	27.8	144	14.5	1017	31.9
	Some ANC visits(1-3 times)	1810	43.3	388	39.0	1422	44.6
	Adequate ANC visits(4 or more)	1211	29.0	463	46.5	748	23.5
Total		4182	100	995	100	3187	100

4.1.2 Descriptive Analysis of Independent Variables

This subsection describes some selected background characteristics of the respondents. To identify the variation in the background characteristics of the population between urban and rural areas, the background characteristics of the respondents in urban as well as in rural are presented in Table 6

Age is as taken as continuous variable. Mean age is 27.04 years as a whole. Majority of the respondent were Hindu religion (87 percent). There were 21 percent female headed households. A large gap exists in education level between the urban and rural residence, it is reported that approximately 41 percent of urban women have higher and secondary education level compared to 18 percent of women in rural areas.

Table 6: Socio- economic and Demographic Characteristics in the Sample Data of Nepal, NDHS 2006

Variables	Description	Total		Urban		Rural	
		Freq.	percent	Freq.	percent	Freq.	percent
Age	Continuous variable	Mean= 27.04	Min=15 Max=49	Mean= 26.33	Min=15 Max=48	Mean = 27.26	Min=15 Max=49
Religion	Hindu	3633	86.9	891	89.5	2742	86
	Others	549	13.1	104	10.5	445	14
Region	Scare(M. W & F. W)	1471	35.2	307	30.9	1164	36.5
	Moderate(E & W)	1680	40.2	414	41.6	1266	39.7
	Adequate(Central)	1031	24.6	274	27.5	575	23.8
Education Level	No education	2455	58.7	390	39.2	2065	64.8
	Primary	745	17.8	201	20.2	544	17.1
	Secondary or higher	982	23.5	404	40.6	578	18.1
Wealth index	Poorest	1111	26.6	82	8.2	1029	32.3
	Poorer	866	20.7	141	14.2	725	22.7
	Middle	751	18	98	9.8	653	20.5
	Richer	773	18.5	220	22.1	553	17.4
	Richest	681	16.3	454	45.6	227	7.1
Birth in last five years	1	2740	65.5	716	72	2024	63.5
	2	1287	30.8	248	24.9	1039	32.6
	3or more	155	3.7	31	3.1	124	3.9
Sex of HH head	Male	3294	78.8	795	79.9	2499	78.4
	Female	888	21.2	200	20.1	688	21.6
Currently working	No	1148	27.5	441	41.3	707	22.2
	Yes	3034	72.5	554	55.7	2480	77.8
Husband's education*	No education	985	23.6	170 642	17.2	815	25.6
	SLC and below	2818	67.6	177	64.9	2176	68.5
	Above SLC	364	8.7		17.9	187	5.9
Occupation	Never work	750	17.9	361	36.3	389	12.2
	Agricultural sector	3099	74.1	453	45.5	2646	83.0
	Modern Sector	333	8.0	181	18.2	152	4.8
ANC by provider	By no one	1161	27.8	144	14.5	1017	31.9
	By informal sources	1071	25.6	52	5.2	1019	32.0
	By SBA	1950	44.6	799	80.3	1151	36.1
Total		4182	100	995	100	3187	100

* There are some missing cases for this variable.

According to Table 6, the urban residence has a greatest proportion of women in richest wealth quintal (46 percent) while the rural residence has the greatest proportion of women in poorest wealth quintal (32 percent). While looking at the pattern of ANC by provider, only 26 percent of the women used ANC by informal sources. The distribution was uneven between the urban and rural women where only 36 percent of rural women were ANC by SBA while 80 percent of the urban women were ANC by SBA.

Around 73 percent of the women were currently working. Around 68 percent of respondent's occupations were agricultural sector, only 8 percent were in modern sector. There were 66 percent respondents who have one birth in last five years. Around 20 percent of respondent's husband did not have education attainment.

4.2 Descriptive Analysis of 2011 NDHS

4.2.1 Descriptive Analysis of the Dependent Variables

Table 7 showed the percentage distribution of mothers who had a live birth in the five years preceding the survey by utilization of maternal health services (Place of delivery, assistance during delivery and frequency of ANC visits) for the most recent birth. From the total sample, only 40 percent of the women gave birth at health institution. 60percent of women gave birth in home. The distribution was uneven between the urban and rural women where only 31 percent of the rural women delivered at health institution while 69 percent of the urban women delivered in health institution. There were large increase in delivery at health institute between the two survey years, 2006 (19 percent) and 2011 (40 percent).

Table 7: Distribution of the Use of POD, ADD and Number of ANC Visits in the Sample Data of Nepal, NDHS 2011

Variables	Description	Total		Urban		Rural	
		Freq.	percent	Freq.	percent	Freq.	percent
Place of Delivery	At home	2464	60.4	280	31.2	2184	68.6
	At health institute	1615	39.6	617	68.8	998	31.4
Assistance during delivery by	No one	155	3.8	15	1.7	140	4.4
	Unskilled birth attendant	2516	61.7	307	34.2	2209	69.4
	Skilled birth attendant	1408	34.5	575	64.1	833	26.2
Number of ANC visits	No ANC visits	611	15.0	62	6.9	549	17.3
	Some ANC visits(1-3 times)	1317	32.3	220	24.5	1097	34.5
	Adequate ANC visits(4 or more)	2151	52.7	615	68.6	1536	48.2
Total		4079	100	897	100	3182	100

Similarly while looking at pattern of assistance during delivery 35percent of the women gave birth with assistance from a skilled birth attendant, this includes doctors, nurses and midwives. The distribution was uneven between the urban and rural women where only 26 percent of rural women delivered with skilled birth attendant while 64 percent of the urban women were assisted during delivery by a skilled birth attendant. In rural area, 69 percent of women gave birth from unskilled birth attendant. Similarly there was a large increment in assistance during delivery by SBA in the five years between 2006 (20 percent) and 2011 (35 percent).

According to Table 7, 15 percent of women in Nepal never visit ANC and 53 percent of women attended adequate antenatal care visits during pregnancy.

4.2.2 Descriptive Analysis of Independent Variables

The background characteristics of the respondents in 2011 in urban as well as in rural are presented in Table 8. Mean age of 27.0 years were obtained as a whole, while in urban areas mean age was 26.6 years, which was slightly lower than the mean age at rural areas (27.16 years).More than 70 percent of women have male as household head in both rural and urban areas: total (74 percent), urban(76 percent), rural (73 percent). Similarly more than 70 percent of women have one birth in last five years in both place of residence: total (73 percent), urban (80 percent) and rural (71 percent).

The currently working women were higher in rural areas (68 percent) as compared to urban areas (44 percent).It can be seen in Table 8 that 64 percent of the women's occupation were agriculture as compared to 13 percent from modern sector occupation. In urban areas only 33 percent has agriculture occupation as compared to 72 percent in rural areas. 47 percent of women were from moderate region followed by scare region (32 percent) than adequate region (21 percent).

As seen in Table 8, the urban residences have a greatest proportion of women in richest wealth quintal (45 percent) while the rural residences have the greatest proportion of women in poorest wealth quintal (34 percent). While looking at the pattern of ANC by provider, only 26 percent of the women used ANC by informal sources. The distribution was uneven between the urban and rural women where only 8 percent of urban women were ANC by informal sources while 32 percent of the urban women were ANC by informal sources.

Around 19 percent women's husband did not have any educational attainment. Large gaps exist in education level between the urban and rural residence, it is reported that approximately 56 percent of urban women have higher and secondary education level compared to 31 percent of women in rural areas.

Table 8: Socio- economic and Demographic Characteristics in the Sample Data of Nepal, NDHS 2011

Variables	Description	Total		Urban		Rural	
		Freq.	percent	Freq.	percent	Freq.	percent
Age	Continuous variable	Mean= 27.0	Min=15 Max=49	Mean= 26.6	Min=17 Max=47	Mean= 27.16	Min=15 Max=49
Religion	Hindu	3480	85.3	781	87.1	2699	84.8
	Others	599	14.7	116	12.9	483	15.2
Region	Scare(M. W & F. W)	1320	32.4	332	37.0	988	31.0
	Moderate(E & W)	1905	46.7	355	39.6	1550	48.7
	Adequate(Central)	854	20.9	210	23.4	644	20.2
Education Level	No education	1765	43.3	234	26.1	1531	48.1
	Primary	817	20.0	164	18.3	653	20.5
	Secondary or higher	1495	36.7	499	55.6	998	31.4
Wealth index	Poorest	1160	28.4	76	8.5	1084	34.1
	Poorer	832	20.4	46	5.1	786	24.7
	Middle	739	18.1	118	13.2	621	19.5
	Richer	677	16.6	251	28.8	426	13.4
	Richest	671	16.5	406	45.3	265	8.3
Birth in last five years	1	2972	72.9	720	80.3	2252	70.8
	2	992	24.3	160	17.8	832	26.1
	3or more	115	2.8	17	1.9	98	3.1
Sex of household head	Male	3002	73.6	681	75.9	2321	72.9
	Female	1077	26.4	216	24.1	861	27.1
Currently working	No	1513	37.1	504	56.2	1009	31.7
	Yes	2566	62.9	393	43.8	2173	68.3
Husband's education*	No education	770	18.9	83 589	9.3	687	21.7
	SLC and below	2779	68.1	222	65.9	2190	69.1
	Above SLC	514	12.7		24.8	292	9.2
Occupation	Never work	962	23.6	393	43.8	569	17.9
	Agricultural sector	2603	63.8	298	33.2	2305	72.4
	Modern Sector	514	12.6	206	23.0	308	9.7
ANC by provider	By no one	611	15.0	62	6.9	549	17.3
	By informal sources	1079	26.5	75	8.4	1004	31.6
	By SBA	2389	58.5	760	84.7	1629	51.2
Total		4079	100	897	100	3182	100

* There are some missing cases for this variable.

4.3 Bi-variate Analysis of 2006 NDHS

The bivariate statistical analysis addresses the marginal effect of a predictor variable on the response without taking into account other predictors. And it shows the association between the outcome variable and other predictor variables, obtained by cross tabulation of the response variables, maternal healthcare (i.e. Place of delivery, assistance during delivery and frequency of ANC visits) usage to the other predictor variables independently.

4.3.1 Relationship between Socio-Economic and Demographic Characteristics and Place of delivery

Bivariate analysis, using Chi-square tests, was used to examine the relationship between Socio-economic and demographic characteristics and utilization of MHCS as place of delivery. The place of delivery is related to a number of factors. Factors which were significantly associated with place of delivery were: Education level, wealth index, birth in last five years, husband's education, working status, place of residence, occupation and ANC by provider.

Region appeared to be significantly associated. Women who live in adequate region were most likely to deliver their babies at health institute. Table 9 indicated that women who live in adequate region had greater chances (26 percent) of using health institute for their delivery compared to women live in scare region (13 percent). It is highly significant with a chi square of 63.20 and $p<0.001$.

As per Table 9, education level was positively associated with place of delivery. It is highly significant with a Chi-square of 705.59 and $p<0.001$.Among those poorest, 4 percent used health institute as place of delivery compared to 39 percent among those rich respondent. The results of the chi-square statistics indicate a statistically significant relationship between wealth index and place of delivery as health care services (χ^2= 874.59, p=0.001,) at 5percent significance level.

With respect to the association between place of delivery and birth order, Table 9 illustrates that the independent variable (birth order) has a significant impact upon the use of health institution as place of delivery. The results of the chi-square statistics indicate a significant relationship between birth in the last five years and place of delivery (χ^2 = 92.2, $p<0.001$).

Table 9: Relationship between POD and Socio-economic and Demographic Characteristic in the Sample Data of Nepal, NDHS 2006

Variables	Description	Place of Delivery		p value (χ^2 value)
		Delivery at home (percent)	Delivery at Health institution (percent)	
Religion	Hindu	2942(81.0)	691(19.0)	0.728
	Others	448(81.6)	101(18.4)	(0.1206)
Region	Scare(MW and FW)	1276(86.7)	195(13.3)	
	Moderate(E and W)	1349(80.3)	331(19.7)	<0.001
	Adequate(central)	765(74.2)	266(25.8)	(63.20)
Highest Education Level	No education	2256(91.9)	119(8.1)	
	Primary	617(82.8)	128(17.2)	<0.001
	Secondary or higher	517(52.8)	465(47.2)	(705.59)
Wealth index	Poorest	1062(95.6)	49(4.4)	
	Poorer	785(90.6)	81(9.4)	
	Middle	659(87.7)	92(12.3)	<0.001
	Richer	590(76.3)	183(23.7)	(874.59)
	Richest	294(43.2)	387(56.8)	
Birth in last five years	1	2107(76.9)	633(23.1)	
	2	1138(88.4)	149(11.6)	<0.001
	3	145(93.5)	10(6.5)	(92.11)
Sex of household head*	Male	2659(80.7)	635(19.3)	0.281
	Female	731(82.3)	157(17.7)	(1.16)
Currently working	No	787(68.6)	361(31.4)	<0.001
	Yes	2603(85.8)	431(14.2)	(161.25)
Husband's education*	No education	906(92.0)	79(8.0)	
	SLC and Below	2314(82.1)	504(17.9)	<0.001
	Above SLC	156(42.9)	208(57.1)	(423.84)
Occupation	never work	457(60.9)	293(39.1)	
	Agriculture sector	2748(88.7)	351(11.3)	<0.001
	Modern sector	185(55.6)	148(44.4)	(456.93)
ANC by provider	No one	1124(96.8)	37(3.2)	
	By informal sources	1001(93.5)	70(6.5)	<0.001
	By SBA	1265(64.5)	685(31.5)	(627.89)
Residence	Urban	583(58.6)	412(41.4)	<0.001
	Rural	2807(88.1)	380(11.9)	(429.36)
Total		3390(88.1)	792(18.9)	4182(100)

* There are some missing cases for this variable.

The working status of women shows a weak association with use of maternal health services. The hypothesis is that female economic participation can lead to greater use of health services, because employment will make women socialize outside the home and finally their raise awareness and change their behavior. However, Table 9 showed that working status does not necessarily translate into greater use of maternal health care. This may be because most of the women who work are from poor households and work for family survival or perhaps workingwomen experience time constraints that reduce their opportunities for receiving health care. This is indicated by the higher percent of these non-working (31 percent) women likely to delivery at health institute as compared to the working women (14 percent).

The results of cross tabulations between the place of delivery and the husband's education provide support to the hypothesis of this study which assumes that women with better educated husbands have a greater likelihood of utilizing adequate maternal health care services. Table 9 indicated that women whose husbands had higher educational level had greater chances (57 percent) of using modern health facilities for their delivery compared to women with lower education (8 percent). It is highly significant with a chi square of 423.84 and $p<0.001$.

As shown in Table 9, the occupation of women and place of delivery is statistically significant. As expected women's occupation in modern sector were more likely to use health institution as place of delivery than those in agricultural sector occupation. Table 9 indicated that women with never work has more give birth at health institution than a worker in an agricultural occupation (11 percent for agriculture sector and 39 percent for never work). It is highly significant with a chi square of 456.93 and $p<0.001$.This may be because most of the women who never work are from higher wealth index.

Antenatal care by provider appears to be significantly associated. Women who had their antenatal care by SBA were most likely to deliver their babies at health institute. On the other hand, mothers who had their ANC by informal sources had greater chances of delivering at a home (94 percent).

Finally, another demographic variable, place of residence is assumed to have relationship with place of delivery. The effect of place of residence upon place of delivery is expected to be positive in urban areas. As expected, among the urban residence 41 percent used health institute as place of delivery compared to 11 percent in rural residence.

4.3.2 Relationship between Socio-Economic and Demographic Characteristics and Assistance during Delivery

Bivariate analysis, using Chi-square tests, was used to examine the relationship between Socio-economic and demographic characteristics and utilization of MHCS as assistance during delivery (ADD). The assistance during delivery is related to a number of factors. Factors which were significantly associated with assistance during delivery were same as in place of delivery. The result of chi square statistics indicate

that there is no considerable significant relationship between religion, sex of household head and assistance during delivery.

As shown in Table 10, region appeared to be significantly associated. Women who live in adequate region were most likely to assistance during delivery by SBA (27 percent) compared to women live in scare region (14 percent). It is highly significant with a chi square of 81.77 and $p<0.001$.

The percent of women obtaining delivery assistance from skilled health professional was much higher for women who had secondary or higher education compared to those with no or primary school education. Results in the Table 10 showed that women with primary education delivered her baby by skilled attendants (19 percent) compared to a woman with no education (9 percent). The effects are even higher for those women who have secondary and higher education (51 percent). The chi square test suggest a significant relationship ($\chi^2 = 780.7$, $p<0.001$)

Among those poorest, 5 percent used SBA during delivery compared to 60 percent among those rich respondent. The results of the chi-square statistics indicate a statistically significant relationship between wealth index and assistance during delivery as health care services ($\chi^2=718.13$, $p<0.001$,) at 5 percent significance level.

Table 10: Relationship between ADD and Socio-economic and Demographic Characteristic in the Sample Data of Nepal, NDHS 2006

Variables	Description	Assistance during delivery by			p value (χ^2)
		No one (percent)	Informal sources(percent)	SBA	
Religion	Hindu	284(7.8)	2608(71.8)	741(20.4)	0.236
	Others	32(3.8)	407(74.1)	110(20.1)	(2.89)
Region	Scare(MW and FW)	155(10.5)	1105(75.1)	211(14.4)	
	Moderate(E and W)	115(6.8)	1198(71.3)	367(21.9)	<0.001
	Adequate(central)	46(4.5)	712(69.1)	273(26.5)	(81.77)
Highest Education Level	No education	247(10.0)	1995(81.3)	213(8.7)	
	Primary	55(7.4)	548(73.6)	142(19.0)	<0.001
	Secondary or higher	14(1.4)	472(48.1)	496(50.5)	(780.7)
Wealth index	Poorest	162(14.6)	892(80.3)	57(5.1)	
	Poorer	47(5.4)	730(84.3)	89(10.3)	
	Middle	60(8.0)	592(78.8)	99(13.2)	<0.001
	Richer	31(4.0)	546(70.6)	196(25.4)	(718.13)
	Richest	16(2.3)	255(37.4)	410(60.2)	
Birth in last five years	1	166(6.0)	1895(69.2)	679(24.8)	<0.001
	2	122(9.5)	1004(78.0)	161(12.5)	(125.46)
	3 or more	28(18.1)	116(74.8)	11(7.1)	
Sex of household head	Male	249(7.6)	2365(71.8)	680(20.6)	0.653
	Female	67(7.5)	650(73.2)	171(19.3)	(0.653)
Currently working	No	25(2.2)	744(64.8)	379(33.0)	<0.001
	Yes	291(9.6)	2271(74.9)	472(15.6)	(196.9)
Husband's education*	No education	109(11.1)	794(80.6)	82(8.3)	
	SLC and Below	196(7.0)	2073(73.6)	549(19.5)	<0.001
	Above SLC	9(2.5)	136(37.4)	219(60.1)	(455.35)
Occupation	never work	12(1.6)	431(57.5)	307(40.9)	
	Agriculture sector	285(9.2)	2424(78.2)	390(12.6)	<0.001
	Modern sector	19(5.7)	160(48.0)	154(46.3)	(470.57)
ANC by provider	No one	188(16.2)	931(80.2)	42(3.6)	
	By informal sources	65(6.1)	935(87.3)	71(6.6)	<0.001
	By SBA	63(3.2)	1149(58.9)	738(37.9)	(840.02)
Residence	Urban	32(3.2)	525(52.8)	438(44.0)	<0.001
	Rural	284(8.9)	2490(78.1)	413(13.0)	(459.73)
Total		316(7.6)	3015(72.1)	851(20.3)	4182(100.0)

* There are some missing cases for this variable.

The negative effect of birth upon the assistance during delivery is illustrated by the consistent decline in the percent of women who received assistance during delivery by SBA with the increase in birth order. Woman with a first pregnancy is more likely to seek delivery by SBA for first order than higher order births. The proportion of women assisted by skilled professional for those with only one child was 25 percent while it was 7 percent of those with three or more children. It is highly statistically significant.

A linear positive association is also found between husband's education and assistance during delivery. Result in the table above shows that the higher the education of husbands, the higher the tendency for using skilled professional birth attendants. As shown in the data, women whose husbands had above SLC educational

level were triple as likely to use skilled attendants as those whose husbands below SLC(20 percent for below SLC and 60 percent for above SLC). Conversely, the percent of women assisted by informal sources was inversely related to husband's education. It is highly significant with a chi square of 455.35 and $p<0.001$.

The working status of women shows a negative association with assistance at delivery. The hypothesis is that female economic participation can lead to greater use of health services, because employment will make women socialize outside the home and finally their raise awareness and change their behavior. However, Table 10 shows that employment does not necessarily translate into greater use of maternal health care. This may be because most of the women who work are from poor households and work for family survival or perhaps working women experience time constraints that reduces their opportunities for receiving health care. The unexpected finding is the relationship between assistance during delivery and currently working status of women. Currently non-working women tend to have a twice likelihood of assistance during delivery by SBA as compared to working women (33 percent for currently not working and 16 percent for currently working).

Looking at the link between women's occupation and assistance during delivery, the findings indicate that women who worked in modern sector occupations are more likely to have their delivery assisted by SBA. In contrast, most of the women engaged in agricultural occupations were assisted by informal sources (78 percent).It is highly significant with a chi square of 70.93 and $p<0.001$.

Urban residence was also found to be associated with an increased likelihood of assistance during delivery by SBA ($\chi^2=459.73$, $p<0.001$). Table 10 showed that the percent of urban women assistance during delivery by SBA is higher than of rural women (44 percent for urban and 13 percent for rural). It is commonly known that the modern health care providers tend to concentrate in urban areas, which may result in the much higher utilization of modern trained birth attendants in these areas.

4.3.3 Relationship between Socio-Economic and Demographic Characteristics and Number of ANC Visits

Bivariate analysis, using Chi-square tests, was used to examine the relationship between Socio-economic and demographic characteristics and utilization of MHCS as number of ANC visits. The assistance during delivery is related to a number of

factors. Factors which were significantly associated with number of ANC visits are same as in place of delivery. The result of chi square statistics indicate that there is no considerable significant relationship between number of ANC visits and sex of household head.

Maternal health service as number of ANC visit is statistically significant with religion with p value <0.01.

Women from the secondary or higher education were two times more likely to adequate ANC visit (60 percent) than those in the no education category (30 percent). It is statistically significant with chi square = 813.8 and p<0.001.

It was establish that 60 percent of those with richest wealth index, adequate visit to ANC compared to 20 percent among those who are in poorer wealth index. The result of chi square statistics indicates a significant relationship between wealth index and number of ANC visits.

The data also showed that women are more likely to adequate ANC visit for the 1stbirth order (32 percent) than any other subsequent birth orders (16 percent for 3^{rd} birth order, 23 percent for 2^{nd} birth order). Rural women were less likely (24 percent) than their counterparts (47 percent) to adequate ANC visits.

