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Abstract

Back ground:. Caesarean Section is a surgical intervention designed to prevent maternal and fetal complications. Maternal Mortality Rate in Ethiopia was 412/100000 live birth. Previous study focuses on comparing cesarean section in public and private hospital in specific urban area. In the best of our knowledge there is no regional level previous community based study that assess trends and associated factors of cesarean section.

Objective:. The objective of the study is to assess trends and associated factors of Cesarean section in Amhara Region, Ethiopia from 2000 to 2016.

Methods and Materials:. The study was based on the four Ethiopia Demographic and Health Surveys data. The surveys used a multi-stage cluster sampling technique. The data were downloaded from the official website of the Demographic and Health Survey program, after getting permission from the Demographic and Health survey team. The regional data were extracted and analyzed by using STATA version 14. Bivariable logistic regression was carried out to identify individual variables associated with the outcome variable in all the four survey and Finally, the multivariable logistic regression analysis was carried out to control confounding and identify independent variables' having p-value <0.05 with 95% confidence interval was considered as statistically significant. The significant of trend line was cheeked by calculating the confidence interval .average annual rate of change was calculated by using formula .

Result:. The rate of cesarean section was increased from 0.1% in2000 to2.3% in2016 Demographic and Health Survey. Only 0.94% of the rural women had a cesarean section compared to11.54% of the urban women. Women who had 4-6 children (AOR0.023, 95%CI 0.00237-0.2303), women who had 7ormore children(AOR,0.0048,95%CI 0.000146-0.162641), maternal age20-34 years (AOR0.046, 95%CI 0.00536-0.39402), and residence being rural (AOR 0.058, 95%CI 0.0120-0.2807) had significant Association with cesarean section.

Conclusion:. The rate of cesarean section is below world health organization standards (5-15%). As maternal age increased the rate of cesarean section increased whereas cesarean section increased when parity decreased. The government should expanded cesarean section set up in the rural area to overcome disparities between urban and rural residence and should improve the service as the standard.

Key words; Caesarean section, associated factors, trend analysis, Ethiopia, Amhara region.

Acronyms

BDU	Bahir Dar University
BEMOC	Basic Emergency Management of Obstetric Care
CSA	Central Statistics Agency
CS	Cesarean Section
CDC	Communicable Diseases Control
EA	Enumeration Areas
EDHS	Ethiopia Demographic and Health Surveys
EPHI	Ethiopian Public Health Institution
ETB	Ethiopian Birr
ICF	Inner City Fund
MCH	Maternal and Child Health
MMR	Maternal Mortality Rate
WHO	World Health Organization

Table of Contents

List of tables

List of figure

List of appendixes

1. Introduction

1.1 Back ground

There are two type of mode of delivery .They are vaginal delivery and cesarean section. Mode of delivery is usually determined by obstetric indications(1).

Cesarean delivery is defined as the birth of a fetus through incisions in the abdominal wall and the uterine wall. Caesarean Section is a surgical intervention designed to prevent maternal and fetal complications(2).In modern clinical practice, any classification of indications for caesarean section has to distinguish between pre-labor, those after spontaneous and induced labor(3). Caesarean sections in modern times have been performed also for non- life threatening indications such as maternal request(4).The crude rate of caesarean section is an important global indicator for measuring access to obstetric services that reduced maternal mortality. The proportion of caesarean sections at the population level is also a measure of the level of access to and use of this intervention. It can serve as a guideline for policy-makers and governments in assessing progress in maternal and infant health as well as monitoring emergency obstetric care and resource use(5). When cesarean section is medically justified, it can effectively prevent maternal and perinatal mortality and morbidity.

Both very low and very high rates of CS can be dangerous but the optimum rate is un known. The conventional range is between 5-15%(minimum and maximum acceptable range) (6).Based on the WHO systematic review, increases CS rates up to 10-15% at the population level are associated with decreases in maternal, neonatal and infant mortality (7). Above this level increasing the rate of CS is no longer associated with reduced mortality.

In addition, a very low rate (< 5%) may reflect a lack of access to obstetrical care and an inadequate level of assistance(8). However, WHO develop global standard of Robson classification system for assessing, monitoring and comparing caesarean section rates within healthcare facilities over time as well as between facilities(9).Caesarean sections have become increasingly common in developed and developing countries. Cesarean section can cause significant and sometimes permanent complications, disability or death particularly in lacked capacity to properly conduct safe surgery and treat surgical complications(9). Another common

complication of cesarean delivery is wound infection. Wound infections may occur in 2.5% to 16% of cesareans. The prevalence of wound infection after CS was 7.8% (10).

Different studies reported that, women who undergo cesarean delivery more commonly experience pain after delivery compared with those having vaginal deliveries. Cesarean delivery may also be a risk factor for placental abruption in the next pregnancy(11).

In Ethiopia the rate of CS varies among administrative region which indicates unequal accesses. Cesarean section were highest among urban mothers than rural mother as well as first birth, births to women with higher education, births to women from the richest of household wealth also highest (12).