Table 11: Relationship between Number of times to ANC visits and Socio-economic and Demographic Characteristic in the Sample Data of Nepal, NDHS 2006

Variables	Description	Number of times to ANC visits			p value (χ^2)
		Never visit(percent)	Some visit (percent)	Adequate visit	
Religion	Hindu	988(27.2)	1560(42.9)	1085(29.9)	0.003
	Others	173(31.5)	250(45.5)	126(23.0)	(11.81)
Region	Scare(MW and FW)	474(32.2)	609(46.5)	388(14.7)	
	Moderate(E and W)	421(25.1)	742(44.2)	517(30.8)	<0.001
	Adequate(central)	266(25.8)	459(44.5)	306(29.7)	(23.74)
Education Level	No education	952(38.8)	1141(63.0)	362(29.9)	
	Primary	145(19.5)	337(45.2)	263(35.3)	<0.001
	Secondary or higher	64(6.5)	332(33.8)	586(59.7)	(813.8)
Wealth index	Poorest	553(49.8)	450(40.5)	108(9.7)	
	Poorer	269(31.1)	421(48.6)	176(20.3)	
	Middle	178(23.7)	366(48.7)	207(27.6)	<0.001
	Richer	117(15.1)	352(45.5)	304(39.3)	(825.9)
	Richest	44(6.5)	221(32.4)	416(61.1)	
Birth in last five years	1	692(25.3)	1161(42.4)	887(32.3)	<0.001
	2	411(31.9)	577(44.8)	299(23.3)	(55.49)
	3 or more	58(37.4)	72(46.5)	25(16.1)	
Sex of household head	Male	915(27.8)	1422(43.2)	957(41.6)	0.954
	Female	246(27.7)	388(43.7)	254(28.6)	(0.095)
Currently working	No	184(16.0)	487(42.4)	477(39.4)	<0.001
	Yes	977(32.2)	1323(43.6)	734(24.2)	(165.4)
Husband's education*	No education	423(32.2)	451(45.8)	111(11.3)	
	SLC and Below	722(25.6)	1299(43.6)	867(30.8)	<0.001
	Above SLC	12(3.3)	122(33.5)	230(63.2)	(431.02)
Occupation	never work	106(14.1)	305(40.7)	339(45.2)	
	Agricultural sector	1012(32.7)	21376(44.4)	711(22.9)	<0.001
	Modern sector	43(12.9)	129(38.7)	161(40.4)	(257.31)
ANC by provider	No one	1161(100.0)	0	0	
	By informal sources	0	855(79.8)	216(20.2)	<0.001
	By SBA	0	955(49.0)	995(51.0)	(456.4)
Residence	Urban	144(14.5)	388(39.0)	463(46.5)	<0.001
	Rural	1017(31.9)	1422(44.6)	748(23.5)	(227.87)
Total		1161(27.8)	1810(43.3)	1211(29.0)	4182

* There are some missing cases for this variable.

The occupation of the women is found to be significantly associated with adequate ANC visit (χ^2=257.31 and p<0.001). Women in modern sector occupation were more likely (40 percent) to have adequate ANC visit compared to agricultural sector women (23 percent).

The pattern of relation between number of ANC visits and covariates has been found to be broadly similar to that of place of delivery and assistance during delivery.

4.4 Bi-variate Analysis of 2011 NDHS

The bivariate statistical analysis addresses the marginal effect of a predictor variable on the response without taking into account other predictors. And it shows the association between the outcome variable and other predictor variables, obtained by

cross tabulation of the response variables, maternal healthcare (i.e. Place of delivery, assistance during delivery and frequency of ANC visits) usage to the other predictor variables independently.

4.4.1 Relationship between Socio-Economic and Demographic Characteristics and Place of delivery

The place of delivery is related to a number of factors. Factors which were significantly associated with place of delivery were: Religion, education level, wealth index, birth in last five years, husband's education, working status, place of residence, occupation and ANC by provider. The result of chi square statistics indicate that there is no considerable significant relationship between region(χ^2=3.89, p=0.143), sex of household head(χ^2=0.035, p=0.439) and Place of delivery.

Below Table 12 shows the relationship between place of delivery and socio-economic and demographic characteristic of 2011 NDHS. Among the Hindu, 41 percent used health institute as place of delivery compared to 33 percent among the other religion. The results of the chi-square statistics indicate a significant relationship between religion of the person and place of delivery as health care services (χ^2=13.19, p<0.001).

Table 12: Relationship between POD and Socio-economic and Demographic Characteristic in the Sample Data of Nepal, NDHS 2011

Variables	Description	Place of Delivery		p value (χ^2)
		Delivery at home(percent)	Delivery at Health institution(percent)	
Religion	Hindu	2062(59.3)	1418(40.7)	<0.001
	Others	402(67.1)	197(32.9)	(13.19)
Region	Scare(MW and FW)	811(61.4)	509(38.6)	
	Moderate(E and W)	1162(61.0)	743(39.0)	0.143
	Adequate(central)	491(57.5)	363(42.5)	(3.89)
Education Level	No education	1412(80.0)	353(20.0)	
	Primary	515(63.0)	302(37.0)	<0.001
	Secondary or higher	537(35.9)	960(64.1)	(662.44)
Wealth index	Poorest	987(85.1)	173(14.9)	
	Poorer	616(74.0)	216(26.0)	
	Middle	448(60.6)	291(39.4)	<0.001
	Richer	291(43.0)	386(57.0)	(946.20)
	Richest	122(18.2)	549(81.8)	
Birth in last five years	1	1684(56.7)	1288(43.3)	
	2	690(69.6)	302(30.4)	<0.001
	3or more	90(78.3)	25(21.7)	(67.48)
Sex of household head	Male	1816(60.5)	1186(39.5)	0.439
	Female	648(60.2)	429(39.8)	(0.035)
Currently working	No	711(47.0)	802(53.0)	<0.001
	Yes	1753(68.3)	813(31.7)	(180.95)
Husband's education*	No education	630(81.8)	140(18.2)	
	SLC and Below	1675(60.3)	1104(39.7)	<0.001
	Above SLC	148(28.8)	366(71.2)	(362.29)
Occupation	never work	372(38.7)	590(61.3)	
	Agri sector	1922(73.8)	681(26.2)	<0.001
	Modern sector	170(33.1)	344(66.9)	(546.95)
ANC by provider	No one	569(93.1)	42(6.9)	
	By informal sources	847(75.5)	232(21.5)	<0.001
	By SBA	1048(43.9)	1341(56.1)	(694.39)
Residence	Urban	280(31.2)	617(68.8)	<0.001
	Rural	2184(68.6)	998(31.4)	(409.69)
Total		2464(60.4)	1615(39.6)	4079(100)

* There are some missing cases for this variable.

A linear positive association is also found between respondent's education and place of delivery. Result in the Table 12 indicated that the higher the education of respondent, the higher the tendency for delivery at health institution. As shown in the data, women with secondary/highest educational level, 64 percent used health institute as place of delivery compared to 20 percent for no education. Conversely, the percent of women delivery at home was inversely related to respondent's education.

Among those poorest, 15 percent used health institute as place of delivery compared to 82 percent among those rich respondent. The results of the chi-square statistics indicate a statistically significant relationship between wealth index and place of delivery as health care services (χ^2= 946.20, p<0.001,).

The results in Table 12 showed that among the respondents whose occupation is agricultural sector, 26percent used health institute as place of delivery compared to 67 percent in modern sector occupations. The chi-square statistic test suggests a significant relationship between place of delivery as health care services and occupation (χ^2=546.925, p<0.001) at 5 percent significance level.

Another social indicator is husband's education. As expected, husband's education shows a strong and significant association with the utilization of all maternal health care services. Women who had better educated husbands tended to have better maternal health care services than those whose husbands were less educated. This is explained by the data which show that delivery at health institute was more prevalent among those women whose husbands had above SLC education, compared to women whose husbands were uneducated or SLC and below level. Further, husband's education appears to give a positive and significant impact on the use of place of delivery, reflected by the large Chi-square value of 326.29 at p<0.001.

4.4.2 Relationship between Socio-Economic and Demographic Characteristics and Assistance during Delivery

The kind of assistance during delivery is dependent on the place of delivery. Most of the deliveries at home are likely to be assisted by unskilled birth attendant (TBAs or close relatives) while births at a health institute are likely to be assisted by trained medical personnel. Table 13 shows the relationship between Assistance during delivery and Socio-economic and Demographic characteristic of NDHS 2011.

Table 13: Relationship between ADD and Socio-economic and Demographic Characteristic in the Sample Data of Nepal, NDHS 2011

Variables	Description	Assistance during delivery by			p value (χ^2)
		No one (percent)	Informal sources(percent)	SBA	
Religion	Hindu	137(3.9)	2109(60.6)	1234(35.5)	0.003
	Others	18(3.0)	407(67.9)	174(29.0)	(11.72)
Region	Scare(MW and FW)	74(5.6)	820(62.1)	426(32.3)	
	Moderate(E and W)	61(3.2)	1196(62.8)	648(34.0)	<0.001
	Adequate(central)	20(2.3)	500(58.5)	334(39.1)	(26.96)
Education Level	No education	114(6.5)	1345(76.2)	306(17.3)	
	Primary	24(2.9)	542(66.3)	251(30.7)	<0.001
	Secondary or higher	17(1.1)	629(42.1)	851(56.8)	(102.18)
Wealth index	Poorest	104(9.0)	926(79.8)	130(11.2)	
	Poorer	25(3.0)	629(75.6)	178(21.4)	
	Middle	10(1.4)	490(66.3)	239(32.3)	<0.001
	Richer	12(1.8)	313(46.2)	352(52.0)	(72.66)
	Richest	4(0.6)	158(23.5)	509(75.9)	
Birth in last five years	1	98(3.3)	1738(58.5)	1136(38.2)	<0.001
	2	49(4.9)	691(69.7)	252(25.4)	(12.45)
	3 or more	8(7.0)	87(75.7)	20(17.3)	
Sex of household head	Male	116(3.9)	1865(62.1)	1021(34.0)	0.513
	Female	39(3.6)	651(60.4)	387(35.9)	(1.33)
Currently working	No	27(1.8)	755(49.9)	731(48.3)	<0.001
	Yes	128(5.0)	1761(68.6)	677(26.4)	(12.45)
Husband's education*	No education	64(8.3)	588(76.4)	118(15.3)	
	SLC and Below	87(3.1)	1735(62.4)	957(34.4)	<0.001
	Above SLC	4(0.8)	182(35.4)	328(63.8)	(351.27)
Occupation	never work	16(1.7)	403(41.9)	543(56.4)	
	Agricultural sector	132(5.1)	1916(73.6)	555(21.3)	<0.001
	Modern sector	7(1.4)	197(38.3)	310(60.3)	(561.6)
ANC by provider	No one	79(12.9)	495(81.0)	37(6.1)	
	By informal sources	34(3.2)	854(79.1)	191(17.7)	<0.001
	By SBA	42(1.8)	1167(48.8)	1180(49.4)	(700.53)
Residence	Urban	15(1.7)	307(34.2)	575(64.1)	<0.001
	Rural	140(4.4)	2209(69.4)	833(26.2)	(445.79)
Total		155(3.8)	2516(61.7)	1408(34.5)	4079(100.0)

* There are some missing cases for this variable.

As shown in Table 13, it appeared that there is a consistent increase in the percent of women who have assistance during delivery by SBA with an increase in women's education level. It is revealed that women with secondary and higher education were more than thrice (57 percent) as likely to assistance during delivery by SBA with no education (17 percent). This association is highly significant with a χ^2= 102.18 and p<0.001)

As expected, women who had better educated husband tended to have better assistance during delivery than those whose husband were less educated (15 percent for no education and 64 percent for above SLC). Further husband's education appears to give a positive and significant impact on the assistance during delivery by the large chi square value of 351.27 at p<0.001.

A linear positive association is found between wealth index and assistance during delivery by SBA. Result in Table 13 showed that higher the wealth index, higher the tendency for assistance during delivery by SBA. Conversely, the percent of women assistance during delivery informal sources (TBA or others) was inversely related to wealth index. This is explained by data which showed that assistance during delivery by informal sources is 80percent for poorest compare to 24 percent for richest. It is highly significant with chi square value 102.18.

Assistance during delivery by SBA is more pronounced among currently not working women than their counter parts. This is indicated by the higher percent of these not currently working women to the currently working women. The assistance during delivery by SBA, who are not currently working is 48 percent compared to 26 percent among those who are currently working.

As expected, women in modern sector occupation were almost three times likelihood to assistance during delivery by SBA (60percent) than those in agriculture sector occupation (21percent).It is highly significant with chi square value 561.6 and $p<0.001$.

4.4.3 Relationship between Socio-Economic and Demographic Characteristics and Number of ANC Visits

An important function of ANC visit is to encourage women to choose biomedical oriented delivery care or assistance during delivery by SBA. Table 14 showed the Relationship between Number of times to ANC visits and Socio-economic and Demographic characteristic for 2011 NDHS survey.

Table 14: Relationship between Number of Times to ANC Visits and Socio-economic and Demographic Characteristic in the Sample Data of Nepal, NDHS 2011

Variables	Description	Number of times to ANC visits			p value (χ^2)
		Never visit(percent)	Some visit(percent)	Adequate visit	
Religion	Hindu	487(14.0)	1100(31.6)	1893(54.4)	<0.001
	Others	124(20.7)	217(36.2)	258(43.1)	(31.15)
Region	Scare(MW and FW)	188(14.2)	410(31.1)	733(54.7)	
	Moderate(E and W)	280(14.7)	620(35.5)	1005(52.8)	0.201
	Adequate(central)	143(16.7)	287(33.6)	424(49.6)	(5.97)
Education Level	No education	451(25.6)	762(43.2)	552(31.3)	
	Primary	104(12.7)	262(32.1)	451(55.2)	<0.001
	Secondary or higher	56(3.7)	293(19.6)	1148(76.7)	(718.39)
Wealth index	Poorest	356(30.7)	432(37.2)	372(32.1)	
	Poorer	140(16.8)	329(39.5)	363(43.6)	
	Middle	63(8.5)	273(36.9)	403(54.5)	<0.001
	Richer	38(5.6)	181(26.7)	458(67.7)	(672.56)
	Richest	14(2.1)	102(15.2)	555(82.7)	
Birth in last five years	1	413(13.9)	884(29.7)	1675(56.4)	<0.001
	2	179(18.0)	382(38.5)	431(43.4)	(59.42)
	3or more	19(16.5)	51(44.3)	45(39.2)	
Sex of household head	Male	463(15.4)	968(32.2)	1571(52.3)	0.397
	Female	148(13.7)	349(32.4)	580(53.9)	(1.85)
Currently working	No	151(10.0)	500(33.0)	862(57.0)	<0.001
	Yes	460(17.9)	817(31.8)	1289(50.2)	(48.75)
Husband's education*	No education	230(29.9)	347(45.1)	193(25.1)	
	SLC and Below	363(13.1)	873(31.4)	1543(55.5)	<0.001
	Above SLC	16(3.1)	92(17.9)	406(79.0)	(424.67)
Occupation	never work	75(7.8)	291(30.2)	596(62.0)	
	Agricultural sector	507(19.5)	929(35.7)	1167(44.8)	<0.001
	Modern sector	29(5.6)	97(17.9)	388(75.5)	(234.22)
ANC by provider	No one	611(100.0)	0	0	
	By informal sources	0	602(55.8)	477(44.2)	<0.001
	By SBA	0	715(29.9)	1674(70.1)	(432.7)
Residence	Urban	62(6.9)	220(24.5)	615(68.5)	<0.001
	Rural	549(17.3)	1097(34.5)	1536(48.3)	(126.04)
Total		611(15.0)	1317(32.3)	2151(52.7)	4079

* There are some missing cases for this variable.

It appears that there is a consistent increase in the percentage of women who have adequate ANC visit with an increase in women's education level. It is revealed that women with secondary and higher education tended to have adequate ANC visit than those with no education (31 percent). This association is highly significant with a chi square of 718.39 and p <0.001.

As expected, women who had better educated husband tended to have adequate ANC visit than those whose husband were less educated (25 percent for no education and 79 percent for above SLC). Further husband's education appears to give a positive and significant impact on the number of times to ANC visit.

Sex of household head has a weak association with assistance during delivery. There is not much variation in the sex of household head in the sample and therefore one cannot expect this variable to affect the dependent variable. Sex of household head does not have a significant impact on number of ANC visits.

Number of times to ANC visit is more pronounced among currently not working women than their counterparts. This is indicated by the higher percent of these not currently working women to the currently working women. The adequate ANC visit, who are not currently working is 39 percent compared to 24 percent among those who are currently working.

Looking at the link between women's occupation and number of times ANC visit, it is highly significant with chi square= 234.22 and $p<0.001$. The findings indicate that women who worked in modern sector occupations are more likely to adequate ANC visit.

Urban residence was also found to be associated with an increased likelihood of adequate ANC visit ($\chi^2=126.04$, $p<0.001$). Table 12shows that the percent of urban women adequate ANC visit is higher than of rural women (68 percent for urban and 48 percent for rural).

Antenatal care by provider appears to be significantly associated. Women who had their antenatal care by formal sources were most likely (70 percent) compared to antenatal by informal sources (44 percent) to adequate ANC visit. It is statistically significant with chi square = 432.8 and $p<0.001$.

Sex of household head has a weak association with number of times ANC visit. There is not much variation in the sex of household head in the sample (52 percent for male household head and 54 percent for female household head) and therefore one cannot expect this variable to affect the number of times ANC visit. Sex of household head does not have a significant impact on assistance during delivery.

The pattern of relationship between number of times to ANC visit and the covariates has been found to be broadly similar to that for assistance during delivery as can be seen in Table 12 and Table 13.

4.5 Logistic Regression Analysis of Selected Socio-economic and Demographic Variables, 2006 NDHS

In previous section bi-variate analysis has been performed to examine the nature of association between explanatory variables and health service use status. However bi-variate association between two variables does not necessarily imply a significant causal relationship between them in the presence of other variables. Therefore, a multivariate analysis was applied to determine which factor explain and predict health care service use outcomes. For multivariate analysis a binary logistic regression was employed, which would allowed the identification of each of the selected predictor variable on place of delivery, controlling for the effect of other predictor variables.

All together six variables are found statistically significant in explaining the delivery at health institute. These variables are highest education level (no education/ Primary/ secondary and higher), Birth in last five years (1/2/more than 2), wealth index (poorest/poorer/middle/richer/richest), Occupation (never work/agriculture sector/ modern sector), residence (rural/urban), and ANC by provider (by no one/by informal sources/by SBA).

Forward stepwise procedure is used to determine which of the predictors should be included in the model. First step in the process is usually to assess the significance of predictors in the model. This usually involves formulation and testing of statistical hypotheses to determine whether the independent variables in the model are significantly associated to the response variable. The likelihood ratio test for the overall significance of all coefficients for the predictor as well as significance of single predictor in the model is shown in Table 15.

The change in deviance follows a chi-square distribution with 13 degree of freedom and measures how well the independent variable affect the outcome or response variable. In this study chi square = 1248.316 with p value <0.001. This is a test of null hypothesis that adding the predictors to the model has not significantly increased our ability to predict the delivery at health institute. Hence it indicate that, we reject the null hypothesis and we may infer that at least one and perhaps most of the coefficients are different from zero and we may infer as a whole the predictors have significant contribution to predict the response variable.

Table 15: Analysis of Likelihood Ratio Chi-square Test, 2006 NDHS

Variables	steps	χ^2 for individual regressor	d.f.	Change in deviance(model χ^2)	d.f.
Wealth index	1	783.559	4	783.559	4
ANC by provider	2	263.368	2	1046.927	6
Highest education level	3	114.278	2	1161.205	8
Occupation	4	35.546	2	1196.751	10
Birth in last 5 years	5	33.519	2	1230.270	12
Residence	6	18.046	1	1248.310	13
Initial -2loglikelihood = 4059.278			All have p value <0.001		
Final -2log likelihood = 2810.96			Chi square = 1248.318		

The chi square for individual predictors is shown in 3rd column of Table 15. If the deviance reduces as predictor incorporated sequentially in the model, indicates the model fits the data well. The change is shown in 5th column of Table 15. Here the χ^2 test for the model is significant showing the acceptable fitting of the logistic regression model.

The overall fit of the model is assessed using the log likelihood (LL) statistics. In this analysis rather than reporting log likelihood itself, the value is multiplied by -2. (-2LL, which has an approximately chi square distribution). At the final stage -2LL should be less than the value when only constant is included in the model (lower value of -2LL indicates that the model is predicated the outcome variable more accurately). When only constant was included, -2LL=4059.276 but when other variables have been included, this -2LL has been reduce to 2810.96. This reduction tells us that the model is better predicting output variable than it has only the constant included. In the above fitted models, the p values are highly significant so we can say that over the model is predicting place of delivery significantly better than it was only constant included.

The results of logistic regression analysis of equation (4) are given in Table 16.

Table 16: Logistic Regression Estimates of the Odds Ratios of Selected Socio-economic and Demographic Characteristic of POD of Nepal, 2006 NDHS

Explanatory variables	Estimated coefficient	S.E.	p Value	Odds Ratio	95% Wald CI for OR	
					Lower	Upper
constant	-3.355	0.243	0.000	0.035		
Residence:						
Rural(R)	-	-	-	-	-	-
Urban	0.472	0.110	0.000	1.603	1.292	1.988
Education level:						
No education(R)		-	-	-	-	-
Primary	0.305	0.135	0.024	1.356	1.040	1.768
Secondary/higher	1.175	0.356	0.000	3.239	2.576	4.047
Wealth index:						
Poorest(R)	-	-	-	-	-	-
Poorer	0.337	0.197	0.088	1.400	0.951	2.061
Middle	0.395	0.197	0.045	1.484	1.010	2.181
Richer	0.626	0.188	0.001	1.869	1.294	2.700
Richest	1.294	0.197	0.000	3.647	2.467	5.392
Birth in last 5 years:						
1(R)	-	-	-	-	-	-
2	-0.610	0.116	0.000	0.543	0.433	0.682
3 or more	-0.869	0.356	0.015	0.420	0.209	0.843
Occupation:						
Never work(R)	-	-	-	-	-	-
Agricultural sector	-0.602	0.121	0.000	0.548	0.433	0.694
Modern sector	-0.057	0.159	0.721	0.945	0.692	1.291
ANC by provider:						
No one (R)	-	-	-			
Informal sources	0.572	0.217	0.008	1.771	1.159	2.708
SBA	1.753	0.187	0.000	5.769	4.002	8.318
C.I= Confidence Interval; Exp. = Exponent; R= Reference category.						
Chi- square	1248.318					
d.f.	13					
-2 Log likelihood	2810.96					
Cox and Snell R^2	0.258					
Negelkerke R^2	0.415					

Table 16 shows the result of logistic regression model, predicting the place of delivery. It presents the estimate of logistic coefficient, significance probability and odds ratio for each category. Residence, education level, wealth index and ANC by provider have a positive association with place of delivery.

The regression coefficient of EMW under urban areas is 0.472, with reference category rural area. The odds ratio for urban areas is 1.603; it indicates that the women of urban areas are 1.63 times more likely to deliver at health institute compare the rural women. The result is highly significant.

The logistic regression coefficient of EMW corresponding education is calculated. No education is considered as reference category. The coefficient corresponding to primary and secondary/higher level of education is 0.305 and1.175 respectively. Secondary/higher education is statistically highly significant but primary level

education is significant at 5 percent level of significance. Women with secondary/higher education level are almost 3.2 times more to deliver at health institute than odds of women with no education.

The logistic regression coefficient of EMW under different wealth index is computed. Poorest as a reference category, the coefficient corresponding to poorer, middle, richer and richest are 0.337, 0.395, 0.626 and 1.294 respectively. Results are statistically significant at $p<0.10$ for poorer, $p<0.05$ for middle and $p<0$ .01 for richer and richest. The expected odds ratios for richer and richest wealth index were found to be 1.87 (87 percent) and 3.65 (65 percent) times more likely to deliver at health institute compare to poorest wealth index.

Births in last 5 years and occupation have a negative association with place of delivery. In term of birth in last 5 years, women with 3 or more children are 58 percent less likely to delivery at health institute compare to women with one child. It is significant at $p<0.05$.

Interestingly, the relationship between women's occupation and place of delivery has an inverse association. Women whose work is in agricultural sector are (1-0.55=0.45) 45 percent less likely to give birth at health institute compare to women who never work. Although not statistically significant, it is suppressing that women whose occupation is in modern sector are less likely to delivery at health institute as compare to women whose occupation is never work. Women who never work may be associated with household of high economic status and for this reason, an inverse may have been found.

We find that antenatal care is a key determinant of whether a woman gives birth at health institute or at home. In general a woman who goes for antenatal care is more likely to deliver at health institute than a woman who does not go for antenatal checkup. The logistic regression coefficient to the ANC by informal sources and SBA is 0.572 and 1.753 respectively. Each has expected sign. The odd ratios indicates that the women having antenatal care by SBA are likely to have 5.77 times higher to deliver at health institute compare to women having ANC by no one.

Once the particular logistic regression model has been fitted, we begin the process of model adequacy tests.

4.5.1 Goodness of Fit

A better way of assessing the fit of a logistic regression model is compare the expected and observed number of positives for different subgroups of the data. If the observed expected numbers are sufficiently close, then we can assume that we have adequate model. It will indicate a poor fit if the significant value is less than 0.05. In general, the Hosmer-Lemeshow goodness of fit test divides subject into deciles based on predicted probabilities and computes a chi square from observed and expected frequencies which is shown in Table 17.

We observed from the Table 17, that the Hosmer-Lemeshow chi-square statistic with 8 degree of freedom is 6.243 with p value 0.620. The large p value signifies that there is no difference between the observed and predicted values, implying that the model fits the data at an acceptable level.

Table 17: Contingency Table for Hosmer-Lemeshow Test, 2006 NDHS

Deciles	Delivery at home		Delivery at health institute		Total	χ^2	d.f.	P value
1	445	443.237	5	6.763	450	6.243	8	0.620
2	330	329.525	7	7.475	337			
3	410	411.925	14	12.075	424			
4	387	390.934	20	16.066	407			
5	393	399.282	34	27.718	427			
6	376	377.530	48	46.470	424			
7	364	360.639	65	68.361	429			
8	312	306.349	106	111.651	418			
9	251	239.228	178	189.772	429			
10	122	131.351	315	305.649	437			

4.5.2 Residual Analysis

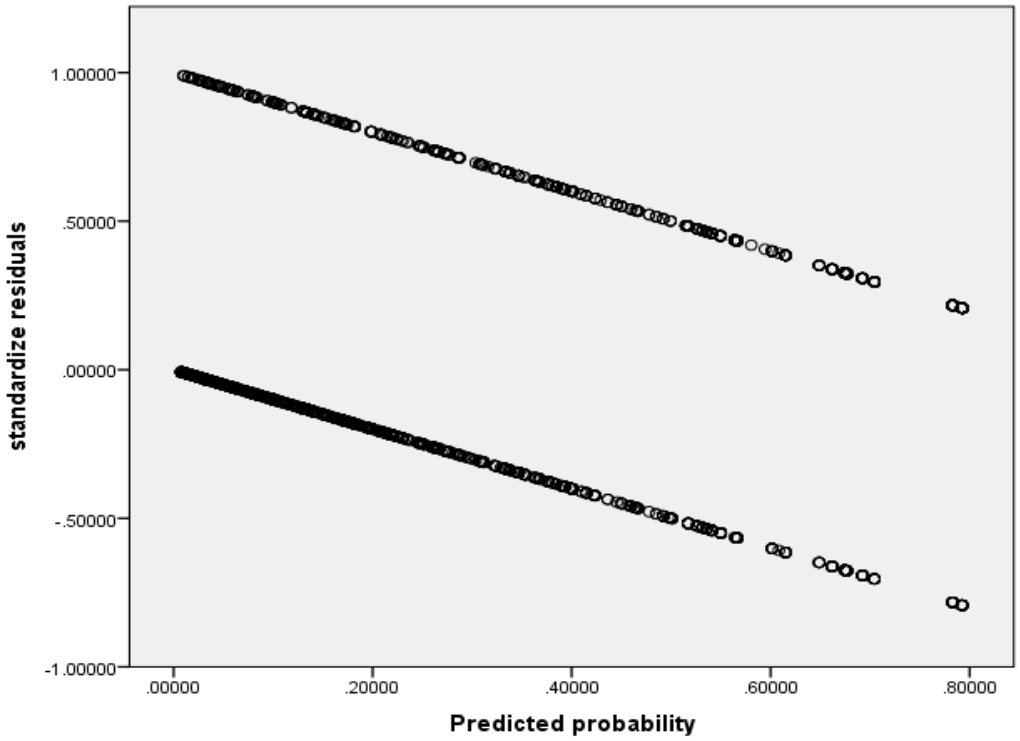
We perform an analysis of residuals and diagnostics to study the influence of observations and taking appropriate remedial measure. A failure to detect outliers and hence influential cases can have severe distortion on the validity of the inferences drawn from the model. It would be reasonable to use diagnostics to check if the model is adequate or not. The main focus here will be to detect outliers and influential cases that have a substantial impact on the fitted logistic regression model through appropriate graphical methods.

The diagnostic test results for detection of outliers and influential cases are included in the Annex 1 (DFBETA table). It reveals that all have values less than absolute value of 3 indicating the absence of outliers in the model implying the models are adequate. From the result presented in Annex 1, there are no high values of

DFBETAS (all values less than 0.025) which means that there are no influential observations for the individual regression coefficients.

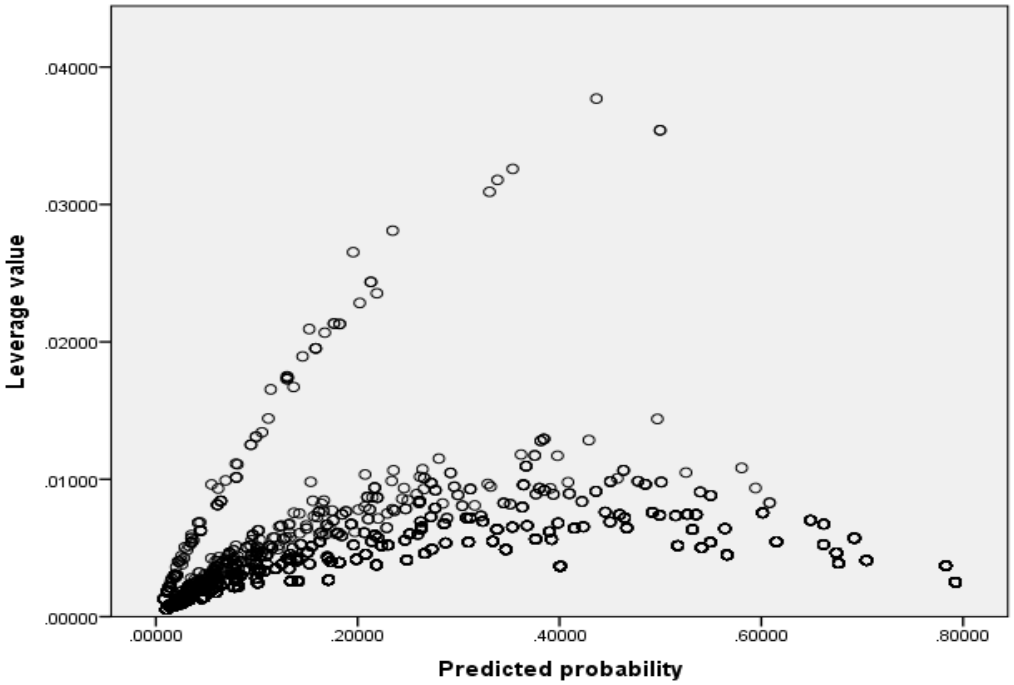
A check of the standardized residuals for the place of delivery is presented in Figure 6. It revealed that all have values less than absolute value of two indicating the absence of outliers in the model implying the models are adequate.

Figure 6: Scatter Plots for Outliers (Standardize Residuals), 2006 NDHS



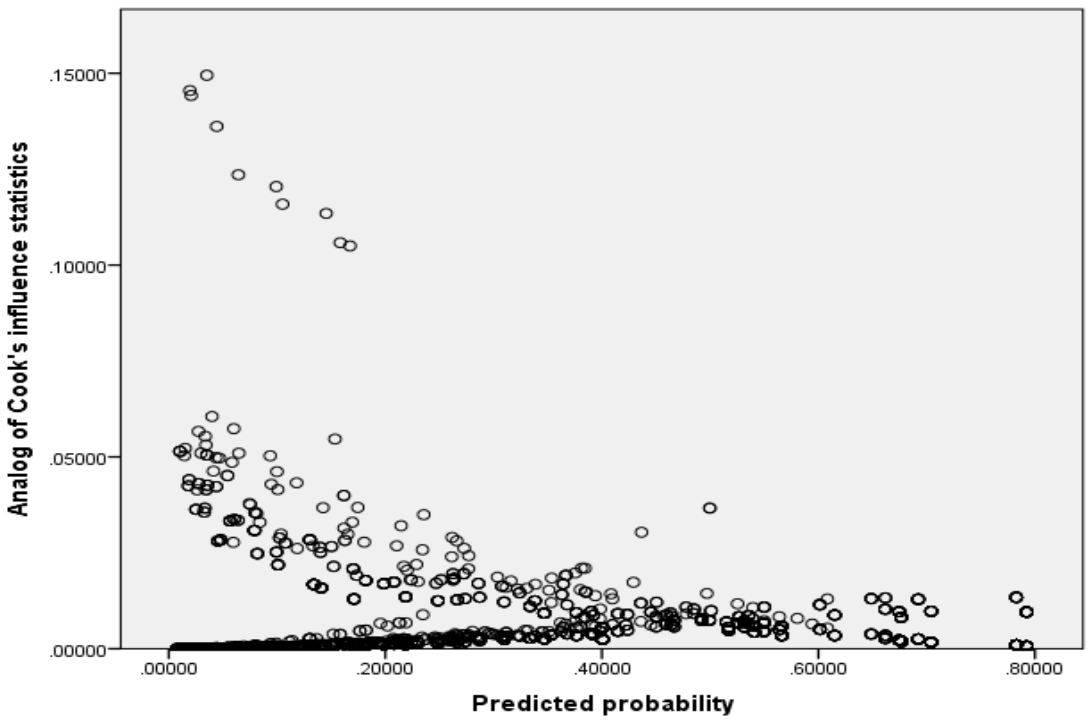
Another method of detecting outliers is leverage value. The greater the value of leverage, more potential that observation has for influencing the model fit. Leverage statistics which should be lie between 0 (the case has no influence whatsoever) and 1(the case exerts complete influence over the model), tell us about whether certain cases are welding undue influence over model. From the scatter plots of leverage values for the place of delivery shown in Figure 7, leverage values are less than one indicating the absence of outlying observation.

Figure 7: Scatter Plots for Diagnostic Checking (Leverage Value), 2006 NDHS



In addition, Cook's distance is proposed to measure the effect of excluding any specific observation on the set of parameter estimates. Cook (1977) gives the value of D, d>1 identifies cases that might be influential. Figure 8 indicated that there are no large values of Cook's distance (Di<1), means that there are no influential cases having an effect on the model.

Figure 8: Scatter Plots for Diagnostic Checking (Cook's Influence Statistics), 2006 NDHS



4.5.3 Examination of Multicollinearity

Multicollinearity in the constructed model is assessed through the examination of tolerance and Variance Inflation Factors (VIF). Examination of the VIF and tolerance did not show the presence of multicollinearity with all tolerance values are greater than 0.1. A VIF value greater than 10 is cause for concern and in this fitted model, values of estimates are less than 2. The collinearity statistics is given inTable 18.

Table 18: Collinearity Analysis, 2006 NDHS

Variables	Collinearity statistics 2006	
	Tolerance	VIF
Residence	0.806	1.240
Wealth index	0.631	1.585
Highest education level	0.702	1.425
Occupation	0.954	1.048
Birth in last 5 years	0.961	1.040
ANC by provider	0.725	1.379

Based on these, we may conclude that the model performance is good. Thus, from the above goodness of fit tests and diagnostic checking, we can say that the model is adequate.

4.6 Logistic Regression Analysis of Selected Socio-economic and Demographic Variables, 2011 NDHS

All together 7 variables are found statistically significant in explaining the delivery at health institute for 2011 NDHS. These variables are age, highest education level (no education/ Primary/ secondary and higher), Birth in last five years (1/2/ more than 2), wealth index (poorest/poorer/middle/richer/richest), Occupation (never work/agriculture sector/modern sector), residence (rural/urban), and ANC by provider (by no one/by informal sources/by SBA).

The change in deviance follows a chi-square distribution with 14 degree of freedom, and measures how well the independent variable affect the outcome or response variable. In this study chi square = 1258.600 with p value<0.001. This is a test of null hypothesis that adding the predictors to the model has not significantly increased our ability to predict the delivery at health institute. Hence it indicate that, we reject the null hypothesis and we may infer that at least one and perhaps most of the coefficients are different from zero and we may infer as a whole the predictors have significant contribution to predict the response variable.

Forward step wise procedure is used to determine which of the predictors should be included in the model. First step in the process is usually to assess the significance of predictors in the model. This usually involves formulation and testing of statistical hypotheses to determine whether the independent variables in the model are significantly associated to the response variable. The likelihood ratio test for the overall significance of all coefficients for the predictor as well as significance of single predictor in the model is shown in Table 19.

The chi square for individual predictors is shown in 3rd column of Table 19. If the deviance reduces as predictor Incorporated sequentially in the model, indicates the model fits the data well. The change is shown in 5th column in Table 19. Here the χ^2test for the model is significant showing the acceptable fitting of the logistic model for the data.

Table 19: Analysis of Likelihood Ratio Chi Square Test, 2011 NDHS

Variables	steps	χ^2 for individual regressor	d.f.	Change in deviance(model χ^2)	d.f.
Wealth index	1	994.277	4	994.277	4
ANC by provider	2	336.29	2	1330.577	6
Highest edu level	3	89.686	2	1420.262	8
Occupation	4	46.127	2	1466.389	10
Residence	5	31.697	1	1498.356	11
Current age	6	20.065	1	1518.422	12
Birth in last 5 years	7	8.051	2	1526.473	14
Initial -2loglikelihood = 5476.686			All have p value < 0.001		
Final -2log likelihood = 3950.213			Chi square = 1526.473		

The overall fit of the model is assessed using the log likelihood (LL) statistics. In this analysis rather than reporting log likelihood itself, the value is multiplied by -2. (-2LL, which has an approximately chi square distribution). At the final stage -2LL should be less than the value when only constant is included in the model (lower value of -2LL indicates that the model is predicated the outcome variable more accurately). When only constant was included, -2LL = 5476.686 but when other variables have been included, this -2LL has been reduce to 3950.213. This reduction tells us that the model is better predicting output variable than it has only the constant included. In the above fitted models, the p values are highly significant so we can say that over the model is predicting place of delivery significantly better than it was only constant included (Table 19).

The results of logistic regression analysis of equation (4) are given in Table 20.

Table 20: Logistic Regression Estimates of the Odds Ratios of Selected Socio-economic and Demographic Characteristic of POD of Nepal, 2011 NDHS

Parameters	b	S.E	P value	OR [Exp.(b)]	95% Wald C.I for OR	
					Lower	Upper
Intercept	-1.07	0.300	0.000	0.191		
Current age	0.036	0.008	0.000	0.965	0.950	0.980
Residence:						
Rural(R)	-	-	-			
Urban	0.590	0.103	0.000	1.804	1.474	2.209
Education level:						
No education(R)	-	-	-	-	-	-
Primary	0.391	0.108*	0.000	1.478	1.195	1.827
Secondary/higher	0.829	0.104	0.000	2.290	1.865	2.807
Wealth index:						
Poorest(R)	-	-	-	-	-	-
Poorer	0.299	0.124	0.016	1.348	1.057	1.720
Middle	0.533	0.126	0.000	1.704	1.331	2.181
Richer	0.718	0.138	0.000	2.051	1.564	2.690
Richest	1.516	0.169	0.000	4.555	3.272	6.339
Birth in last 5 years:						
1(R)	-	-	-	-	-	-
2	-0.216	0.095	0.023	0.806	0.669	0.971
3 or more	-0.514	0.273	0.059	0.598	0.350	1,213
Occupation:						
Never work(R)	-	-	-	-	-	-
Agricultural sector	-0.588	0.102	0.000	0.555	0.454	0.679
Modern sector	-0.070	0.273	0.601	0.932	0.716	1.213
ANC by provider:						
No one (R)	-	-	-	-	-	-
Informal sources	0.965	0.188	0.000	2.624	1.816	3.791
SBA	1.956	0.176	0.000	7.068	5.003	9.985
C.I= Confidence Interval; Exp. = Exponent; R= Reference category.						
Chi-square	1526.473					
d.f.	14					
-2Log likelihood	3950.213					
Cox and Snell's R^2	0.314					
Negelkerke R^2	0.423					

Estimated model coefficients and corresponding values of odds ratios revealed the following important result on predicting place of delivery. It is to be noted that estimated parameter coefficients are statistically significant with p value less than 0.01 for most of the independent variables. As in 2006 NDHS, residence; highest education level, wealth index and ANC by provider have a positive association with place of delivery and births in last 5 years and occupation and birth in last 5 years have a negative association with place of delivery.

The regression coefficient of EMW under urban areas is 0.590, with reference category rural area. The odds ratio suggests that compared to women who lived in rural areas, women who resided in urban areas were about 1.80 times more likely to have delivery in health institute, which is slightly higher based upon 2006 data (OR 1.6).

Education, again, have significantly strong positive associations with the use health institute as place of delivery. All the results are statistically highly significant. Women with primary and secondary/higher education level are almost 1.48 and 2.29 times more to deliver at health institute than odds of women with no education.

As compared to poorest women, the odd ratio of poorer/ middle/ richer/ richest women have more odd ratios as shown in Table 20. All values are highly significant compared to 2006 NDH($p<0.05$ for poorer, $p<0.001$ for middle richer and richest). The odd ratios are also increased compared to 2006 NDHS data. This suggests that as the economic condition of Nepalese women improve, delivery at health institute increases gradually.

Interestingly, the relationship between women's occupation and place of delivery has an inverse association. Women whose work is in agricultural sector are (1-0.55=0.45) 45percent less likely to give birth at health institute compare to women who never work. Although not statistically significant, it is suppressing that women whose occupation is in modern sector are (1-0.93=0.07) 7percent less likely to delivery at health institute as compare to women whose occupation is never work. Women who never work may be associated with household of high economic status and for this reason, an inverse may have been found.

The logistic regression coefficient to the ANC by informal sources and SBA is 0.965 and 1.956 respectively. Each has expected sign. The odds ratios indicates that the women having antenatal care by SBA are likely to have 7.07 times higher to deliver at health institute compare to women having ANC by no one which is higher than 2006 NDHS (5.77).

There is not statistically significant relationship between the birth in last 5 years with delivery at health institute ($p>0.06$) for 3 or more birth in last 5 years.

4.6.1 Goodness of Fit

A better way of assessing the fit of a logistic regression model is compare the expected and observed number of positives for different subgroups of the data. If the observed expected numbers are sufficiently close, then we can assume that we have adequate model. It will indicate a poor fit if the significant value is less than 0.05. In general, the Hosmer-Lemeshow goodness of fit test divides subject into deciles based

on predicted probabilities and computes a chi square from observed and expected frequencies which is shown in Table 21.

Table 21: Contingency Table for Hosmer-LemeshowTest, 2011 NDHS

Deciles	Delivery at home		Delivery at health institute		Total	χ^2	d.f.	P value
1	393	392.713	14	14.287	407	7.901	8	0.443
2	381	376.802	29	33.198	410			
3	340	350.540	68	57.460	408			
4	325	320.328	83	87.672	408			
5	289	289.930	120	119.070	409			
6	237	244.352	167	159.648	404			
7	212	201.111	199	209.889	411			
8	149	148.347	257	257.653	406			
9	101	93.341	310	317.659	411			
10	37	46.537	368	358.463	405			

We observed from the Table 21, that the Hosmer-Lemeshow chi-square statistic with 8 degree of freedom is 7.901 with p value 0.443. The large p value signifies that there is no difference between the observed and predicted values, implying that the model fits the data at an acceptable level.

In this study, Cox and Snell's R^2 has been used, which is based on the log likelihood of the model (LL_{new}) and log likelihood of the original model ($LL_{baseline}$) and the sample size. Here Cox and Snell's R^2 is 0.314 and Negelkerke R^2 is 0.423.

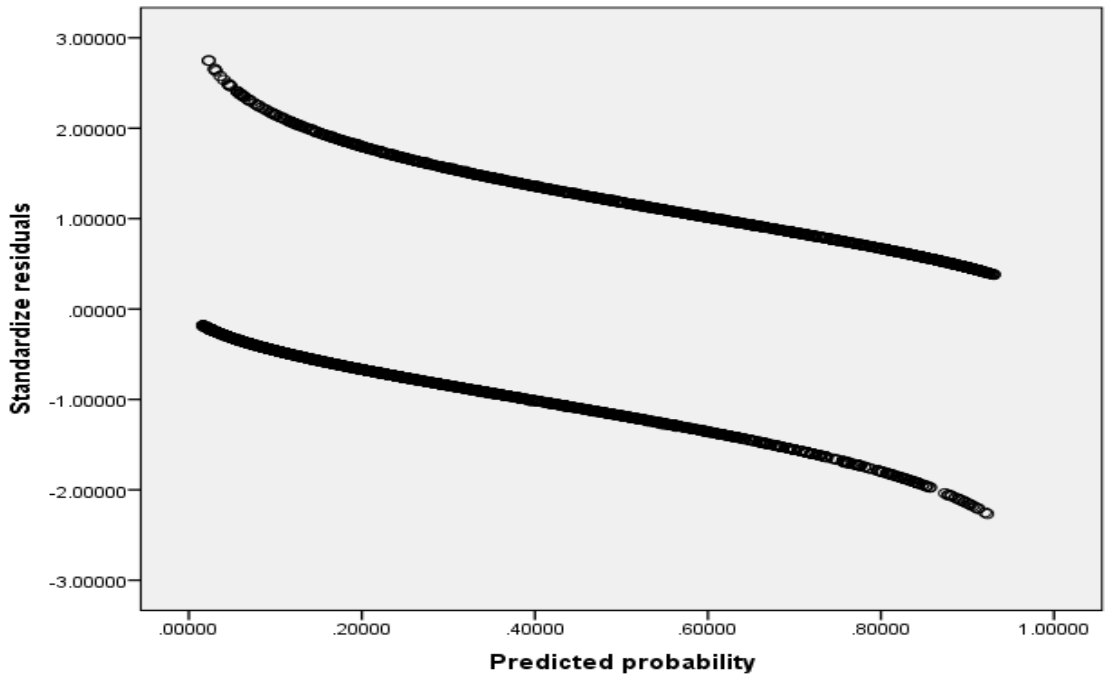
4.6.2 Residual Analysis

We perform an analysis of residuals and diagnostics to study the influence of observations and taking appropriate remedial measure. A failure to detect outliers and hence influential cases can have severe distortion on the validity of the inferences drawn from the model. It would be reasonable to use diagnostics to check if the model is adequate or not. The main focus here will be to detect outliers and influential cases that have a substantial impact on the fitted logistic regression model through appropriate graphical methods.