1.2 Statement of the problem

A caesarean section is a life-saving surgical procedure when certain complications arise during pregnancy and labor(3). The global maternal mortality ratio was 216 deaths per 100,000 live births(13).The study conducted in Sub Saharan Africa, the average rate of cesarean delivery was negatively correlated with maternal mortality ratio, neonatal mortality ratio and infant mortality ratio. Major barriers to perform cesarean section include poverty, limited access to healthcare services, and a shortage of skilled man power(14).In the absence of cesarean section women with obstructed labor are at risk of death or developing a fistula during childbirth in addition to risk of perinatal morbidity and mortality(15).

Based on WHO standard(5-15%), CS is a measure of accesses of basic emergency management of obstetric care in health facility(6).When low incoming countries increase their CS rates to WHO recommended levels, the average MMR(Maternal Mortality Rate)reduced by 62.75 %(16).Ethiopia's Health Sector Development Plan target was to reduce MMRto 267 per 100,000 live births by the year 2015 but EDHS 2016 report indicated that MMR was 412 Per100, 000 live birth(17).The country was unable to meet the target by 2015.

Even though Caesarean delivery has become a much safer procedure, it is still associated with potential clinical short and long term risk to the mother and the fetus(18). Compared to vaginal birth, maternal mortality after cesarean section was three times higher in Netherlands(19). The systematic review and meta-analysis study in low-income and middle - income countries reported that risk of maternal death in women who had a caesarean section

was 7·6 per 1000 procedures, the highest burden was in sub-Saharan Africa 10·9 per 1000 procedures(20). Previous study showed that children delivered by CS had significantly increased the risk of chronic diseases such as asthma, systemic connective tissue disorders, juvenile arthritis, inflammatory bowel disease, immune deficiencies, and leukemia when compared with spontaneous vaginal delivery (21).Caesarean delivery is also associated with increased cost to the health care system and the patient which is highly important in low resource economics etting.

In Ethiopia, WHO global study estimated the financial implication of unnecessary Caesarean delivery in terms of hospital consumables, length of stay in the hospital after surgery, human and time resources and cost of potential complications from surgery to be 132.7 US dollars per procedure which was high cost (22).There are different socio-demographic and socio economic factors that combined to play important role in associated with caesarean section intervention.

EPHI(Ethiopian public health institution) 2010 Ethiopian financial year annual report indicated that from twenty highest maternal death reporting zones from the country , seven were from Amhara region (West Gojam,NorthShewa,NorthGondar,SouthGondar,EastGojam,South Wolo and BahirDar,4.2%,3.8%,3.6%,3.3%, 2.1%, 1.8%, and 1.7%respectively(23).Availability service of Cesarean section in health facilities are a measure of besic emergency obstetric care service that reduced maternal mortality so that it is important to assess CS trends and associated factors. Previous study conducted in different places focus on comparing cesarean section in public and private hospital in specific urban area and there is no regional level previous community based cesarean section study. The current study assesses trends and associated factors of CS in Amhara region based on EDHS data.

1.3 Significance of the study

Cesarean section is the key intervention for preventing maternal and fetal complication due to prolonged or obstructed labor. It is one of the components that measure accesses of basic emergency and management of obstetric care during fetal and maternal complication arise in the health facility. The result from this study will help to better understand the important factor associated with CS and provided same knowledge to the temporal trends of CS in Amhara region. Additionally the finding of this study will benefit for policy makers and service providers by providing important information for decision making on service provision and service utilization of cesarean section in the region.

1.4. Literature review

1.4.1. Cesarean section rates

Reducing maternal mortality has arrived at the top of health and development agendas by world health organization. WHO consider the percentage of births by CS was a health care quality indicator which providing to protect health of mother and newborn. A study conducted WHO between 1990and 2014 the global average CS rate increased from 12.4% to 18.6% with rates ranging depends on region between 6 and 27.2 % and an average rate of 4.4 % per year(24). The study conducted in USA reported a Caesarean delivery rate of 32.2% in 2014 which was increased from the rate of 22.8% reported in 1993(25). Similar study done in Pakistan showed that C-section rates were 15.8%% (26) . In 2016 the study conducted by WHO indicated that rate of cesarean section in Africa was 7.3 %(24). The study done in south Africa hospital indicated that cesarean section rate was 15%(4).

The study done in sub Saharan Africa reported that the CS rate was 6.2% , ranging between 4.1–16.8%(27) . According to the study in Egypt showed that more than half of all women give birth by CS without much difference between urban and rural areas(28).

In Ethiopia 2016 EDHS found that 2% of live births in the 5 years before the survey were delivered by caesarean section (29).The cross sectional study conducted in Addis Ababa Teaching hospital and non government mother and child health hospital showed that CS deliveries were31.1% and 48.3% respectively(30) . Another study done based on EDHS data, rate of CS in Addis Ababa city was24.4%(2).The CS rate in Addis Ababa has exceeded beyond the level recommended by the WHO. Similar study in Harare indicated that the prevalence of cesarean section in public and private hospitals was 34.3%(31).

The factors responsible for Caesarean section is very complex and, in addition to clinical symptoms. It is also dependent on the economic, organizational, and socio-cultural status of women. Those factors associated with CS delivery was categorized as socio-demographic factors ,obstetric factors and non obstetric factors(4).In Ethiopia maternal indication accounted for 17% and fetal indication accounted 30.7% of CS deliveries(32).

1.4.2. Demographic characteristics

Important socio demographic factors identified in previous studies associated with CS was maternal age ,educational status,, parity,marital status and residence [(2),(3),(4),(24),(26)].

Maternal age is one of the factors that have been to associated with cesarean section globally. The study conducted in Mexico reported that when the age of the mothers were above 30 years ,CS delivery increased while vaginal delivery decreased(33). Similar study in South Africa reported that maternal age was associated with CS delivery(4).In previous published retrospective study in North west Ethiopia women in the age category of 15–19 had lower CS delivery compared to age category of 20–34 years(34).Other studies in Addis Ababa(2) and Harar (31).indicated that CS was not associated with maternal age

The level of education has also correlate with the choice of delivery. Previous study in Pakistan based on Pakistan demographic and health survey data reported that , the rate of CS in educated women were five times higher than non- educated women(26). The study conducted in China indicated that women those educated were 3-4 times more likely to have a cesarean section as compared to illiterates(35). These findings are also Consistent with the findings in Ethiopia where higher level of education was associated with increased prevalence of Cesarean section (2).Study in Harar reported similar finding related to educational status (31).

Parity is also an important factors associated with CS. The study done study in Harar reported that Prevalence of CS delivery among nulliparous women were high (31).

The study done in South Africa showed that marital status had no statistically significant association with Caesarean section(4). Similar study done in Harar Ethiopia reported showed that marital status was no associated with CS(31) .

1.4.3. Socio-Economic factors

Wealth index's was one of the factors that correlated with CS. The trend analysis of Pakistan based on PDHS data from 1990- 2013, C-section rates among the richest women were higher than the poorest women(26).Similar study in Ethiopia Addis Ababa city , Based EDHS data from 2000-2011cesarean delivery among women from the rich households were higher than thosefrom the poor and middle households(2).But the study conducted in Harar indicated that monthly family income was not associated with CS(31).

There was association between CS and place of delivery. The study done in South Africa showed that residence were no statistically significant associated with Caesarean section(4)but the study in Harar Ethiopia showed that residence was associated with CS(31) . Another study done in FelegeHiwotReferal hospital residence being rural was associated with CS (36).The study conducted in Arba-minich reported that being rural resident women were associated with CS(37).

In South African studies, Caesarean on demand is not a major contributor to Caesarean section rates in public hospitals. The study done in Bangladesh Financial incentive also influenced some doctors to perform unnecessary Caesarean sections in the private sector as more money is made in performing a Caesarean delivery than a vaginal delivery(38). The study done in Addis Ababa indicated that , CS rate among women who delivered in private health facilities was twice higher than women who gave birth in the public health facilities (2). The study done in Harar showed that delivery in private facilities was associated with higher CS(31).Employment status did not show significant association with CS (2).

1.5. Conceptual Framework

The following diagram gives the factors that affect Caesarean section rates. Among those factors identified from previous studies ,socio-demographic factor like maternal age, marital status, educational status ,parity and residence were associated with CS while ,Socio-economic factors associated with CS were wealth index, employment status and place of delivery(39).

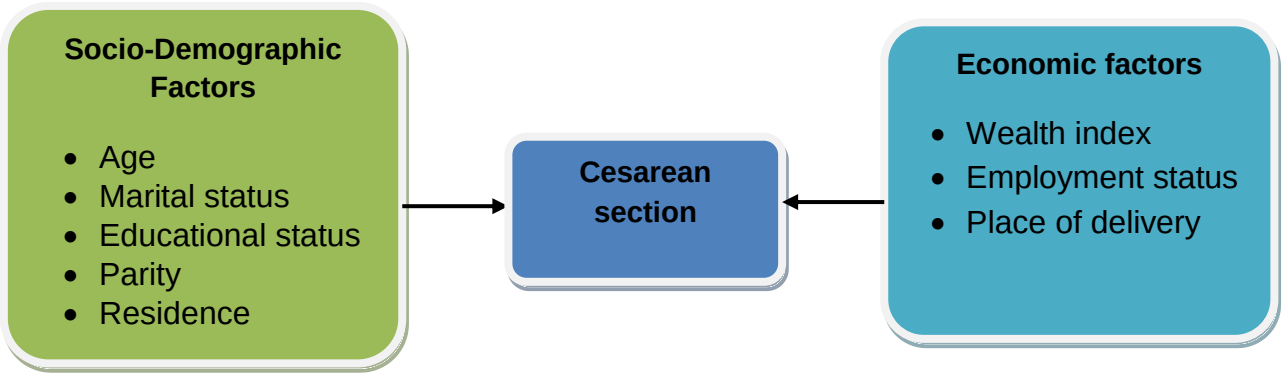


Figure 1 conceptual framework on assessment of trends and associated factors of Cesarean section in Amhara region, Ethiopia

2. Objective

2.1 General objective

✓ To assess the trends and its associated factors of cesarean section in Amhara Region, Ethiopia from 2000 to 2016 EDHS.