The diagnostic test results for detection of outliers and influential cases are included in the Annex 2 (DFBETA table). It reveals that all have values less than absolute value of 3 indicating the absence of outliers in the model implying the models are adequate. From the result presented in Annex 2, there are no high values of DFBETAS (all values less than 0.025) which means that there are no influential observations for the individual regression coefficients.

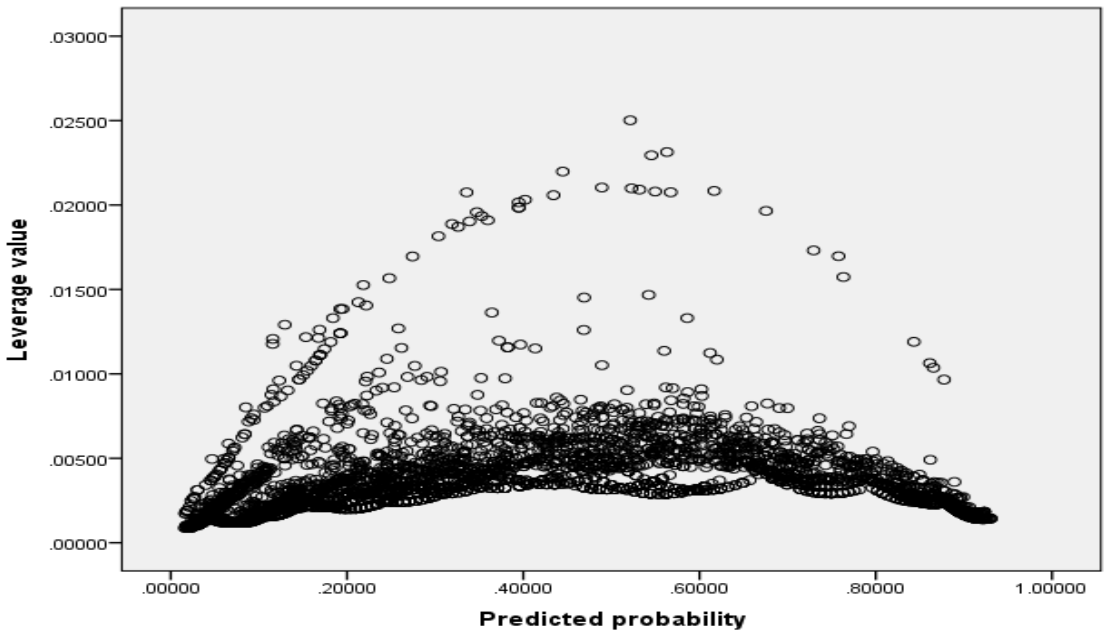
A check of the standardized residuals for the place of delivery is presented in Figure 9. Residual should be checked for influential and outliers. As a brief guide, the output list cases with standardized residuals greater than absolute value two. In a sample, we would expect around 5-10 percent of cases to have standardized residuals with absolute value greater than this. In this study, only 79 cases out of 4079 cases have absolute value greater than two. Therefore we can fairly sure that there is no outliers.

Figure 9: Scatter Plots for Outliers (Standardize Residuals), 2011 NDHS



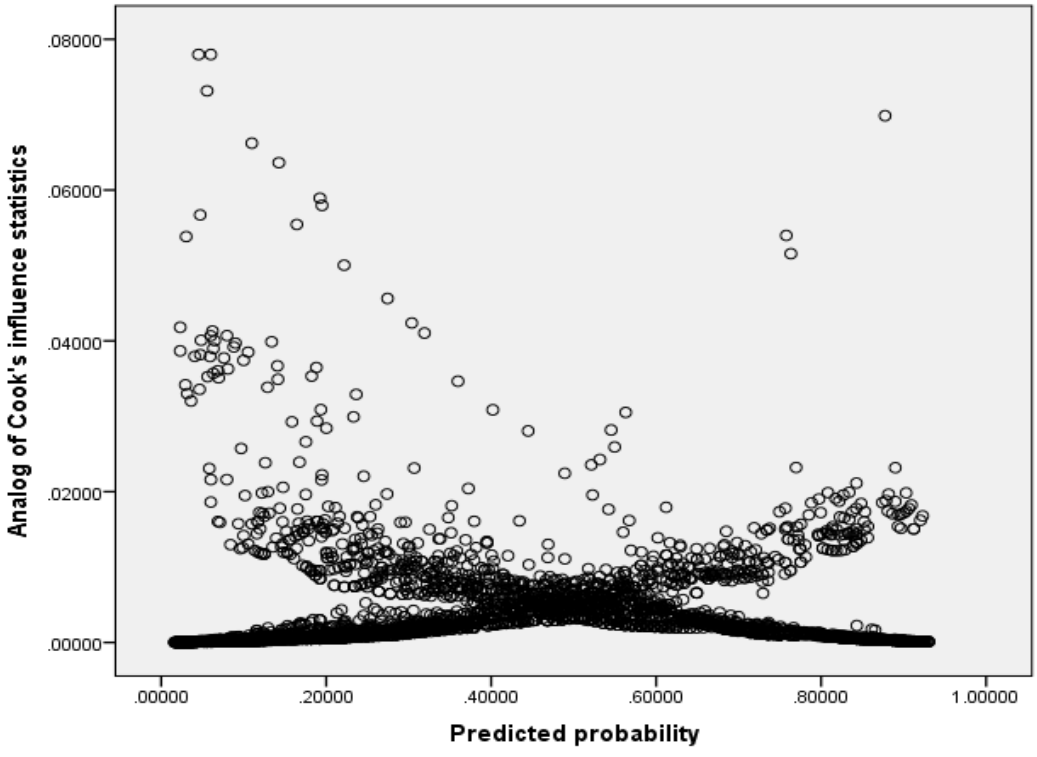
Another method of detecting outliers is leverage value. The greater the value of leverage, more potential that observation has for influencing the model fit. Leverage statistics which should be lie between 0(the case has no influence whatsoever) and 1(the case exerts complete influence over the model), tell us about whether certain cases are welding undue influence over model. From the scatter plots of leverage values for the place of delivery shown in Figure 10, leverage values are less than one indicating the absence of outlying observation.

Figure 10: Scatter Plots for Diagnostic Checking (Leverage Value), 2011NDHS



In addition, Cook's distance is proposed to measure the effect of excluding any specific observation on the set of parameter estimates. Cook (1977) gives the value of D, d>1 identifies cases that might be influential. Figure 8 indicated that there are no large values of Cook's distance (Di<1), means that there are no influential cases having an effect on the model.

Figure 11: Scatter Plots for Diagnostic Checking (Cook's Influence Statistics), 2011 NDHS



4.6.3 Examination of Multicollinearity

Multicollinearity in the constructed model is assessed through the examination of tolerance and Variance Inflation Factors (VIF). Examination of the VIF and tolerance did not show the presence of multicollinearity with all tolerance values are greater than 0.1. A VIF value greater than 10 is cause for concern and in this fitted model, values of estimates are less than 2. The collinearity statistics is given in Table 22.

Table 22: Collinearity Analysis, 2011 NDHS

Variables	Collinearity statistics 2011	
	Tolerance	VIF
Current age	0.859	1.164
Residence	0.777	1.286
Wealth index	0.550	1.818
Highest education level	0.625	1.601
Occupation	0.962	1.040
Birth in last 5 years	0.938	1.066
ANC by provider	0.793	1.261

Based on these, we may conclude that the model performance is good. Thus, from the above goodness of fit tests and diagnostic checking, we can say that the model is adequate.

4.7 Predicted Probabilities for Place of delivery, 2006 NDHS

In the logistic regression model for assessing, the impact of socio-economic and demographic variables on place of delivery, highest education level, wealth index and place of residence have shown highly significant. So predicting probabilities for place of delivery at health institute, another logistic regression was fitted with highest education level, wealth index and place of residence as independent variables. The form of the logistic regression model is as following

Log_e(probability for place of delivery at health facility) = $\alpha+\beta_1 X_1 +\beta_2 X_2 + \beta_3 X_3$

$$\text{Log}_e(p) = -3.439 +\beta_1 X_1 +\beta_2 X_2 + \beta_3 X_3$$

Where, X_1 = highest level of education achieved = ($X_{10} = 0$, $X_{11} = 1$, $X_{12} = 2$)

$\beta_{1o} = 0$, $\beta_{11} = 0.498$, $\beta_{12} = 1.511$)

X_2 = Wealth index = ($X_{20} = 0$, $X_{21} = 1$, $X_{22} = 2$, $X_{23} = 3$, $X_{24} = 4$;

$\beta_{2o} = 0$, $\beta_{21} = 0.638$, $\beta_{22} = 0.866$, $\beta_{23} = 1.301$, $\beta_{24} = 2.141$)

X_3 = Place of residence = ($X_{30} = 0$, $X_{31} = 1$; $\beta_{3o} = 0$, $\beta_{31} = 0.805$)

Figure 12: Predicted Probabilities for POD by Wealth Index, Education Level and Residence, 2006 NDHS

As display in Table 12(Table is given in Annex 3) the predicted probabilities for the three independent variables are presented. As shown in the Table 12, the probability of delivery at health institute increases as the wealth index increases. However there are differences in the predicted probabilities depending on the education level and place of residence. The predicted probabilities are clustered together towards the lower end of wealth index. When the wealth index of the household is low, difference in education level and place of residence do not seem to be substantially effect place of delivery. The inability to pay for the cost of an institutional delivery seems to be major in determining place of delivery.

At the lowest household wealth index, group of EMW with no education & from the rural area have the probability for delivery at health institute is. 3.1 percent ($1/1+e^{-[-3.439 + 0\ (0) - 0\ (0) + 0(0)]} = 0.0311$). As the wealth index increases, this group's probability for delivery at health institute increased to 21.4 percent ($1/1+e^{-[-3.439 + 0\ (0) - 2.141\ (4) + 0(0)]} = 0.21463$).

As the wealth index increases, the gap between the different groups widens. At the highest household wealth index, with highest level of education (secondary and above) and from the urban areas women have 74percent [$1 / 1 + e^{-[-3.439 + 1.511\ (1) - 2.141\ (2) + 0.805\ (1)]} = 0.73485$] probability of having an institutional delivery. Fig 12 shows that probability for delivery at health facility for primary education in rural areas is

less than for no education in urban areas. Even though less in education level, women from urban areas are more likely to deliver in health institute than women from rural areas. It may be due to the easy access of the health services in urban areas than rural areas.

Besides, to get a better understanding of why women do not give birth at a health institute, the 2006 NDHS asked women who gave birth in the five years before the survey, why didn't they give birth in a health institute. Table 23 indicates the reason of not delivery in health institute. In a data set 792 respondents delivered at health institute, therefore only 3,390 respondents gave the answer of that question.

Table 23 presents the percentage distribution of women who did not seek maternal health care by various reasons. As can be seen lack of awareness appears to be the most important factor for not delivery at health institute. 64 percent of women thought that delivery at health institute is not necessary, 18 percent of the respondent answered that 'it was not customary' and 5 percent of the respondents said 'it was too far'. Four percent of the respondent said that child born before went to health institute. Other reasons are presented in Table 23.

Table 23: Reason for Not Delivery at Health Institute, 2006 NDHS

Reason of not delivery in health facility	Frequency	Percent (%)	Cumulative Percent
cost too much	81	2.4	2.4
facility not open	11	0.3	2.7
too far/ no transportation	162	4.8	7.5
don't trust facility	27	0.8	8.3
no female provider	5	0.1	8.4
husband/ family did	60	1.8	10.2
not necessary	2169	64.0	74.2
not customary	619	18.3	92.4
security concern	33	1.0	93.4
child born before	122	3.6	97.0
others	101	3.0	100.0
Total	3390	100.0	

4.8 Predicted Probabilities for Place of Delivery, 2011 NDHS

Highest educational level, wealth index and place of residence of women are strongly significant and most important predictor in this model. So the predicted probabilities of place of delivery are calculated only for these three variables. Separate logistic regression was fitted with highest education level, wealth index and place of residence as independent variables. The form of the logistic regression model is as following

Log_e(probability for place of delivery at health facility) = $\alpha+\beta_1 X_1 +\beta_2 X_2 + \beta_3 X_3$

$$Log_e(p) = -2.080 +\beta_1 X_1 +\beta_2 X_2 + \beta_3 X_3$$

Where, X_1 = highest level of education achieved = ($X_{10} = 0$, $X_{11} = 1$, $X_{12} = 2$)

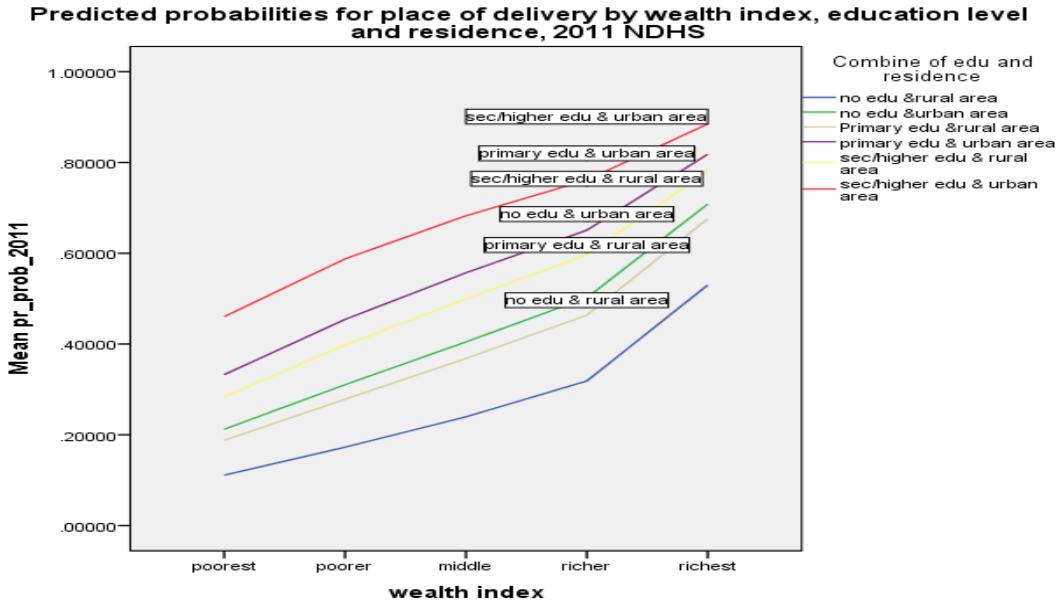
$\beta_{1o} = 0$, $\beta_{11} = 0.615$, $\beta_{12} = 1.152$)

X_2 = Wealth index = ($X_{20} = 0$, $X_{21} = 1$, $X_{22} = 2$, $X_{23} = 3$, $X_{24} = 4$;

$\beta_{2o} = 0$, $\beta_{21} = 0.514$, $\beta_{22} = 0.925$, $\beta_{23} = 1.320$, $\beta_{24} = 2.20$)

X_3 = Place of residence = ($X_{30} = 0$, $X_{31} = 1$; $\beta_{3o} = 0$, $\beta_{31} = 0.769$)

Figure 13: Predicted Probabilities for POD by Wealth Index, Education level and Residence, 2011 NDHS



As display in Figure 13(Table is given in Annex 4) the predicted probabilities for the three independent variables are presented. As shown in the fig, the probability of delivery at health institute increases as the wealth index increases. However there are differences in the predicted probabilities depending on the education level and place of residence. The predicted probabilities are not so clustered together towards the lower end of wealth index as in 2006 NDHS data

At the lowest household wealth index, group of EMW with no education & from the rural area have the probability for delivery at health institute is. 11.1 percent ([1/ 1 + e

$^{-[-2.080 + 0\ (0) - 0(0) + 0(0)]}$ = 0.11106), which is higher than predicted probability for 2006 NDHS (3.1 percent). As wealth index increases, this group's probability for delivery at health institute increased to 53.0 percent (1/ 1 + e $^{-[-2.080 + 0\ (0) - 2.200\ (4) + 0(0)]}$ = 0.53003). At the highest household wealth index, with highest level of education (secondary and above) and from the urban areas women have 89 percent [1 / 1 + e $^{-[-2.080 + 1.152\ (2) - 2.2\ (4) + 0.769\ (1)]}$ = 0.88502] probability of having an institutional delivery.

Figure 13 shows that in all wealth index, probability for delivery at health facility for primary education in rural areas is less than for no education in urban areas and secondary/higher education in rural area is less than primary education in urban areas. Even though less in education level, women from urban areas are more likely to deliver in health institute than women from rural areas. It may be due to the easy access of the health services in urban areas than rural areas.

Besides, to get a better understanding of why women do not give birth at a health institute, the 2011 NDHS asked women who gave birth in the five years before the survey, why didn't they give birth in a health institute. Table 24 indicates the reason of not delivery in health institute. In a data set 1615 respondents delivered at health institute, therefore only 2464 respondents gave the answer of that question.

Table 24 presents the percentage distribution of women who did not seek maternal health care by various reasons. As in 2006 NDHS, lack of awareness appears to be the most important factor for not delivery at health institute. 57 percent of women thought that delivery at health institute is not necessary which is 7 percent less than 2006 NDHS. 13 percent of the respondent answered that 'it was too far' and 10 percent of the respondents said 'it was not customary. 8 percent of the respondent said that child born before went to health institute. Other reasons are presented in Table 24.

Table 24: Reason for Not Delivery at Health Institute, 2011 NDHS

Reason of not delivery in health facility	Frequency	Percent(%)	Cumulative Percent
cost too much	42	1.7	1.7
facility not open	32	1.3	3
too far/ no transportation	314	12.7	15.7
don't trust facility	34	1.4	17.1
no female provider	6	0.2	17.3
husband/ family did	53	2.2	19.5
not necessary	1396	56.7	76.2
not customary	256	10.4	86.6
security concern	7	0.3	86.9
child born before	208	8.4	95.3
others	116	4.7	100
Total	2464	100	

4.9 Multinomial Logistic Regression Analysis of Selected Socio-economic and Demographic Variables, 2006 NDHS

In previous section, for place of delivery as binary response variable, logistic regression model has been applied. In this section, the response variable as maternal health service utilization is assistance during delivery which takes the three categories: a) assistance during delivery by no one b) assistance during delivery by unskilled birth attendant (USBA) and c) assistance during delivery by skilled birth attendant (SBA). For this Multi Nominal Logistic Regression (MNLR) model have been applied which would allowed the identification of the each of the selected predictor variable on assistance during delivery, controlling for the effect of other predictor variables. All together 8 variables are found statistically significant. These variables are current age, education level (no education/Primary/ secondary and higher), birth in last five years (1/2/more than 2), wealth index (poorest/poorer/middle/richer/richest), region (scare/moderate/ adequate), residence (rural/urban), ANC by provider (by no one/by informal sources/ by SBA) and currently working(yes/no).

For MNLR model, one of response category is taken as a base line or reference category to calculate the log odds of other categories relative to the reference category. In this study, assistance during delivery by no one is taken as reference category hence would take odds of being assistance during delivery by USBA verses assistance during delivery by no one and assistance during delivery by SBA verses assistance during delivery by no one. To run MNLR model in SPSS, the minimum sample size required is 15-20 cases per independent variable. In this study, the data set has 4182 cases and 8 independent variables for a ratio of 522 to 1.

First step in the process is usually to assess the significance of predictors in the model. This usually involves formulation and testing of statistical hypotheses to determine whether the independent variables in the model are significantly associated to the response variable. The likelihood ratio test for the overall significance of all coefficients for the predictor as well as significance of single predictor in the model is shown in Table 24.

The -2LL value is 5657.763 measures of models with no independent variables i.e. only intercept term. The final -2LL values is 4045.932 which is computed after all the

independent variables have been interred into the MNLR model. The difference between these two measures follows a chi-square distribution with 30 degree of freedom and measures how well the independent variable affect the outcome or response variable. In this study chi square = 1611.831 with p value<0.001.

Table 25: Analysis of Likelihood Ratio Chi Square Test, 2006 NDHS

Variables	-2loglikelihood	Chi square	d.f.
Intercept	5657.763		
Wealth index	4765.212	892.551	8
ANC by provider	4393.536	371.676	4
Highest education level	4284.173	145.363	4
Age	4193.105	55.068	2
Birth in last 5 years	4138.538	54.567	4
region	4098.956	39.582	4
Residence	4066.914	32.042	2
Currently working	4045.932	20.982	2
Initial -2loglikelihood = 5657.763		All have p value <0.001	
Final -2log likelihood = 4045.932		Chi square = 1611.831	

This is a test of null hypothesis that adding the predictors to the model has not significantly increased our ability to predict the delivery at health institute. Hence it indicate that, we reject the null hypothesis and we may infer that at least one and perhaps most of the coefficients are different from zero and we may infer as a whole the predictors have significant contribution to predict the response variable. Here the χ^2 test for the model is significant showing the acceptable fitting of the MNLR model. The results of MNLR analysis of equation (19) are given in Table 26.

Table 26: MNLR Estimates of the Odds Ratios of Selected Socio-economic and Demographic Characteristic of ADD of Nepal, 2006 NDHS

Variables	ADD by USBA verses ADD by no one				ADD by SBA verses ADD by no one			
	b(S.E)	e^b	p value	95% CI forOR	b(S.E)	e^b	p value	95% CI forOR
Constant	3.540(0.341)		0.000		-0.210(0.468)		0.201	
Age	-0.071(0.010)	0.931	0.000	0.914-0.949	-0.070(0.013)	0.932	0.000	0.909 0.956
Residence: Rural(R)								
Urban	0.345(0.215)	1.412	0.109	0.926-2.152	0.888(0.233)	2.431	0.000	1.541-3.834
Edu. level: No Edu. (R)								
Primary	0.381(0.174)	0.683	0.028	0.486-1.071	0.012(0.212)	1.012	0.955	0.668-1.533
Sec/higher	0.690(0.186)	1.939	0.029	0.960-3.512	1.942(0.318)	3.740	0.000	12.999
W.I: Poorest(R)								
Poorer	0.639(0.181)	1.894	0.000	1.327-0.681	0.883(0.254)	2.418	0.001	1.469-3.980
Middle	-0.038(0.177)	0.963	0.830	0.873-0.370	0.274(0.251)	1.315	0.274	0.805-2.149
Richer	0.303(0.224)	1.354	0.176	2.703-1.361	0.846((0.279)	2.330	0.002	1.384-4.027
Richest	-0.368(0.319)	0.692	0.249	2.101-1.294	1.003(0.356)	2.728	0.005	1.357-5.482
Region: Scare(R)								
Moderate	0.308(0.144)	1.361	0.032	1.020-1.386	0.324(0.180)	1.383	0.071	0.972-1.979
Adequate	0.690(0.186)	1.994	0.000	1.805-2.870	1.116(0.221)	3.051	0.000	1.967-4.704
Birth order: 1(R)								
2	-0.406(0.135)	0.666	0.003	0.512-0.197	-1.021(0.172)	0.360	0.000	0.257-0.067
3 or more	-1.142(0.245)	0.319	0.000	0.867-0.16	-1.910(0.408)	0.148	0.000	0.504-0.330
ANC by provider: No one (R)								
Info sources	0.813(0.159)	2.254	0.000	1.652-1.634	1.187(0.256)	3.277	0.000	1.984-5.412
SBA	0.828(0.172)	2.289	0.000	3.075-3.206	2.523(0.240)	12.46	0.000	7.792-9.929
Cur.working: Yes								
No	0.869(0.226)	2.385	0.000	1.532-3.715	1.036(0.243)	2.818	0.000	1.749-4.539
C.I= Confidence Interval; Exp. = Exponent; R= Reference category.								