2.2 Specific objective

✓ To describe the temporal trends of CS based on the four EDHS datain Amhara Region, Ethiopia.

✓ To identify socio-demographic factors associated with Caesarean section based on the four EDHS data in Amhara Region , Ethiopia.

3. Methods and materials

3.1 Study design

The study design for all EDHS was community based cross-sectional

3.2 Study area

The Amhara region is the second largest and populous regional states in Ethiopia. The region has 15zones, 181 woredas 3960 kebeles , 79hospitals, 853 health center and 3531 health posts and 1200 private health facilities. The CS service is available in hospitals. Based on EDHS report ,the region has 67.1% antenatal visit and 27.1% those delivered in health facility(17).The Region is located in the north part of Ethiopia between 9°20' and **14**°20' North latitude and 36° 20' and **40**° 20' East longitude. Based on conducted by CSA, Amhara Region has a population of 22,191,890.Among this 10874026 were men and 11317864women. Urban inhabitants number4,277,196 (19%)of the population. With an estimated area of 154,708.96 kilometer square, this region has an estimated density of 108.2 people per square kilometer(40).The annual mean temperature of the region is between 15 and 21°C, but in valleys and marginal areas the temperature exceeds 27°C.and The mean annual rainfall of the Region is 1165.2 mm(41).

3.3 Data extraction and analysis period

The data were extracted and analyzed from September to October 2019.

3.4 Source population

Child bearing women age15-49 years in 2000, 2005, 2011 and 2016 EDHS in Amhara region was included in the study.

3.5 Study population

All Child bearing women age 15-49 years in the preceding five years of each 2000, 2005, 2011 and 2016 EDHS in Amhara region was included in the study.

3.6 Study variable

3.6.1 Dependent variable

Cesarean section delivery

3.6.2 In dependent variable

The independent variables for this study were maternal age, parity, women's educational status, women's working status, wealth index, place of delivery and area of residence were included in the study. Based on household asset, in DHS households wealth index categorized as poor, middle and rich.

3.7 Definition of terms

Caesarean section: Birth of a fetus through an incision in the abdominal wall and the uterine wall.

Caesarean section rate: is the proportion of Caesarean sections performed in a health facility or a geographical region in relation to the total number of live births. It is expressed as a percentage pere year.

Socio-Demographic factors: Quantifiable characteristics of a study population, such as age, parity, marital status, level of education and residence were studied.

Parity: This refers to the number of pregnancies carried to fetal viability. Primipara refers to a woman who has been delivered only once of a fetus or fetuses who reached viability. Multipara refers to a woman who has completed two or more pregnancies to viability.

3.8 Sample size

The analysis were based on the available data of 10551 women (3202, 2621, 2656and 2072from EDHS 2000,2005,2011and 2016 total delivery respectively who gave birth in the preceding 5 years of each surveys in Amhara region. Therefore, this study included all women who gave birth in the preceding five years of each survey and had common characteristics over the four EDHS data sets(42-45).

3.9 Sampling technique

All the four EDHS surveys used a multi-stage cluster sampling technique. Initially Enumeration area a cluster that conventionally encompasses150–200 adjacent households' average 181 households were selected as primary sampling units from the sampling frame developed based on the 1994 and 2007 censuses. Then in each of the selected EA a complete listing of households was carried out and ultimately households were drawn as secondary sampling units using systematic random sampling technique. For this specific analysis, all data collected from women who gave birth in the preceding five years of the survey were included. At times when

women had more than one birth in the reference period, the most recent one was considered (42-45).

3.10 Data analysis and management

This study used globally authorized, publicly available data and nationally representative of demographic and health survey of Ethiopia conducted during 2000, 2005, 2011 and 2016 .The data were downloaded from the official website of the DHS program, https://dhsprogram.com after getting the permission from the DHS team. Amhara region data, from the whole data of EDHS were extracted and analyzed by using STATA version 14.The rate of CS was obtained by CS delivery divided by total delivery in each survey. The trend and rate of CS among socio-demographic factors were made by using EDHS 2000, 2005, 2011 and 2016 data. Cesarean section rate was compared across various categorical variables based on all the four EDHS data and explained by table. Trends of cesarean section rate was explained by line graph. The regression line was fitted to cheek weather the line fitted the rate of CS. CI if each trend line was calculated and cheeked the significant of CS. factors of CS was identified based on the four EDHS data. Binary logistic regression model was used. Bivariable logistic regression analysis was carried out to identify individual variables associated with the outcome variable for the recent EDHS data. Finally, multivariable binary logistic regression analysis was done to control confounding. Variables with P-value <0.05 and 95% confidence interval were considered statistically significant. Hosmer-Lemeshow used for goodness fit test of the model in all the four survey. The unit of analysis for this study was women aged 15-49 years with their most recent live birth in each survey. Sampling weights are used in all analyses to make the sample data representative of the entire regional population. Sampling weights were applied before carrying out analysis. Sampling weight was generated by women individual sampling weight divided by 1000000 to get the actual sampling weight with six decimal points as DHS standard in all the four surveys. The average annual rate of change was calculated by the formula adapted from UNICEF.AARI=$(an/am)^{1/n-m)-1,an=last}$ observed CS rate, am=first observed CS, m=first observed year ,n=last observed year . We used Generalized Linear Models with Poisson family, Log link, and Unbiased Sandwich Standard errors to test the significance of CS trends .CS delivery as dependent variable and EDHS year as independent variable trends of CS was checked weather significant or not. The wealth index of 2000EDHS was calculated by principal component analysis using STATA.