Table 26 shows the result of MNLR model, predicting the assistance during delivery. It presents the estimate of multinomial logistic regression coefficients, significance probability and odd ratios for each category. Thus multinomial regression model was used to examine the specific effect of independent variables on assistance during delivery. Moderate and adequate region, secondary/highest education level, poorer wealth index and ANC by provider and currently working women have a positive association with assistance during delivery by USBA verses none whereas age and birth in last 5 years have a negative association. Urban residence, middle, richer, richest wealth index gives non-significant result.

Similarly urban residence, middle richer and richest wealth index, adequate region, ANC by informal and formal sources and currently not working shows a positive association with add by SBA verses no one whereas age and birth in last 5years

showed negative association. Primary education level, middle wealth index and moderate region gives non-significant result. Estimated model coefficients and corresponding values of odd ratios reveal the following important result on assistance during delivery when values of predictor variables are change from one level to another (Table 26).

For age, the MNLR coefficient of EMW is found to be -0,071 and odd ratio is 0.93 which can be understood as increase in one year of age, (1-0.93=0.07) or 7 percent less of performing assistance during delivery by USBA verses no one. It is highly significant with p value<0.001. Similarly it is same for performing assistance during delivery by SBA verses no one.

The place of residence did not show significant effect for the assistance during delivery by USBA verses none. However place of residence has strong and significant effect on assistance during delivery by SBA verses no one. The likelihood of assistance during delivery by SBA for urban residence women has 2.43 odd factors in comparison to rural women.

The odd ratio of performing assistance during delivery by USBA verses no one is 1.99 times higher for EMW with a secondary/higher education relative to no education. Similarly, the odd ratio performing assistance during delivery by SBA verses no one is 3.74 times higher for EMW with secondary/higher education relative to no education. It is significant with p value <0.05 and p value <0.001 respectively. But it did not show significant for primary education.

EMW with richest is found to have 2.72 odds of performing assistance during delivery by SBA verses no one compared to poorest. It is found to be 2.42 odds for poorer and 2.33 odds for richer relative to poorest. All are significant at p value <0.01 but middle relative to poorest is insignificant. The odd ratio of performing assistance during delivery by USBA verses no one is 1.89 times higher for EMW with a poorer relative to poorest and the rest three contrast variables are found to be insignificant.

The estimated coefficients of EMW under different regions are obtained. Also some disparities exist in assistance during delivery in region. The odds corresponding to moderate and adequate regions are 1.36 and 1.99 times more likely to assistance during delivery by USBA verses no one compared with scare region. Similarly the odds of performing assistance during delivery by SBA verses no one is 3.05 times

higher for EMW living in adequate region relative to scare region and it is highly significant. It is not significant for the moderate region to performing assistance during delivery by SBA verses no one.

The odds ratio of performing assistance during delivery by USBA verses no one is about 68 percent (1-0.32=0.68) lower for EMW with 3 or more birth order and 33 percent (1- 0.67) lower for 2 birth order relative to one birth order. Similarly, the odd ratio of performing assistance during delivery by SBA verses no one is about 85 percent (1-0.15=0.85) lower for EMW with 3 or more birth order and 64 percent (1-0.36) lower for 2 birth order relative to one birth order.

The odds ratio of performing assistance during delivery by USBA verses no one is 2.25 times higher for EMW with ANC provided by informal sources and 2.29 times higher for EMW with ANC by formal sources relative to ANC by no one. Similarly, the odd ratio of performing assistance during delivery by SBA verses no one is 3.27 times higher for EMW with ANC provided by informal sources and 12.46 times higher for EMW with ANC by formal sources relative to ANC by no one. It is to be noted that estimated parameter coefficients of ANC provider are statistically highly significant with p value less than 0.001.

The odds ratio of performing assistance during delivery by USBA verses no one is 2.38 times higher for EMW with currently not working relative to currently working. Similarly, the odd ratio of performing assistance during delivery by SBA verses no one is 2.82 times higher for EMW with currently not working relative to currently working.

Once the particular multinomial logistic regression model has been fitted, we begin the process of model adequacy tests.

4.9.1 Goodness of Fit

The overall goodness of fit of the estimated model is judge by deviance and Pearson's chi square. In this study, deviance residual is found to be 5791.65 at 5818 degree of freedom and Pearson's chi square is found to be 3565.79. Both are found to be statistically non-significant with p value 0.594 and 1.00 respectively. Non-significant p values suggest that the estimated model fit well to the MNLR model (Table 27).

Table 27: Goodness of Fit for MNLR Model, NDHS 2006

	Chi square	d.f.	P value
Pearson's	5791. 651	5818	0.594
Deviance	3565.790	5818	1.000

In this study, Cox and Snell's R^2 has been used, which is based on the log likelihood of the model (LL_{new}) and log likelihood of the original model ($LL_{baseline}$) and the sample size n. Here Cox and Snell's R^2 = 0.32. However this statistics measure is limited that never reaches as its theoretical maximum of 1. Therefore we used Negelkerke's R^2. Here,R_N^2= 0.411.

A more useful measure to assess the utility of MNLR model is classification accuracy, which compare predicted group membership based on the MNLR model to the actual known group membership, which is the value of the response variable. The benchmark that will use to characterize, a MNLR model as useful is a 25 percent improvement over the rate of accuracy achievable by chance alone. The estimate of by chance accuracy that will use is the proportional accuracy rate, computed by summing the squared percentage of case in each group (The only difference between the chance accuracy for binary logistic regression model and by chance accuracy for MNLR model is the number of groups defined by the dependent variable). In this study, the number of cases in each categories of dependent variable is given in Table 28.

Table 28: Assistance During Delivery, NDHS 2006

Description	2006 NDHS	
	Frequency	%
Assistance during delivery :		
by no one	316	7.6
by unskilled birth attendant	3015	72.1
by skilled birth attendant	851	20.3
Total	4182	100

The proportional by chance accuracy criteria is $1.25(0.076^2+0.721^2+0.203^2)=70.85$ percent since the classification accuracy rate was 77.9 percent (Table 29) for which were greater than by chance accuracy. Hence the classification accuracy is satisfied in this study

Table 29: Classification Table, 2006 NDHS

Observed	Assistance during delivery by no one	Assistance during delivery by unskilled birth attendant	Assistance during delivery by skilled birth attendant	Percent count
Assistance during delivery:				
by no one	5	306	5	16%
by unskilled birth attendant	5	2825	185	93.7%
by skilled birth attendant	0	422	429	50.4%
Over all %	2%	85.0%	15.0%	77.9%

4.9.2 Multicollinearity

Multicollinearity in the multinomial logistic regression solution is detected by examining the standard errors for the b coefficients. A standard error larger than 2.0 indicates numerical problems. Analyses that indicate numerical problems should not be interpreted. None of the independent variables in this analysis had a standard error larger than 2.0. (We are not interested in the standard errors associated with the intercept) so there is no evidence of a multicollinearity problem with this analysis.

4.10 Multinomial Logistic Regression Analysis of Selected Socio-economic and Demographic Variables, 2011 NDHS

The response and predictors are same as in 2006 NDHS. First step in the process is usually to assess the significance of predictors in the model. This usually involves formulation and testing of statistical hypotheses to determine whether the independent variables in the model are significantly associated to the response variable. The likelihood ratio test for the overall significance of all coefficients for the predictor as well as significance of single predictor in the model is shown in Table 30.

Table 30: Analysis of Likelihood Ratio Chi Square Test, 2011 NDHS

Variables	-2loglikelihood	Chi square	d.f.
Intercept	5671.664		
Wealth index	4642.554	1028.670	8
ANC by provider	4340.674	302.796	4
Age	4280.674	59.525	2
Residence	4238.147	42.528	2
Highest education level	4199.360	38.788	4
Currently working	4178.382	20.977	2
Region	4164.256	14.127	4
Birth in last 5 years	4150.950	13.306	4
Initial -2loglikelihood = 5671.664		All have p value < 0.001	
Final -2log likelihood = 4150.954		Chi square = 1520.714	

The -2LL value is 5671.664 which measure the model with no independent variables i.e. only intercepts term. The final -2LL values is 4150.954 which computed after all

the independent variables have been interred into the MNLR model. The difference between these two measures follows a chi-square distribution with 30 degree of freedom and measures how well the independent variable affect the outcome or response variable. In this study chi square = 1520.714 p value <0.001. This is a test of null hypothesis that adding the predictors to the model has not significantly increased our ability to predict the delivery at health institute. Hence it indicate that, we reject the null hypothesis and we may infer that at least one and perhaps most of the coefficients are different from zero and we may infer as a whole the predictors have significant contribution to predict the response variable. Here the χ^2 test for the model is significant showing the acceptable fitting of the MNLR model.

The results of MNLR analysis of equation (19) are given in Table 31.

Table 31: MNLR Estimates of the Odds Ratios of Selected Socio-economic and Demographic Characteristic of ADD of Nepal, 2011 NDHS

	ADD by USBA verses ADD by no one				ADD by SBA verses ADD by no one			
Variables	**b(S.E)**	**e^b**	**p value**	**95% CI for OR**	**B(S.E)**	**e^b**	**p value**	**95% CI for OR**
Intercept	3.137(0.42)		0.000		0.719(0.57)		0.203	
Age	-0.060(0.01)	0.942	0.000	0.918-0.967	-0.089(0.02)	0.915	0.000	0.888-0.942
Residence:								
Rural(R)								
Urban	0.088(0.31)	0.915	0.776	0.498-1.682	0.572(0.32)	1.772	0.071	0.952-3.299
Education level:								
No education(R)								
Primary	-0.003(0.25)	1.003	0.991	0.613-1.639	0.272(0.27)	1.312	0.311	0.776-2.219
Secondary/higher	0.145(0.32)	1.156	0.646	0.623-2.145	0.838(0.32)	2.312	0.010	1.222-4.375
Wealth index:								
Poorest(R)								
Poorer	0.610(0.24)	1.841	0.012	1.146-2.958	1.005(0.27)	2.732	0.000	1.611-4.631
Middle	1.031(0.36)	2.805	0.004	1.400-5.620	1.647(0.37)	5.190	0.000	2.507-10.48
Richer	0.196(0.30)	1.216	0.588	0.600-2.466	1.213(0.38)	3.364	0.001	1.611-7.025
Richest	0.579(0.58)	1.784	0.322	0.568-5.603	2.316(0.59)	10.14	0.000	3.181-32.30
Region:								
Scare(R)								
Moderate	0.548(0.19)	1.793	0.002	1.231-2.614	0.461(0.18)	1.585	0.027	1.055-2.382
Adequate	0.701(0.28)	2.016	0.011	1.176-3.456	0.741(0.29)	2.098	0.011	1.186-3.714
Birth in last 5 years:								
1(R)								
2	-0.236(0.19)	0.790	0.222	0.541-1.153	-0.478(0.21)	0.620	0.023	0.411-0.937
3 or more	-0.533(0.40)	0.575	0.171	0.260-1.270	-1.170(0.48)	0.310	0.016	0.120-0.803
ANC by provider:								
No one (R)								
Informal sources	1.089(0.22)	2.971	0.000	1.922-4.591	1.868(0.29)	6.475	0.000	3.671-11.42
SBA	0.083(0.29)	2.954	0.000	1.921-4.541	2.802(0.28)	16.48	0.000	9.553-28.43
Currently working:								
Yes								
No	0.430(0.23)	1.538	0.065	0.974-2.428	0.796(0.24)	2.217	0.001	1.378-3.567
C.I= Confidence Interval; Exp. = Exponent; R= Reference category.								

Estimated model coefficients and corresponding values of odd ratios reveal the following important results on change in assistance during delivery when values of predictors are change from one level to another.

The regression coefficient of age is found to be -0.060 and odd ratio is 0.94 which can be understood as increase in one year of age, (1-0.94=0.06) or 6 percent less of performing assistance during delivery by USBA verses no one. Similarly it is (1-0.92=0.08) or 8 percent less of performing assistance during delivery by SBA verses no one. Both are highly significant with p value <0.001.

The place of residence does not show significant effect for the assistance during delivery by USBA verses none and assistance during delivery by SBA verses no one.

The odd ratio of performing assistance during delivery by SBA verses no one is 2.31 times higher for EMW with a secondary/higher education relative to no education. It is significant with p value <0.05. But it shows insignificant for assistance during delivery by SBA verses no one for primary education.

As compared to poorest women, the odd ratios for poorer/middle/richer/richest women have more odd ratios of performing assistance during delivery by SBA verses no one as shown in Table 31. All is highly significant with p values less than 0.001. EMW with middle is found to have 2.81 odds of performing assistance during delivery by USBA verses no one compared to poorest. But Richer/richest relative to poorest are found to have insignificant result of performing assistance during delivery by USBA verses no one.

The estimated coefficients of EMW under different regions are obtained. Also some disparities exist in assistance during delivery in region. The odds corresponding to moderate and adequate regions are 1.79 and 2.02 times more likely to assistance during delivery by USBA verses no one compared with scare region. Similarly the odds of performing assistance during delivery by SBA verses no one is 1.59 times higher for EMW living in moderate region and 2.10 times higher for EMW living in adequate region relative to scare region and it is significant with p value less than 0.05.

The odd ratio of performing assistance during delivery by SBA verses no one is about 69 percent (1-0.31=0.69) lower for EMW with 3 or more birth order and 38 percent (1- 0.62) lower for 2 birth order relative to one birth order. It is significant with p value less than 0.05. It is found to be insignificant for performing assistance during delivery by USBA verses no one.

The odd ratio of performing assistance during delivery by USBA verses no one is 2.97 times higher for EMW with ANC provided by informal sources and 2.95 times higher for EMW with ANC by formal sources relative to ANC by no one. Similarly, the odd ratio of performing assistance during delivery by SBA verses no one is 6.48 times higher for EMW with ANC provided by informal sources and 16.48 times higher for EMW with ANC by formal sources relative to ANC by no one. It is to be noted that estimated parameter coefficients of ANC provider are statistically highly significant with p value less than 0.001.

The odd ratio of performing assistance during delivery by SBA verses no one is 2.22 times higher for EMW with currently not working relative to currently working. It is significant with p value less than 0.01 but it is insignificant for delivery by USBA verses no one.

4.10.1 Goodness of Fit

The overall goodness of fit of the estimated model is judge by deviance and Pearson's chi square. Deviance residual is found to be 5192.156 at 5660 degree of freedom and Pearson's chi square is found to be 3594.07. Both are found to be statistically non-significant with p values of 0.99 and 1.00 respectively. Non-significant p values suggest that the MNLR model fit well for the given data set.

Table 32: Goodness of Fit for MNLR Model,NDHS 2011

	Chi square	d.f.	P value
Pearson's	5192. 156	5560	0.99
Deviance	3594.074	5560	1.000

In this study, Cox and Snell's R2 has been used, which is based on the log likelihood of the model (LL_{new}) and log likelihood of the original model ($LL_{baseline}$) and the sample size n. Here = 0.311. However this statistics measure is limited that never reaches as its theoretical maximum of 1. Therefore we used Negelkerke's R^2. Here, R_N^2=0.392.

A more useful measure to assess the utility of MNLR model is classification accuracy, which compare predicted group membership based on the logistic model to the actual known group membership, which is the value of the response variable. The benchmark that will use to characterize, a MNLR model as useful is a 25 percent improvement over the rate of accuracy achievable by chance alone. The estimate of by chance accuracy that will use is the proportional accuracy rate, computed by

summing the squared percentage of case in each group (The only difference between the chance accuracy for binary logistic regression model and by chance accuracy for MNLR model is the number of groups defined by the dependent variable). In this study, the number of cases in each categories of dependent variable is given inTable 32.

Table 33: Frequency of ADD, NDHS 2011

Description	2011 NDHS	
	Frequency	percent
Assistance during delivery :		
by no one	155	1.7
by unskilled birth attendant	2516	34.2
by skilled birth attendant	1408	64.1
Total	4182	100

The proportional by chance accuracy criteria is $1.25(0.017^2+0.342^2+0.641^2) = 66.01$ percent. Since the classification accuracy rate was 73.3 percent (Table 34), which is greater than by chance accuracy. Hence the classification accuracy is satisfied in this study

Table 34: Classification Table, 2011 NDHS

Observed	Assistance during delivery by no one	Assistance during delivery by unskilled birth attendant	Assistance during delivery by skilled birth attendant	percent count
Assistance during delivery				
by no one	0	145	10	0%
by unskilled birth attendant	0	2162	354	85.9%
skilled birth attendant	0	580	828	98.8%
Over all %	0%	70.8%	29.2%	73.3%

4.10.2 Multicollinearity

Multicollinearity in the multinomial logistic regression solution is detected by examining the standard errors for the b coefficients. A standard error larger than 2.0 indicates numerical problems. Analyses that indicate numerical problems should not be interpreted. None of the independent variables in this analysis had a standard error larger than 2.0. (We are not interested in the standard errors associated with the intercept) so there is no evidence of a multicollinearity problem with this analysis.

4.11 Ordinal logistic Regression Analysis of Selected Socio-economic and Demographic Variables, 2006 NDHS

In previous section “assistance during delivery” as a response variable which takes the three categories: a) assistance during delivery by no one b) assistance during delivery

by unskilled birth attendant and c) assistance during delivery by skilled birth attendant. For this MNLR model have been applied which would allowed the identification of the each of the selected predictor variable on assistance during delivery, controlling for the effect of other predictor variables. MNLR model is one of the statistical methods that can be used when dealing with categorical dependent variable with more than two categories. In this study, the response variable is "Number of ANC visits" which takes the three categories: a) no ANC visit b) 1-3 ANC visits (some visits) c) 4 or more visit (adequate visit). To establish the effect of the identified predictor variables on the response variables "Number of ANC visits", Ordinal Logistic Regression (OLR) model was fitted.

This model was chosen since the response variable is a three category ordinal. Using MNLR model, mean that the information conveyed by the ordered nature of response variable is discarded. In addition not treating the variable as ordered, may lead to loss of efficiency. In this study, a three category outcome will have two binary logit equations based on the following comparison: none verses some visit, adequate visits and none and some visits verses adequate visit.

The 1st step in the process is usually asses the significance of predictor in the model. Hence cross tab and chi square test is carried out for number of ANC visits (outcome variable) with different predictors. The checking of empty cell is also determined by the cross tab of the response variable by each of the categorical predictor variable and those tables look fine. The bivariate analysis showed that Region, sex of household head are not significantly associated with response variable, hence final model is acquired using other variables except these two variables.

Before fitting an OLR model in 2006 NDHS, One of the assumptions underlying ordinal regression is that the relationship between each pair of outcome groups is the same. In other words, ordinal regression model assumes that the coefficients that describe the relationship between, say, the lowest versus all higher categories of the response variable are the same as those that describe the relationship between the next lowest category and all higher categories, etc. This is called the proportional odds assumption or the parallel regression assumption. Because the relationship between all pairs of groups is the same, there is only one set of coefficients. Thus, in order to

assess the appropriateness of the model, proportional odds assumption is normally evaluated.

4.11.1 Test of Parallel Line

The test of parallel line was designed to make judgment concerning the assumption that all the logit surfaces are parallel. It was assessed using the Brant test of proportionality which determines the extent of the parallelism with the 1st and 2nd cut off points of the response variable. This is shown in Table 35, where we accept the null hypothesis of equal location parameters. The null hypothesis states that the slop coefficients in the model are the same across the response categories. The significance p=0.963>0.05 indicated that there was no significance difference for the corresponding slop coefficient across the slope categories hence we conclude that the model assumption of parallel lines was not violated in the model.

Table 35: Test of Parallel Line, 2006 NDHS

Model	-2Loglikelihood	Chi square	d.f.	Sig.
Null hypothesis	5150.747			
General	5144.598	6.149	14	0..963

4.11.2 Model Fitting Information

Overall fit of model, i st step in the process is usually to assess the significance of predictors in the model. The presence of the relationship between the response variable and predictors is based on the statistical significance of the final model. From the table 36, the -2LL of the model with only intercept is 6468.596 while the -2LL of the model with intercept and predictors is 5150.747. The difference (chi square statistics) is 1317.848, which is significant at 5 percent level of significance. Here p<0.001, conclude that there is association between the response variable and predictors in OLR model.

Table 36: OLR Model Fitting Information, 2006 NDHS

Model	-2Loglikelihood	Chi square	d.f.	Sig.
Intercept only	6468.596			
Final	5150.747	1317.848	14	0.000

The Proportional Odds Model (POM) is fitted to the 2006 NDHS (equation 22) and there results are summarized in Table 37. All together 8 variables are found statistically significant. These variables are current age, highest education level (no education/Primary/Secondary and higher), Birth in last five years (1/2/more than 2), wealth index (poorest/poorer/middle/richer/richest), Occupation (never

work/agriculture sector/modern sector), residence (rural/urban) currently working and religion (others/Hindu).

Table 37: OLR Estimate of the ODDS Ratios of Selected Socio-economic and Demographic Characteristics of Number of ANC Visits of Nepal, 2006 NDHS

Number of ANC visits	b(S.E)	e^b (S.E)	p value	95% CI for OR	
				Lower	Upper
Cut1	-0.698(0.225)			1.139	0.256
Cut 2	1.687(0.227)			1.242	2.132
Age	−0.043(0.005)	0.959(0.005)	0.000	0.948	0.968
Residence:					
Rural(R)					
Urban	0.275(0.083)	1.317(0.109)	0.01	1.120	1.548
Education level:					
No education (R)					
Primary	0.693(0.085)	1.999(0.171)	0.000	1.691	2.363
Secondary/higher	1.368(0.091)	3.927(0.354)	0.000	3.291	4.686
Wealth index:					
Poorest(R)					
Poorer	0.637(0.090)	1.892(0.170)	0.000	1.587	2.254
Middle	0.928(0.095)	2.530(0.240)	0.000	2.010	3.048
Rich	1.*187*(0.*100*)	3.279(0.328)	0.000	2.695	3.989
Richest	1.*598*(0.129)	4.941(0.636)	0.000	3.839	6.359
Religion:					
Others(R)					
Hindu	0.224(.090)	1.250(0.113)	0.01	1.048	1.492
Birth order:					
1 birth(R)					
2 birth	-0.186(0.067)	0.830(0.056)	0.006	0.727	0.947
3 or more birth	-0.312(0.161)	0.732(0.118)	0.053	0.534	1.005
Occupation:					
Never work(R)					
Agriculturalsector	0.216(0.128)	1.241(0.159)	0.091	0.966	1.594
Modern sector	0.346(0.166)	1.414(0.234)	0.037	1.022	1.957
current working:					
Yes(R)					
No	0.382(0.106)	1.466(0.155)	0.000	1.191	1.803
Number of observation= 4182, Initial Log likelihood = -4504.4828, Final Log likelihood = -3842.0058		LR chi square(14) = 1324.75 Prob.> chi square = 0.0000,			
C.I= Confidence Interval; R= Reference category.					

Table 37 revealed that the coefficients, their S.E, odds ratios and their associated p values, the 95 percent confidence interval of the coefficients and odd ratio's. It describe the coefficients and odds of being in either of these categories i.e., None versus 1-3 ANC visits and 4 or more ANC visits or none and 1-3 ANC visits versus 4 or more ANC visits. Age, education level, wealth index, residence, religion and currently working were significant with p value less than 0.01.birth order(2), occupation (modern sector) were significant at p value less than 0.05 whereas occupation (agriculture sector) and birth order (3 or more) showed insignificant result.

Since age is a continuous variable, the presented odd ratio refers to a difference of one year in age. We would say that for a one year increase, we expect a .043 decrease in

coefficient of being in a higher number of ANC visits, given all of the variables in the model are held constant. Respondent with one year increase is found to be .96 odds factor or 4 percent less of performing higher number of ANC visits.

For residence, the odds among women with residence in urban areas, increase the number of ANC visits by (1.316-1) = 32 percent holding all other variables constant.

Education emerged as an important variable. The fitted coefficients to primary, secondary and higher level of education are 0.69, and 1.37 respectively. Women with primary education are 1.99 times more likely to have higher number of ANC visits than women with no education. The odds could be a little as 1.69 times or as much as 2.36 times larger with 95 percent confidence. Similarly women with secondary/higher level of education are 3.29 times more likely to have higher number of ANC visits.

The effect of wealth index on ANC visits appeared to be very strong. The estimated coefficient of EMW under different wealth index is computed. Poorest as a reference category, the coefficient corresponding to poorer, middle, richer and richest are 0.64, 0.93, 1.19 and 1.60 respectively. Results are statistically significant at $p<0.001$.The odds ratios for richer and richest wealth index are almost 3.28 and 4.94 times more likely to use higher number of ANC visits.

Hindu religion is found to be 1.25 odds factor or 25 percent more of performing higher number of ANC visits with the reference category of other. It is statistically significant only at p value less than 0.05.

For birth order, the odds among women with 2 birth, reduce the number of ANC visits by (1.0-0.83) = 17 percent holding all other variables constant. 3 or more than 3 births did not show significant result.

Occupation in modern sector found to be 1.41 odds factor or 45 percent more of performing higher number of ANC visits with the reference category of never work. It is statistically significant only at 0.05 levels but occupation in agricultural sector did not show significant result.

4.11.3 Goodness of Fit:

The overall goodness of fit of the estimated model is judge by deviance and Pearson's chi square statistic. For 2006 NDHS data, deviance residual is found to be 3959.236 at 3974 degree of freedom and Pearson's chi square is found to be 4014.256. Both are

found to be statistically non-significant with p value 0.324 and 0.563 respectively. Non-significant p values suggest that the estimated model fit well to the OLR model.

Table 38: Goodness of Fit, 2006 NDHS.

	Chi square	d.f.	Sig.
Pearson's	4014.256	3974	0.324
Deviance	3959.236	3974	0.56

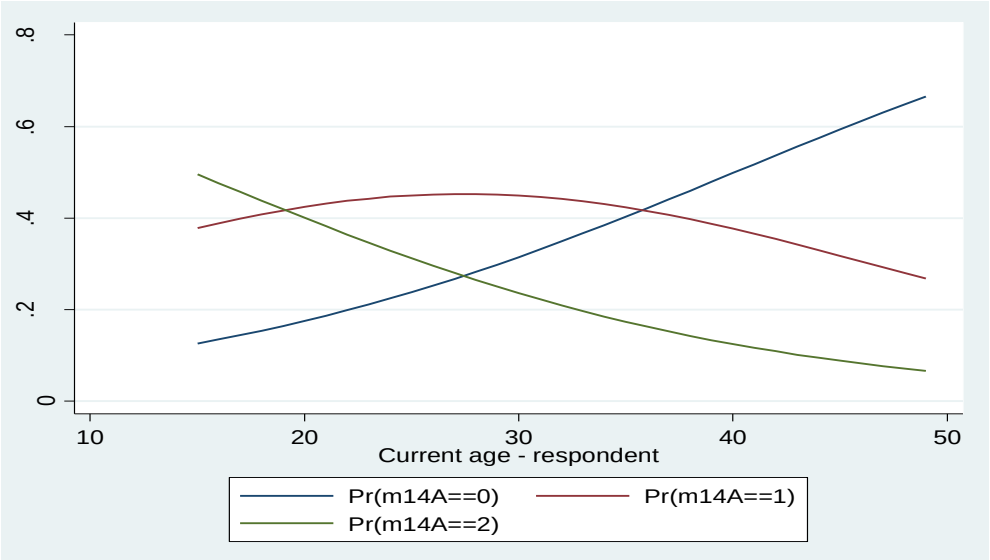
The pseudo R^2 provides a quick way to describe or compare the fit of different model for the same response variable. In this study, McFadden's, the ratio of the likelihoods suggests the level of improvement over the intercept model that is model without predictors offered by the full model that is the model with predictors. Here R_N^2=0.146 and Cox and Snell's R_{CS}^2 is 0.270. However this statistics measure is limited that never reaches as its theoretical maximum of 1. Therefore Negelkerke R_N^2 = 0.306.

Table 39:Pseudo R^2, 2006 NDHS.

Cox and Snell R^2	0.270
Mc Fadden R^2	0.15
Nagelkerke R^2	0.15

Figure 14 illustrate the dramatic effect of age on the number of ANC visits. The predicted probability of number of antenatal care visit based on the age is depicted. It shows that with age the probability of number of no ANC visits is increased rapidly while four or more visits are decreases.

Figure 14: Predicted Probability of Number of ANC Visits Based on the Age



4.12 Ordinal Logistic Regression Analysis of Selected Socio-economic and Demographic Variables, 2011 NDHS

For 2011 NDHS, the assumption of the parallel line is violated (Table 40). The use of OLR model when its assumptions are violated creates a misleading impression of how the response variable and predictors are related. It would need different model to describe the relationship between response variable and predictors.

Table 40: Test of Parallel Line, 2011 NDHS

Model	-2Loglikelihood	Chi square	d.f.	Sig.
Null hypothesis	4867.127			
General	4812.753	54.374	14	0.000

Hence, a legal alternative is to develop a Partial Proportional Odds(PPO) model. This was used to generate the estimate of partial proportional ratios across the categories of the outcome variable: never visit verses some and adequate visits; never and some visits verses adequate visits. The PPO model works well in situation where proportionality or parallel slop assumption of ordinal logistic regression is violated. This unrestricted PPO model will estimate as many coefficients as multinomial model does but the model is not identical to MNLR model. The ordering of the categories is important in unrestricted PPO model. This is not true for MNLR model where the ordering of categories is arbitrary. The unrestricted partial proportional coefficients and 95 percent confidence interval are reported in Table 41.

Table 41: Estimate of Parameters of Unrestricted PPO Model of Selected Socio-economic and Demographic Characteristics of Number of ANC Visits of Nepal, 2011 NDHS

	Never visit vs. some & adequate visits				Never & some visits vs. adequate visits			
Number of ANC visits	**b(S.E)**	**p value**	**95% C.I**		**b(S.E)**	**p value**	**95% C.I**	
			Lower	**Upper**			**Lower**	**Upper**
Constant	1.844(0.324)	0.000	1.210	2.478	-0.049	0.848	-0.548	0.45
Age	−0.053(0.007)	0.000	−0.068	-0.039	-0.038(0.006)	0.000	-0.051	0.03
Residence:								
Rural(R)								
Urban	0.057(0.160)	0.722	-0.257	0.371	0.089(0.100)	0.375	-0.107	0.29
Education level:								
No education (R)								
Primary	0.416(0.126)	0.001	0.170	0.662	0.709(0.093)	0.000	0.527	0.891
Secondary/higher	1.115(0.166)	0.000	0.790	1.440	1.219(0.096)	0.000	1.031	1.407
Wealth index:								
Poorest(R)								
Poorer	0.604(0.119)	0.000	0.371	0.837	0.271(0.101)	0.007	0.074	0.468
Middle	1.155(0.157)	0.000	0.848	1.462	0.511(0.108)	0.000	0.299	0.722
Richer	1.335(0.204)	0.000	0.935	1.734	0.855(0.127)	0.000	0.606	1.104
Richest	2.140(0.320)	0.000	1.513	2.767	1.469(0.161)	0.000	1.154	1.785
Religion:								
Others(R)								
Hindu	0.503(.121)	0.000	0.266	0.741	0.417(0.100)	0	0.222	0.61
Birth order:								
1 birth(R)								
2 birth	-0.039(0.106)	0.715	-0.247	-0.169	-0.196(0.083)	0.018	-0.358	-0.033
3 or more birth	0.317(0.268)	0.237	-0.208	-0.842	-0.095(0.210)	0.653	-0.507	0.318
Occupation:								
Never work(R)								
Agri. sector	-0.055(0.188)	0.772	-0.423	0.314	-0.158(0.126)	0.209	-0.405	0.088
Modern sector	0.034(0.271)	0.972	-0.498	0.565	0.074(0.164)	0.651	0.248	0.397
current working:								
working(R)								
not working	0.042(0.144)	0.77	-0.240	0.324	0.313(0.108)	0	-0.524	-0.1
C.I= Confidence Interval R= Reference category.								
Number of observation= 4079 Log likelihood = -3466.2256 LR $chi^2(28)$ = 1118.18 Prob> chi^2 = 0.0000 Pseudo R^2 = 0.1389								

Here positive coefficients indicate that high value on the explanatory variable make it more likely that the respondent will be in a higher category of response variable than the current or lower category. PPO model are very similar to what we get with the series of binary logistic regression model such as we operated earlier and can be interpreted the same way. Small differences are typically found because the PPO model estimates all the parameters simultaneously whereas the separate binary logistic regression model estimate them one cumulative at a time.

The main problem with unrestricted PPO model is that they include more parameters than OLR model. This is because this method frees all variables from the parallel line constraint, even though the parallel line assumption may only be violated by one or

few of them. This limitation can overcome by estimating Partial Proportional Odd (PPO) model with constraint. Here the parallel line constraint is only released for those variables where it is not justified. Therefore PPO model with constraint(restricted partial proportional odds model) was employed in this study. In This study ten of which meet the proportional odds assumption and only four (age, primary education, middle wealth index and currently not working) does not (Table 42).

Table 42: Testing Parallel-Lines Assumptions Using the .05 Level of Significance, 2011 NDHS

Step	Constraints for parallel lines imposed for	P Value
1	Occupation in modern sector	0 .8780
2	Urban residence	0.8393
3	Secondary and higher education	0.5107
4	Hindu religion	0.5105
5	Occupation in agricultural sector	0.3675
6	Two birth in last 5 years	0.1380
7	three or more birth in last 5 years	0.1899
8	Richest wealth index	0.0834
9	Richer wealth index	0.0978
10	Poorer wealth index	0.0973
11	Constraints for parallel lines not imposed for	
	Age	0.02088
	Primary education	0.01783
	Middle wealth index	0.00487
	Currently not working	0.0007

The restricted PPO coefficients and 95 percent confidence interval are reported in Table 43.

Table 43: Estimate of Parameters of restricted PPO model of Selected Socio-economic and Demographic Characteristics of Number of ANC Visits of Nepal, 2011 NDHS

	Never visit vs. some & adequate visits				Never & some visits vs. adequate visits			
Number of ANC visits	**b(S.E)**	**p value**	**95% C.I**		**b(S.E)**	**p value**	**95% C.I**	
			Lower	**Upper**			**Lower**	**Upper**
Constant	2.137(0.272)	0.000	1.604	2.67	-0.181(0.246)	0.462	-0.662	0.301
Age	**−0.055(0.007)**	**0.000**	**−0.069**	**-0.04**	**-0.038(0.666)**	**0.000**	**-0.051**	**0.026**
Residence:								
Rural(R)								
Urban	0.084(0.096)	0.381	-0.104	0.272	0.084(0.096)	0.381	-0.104	0.272
Education level:								
No education (R)								
Primary	**0.425(0.123)**	**0.001**	**0.183**	**0.667**	**0.705(0.091)**	**0.000**	**0.525**	**0.885**
Secondary/higher	1.199(0.093)	0.000	1.017	1.382	1.199(0.093)	0.000	1.017	1.382
Wealth index:								
Poorest(R)								
Poorer	0.399(0.089)	0.000	0.224**0.**	0.574	0.399(0.089)	0.000	0.224	0.574
Middle	**1.011(0.151)**0.	**0.000**	**714**0.7	**1.308**	**0.608(0.108)**0	**0.000**	**0.402**	**0.814**
Richer	986(0.121)	0.000	50	1.222	.986(0.121)	0.000	0.750	1.222
Richest	1.611(0.156)	0.000	1.305	1.916	1.611(0.156)	0.000	1.305	1.916
Religion:								
Others(R)								
Hindu	0.438(0.089)	0.000	0.264	0.613	0.438(0.089)	0.000	0.264	0.612
Birth order:								
1 birth(R)								
2 birth	-0.149(0.075)	0.048	-0.296	-0.002	-0.149(0.075)	0.048	-0.296	-0.002
3 or more birth	0.043(0.185)	0.815	-0.319	-0.407	-0.043(0.185)	0.815	-0.319	-0.407
Occupation:								
Never work(R)								
Agri_sector	-0.135(0.117)	0.249	-0.365	0.095	-0.135(0.117)	0.249	-0.365	0.095
Modern sector	0.067(0.157)	0.671	-0.242	0.375	0.067(0.157)	0.671	-0.242	0.375
current working:								
working(R)								
not working	**0.098(0.123)**	**0.426**	**-0.144**	**0.340**	**0.335(0.104)**	**0.001**	**-0.54**	**-0.101**
C.I= Confidence Interval R= Reference category.								
Number of observation= 4079 Log likelihood = -3473.7544 LR $chi^2(18)$ = 1103.13 Prob> chi^2 = 0.0000 Pseudo R^2 = 0.137								

Noteworthy that in OLR model there are 14 degree of freedom, in unrestricted PPO model there are 28 degree of freedom and in restricted PPO model there is 18 degree of freedom. This is due to the 10 constraint above. In above table note that the parameters estimate for the constraint variables are the same in all two panels hence only 18 unique b coefficients needs to be examined compared to be 28 produced by unrestricted PPO model.

With the partial proportional odds model, the effects of the variables that meet the parallel lines assumption are easily interpretable in the same way as in logit. For other variables, an examination of the pattern of coefficients reveals insights that would be obscured or distorted if a parallel lines model were estimated instead. There would be

many more parameters to look at, and the increased number of parameters could cause some effects to become statistically insignificant. In this study, residence, birth order, occupation and currently working showed statistically insignificant result.

Here the model may not seem very parsimonious. However the same coefficients are reported in each of the two panels for ten parameters (urban residence, secondary/ higher education, poorer, richer and richest wealth index, Hindu religion, birth order, occupation and current working).only the coefficients for age, primary education, middle wealth index and not working differ across the two panels. The repetition of identical parameter can become confusing. Therefore Williams (2006) suggests an alternative more succinct approach that he calls Gamma.

The alternative Gamma parameterization can be used for alternative statistical test for violation of assumption. It is more theory based model selection. Under the Gamma parameterization, γ coefficient represents deviation from proportionality (Table 44).

Table 44: Alternative Parameterization: Gammas are Deviations from Proportionality, 2011 NDHS

Number of ANC visits	b(S.E)	p value	95% C.I	
			Lower	Upper
Constant	2.137(0.272)	0.000	1.604	2.67
Age	**−0.055(0.007)**	**0.000**	**−0.069**	**-0.04**
Residence:				
Rural(R)				
Urban	0.084(0.096)	0.381	-0104	0.272
Education level:				
No education (R)				
Primary	**0.425(0.123)**	**0.001**	**0.183**	**0.667**
Secondary/higher	1.199(0.093)	0.000	1.017	1.382
Wealth index:				
Poorest(R)				
Poorer	0.399(0.089)	0.000		0.574
Middle	**1.011(0.151)**0.9	**0.000**	0.224**0.7**	**1.308**
Richer	86(0.121)	0.000	**14**0.750	1.222
Rich	1.611(0.156)	0.000	1.305	1.916
Religion:				
Others(R)				
Hindu	0.438(0.089)	0.000	0.264	0.613
Birth order:				
1 birth(R)				
2 birth	-0.149(0.075)	0.048	-0.296	-0.002
3 or more birth	0.043(0.185)	0.815	-0.319	-0.407
Occupation:				
Never work(R)				
Agri. sector	-0.135(0.117)	0.249	-0.365	0.095
Modern sector	0.067(0.157)	0.671	-0.242	0.375
current working:				
working(R)				
not working	**0.098(0.123)**	**0.426**	**-0.144**	**0.340**
Gamma2:				
Age	0.017(0.007)	0.021	0.003	0.032
Primary education	0.280(0.118)	0.018	0.049	0.512
middle W.I	-0.403(0.143)	0.005	-0.684	-0.123
not working	-0.434(0.109)	0.000	-0.648	-0.219

The relationship between the two parameterization is straight forward. The coefficient for the 1st equation is the default parameterization corresponding to the b's in the gamma parameterization. Gamma2 parameter = equation 2 – equation 1 parameter estimates. For example, in the "never and some visits verses adequate visit" panel for default parameterization the coefficient for age is -0.038 and in the "never visit verses some and adequate visits' panel it is -0.055. Gamma_2 for age therefore equals -0.038 - (-0.055) = 0.017.The Gammas only for variables that are not constrained to meet the parallel lines assumption.

Table 44 revealed that the coefficients, their S.E, their associated p values, the 95 percent confidence interval of the coefficients. It describe the coefficients of being in either of these categories i.e., None versus 1-3 ANC visits and 4 or more ANC visits or none and 1-3 ANC visits versus 4 or more ANC visits for those variables which has

gamma parameterization is zero. Age, education level, wealth index and religion predictors are highly statistically significant.

The coefficient of EMW under different wealth index is computed. Poorest as a reference category, the coefficient corresponding to poorer, richer and richest are 0.399, 0.986, and 1.611 respectively performing higher number of ANC visits. . Since middle wealth index has b coefficient 1.011 for performing never visit versus some and adequate visit. Here Gamma for middle wealth index is -0.403. Therefore b coefficient for performing never and some visit versus adequate visit is -0.403 + 1.011 = 0.608.

No education is considered as reference category. The coefficient corresponding to secondary/higher level of education is 1.199. But has primary education has b coefficient 0.425 for performing never visit versus some and adequate visit. Here Gamma for primary education is 0.281. Therefore b coefficient for performing never and some visit versus adequate visit is 0.281 + 0.425 = 0.706.

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

This chapter presents the conclusion arising from the discussion of the result and followed by the recommendation, which are grounded in the finding of the study and aspects for the future research are highlighted.

5.1 Conclusion

This study was based on the two demographic health survey (2006 NDHS and 2011 NDHS). In this thesis an attempt has been made to examine the impact of socio-economic and demographic variables on maternal health service utilization.

Univariate, bivariate, and multivariate analysis were used to meet the study objectives. Univariate analysis was carried out to understand the frequency distribution, while bivariate analysis examined the relationship between socio-economic and demographic variables and maternal health care service utilization(place of delivery, assistance during delivery and number of ANC visits). Chi-square tests were carried out. For multivariate analysis, logistic regression methods were applied to establish significance of the association between place of delivery and socio-economic variables, multinomial logistic regression analysis for assistance during delivery and ordinal logistic regression analysis for number of ANC visits.

The descriptive analysis suggest that in 2006 around 19 percent, 20 percent and 29 percent of women have received delivery in health institute, assistance during delivery by SBA and adequate ANC visits respectively . These level of service utilization were low for rural areas (12 percent delivered at health institute, 13 percent assistance during delivery by SBA and 24 percent has adequate ANC visits). Similarly, in 2011, 40 percent, 35 percent and 53 percent of women have received delivery in health institute, assistance during delivery by SBA and adequate ANC visits respectively. However, it showed increasing trend for all these maternal health services. But until the time of the survey 60 percent delivered at home 62 percent assistance during delivery by USBA and 15 percent has no ANC visit (Table 7).

In both survey, mean age of women were 27 years. Majority of respondents were Hindu religion (87 percent for 2006, 86 percent for 2011). A large gap exists in education level between the urban and rural residence. Approximately, 41 percent in 2006 and 57 percent in 2011 of urban women have secondary/ higher education level compared to 18 percent in 2006 and 32 percent in 2011 women in rural residence.

In both survey, the urban residence have the greatest proportion of women in richest wealth index (46 percent in 2006 and 45 percent in 2011) while the rural residence have the greatest proportion of women in poorest wealth index (23 percent in 2006 and 34 percent in 2011). More than 70 percent of household head was male (79 percent in 2006 and 74 percent in 2011) in both rural and urban residences. Similarly more than 60 percent of women had one birth in last five years in both places of residences (total 66 percent, urban 72 percent and rural 64 percent in 2006; total 73 percent, urban 80 percent and rural 71 percent in 2006;).

The currently working women were higher in rural residence (78 percent in 2006, 68 percent in 2011) as compared to urban residence (56 percent in2006, 44 percent in 2011). Around 24 percent in 2006 and 20 percent in 2011 of women's husband did not have any education attainment. While looking at ANC by provider, only 45 percent of the women used ANC by skilled provider which was increased to 59 percent in 2011. Around 68 percent of women's occupations were agriculture in 2006 which was decrease to 24 percent in 2011.

In bivariate analysis, the magnitude of the association, however, varies for each of the predictor variable, some variables showed a strong relationship, while some others showed weak relationships. Among all the demographic variables, sex of household head showed insignificant association with all three forms of maternal health care services in both survey. Religion showed insignificant association with place of delivery and assistance during delivery but significant association with number of ANC visits in 2006 survey where as it was significant association with all three forms of maternal health care services. Similarly Region showed insignificant association with place of delivery and number of ANC visits in 2011 survey.

Women's education appears to be a strong predictor related to the use of antenatal care, place of delivery and assistance during delivery. The relationship is in the positive direction which means that educated women are more likely to use all kinds

of modern maternal health care services than less educated women. A positive correlation is also observed with respect to husbands' education. Women with higher educated husbands were also found to be significantly more likely to use all kinds of modern maternal health care services than the women whose husbands had no education or primary education. Another social indicator that is significantly associated with the maternal health care services is wealth index. The relationship is in the positive direction.

Finding of cross tabulation between economic variables and the maternal health services showed that women's work status (i.e. whether working or not working) shows a weak but significant association with maternal health care utilization. The relationship, however, seems to be unexpected because the results show that non-working women were slightly more likely to use all three forms of maternal health care services. This may be because most of the women who work are from poor households and work for family survival or perhaps working women experience time constraints that reduces their opportunities for receiving health care. Similarly occupation of women and all three forms of maternal health services are statistically significant. As expected, women's occupations in modern sector were more likely to use all three formsof health services than those in agricultural sector occupation. But women who never worked had more use of all three formsof health services than a worker in agricultural occupation. This may be because most of the women who never worked are from higher wealth index.