3.11 Ethical consideration

The datasets was accessed by legally requisition from Measure DHS team online. The primary data were collected in line with national and international ethical guidelines. Ethical clearance was provided by the Institutional Review Boards of Ethiopian Health and Nutrition Research Institute, Ministry of Science and Technology of Ethiopia, ICF International, and the CDC.

4 Results

4.1 Socio-demographic and socio- economic factors of the respondents

The total number of women who gave birth from 2000, 2005,2011 and 2016 was 10551 including 101 who had cesarean section (**Table1).**The age of the women ranged from15-49years. Among this Most of the women were 20-34 years old and constituted 2099(65.55%)in 2000and 1348(65.06%) in 2016 EDHS respectively. About 1015(31.7%) in 2000 followed by 690(33.30%) in 2016 were Para two-three. As to the educational status of the women 2806 (87.63%) and 1515(73.12%) were illiterate while 5(0.16%) and 57(2.75%) were attending higher education in 2000 and 2016 EDHS respectively. Of the women increased from 306(9.56%) to 404(19.5%) attending primary education in 2000 and 2016 EDHS in the region respectively. Among the women wealth index distribution indicated that1000 (38%) in 2005 and 923(44.55 %) in 2016 became poor respectively.

Of the respondents [639(24.38%), 595(22.4%), 475(22.93%)] belongs to the middle group and [982(37.47%),764(28.77%),674(32.53%] belongs to the richest group in 2005,2011 and 2016 surveys respectively. There is small variation across the four EDHS. From total women in 2000 and 2016 surveys, 2988(93.63%) and1812(87.45%) of them living in the rural area. Among 2889 (90%) women in 2000 to1963 (94.7%) in2016 were married. The proportion of women giving birth at public sector increased rapidly from 82(2.5%) in 2000 to 548(26.5%) in 2016.

Table 1Socio-demographic and socio-economic characteristics of respondents in Amhara region EDHS in 2000 ,2005, 2011, 2016

Characteristics	**EDHS 2000**		**EDHS 2005**		**EDHS 2011**		**EDHS 2016**	
	(N=3202)		(N=2621)		(N=2656)		(N=2072)	
Maternal age(years)	**Frequency**	**Percent**	**Frequency**	**Percent**	**Frequency**	**Percent**	**Frequency**	**Percent**
<19	219	6.84	162	6.18	124	4.67	55	2.65

20-34	2099	65.55	1760	67.14	1840	69.28	1348	65.06
>=35	884	27.61	699	26.68	692	26.05	669	32.29
Parity								
1	387	12.09	337	12.86	377	14.19	329	15.88
2-3	1015	31.70	884	33.73	929	34.98	690	33.30
4-6	1024	31.98	828	31.59	836	31.48	630	30.40
7 more	776	24.23	572	21.82	514	19.35	423	20.42
Educational status								
No education (Illiterate)	2806	87.63	2218	84.62	2147	80.83	1515	73.12
Primary	306	9.56	322	12.29	439	16.53	404	19.50
Secondary	85	2.65	69	2.63	35	1.32	96	4.63
Higher	5	0.16	12	0.46	35	1.32	57	2.75
Employment status								
Employed	2338	73.02	634	24.19	706	26.58	436	21.04
Un employed	864	26.98	1987	75.81	1950	73.42	1636	78.96
Wealth index								
Poor	589	18.39	1000	38.15	1297	48.83	923	44.54
Middle	755	23.57	639	24.38	595	22.40	475	22.93
Rich	1857	58.04	982	37.47	764	28.77	674	32.53
Residence								
Urban	204	6.37	137	5.23	369	13.90	260	12.55
Rural	2998	93.63	2484	94.77	2287	86.10	1812	87.45
Marital status								
Married/living together	2889	90.22	2408	91.87	2405	90.55	1963	94.74
Divorced/separated	217	6.78	160	6.11	199	7.49	92	4.44
Single	22	0.69	7	0.27	25	0.94	9	0.43
Widowed	74	2.31	46	1.75	27	1.02	8	0.39
Place of delivery								
Private sector	7	0.22	0	0	15	0.57	10	0.48
Public sector	82	2.56	93	3.55	255	9.6	548	26.45
Home	3108	97.06	2525	96.34	2372	89.31	1479	71.38
Other	5	0.16	3	0.11	14	0.52	35	1.69