The bivariate analysis results suggest that maternal health care utilization show a statistically significant relationship with demographic factors. Women's age seems to be related to all forms of maternal health care utilization. Study showed that older women are less likely to use maternal health care services. The association between birth order and the use of maternal health care occurs in a negative way and indicates strong association. The consistent declined in the percentage of women who receive antenatal care and delivery care is associated with an increase in the number of children ever born.

An analysis of the residence variation in maternal health care usage confirm that the use of antenatal care and modern delivery care were less apparent among women in rural areas than their urban counterparts. The lower utilization of all three form of

maternal health services utilization among rural women could be closely linked to the association of rural women to unfavorable socio-economic characteristics and the lack of availability of modern health care facilities.

In this research logistic regression has been used to estimate the socio-economic and demographic variables on maternal health service utilization as place of delivery. Logistic regression model has been extensively used since place of delivery has two outcomes (delivery at home, delivery at health institute). Two of the independent variables sex of household head and religion were excluded from the analysis due to their insignificant association with maternal health services utilization. Husband's education was excluded from the analysis due to missed observations. The final model was selected using forward step wise method. The model selection criterion for the inclusion of relevant variables in the models is based upon likelihood ratio criteria. It is possible to calculate log likelihood for different model and compare these models by looking at the difference between the log likelihood. Finally six variables (residence, education level, birth in last five years, wealth index, occupation and ANC by provider) have been found as the most influential variables on place of delivery for 2006 NDHS survey and seven variables (age, residence, education level, birth in last five years, wealth index, occupation and ANC by provider) have been found as the most influential variables on place of delivery for 2011 NDHS survey.

On the basis of socio economic variables It has been shown from the logistic regression analysis that increase in education level tended to have increased the use of health institute as place of delivery. Women with secondary/ higher education level are almost 3.2 times (for 2006 NDHS) and 2.3 times (for 2011 NDHS) more to deliver at health institute than odds of women with no education. These results are statistically highly significant. This finding is consistent with many previous studies that showed education of women to be the most significant predictor of increased utilization of health services (Bhatia and Cleland, 1995; Becker et al., 1993; Celik and Hotchkiss, 2000; Obermeyer, 1993). There are a number of reasons that education of women has a significant positive relation with maternal health care utilization. Educated women are more likely to realize the benefits of using maternal health services. Therefore, they are more likely to use the services. In addition, education may enhance female autonomy, hence, increasing women’s ability to make decisions regarding their own health. Education also increases the knowledge of modern health

care, thus increasing the demand for modern health services (Jejeebhoy, 1995; Celik and Hotchkiss, 2000).

Logistic regression analysis revealed that the estimated odds ratio for women whose household wealth index is poorer, middle, richer and richest compared to those mothers whose wealth index is poorest are 1.4, 1.5, 1.9 and 3.7 respectively for 2006 NDHS. Results are statistically significant at $p<0.10$ for poorer, $p<0.05$ for middle and $p<0.01$ for richer and richest. Similarly for women whose household wealth index is poorer, middle, richer and richest compared to those mothers whose wealth index is poorest are 1.4, 1.7, 2.1 and 4.6 respectively for 20011 NDHS. Results are highly statistically significant compared to 2006 NDHS. Strong association has been found between wealth index and the use of health institute as place of delivery which is also supported by other studies (Celik and Hotchkiss, 2000; Babalola and Fatusi, 2009). This can be explained by the fact that women should be able to cover the costs needed in order to access health institute. Even in areas where maternal health care services are provided for free, women still have to pay for transportation and additional costs. As a result only those women who can afford to pay for such costs are able to visit health institute.

Interestingly, the relationship between women's occupation and place of delivery has an inverse association. Women whose work is in agricultural sector are (1-0.55=0.45) 45 percent less likely to give birth at health institute compare to women who never work. The result is statistically significant. Although not statistically significant, it is suppressing that women whose occupation is in modern sector are (1-0.95=0.05) 5 percent and (1-0.93=0.07) 7 percent less likely to deliver at health institute as compare to women who never work for 2006 NDHS and 2011 NDHS respectively. Women who never work may be associated with household of high economic status and for this reason, an inverse may have been found.

On the basis of demographic variables, birth order of the child showed inverse association with use of health institute as place of delivery. Women whose 2nd birth order is (1-0.54=0.46) 46 percent less likely to give birth at health institute compare to women with 1st birth order. The result is statistically highly significant. Similarly women with birth order 3 or more are (1-0.42=0.58) 58 percent less likely to deliver at health institute as compared to women with 1st birth order for 2006 NDHS but it is

statistically significant at 5 percent level of significance. There is no statistically significant relationship between the birth in last 5 years with delivery at health institute ($p > 0.10$) for 3 or more birth order. This finding is similar with other studies (Woldemical and Tenkorang, 2009; Mesfin and Getnet, 2004). One study from Bangladeshi showed that women with parity of five or more were seen to have a low health seeking behaviour when compared to those who had only one child. The possible explanation could be women who have more children usually do not have enough time to go to the health services. In addition to this as the number of children in the household increase there will also be scarcity of resources (Chowdhury et al, 2007).

Urban-rural place of residence served as a control for the study and was used as a proxy for availability and accessibility of health services. Urban rural place of residence emerged significant for place of delivery as maternal health service utilization. The odds ratio suggests that compared to women who lived in rural areas, women who resided in urban areas were about 1.8 times more likely to have delivery in health institute, which is slightly higher based upon 2006 data (OR 1.6). This implies that availability and accessibility of health services are important in decisions to seek care.

We find that antenatal care is a key determinant of whether a woman gives birth at health institute or at home. In general a woman who goes for antenatal care is more likely to deliver at health institute than a woman who does not go for antenatal checkup. The odd ratios indicates that the women having antenatal care by SBA are likely to have 5.77 times higher to deliver at health institute compared to women having ANC by no one for 2006 NDHS which is lower than 2011 NDHS (OR 7.1).

For the model adequacy test, in the fitted model, the p values of the model chi- square tests are found to be significant ($p < 0.001$) which imply that the reduction in -2 log likelihood values with inclusion of the independent variables in the models are statistically significant (table 15, 19). Considering Hosmer-Lemeshow goodness of fit test, chi-square statistic with 8 degree of freedom, is 6.243 with p value 0.620 (2006 NDHS) and with p value 0.443 (2011 NDHS).The insignificant p value demonstrating that there is no difference between the observed and predicted values, implying that the model fits the data at an acceptable level (Table 17 and Table 21). The

NegelkerkeR^2 is found to be 0.415 (2006 NDHS) and 0.423 (2011 NDHS)(Table 16 and Table 20).

Residual analysis was conducted to study the influence of observations. A check of the standardized residuals for the place of delivery (Figure 6 and Figure 9) revealed that all have values less than absolute value of 3 indicating the absence of outliers in the model implying the models are adequate. Another method of detecting outliers is leverage value. From the scatter plots of leverage values for the place of delivery (Figure 7 and Figure 10), less than one indicating the absence of outlying observation. In addition, Cook's distance is proposed to measure the effect of excluding any specific observation on the set of parameter estimates. Cook (1977) gives the value of D, d>1 identifies cases that might be influential. It indicated that there are no large values of Cook's distance (Di<1), which means that there are no influential cases having an effect on the model (Figure 8 and Figure 11).

Multicollinearity in the constructed model is assessed through the examination of tolerance and Variance Inflation Factors (VIF). Examination of the VIF and tolerance did not show the presence of multicollinearity with all tolerance values greater than 0.1. A VIF value greater than 10 is a cause for concern and in this fitted model, values of estimates is less than 2 (Table 18 and Table 22).

Predicted probabilities of place of delivery were calculated using three of the variables that showed strong effect in the logistic regression model. These variables were place of residence, wealth index and education level of the women. A separate logistic regression model was fitted using these three independent variables by taking place of delivery as an outcome variable. As the wealth index increases, the gap between the different groups widens. At the highest household wealth index, with highest level of education (secondary and above) and from the urban areas women have 74 percent [$1 / 1 + e^{-[-3.439 + 1.511\ (1) - 2.141\ (2) + 0.805\ (1)]} = 0.73485$] probability of having an institutional delivery (2006 NDHS). Similarly at the highest household wealth index, with highest level of education (secondary and above) and from the urban areas women have 89 percent [$1 / 1 + e^{-[-2.080 + 1.152\ (2) - 2.2\ (4) + 0.769\ (1)]} = 0.88502$] probability of having an institutional delivery (2011 NDHS). The predicted probabilities are not so clustered together towards the lower end of wealth index as in 2006 NDHS data. Both survey revealed that probability for delivery at health facility

for primary education in rural areas is less than for no education in urban areas. Even though less in education level, women from urban areas are more likely to deliver in health institute than women from rural areas. It may be due to the easy access of the health services in urban areas than rural areas (Figure 12 and Figure 13).

Besides, to get a better understanding of why women do not give birth at a health institute, the 2006 and 2011 NDHS asked women who gave birth in the five years before the survey, why didn't they give birth in a health facility. In a data set 792 respondents delivered at health facility, therefore only 3390 respondents gave the answer of that question for 2006 and in a data set 1615 respondents delivered at health institute, therefore only 2464 respondents gave the answer of that question for 2011. Lack of awareness appears to be the most important factor for not delivering at health institute in both survey (64 percent for 2006 and 57 percent for 2011) (Table 23, 24).

In this research, the next response variable as maternal health service utilization is assistance during delivery which takes the three categories: a) assistance during delivery by no one b) assistance during delivery by unskilled birth attendant (USBA) and c) assistance during delivery by skilled birth attendant. For this Multi Nominal Logistic Regression (MNLR) model have been applied which would allowed the identification of each of the selected predictor variable on assistance during delivery, controlling for the effect of other predictor variables. These models are appropriate when the dependent variable is composed of polychotomous categories. The model selection criterion for the inclusion of relevant variables in the models is based upon likelihood ratio criteria. The likelihood ratio test for the overall significance of all coefficients for the predictor as well as significance of single predictor in the model is tested significant p value revealed the acceptable fitting of MNLR model. Finally, in both survey all together 8 variables are found statistically significant. These variables are current age, education level (no education/ Primary/ secondary and higher), Birth in last five years (1/2/more than 2), wealth index (poorest/ poorer/ middle/ richer/ richest), region (scare/ moderate/ adequate), residence (rural/ urban), ANC by provider (by no one/ by informal sources/ by SBA) and currently working (yes/no).

For MNLR model, one of response category is taken as a base line or reference category to calculate the log odds of other categories relative to the reference category. In this study, assistance during delivery by no one is taken as reference

category hence would take odds of being assistance during delivery by USBA versus assistance during delivery by no one and assistance during delivery by SBA versus assistance during delivery by no one.

In terms of demographic variable, however there is a debate in literature about woman's age and place of delivery. The present research shows the negative effect of age on assistance during delivery by USBA and assistance during delivery by SBA with reference to assistance by no one. This finding clearly indicates that younger women are more likely to assistance during delivery by USBA and SBA than their older counterparts. Both are highly significant with p value < 0.001. Association between age and place of delivery has also been inconsistent across studies. Whereas many studies found a positive correlation between age and the use of skilled attendants at child birth (Celik and Hotchkiss, 2000; Obermeyer, 1993; Gerlter and Rahaman, 1993), others have found a curvilinear relationship (Gage 1998).

In 2006 NDHS, the place of residence did not show significant effect for the assistance during delivery by USBA versus no one. However place of residence has strong and significant effect on assistance during delivery by SBA versus no one. The likelihood of assistance during delivery by SBA for urban residence women has 2.43 odd factors in comparison to rural women but in 2011 NDHS the place of residence does not show significant effect for the assistance during delivery by USBA verses no one and assistance during delivery by SBA versus no one.

In 2006 NDHS, the odd ratio of performing assistance during delivery by USBA versus no one is 1.99 times higher for EMW with a secondary/higher education relative to no education. Similarly, the odd ratio performing assistance during delivery by SBA versus no one is 3.74 times higher for EMW with secondary/higher education relative to no education. It is significant with p value < 0.05 and p value <0.001 respectively. But it did not show significant for primary education. But in 2011 NDHS, assistance during delivery by USBA verses no one for primary and secondary/ higher education showed insignificant result. The odd ratio of performing assistance during delivery by SBA versus no one is 2.31 times higher for EMW with a secondary/higher education relative to no education. It is significant with p value < 0.05. Several studies have assessed the education level and utilization of maternal services. These studies have not yielded a consistent pattern of relationships between

education level and assistance during delivery. For example, whereas studies in Peru (Elo 1992)and Guatemala (Goldman 1996) showed that women with primary level education were more likely to utilize maternal health services compared to those without any formal education, some studies in Thailand (Ragupathy, 1996) and Bangladesh (Dharmalingam, 2000) did not record any significant difference between the two educational groups.

The estimated coefficients of EMW under different regions are obtained. Also some disparities exist in assistance during delivery in region. The odds corresponding to moderate and adequate regions are 1.36 and 1.99 times more likely to assistance during delivery by USBA versus no one compared with scare region. Similarly the odds of performing assistance during delivery by SBA versus no one is 3.05 times higher for EMW living in adequate region relative to scare region and it is highly significant for 2006 NDHS. But these were significant with p value < 0.05 for 2011 NDHS.

In both survey birth order showed negative association. The odds ratio of performing assistance during delivery by USBA versus no one is about 68 percent for 2006 and 69 percent for 2011 lower for EMW with 3 or more birth order and 33 percent for 2006 and 38 percent for 2011 lower for 2 birth orders relative to one birth order. Birth order has been consistently shown to be negatively correlated with the use of skilled birth attendants(Raghupathy, 1996; Bhatia and Clend, 1995; Obermeyer 1993).

In both survey the strong positive association that has been shown to exist between ANC by provider and assistance during delivery, all are highly significant. Similarly there was a strong positive association between working status and assistance during delivery in both survey but it is insignificant for delivery by USBA versus no one in 2011 NDHS.

The overall goodness of fit of the estimated MNLR model was judged by deviance and Pearson's chi square. In both survey, deviance residual and Pearson's chi square were found to be statistically non-significant with p value 0.594 and 1.00 for 2006 NDHS and 0.99 and 1.00 for 2011 NDHS respectively. Non-significant p values suggest that the estimated model fit well to the MNLR model (Table 27 and Table 32). The Negelkerke R^2 is found to be 0.411 (2006 NDHS) and 0.392 (2011 NDHS).

A more useful measure to assess the utility of MNLR model is classification accuracy, which compares predicted group membership based on the MNLR model to the actual known group membership, which is the value of the response variable. In both survey, classification accuracy rate were greater than by chance accuracy (chance accuracy =70.85 percent for 2006, 66.01 percent for 2011 and classification accuracy = 77.9 percent for 2006, 73.3 percent for 2011) (Table 29 and Table 34). Hence the classification accuracy is satisfactory in both studies.

Multicollinearity in the multinomial logistic regression solution is detected by examining the standard errors for the b coefficients. A standard error larger than 2.0 indicates numerical problems. Analyses that indicate numerical problems should not be interpreted. In both study none of the independent variables in this analysis had a standard error larger than 2.0. (We are not interested in the standard errors associated with the intercept) so there is no evidence of a multicollinearity problem with these analysis (Table 26 and Table 31).

In this research, the 3rd response variable is "Number of ANC visits" which takes the three categories: a) no ANC visit b) 1-3 ANC visits (some visits) c) 4 or more visit (adequate visit). To establish the effect of the identified predictor variables on the response variables "Number of ANC visits", Ordinal Logistic Regression (OLR) model was fitted. This model was chosen since the response variable is a three category ordinal. Using MNLR model, mean that the information conveyed by the ordered nature of response variable is discarded. In addition not treating the variable as ordered, may lead to loss of efficiency.

Before fitting an OLR model in 2006 and 2011 NDHS, One of the assumptions underlying ordinal regression is that the relationship between each pair of outcome groups is the same. In other words, ordinal regression model assumes that the coefficients that describe the relationship between, say, the lowest versus all higher categories of the response variable are the same as those that describe the relationship between the next lowest category and all higher categories, etc. This is called the proportional odds assumption or the parallel regression assumption. Because the relationship between all pairs of groups is the same, there is only one set of coefficients. The test of parallel line was designed to make judgment concerning the assumption that all the logit surfaces are parallel .It was assessed using the Brant test of proportionality which determines the extent of the parallelism with the 1st and 2nd

cut off points of the response variable. Here null hypothesis states that the slop coefficients in the model are the same across the response categories. For 2006 NDHS, the significance p=0.963>0.05 indicated that there was no significance difference for the corresponding slop coefficient across the slope categories hence the model assumption of parallel lines was not violated in the model(Table 35). But For 2011 NDHS, the assumption of the parallel line is violated (Table 40). The use of OLR model when its assumptions are violated creates a misleading impression of how the response variable and predictors are related. It would need different model to describe the relationship between response variable and predictors.

Though proportional odds model are suited for the analysis of 2006 NDHS survey, a critical assumption is that of parallel slopes. This assumption was assessed in preliminary analyses, using Brant test. The test showed that overall, there was not a violation of the parallel regression assumption (chi square = 6.419, p= 0.963). The presence of a relationship between the dependent variable and combination of independent variables is based on the statistical significance of the final model. In this study, the -2LL of the model with only intercept is 6468.596 while the -2LL of the model with intercept and independent variables is 5150.747. The difference (Chi-square statistics) is 6468. 596- 5150.747 = 1317.848 which is significant at α=0.05. Here p<0.001, conclude that there is association between the response variable and predictors in OLR model (Table 34). Finally all together 8 variables are found statistically significant. These variables are current age, highest education level (no education/Primary/secondary and higher), Birth in last five years (1/2/ more than 2), wealth index (poorest/poorer/middle/richer/richest), Occupation (never work/ agriculture sector/ modern sector), residence (rural/ urban) and currently working (yes no) and religion (Hindu/others).

In proportional odds model, the effects of predictors on response variable can be quantified by one regression coefficient hence calculation of one common odds ratio is possible therefore the presentation of result is short and simple. Since age is a continuous variable, the presented odd ratio refers to a difference of one year in age. We would say that for a one year increase, we expect a .043 decrease in coefficient of being in a higher number of ANC visits, given all of the variables in the model are held constant. Respondent with one year increase is found to be .96 odds factor or 4percent less of performing higher number of ANC visits. It is statistically highly

significant at 0.001 levels. For residence, the odds among women with residence in urban areas, increase the number of ANC visits by (1.316-1) = 32 percent holding all other variables constant. Education emerged as an important variable. Women with primary education are 1.99 times more likely to have higher number of ANC visits than women with no education. The odds could be as little as 1.69 times or as much as 2.36 times larger with 95 percent confidence. Similarly women with secondary/ higher level of education are 3.29 times more likely to have higher number of ANC visits.

The effect of wealth index on ANC visits appeared to be very strong. The odds ratios for richer and richest wealth index are almost 3.28 and 4.94 times more likely to deliver at health facility. Hindu religion is found to be 1.25 odds factor or 25 percent more of performing higher number of ANC visits with the reference category of other. It is statistically significant only at 0.05 levels.

For birth order, the odds among women with 2 birth, reduce the number of ANC visits by (1.0-0.83) = 17 percent holding all other variables constant. 3 or more than 3 births did not show significant result. Occupation in modern sector is found to be 1.41 odds factor or 45 percent more of performing higher number of ANC visits with the reference category of never work. It is statistically significant only at 0.05 levels but occupation in agricultural sector did not show significant result.

Several standard measures of model adequacy tests have been considered in order to examine how well the fitted model matches the observed data. The overall goodness of fit was computed by deviance and Pearson's chi square statistics. For 2006 NDHS data, deviance residual is found to be 3959.236 at 3974 degree of freedom and Pearson's chi square is found to be 4014.256. Both are found to be statistically non-significant with p value 0.324 and 0.563 respectively. Non-significant p values suggest that the estimated model fit well to the OLR model (Table 38). Here Negelkerke R_N^2= 0.306 (Table 39).

The predicted probability of number of antenatal care visit based on the age is depicted. It shows that with age the probability of number of no ANC visits increased rapidly while four or more visits decreased (Figure 14).

For 2011 NDHS, the assumption of the parallel line is violated (Table 40). The use of OLR model when its assumptions are violated creates a misleading impression of how

the response variable and predictors are related. It would need different model to describe the relationship between response variable and predictors. Hence, a legal alternative is to develop a Partial proportional Odds (PPO) model. This was used to generate the estimate of partial proportional ratios across the categories of the outcome variable: never visit versus some and adequate visits; never and some visits versus adequate visits. This unconstrained PPO model will estimate as many coefficients as multinomial model does but the model is not identical to MNLR model. The ordering of the categories is important in PPO model. This is not true for MNLR model where the ordering of categories is arbitrary. PPO model are very similar to what we get with the series of binary logistic regression model such as we operated earlier and can be interpreted the same way. Small differences are typically found because the PPO model estimates all the parameters simultaneously whereas the separate binary logistic regression model estimate them one cumulative at a time.

The main problem with PPO model is that they include more parameters than OLR model. This is because this method frees all variables from the parallel line constraint, even though the parallel line assumption may only be violated by one or few of them. Brant test in preliminary runs indicated that age, primary education, middle wealth index and currently not working violated proportional odd assumptions in the model. The corresponding odds ratios therefore allowed varying across categories. It is called restricted Partial Proportional Odds (PPO) model. Here the parallel line constraint is only released for those variables where it is not justified. Therefore restricted PPO model was employed in this study. In This study ten independent variables which meet the proportional odds assumption and only four (age, primary education, middle wealth index and currently not working)does not meet proportional odds assumption (Table 42). Therefore we analyzed by constraints partial proportional odds model which relax the parallel line constraints for those variables where it is violated. A key enhancement of restricted PPO is that it allows some of the beta coefficients to be the same for all values of j, while others can differ. i.e., it can estimate partial proportional odds models.

Noteworthy that in OLR model there are 14 degree of freedom, in PPO model there are 28 degree of freedom and with restricted PPO model there is 18 degree of freedom. This is due to the 10 constraint above. In above table note that the parameters estimate for the constraint variables are the same in all two panels hence

only 18 unique b coefficients needs to be examined compared to be 28 produced by PPO model (Table 43).

With the partial proportional odds model(restricted), the effects of the variables that meet the parallel lines assumption are easily interpretable in the same way as in OLR model. For other variables, an examination of the pattern of coefficients reveals insights that would be obscured or distorted if a parallel lines model were estimated instead. There would be many more parameters to look at, and the increased number of parameters could cause some effects to become statistically insignificant. In this study, residence, birth order, occupation and currently working showed statistically insignificant result.

Here the model may not look very parsimonious. However the same coefficients are reported in each of the two panels for ten parameters (urban residence, secondary/ higher education, poorer, richer and richest wealth index, Hindu religion, birth order, occupation and current working).only the coefficients for age, primary education, middle wealth index and not working differ across the two panels. The repetition of identical parameter can become confusing. Therefore Williams (2006) suggests an alternative more succinct approach that he calls Gamma.

The alternative Gamma parameterization can be used for alternative statistical test for violation of assumption. It is more theory based model selection. Under the Gamma parameterization, γ coefficient represents deviation from proportionality (Table 44).

5.2 Recommendations

Education was found to have an important effect on the utilization of all three forms of maternal health care services suggesting that improving educational opportunity for women may have a large influence on improving the utilization of such services. However, this is a long term investment so as an alternative health programs need to focus on attracting women with little education. Because these women can bring behavioral change easily and as the bivariate test address these were the disadvantaged women.

In this study, wealth index has a very significant impact on the utilization of all three forms of maternal health care services, with wealthier families more likely to use the health service. Increasing the economic situation of the population is a long term

national objective and goes beyond the responsibility of the Ministry of Health. Nevertheless, the Ministry of Health could align its plan of actions to meet the objectives of the poverty reduction strategy.

The role of birth order points to the need for messages that target specifically higher birth order mothers when establishing safe motherhood programs. It is better to educate mothers the disadvantage of higher birth order to overcome the problem, so that this group of mothers would be encouraged to have health facility services. The Ministry of Health could also use media to disseminate consistent messages promoting the use of maternal healthcare services by all women and most particularly higher birth order women.

Antenatal care by formal sources itself emerged as a most important factor for utilization of other services. Antenatal care provides the opportunity to educate women about danger signs of pregnancy, potential complications, where to seek help and importance of other maternal health care services. Additionally, helps to offer preventive care that will benefit the infant as well as the mother and to treat existing diseases that may be aggravated by pregnancy. Therefore, enabling women to get adequate antenatal care by formal sources may bring immediate change on utilization of other services and well-being of women.

Similarly, policies and efforts have to be put in place to creating job opportunity to women in rural residence. Future plans on MHC service provision should target on older women, women with at low level of education and women without work for most of the services.

CHAPTER 6: SUMMARY

In this thesis an attempt has been made to examine the impact of socio-economic and demographic variables on maternal health care service utilization behavior. Globally the indicators that are widely used to track maternal health care can be classified into four groups: Contraceptive use, antenatal care (ANC), delivery care and postnatal care (PNC). The present study focuses on the delivery care and antenatal care. For the study of delivery care, the place of delivery and assistance during delivery is used. Similarly for the study of antenatal care, frequency of antenatal checkup is used. The rationale for antenatal care is that it is essential to screen a predominantly healthy population to detect early signs of any risk factors for pregnancy related complications and followed by timely intervention. This study focuses on the importance of a place of delivery as maternal health services, because delivery at health facilities (government/private hospital/hospital running by NGOs/clinics/ centers or other type of health facility) women receive better facilities and assistance than delivery at home. Delivery assistance by SBA is one of the key indicators to reflect the progress towards the Millennium Development Goal of improving maternal health therefore this study focuses on assistance during delivery.

Lack of maternal health care service utilization has been marked as important cause for the large number of maternal death. Even though significant improvement in utilization of maternal health care services attained between 2006 and 2011, the rate of utilization of these services is inadequate. Recent data (2011 NDHS) shows that nearly 60 percent of births take place at home; most of them are performed without the assistance of any skilled birth attendant. The proportion of women is very less utilizing all form maternal health care services starting from antenatal care to institutional delivery. It is seen that while 53 percent of pregnant women use adequate ANC visits but assistance during delivery by SBA is only 35 percent.

The general objective of this study is to analyze factors associated with the utilization of health care services, which influence the use of maternal health care services in Nepal.

The data for this study is chosen from the Demographic Health Survey (DHS), 2006 and 2011 of Nepal. Both data sets are nationally representative cross sectional survey

designed to provide information on topics related to fertility levels and determinants, family planning, fertility preferences, infant, child, adult and maternal mortality, maternal and child health, nutrition, knowledge of HIV/AIDS and women's empowerment. The unit of analysis for both studies is Ever Married Women (EMW) who had at least one live birth in the five year preceding the survey. For those EMW, who had more than one birth, only utilization behavior of maternal health services associated with most recent pregnancy within five years was considered, so the sample of this study consists of 4182 EMW for 2006 NDHS and 4079 EMW for 2011 NDHS. The sample was selected with the rationale that mothers would most accurately be able to recall the utilization behavior of their pregnancy that occurred within the past years.

Three Maternal Health Care Services' (MHCS) were selected as dependent variables. These dependent variables were created from questionnaires included in the maternal health component of the DHS questionnaire. These include frequency of ANC visits, place of delivery and assistance during delivery. As noted in the literature review, majority of maternal deaths and disabilities occur around the time of delivery. For this reason, Delivery care (represented by place of delivery and assistance during delivery) was selected as dependent variable. Antenatal care was selected as dependent variable, since its importance as proxy to the early detection of complication has been demonstrated in the literature.

The WHO recommended 4 or more ANC visits as optimum number of visits for those with uncomplicated pregnancy therefore, the frequency of ANC visits is taken as indicator of antenatal care and categorized into three levels as no ANC visit, some visit (1-3 visits) and adequate visit (4 or more visits). As an indicator of delivery care, the study accessed place of delivery and assistance during delivery. The place of delivery was collapsed to create a dichotomous variable on the basis of whether the woman delivery at health institution or home. Next indicator assistance during delivery is categorized into three levels as assistance during delivery by no one, by unskilled birth attendant and skilled birth attendant (SBA).

A number of independent variables are taken into account based on scientific literature review of both socio-economic and demographic variables. The independent variables are mixture of categorical and continuous variables and basic description are

presented in Table 4. It also presents the information on how the variables are re coded. Socio-economic covariates include education level, wealth index, working status, husband's education and occupation similarly demographic covariates include age, religion, region, sex of household head, birth in last five years and residence. ANC by provider is also included as predictor.

In analyzing data, univariate, bi-variate and multivariate analysis were employed. In the univariate analysis, descriptive statistics were used to present socio-economic and demographic characteristics of respondents. Frequency and percentage was used to describe the data. Bivariate analysis was done by taking each independent variables and calculating proportion of all three form of health service utilization. The final data was analyzed for identification and building of suitable statistical models. . In this process various type of models were explored and test for their suitability reliability and validity and practical utility in full filling the objective of the research. In this research, logistic regression model, multinomial logit model and Ordinal logistic regression model were used to assess the influence of socio-economic and demographic characteristics of individuals on maternal health care services as place of delivery, assistance during delivery and number of ANC visits respectively.

Logistic regression analysis was used to analyze the data because the 1st response variable, place of delivery was classified into two categories delivery at health institution and delivery at home. This model was chosen as the most suitable method because of its computation ease and desirable statistical properties. The 2nd response variable is assistance during delivery which is classified into three categories therefore Multi Nomial Logistic Regression (MNLR) model have been applied which would allowed the identification of the each of the selected predictor variable on assistance during delivery, controlling for the effect of other predictor variables. To establish the effect of the identified predictor variables on the 3rdresponse variables "Number of ANC visits", Ordinal Logistic Regression (OLR) model was fitted. This model was chosen since the response variable is a three category ordinal. Using MNLR model, mean that the information conveyed by the ordered nature of response variable is discarded. In addition not treating the variable as ordered, may lead to loss of efficiency. In this study, A three category outcome will have two binary logit equations based on the following comparison: none verses some visit, adequate visits and none and some visits verses adequate visit.

Regarding fitted models for predicting place of delivery, the following are summarized:

- Education level, wealth index, birth order, residence and ANC by provider were highly significant predictors for the selection of place of delivery for 2006 NDHS survey but in 2011 NDHS survey age was also highly significant.
- Residence, education level, wealth index and ANC by provider have a positive association with place of delivery but birth order, occupation and age have a negative association.
- No education is considered as reference category. The coefficient corresponding to primary and secondary/higher level of education is 0.305 and 1.175 respectively for 2006 NDHS and for 2011 NDHS it is 0.391 and 0.829 respectively.
- Poorest as a reference category, the coefficient corresponding to poorer, middle, richer and richest are 0.337, 0.395, 0.626 and 1.294 respectively for 2006 NDHS and for 2011 NDHS it is 0.2919, 0.533, 0.718 and 1.516 respectively.
- The logistic regression coefficient to the ANC by informal sources and SBA is 0.572 and 1.753 respectively for 2006 NDHS and for 2011 NDHS it is 0.965 and 1.956 respectively.ANC by no one is consider as reference category.
- In both models, although not statistically significant, it is suppressing that women whose occupation is in modern sector are less likely (OR= 0.95 for 2006 NDHS, OR= 0.93 for 2011 NDHS) to delivery at health institute as compare to women whose occupation is never work. Women who never work may be associated with household of high economic status and for this reason, an inverse may have been found.
- Considering model adequacy test such as goodness of fit tests (Hosmer-Lemeshow chi-square statistic), multicollinearity diagnostics (tolerance and VIF), residual analysis and outliers (leverage value) showed that both models fit well to the proposed logistic regression model.
- Education level, wealth index and residence have shown highly significant. So predicting probabilities for place of delivery as health institute, another

logistic regression was fitted with education level, wealth index and place of residence as independent variables. It showed that even though less in education level, women from urban areas are more likely to deliver in health institute than women from rural areas in both survey. It may be due to the easy access of the health services in urban areas than rural areas. The predicted probabilities are not so clustered together towards the lower end of wealth index as in 2006 NDHS data.

- Besides, to get a better understanding of why women do not give birth at a health institute, in both survey, asked women who gave birth in the five years before the survey, why didn't they give birth in a health institute. Most women replied that delivery at health institute is not necessary (64 percent in 2006 NDHS and 57 percent in 2011 NDHS).

Regarding fitted models for predicting maternal health service utilization as assistance during delivery, the following are summarized:

1. In 2006 NDHS survey, age, wealth index (poorer), region (adequate), birth order, ANC by provider and currently working were highly significant predictors for the ADD by USBA versus no one. Similarly education level and region (moderate) were significant at 5 percent level of significance and wealth index (middle, richer and richest) were not significant predictors for the ADD by USBA versus no one. But ADD by SBA versus no one age, residence education level (secondary/higher), wealth index (poorer, richer, richest), region (adequate) birth order, ANC by provider and currently working were highly significant whereas education level (primary), wealth index (middle) and region (moderate), were not significant predictors.
2. In 2011 NDHS survey, age, wealth index (poorer, middle), region, ANC by provider and currently working were highly significant predictors for the ADD by USBA versus no one. Whereas residence, education level, wealth index (richer and richest), birth order and currently working were not significant predictors for the ADD by USBA versus no one. But ADD by SBA versus no one age, education level (secondary/higher), wealth index, region (adequate), ANC by provider and currently working were highly significant whereas

region (moderate), and birth order significant at 5 percent level of significance and residence and education level (primary), were not significant predictors.

3. The strong positive association that has been shown to exist between ANC by provider and assistance during delivery. The odds ratio of performing assistance during delivery by USBA verses no one is 2.25 (2006 NDHS) and 2.97 (2011 NDHS) times higher for EMW with ANC provided by informal sources and 2.29 (2006 NDHS) and 2.95 (2011 NDHS) times higher for EMW with ANC by formal sources relative to ANC by no one. Similarly, the odd ratio of performing assistance during delivery by SBA verses no one is 3.27 (2006 NDHS) and 6.48 (2011 NDHS) times higher for EMW with ANC provided by informal sources whereas 12.46(2006 NDHS) 16.48 (2011 NDHS) times higher for EMW with ANC by formal sources relative to ANC by no one.
4. Considering model adequacy test such as goodness of fit tests (Deviance and Pearson's chi-square statistic), Negelkerke R^2 , multicollinearity diagnostics (S.E for b coefficients), Classification accuracy (which compare predicted group membership based on the MNLR model to the actual known group membership) showed that both models fit well to the proposed multinomial logistic regression model.

Regarding fitted models for predicting maternal health service utilization as umber of ANC visits, the following are summarized:

- In 2006 NDHS, assumption of parallel lines was assessed in preliminary analysis using Brant test. Insignificant at 5 percent level of significance indicating proportion odds assumption is not violated. Therefore we used proportional Odds Model.
- Age, education level, wealth index, residence, religion and currently working were significant with p value less than 0.01birth order (2), occupation (modern sector) were significant at p value less than 0.05 whereas occupation (agriculture sector) and birth order (3 or more) showed insignificant result.

- Age, births order was found negatively associated with number of ANC visits. Respondent with one year increase is found to be .96 odds factor or 4% less of performing higher number of ANC visits.
- Education emerged as an important variable. The fitted coefficients to primary, secondary/higher level of education are 0.69 and 1.37 respectively.
- The odds ratios for poorer, middle, richer and richest wealth index are almost 1.89, 2.53, 3.28 and 4.94 times more likely to performing higher number of ANC visits.
- Hindu religion is found to be 1.25 odds factor or 25 percent more of performing higher number of ANC visits with the reference category of other.
- In the fitted models, the p value of the model chi square test are found to be significant ($p<0.001$) which imply that the reduction in -2 log likelihood values with inclusion of the independent variables in the model are statistically significant.
- Considering model adequacy test such as goodness of fit tests (Deviance and Pearson's chi-square statistic), Negelkerke R^2 showed that model fist well to the proposed ordinal logistic regression model.
- For 2011 NDHS, the assumption of the parallel line is violated. Therefore partial proportional odds model (PPO) has been used. This model free all the variables from the parallel line constraints even though, the parallel line assumption be violated only few of them.
- Therefore the study used restricted PPO model where parallel line constraint is relaxed only for those variables where the assumption was not justified and parallel line constraint is consider for other variables.
- In this study, only 18 unique b coefficients need to be explained in PPOM with constrained compared to be 28 coefficients produced by PPOM with unconstrained.
- The PPO model works best when relatively few variables violate the assumption of parallel line. If several variables violate the assumptions of parallel line, MNLR model will be superior.

- Here the model may not be seen very parsimonious. However the same coefficients are reported in each of the two panels for ten parameters only the coefficients for age, primary education, middle wealth index and not working differ across the two panels. The repetition of identical parameter can become confusing. Therefore Williams (2006) suggests an alternative more succinct approach that he calls Gamma.
- The Gamma parameterization can be used for alternative statistical test for violation of assumption. It is more theory based model selection. Here γcoefficient represents deviation from proportionality (Table 44).
- Age, education level, wealth index and religion are found to be significant with p value less than0.01 whereas residence, birth order, occupation and currently working showed statistically insignificant result.
- The coefficient of EMW under different wealth index is computed. Poorest as a reference category, the coefficient corresponding to poorer, richer and richest are 0.399, 0.986, and 1.611 respectively performing higher number of ANC visits. Since middle wealth index has b coefficient 1.011 for performing never visit versus some and adequate visit. Here Gamma parameterization for middle wealth index is -0.403. Therefore b coefficient for performing never and some visit versus adequate visit is -0.403 + 1.011 = 0.608.
- No education is considered as reference category. The coefficient corresponding to secondary/higher level of education is 1.199. But has primary education has b coefficient. 0.425 for performing never visit versus some and adequate visit. Here Gamma parameterization for primary education is 0.281. Therefore b coefficient for performing never and some visit versus adequate visit is 0.281 + 0.425 = 0.706.

The main strength of the study deserves mention. The strength of the present study was the use of nationally representative large sample of married women with a high response rate. Detailed content of the data has given opportunity to explore the existing situation of maternal health care services in the country. Several studies carried out about maternal health care services and its determinants focus mainly on use of binary logistic regression model which lack the essence of order present in dependent variable as measured: no ANC visit, some ANC visits and adequate ANC

visits, hence the problem of losing ordinal nature of outcome variable at one hand and maintaining parsimony of the result on the other hand through fitting OLR model was tried to overcome. This study has used OLR model along with unrestricted PPO and restricted PPO model which has not been commonly used in other study.

This study has some limitation that should be noted. Some known predictors of maternal health care service utilization are obviously missing from the analysis which has not been covered. For example distance or time to reach health institute, transportation in services, respondent's beliefs concerning health care practices, cost associate with use of services, waiting time to receive assistance and presence of profession providers. Further the analysis did not take into account factors related to complications during the current pregnancy and difficulties encountered during previous childbirth which may influence the decision about preferred place of delivery.

The magnitude of the association between socio-economic and demographic variables and maternal health care service utilization varied from one study to other both within and between countries. This diversity in finding may be due to the difference inclusion criteria and study design. Study used different statistical analysis tools and some did not adjust for important variables. The definition of dependent variables and independent variables differ among studies. This variation created methodological challenge that made result more heterogeneous and difficult to compare.

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PUBLICATIONS/SEMINAR PRESENTATION

List of published papers and paper presented in seminar related to this research

Published Papers:

1. Shrestha, G. (2011) 'Mathematical Modeling of Health Services Utilization Data Using Multiple Logistic Regression' ***BRAC University Journal,*** Vol. VIII, no. 1 & 2, pp. 47-54.

2. Shrestha, G. and Shrestha, G. (2011) 'Statistical analysis of factors affecting utilization of antenatal care in Nepal, ***Nepal Journal of Science and Technology,*** V0l. 12, pp. 268-275.

3. Shrestha, G. (2013) 'Utilization of Antenatal Health Services: An Application of Ordinal Logistic Regression Model' ***Himalayan Scientific Journal,*** V0l. 6, pp. 35-40.

Seminar Presentation:

4. Presented the paper entitled *"Ordinal Logistic Regression Model: An Application to Health Service Utilization Data"* presented in the 6th National Conference on Science and Technology organized by the Nepal Academy of Science and Technology, from September 25-27, 2012.

5. Presented the paper entitled *"Mathematical modeling of Health Service utilization Data using Multiple Logistic Regressions"* presented in the National Conference on Statistics for Twenty-first Century [NCSTC] & Annual Conference of Kerala Statistical Association Conducted by the Department of Statistics, University of Kerala, Trivandrum, from March 17-19, 2011.

List of published papers and presented in seminar not directly related to this research:

Published paper:

6. Shrestha, G.(2013) 'Factors related to utilization of antenatal care in Nepal: A Generalized Linear Approach', ***Journal of Kathmandu Medical College,*** Vol. 2(2),Issue 4 2013, pp. 69-74

7. Shrestha, S. L. and Shrestha, G. (2010) 'Statistical analysis of factors associated with maternal mortality in Nepal', ***International Journal of Statistical Sciences,*** Vol. 10, , pp 57-70 (ISSN 1683-5603)

8. Shrestha, G. 'Enrollment of Female Students in Higher Education with Special Reference to Tribhuvan University', NUTA ***Journal***, Vol.3, No. 3, pp. 62 – 71.

Seminar Presentation:

9. Shrestha, G. ***'Factors related to Utilization of Antenatal care in Nepal: A generalized linear Approach'*** presented in the International Conference on Operational Research organized by the Operational Research Society of Nepal (ORSN), from February 1-2, 2012.

10. Shrestha, G. '***Statistical Analysis of Factors Associated with Maternal Mortality in Nepal'*** presented in the National Conference on Science and Technology conducted by Nepal Academy of Science and Technology (NAST), from November 10-12, 2008.

11. Shrestha, G. '***Women in Nepal, with Socio-Economic and Demographic perspective'*** presented in the conference, Some Application of Statistics in Development Initiatives with Special Reference to Nepal, conducted by Central Department of Statistics and Department of Statistics, P. N Campus, Pokhara, from May 28-30,2006.

Annex 1: Descriptive Statistics for DFBETA, 2006 NDHS

	N	Minimum	Maximum
DFBETA for constant	4182	-0.01259	0.0573
DFBETA for V190(1)	4182	-0.02249	0.01885
DFBETA for V190(2)	4182	-0.02251	0.01969
DFBETA for V190(3)	4182	-0.02349	0.01636
DFBETA for V190(4)	4182	-0.02841	0.01906
DFBETA for M2anc_a$1(1)	4182	-0.03046	0.01897
DFBETA for M2anc_a$1(2)	4182	-0.02991	0.01379
DFBETA for occupation_3(1)	4182	-0.01356	0.00817
DFBETA for occupation_3(2)	4182	-0.01253	0.01778
DFBETA for V208_3(1)	4182	-0.00724	0.01071
DFBETA for V208_3(2)	4182	-0.06446	0.12147
DFBETA for edu. (1)	4182	-0.00676	0.0143
DFBETA for edu. (2)	4182	-0.00818	0.01091
DFBETA for residence (1)	4182	-0.00776	0.01154
Valid N (list wise)	4182		

Annex 2: Descriptive Statistics for DFBETA, 20011NDHS

	N	Minimum	Maximum
DFBETA for constant	4079	-0.02659	0.04284
DFBETA for current age	4079	-0.0005	0.00094
DFBETA for residence (1)	4079	-0.00717	0.00877
DFBETA for wealth index (1)	4079	-0.00738	0.00928
DFBETA for wealth index (2)	4079	-0.00823	0.01138
DFBETA for wealth index (3)	4079	-0.01049	0.01331
DFBETA for wealth index (4)	4079	-0.01365	0.01562
DFBETA for education level (1)	4079	-0.00574	0.00801
DFBETA for education level (2)	4079	-0.0071	0.009
DFBETA for occupation (1)	4079	-0.0088	0.00617
DFBETA for occupation (2)	4079	-0.01053	0.01129
DFBETA for ANC by provider (1)	4079	-0.02767	0.01758
DFBETA for ANC by provider (2)	4079	-0.02739	0.01849
DFBETA for birth order (1)	4079	-0.00724	0.00758
DFBETA for birth order (2)	4079	-0.06405	0.06805
Valid N (list wise)	4079		

Annex 3: Predicted probabilities for POD by wealth Index, education level and residence, 2006 NDHS

Group	Education level	Residence	Wealth index	Predicted prob.
1	0	0	0	0.03
1	0	0	1	0.06
1	0	0	2	0.07
1	0	0	3	0.11
1	0	0	4	0.21
2	0	1	0	0.07
2	0	1	1	0.12
2	0	1	2	0.15
2	0	1	3	0.21
2	0	1	4	0.38
3	1	0	0	0.05
3	1	0	1	0.09
3	1	0	2	0.11
3	1	0	3	0.16
3	1	0	4	0.31
4	1	1	0	0.11
4	1	1	1	0.18
4	1	1	2	0.22
4	1	1	3	0.3
4	1	1	4	0.5
5	2	0	0	0.13
5	2	0	1	0.22
5	2	0	2	0.26
5	2	0	3	0.35
5	2	0	4	0.55
6	2	1	0	0.25
6	2	1	1	0.38
6	2	1	2	0.44
6	2	1	3	0.54
6	2	1	4	0.73

Annex 4: Predicted probabilities for POD by wealth Index, education level and residence 2011 NDHS

Group	Education level	Residence	Wealth index	Predicted prob.
1	0	0	0	0.11
1	0	0	1	0.24
1	0	0	2	0.07
1	0	0	3	0.32
1	0	0	4	0.53
2	0	1	0	0.21
2	0	1	1	0.31
2	0	1	2	0.4
2	0	1	3	0.5
2	0	1	4	0.71
3	1	0	0	0.19
3	1	0	1	0.28
3	1	0	2	0.37
3	1	0	3	0.46
3	1	0	4	0.68
4	1	1	0	0.33
4	1	1	1	0.45
4	1	1	2	0.56
4	1	1	3	0.65
4	1	1	4	0.82
5	2	0	0	0.28
5	2	0	1	0.4
5	2	0	2	0.5
5	2	0	3	0.6
5	2	0	4	0.78
6	2	1	0	0.46
6	2	1	1	0.59
6	2	1	2	0.68
6	2	1	3	0.76
6	2	1	4	0.89