*NA no available data

The rate of CS increased from 0% in 2000 to 2.69% in 2016with women under the age group of >=35 years as well as the rate of CS increased from 0.78 % in 2000 in to 5.17% in 2016 with women who had parity 1(**Table 2)**. The rate of CS among women in higher educational level was increasedfrom 0% in 2000 in to 15.7% in 2016 respectively. The rate of CS increased from 0% to 11.5% from 2000 to 2016 in urban resident's women respectively. The rate of CS increased from 1.2% in 2000 in to 4.4% in 2016 in divorced women**(Table 2)**.

Table 2Caesarean section rate by socio-demographic characteristics in Amhara region from Ethiopian demographic and health survey (EDHS), 2000 ,2005, 2011, 2016

Characteristics''	EDHS2000			EDHS2005			EDHS2011			EDHS 2016		
	Total birth	CS	%	Total birth	CS	%	Total birth	CS	%	Total birth	CS	%
Total (N)	3202	3	0.1	2621	17	0.6	2656	34	1.3	2072	47	2.3
Maternal age(years)												
<19	219	2	0.91	162	2	1.23	124	0	0	55	0	0
20-34	2099	1	0.05	1760	15	0.85	1840	22	1.20	1348	29	2.15
>=35	884	0	0	699	1	0.14	692	12	1.73	669	18	2.69
Parity												
1	387	3	0.78	337	10	2.97	377	14	3.71	329	17	5.17
2-3	1015	0	0	884	7	0.79	929	10	1.10	690	18	2.61
4-6	1024	0	0	828	0	0	836	8	0.96	630	10	1.59
7 more	776	0	0	572	0	0	514	2	0.39	423	2	0.47
Educational status												
No education (Illiterate)	2806	1	0.04	2218	5	0.23	2147	3	0.14	1515	22	1.45
Primary	306	2	0.65	322	1	0.31	439	23	5.24	404	16	3.96
Secondary	85	0	0	69	11	15.94	35	4	11.43	96	0	0
Higher	5	0	0	12	0	0	35	4	11.43	57	9	15.79
Residence												
Urban	204	0	0	137	13	9.49	369	23	6.23	260	30	11.54
Rural	2998	3	0.1	2484	4	0.16	2287	11	0.48	1812	17	0.94
Marital status												
Married/living together	2889	0	0	2408	14	0.56	2405	32	1.33	1963	43	2.19
Divorced/separate	217	3	1.38	160	2	1.25	199	2	1	92	4	4.35
Single	22	0	0	7	1	14.85	25	0	0	9	0	0
Widowed	74	0	0	46	0	0	27	0	0	8	0	0

The rate of CS in women who were employed increased from 0.8% in 2000 to 5% in 2016as well as in the same year the rate of CS increased from 1.5% to 4.45% in the rich women

respectively (**Table 3**).The rate of CS increased from 3.66% in 2000 to8.58% in 2016 women who delivered in public sector.

Table 3Caesarean section rate by socio-economic characteristics in Amhara region from Ethiopian demographic and health survey (EDHS), 2000, 2005, 2011 and 2016

Characteristics''	**EDHS2000**			**EDHS2005**			**EDHS2011**			**EDHS 2016**		
	Total birth	CS	%	Total birth	CS	%	Total birth	CS	%	Total birth	CS	%
Total (N)	3202	3	0.1	2621	17	0.6	2656	34	1.3	2072	47	2.3
Employment status												
Employed	2338	2	0.86	634	7	1.1	706	10	1.42	436	22	5.05
Un employed	864	1	0.12	1987	10	0.5	1950	24	1.23	1636	25	1.53
Wealth index												
Poor	511	2	0.4	1000	2	0.2	1297	3	0.23	923	12	1.3
Middle	755	0	0	639	0	0	595	5	0.84	475	5	1.05
Rich	1857	1	0.05	982	15	1.53	764	26	3.40	674	30	4.45
Place of delivery												
Private sector	7	0	0	0	0		15	5	33.33	10	0	0
Public sector	82	3	3.66	93	17	18.28	255	29	11.37	548	47	8.58
Home	3108	0	0	2525	0	0	2372	0	0	1479	0	0
Other	5	0	0	3	0	0	14	0	0	35	0	0

4.2 trends of cesarean section

From generalized linear model the CS trend is statistically significant across the survey. P-value<0.05(0. 001<0.05) with CI (0.0517-0.1945)

CS delivery	Coef.	Std. Err.	z	P>z	[95% Conf. Interval]	
EDHS year	.1231526	.0364468	3.38	0.001	.0517181	.194587
_cons	-244.3219	73.32466	-3.33	0.001	-388.0356	-100.6083

Cesarean section increased from 0.1% to 2.3% in EDHS 2000 and 2016 respectively (**Figure 3**). When we see the equation of the graph and R2 value indicated that appropriately fit the line and for the next five year 2020EDHS forecasting to reach the rate of CS 8%

Average annual rate of increase`=AARI=(an/am) $^{(1/n-m)-1}$

=(2.3/0.1) $^{(1/2000-2016)-1}$ =0.053%. The average annual rate of increase in the region is 0.053%

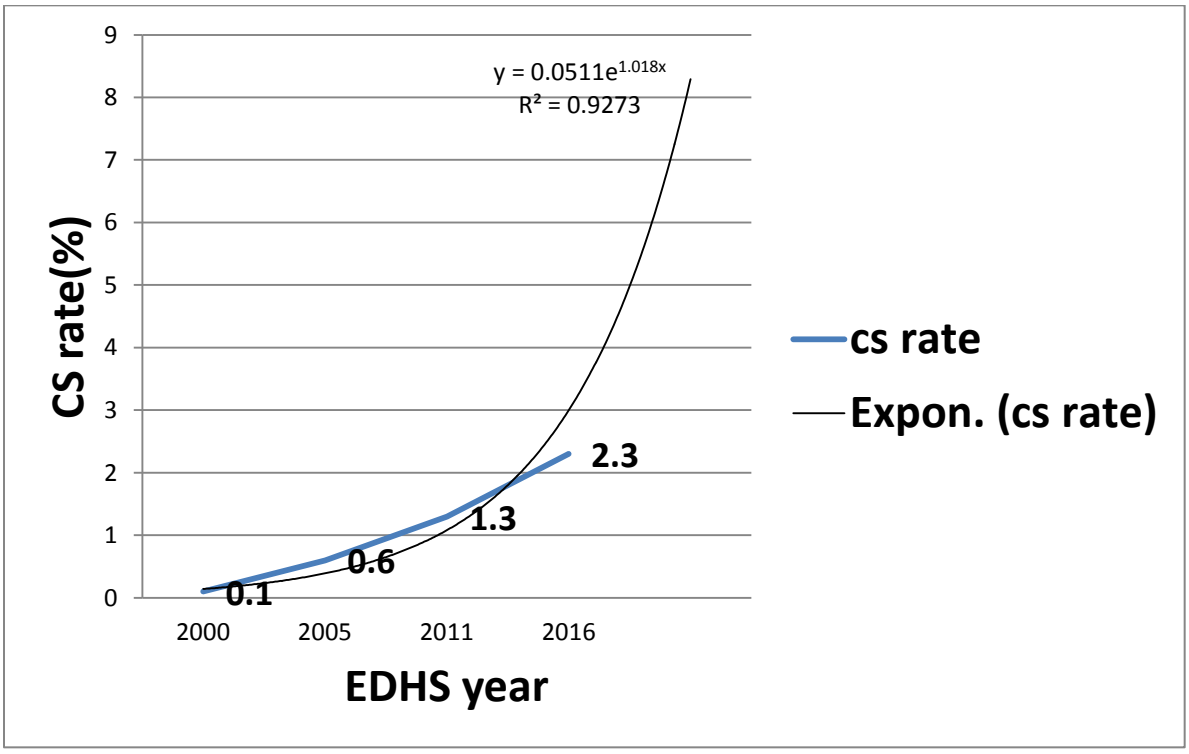


Figure 2Trends of cesarean section in Amhara region from 2000-2016 based on EDHS data

The rate of CS in rural women are increase from 0.1 to 0.94% in 2016 EDHS for the next five(2020EDHS) year the rate of CS will be 2%

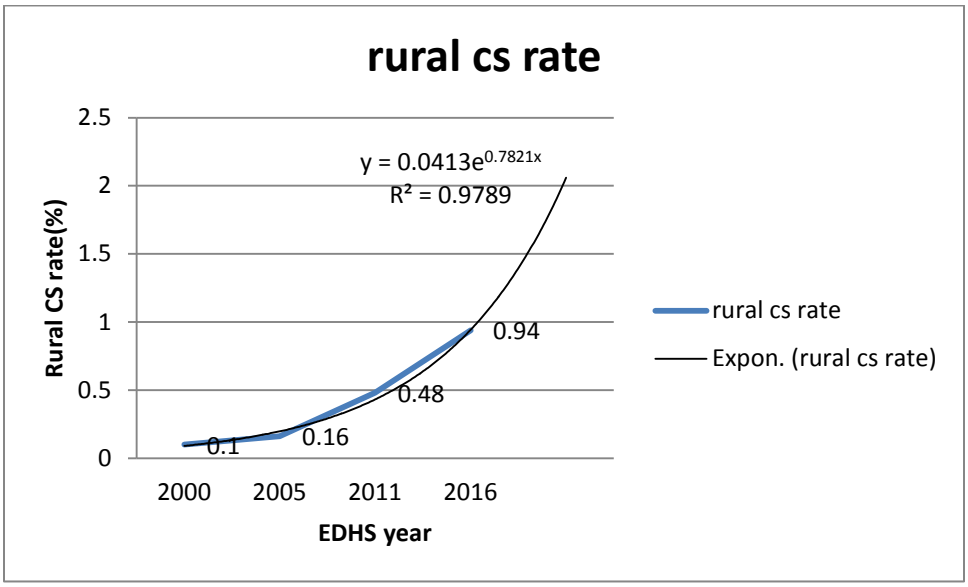
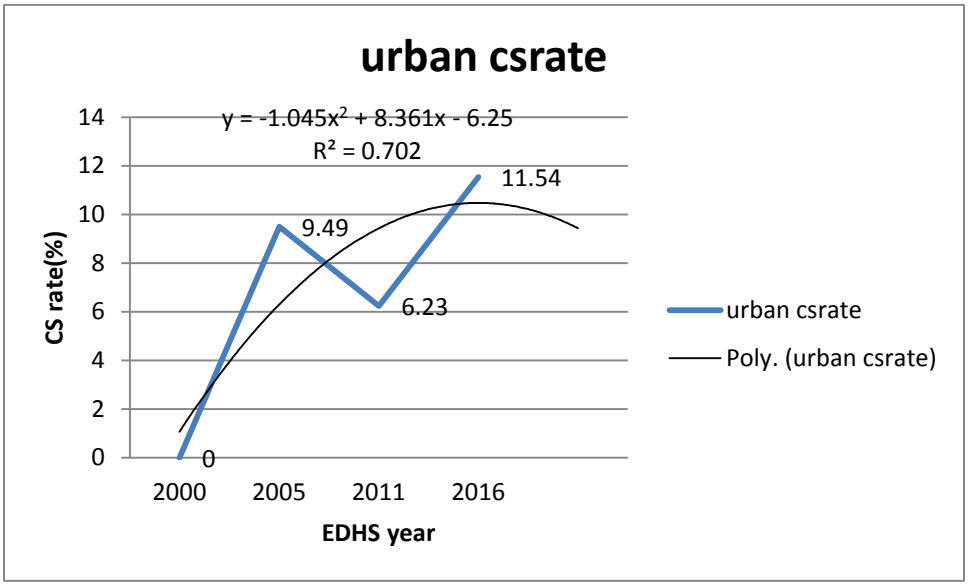


Figure 3Trends of cesarean section rural resident womenin Amhara region from 2000-2016 based on EDHS data

The rate of CS in urban resident women the rate of CS is increased from 0% in 2000 to 11.54% in 2016 EDHS. The prediction of CS rate in the next survey will be below 10%(**figure 4**)



.Figure 4Trends of cesarean section urban resident women in Amhara region from 2000-2016 based on ED

4.4 Result of multi-variable analysis of socio-demographic and socio-economic factors associated with cesarean section.

All independent variables interred to bi-variable and multi-variable analyses

Due to small number of CS(3 from total) the table become shrieked and the CI is wider due to small sample size. The model is appropriately fit p-value>0.05(0.229>0.05)(**Table 4)**. There is no statistical significant variable (**Table 4)**

Table 4Multi-variable binary logistic regression analysis of caesarean section in Amhara region based on socio-demographic and socio-economic characteristics 2000 EDHS

Characteristics	**Cesarean section**		**EDHS 2000**			
	Yes N (%)	No N (%)	COR	p-value	AOR(CI)	p-value
Maternal age(years)						
<19	2(0.91)	217(99.09)	13.7	0.072	12.82(0.652-252.1973)	0.091
20-34	1(0.05)	2098(99.95)	Reference		Reference	
Educational status						
No education (Illiterate)	1(0.04)	2805(99.96)	Reference		Reference	
Primary	2(0.65)	304(99.35)	13.1	0.075	8.8(0.3014-261.345)	0.199
Employment status						
Employed	2(0.09)	2336(99.91)	0.5	0.650	0.7(0.02079-29.3773)	0.891
Un employed	1(0.12)	863(99.88)	Reference		Reference	

All variables interred in to multivariable analyses the model is appropriately fit p-value 0.616>0.05.there is no statistical significant association between CS and demographic and economic factors (**Table5)**

Table 5Multi-variable binary logistic regression analysis of caesarean section in Amhara region based on socio-demographic and socio-economic characteristics 2005 EDHS

Characteristics	**Cesarean section**		**EDHS 2005**			
	Yes N (%)	No N (%)	COR	p-value	AOR(CI)	p-value
Maternal age(years)						
<19	2(1.23)	160(98.77)	8.7	0.286	0.5(0.0045-4.6089)	0.735
20-34	15(0.85)	1745(99.15)	7.9	0.100	0.4(0.0463-3.9705	0.447
>=35	1(0.14)	698(99.86)	Reference			
Parity						
1	10(2.97)	327(97.03)	Reference			
2-3	7(0.79)	877(99.21)	0.2	0.025	0.3(0.0775-1.2706	0.102
Educational status						
No education (Illiterate)	5(0.23)	2213(99.77)	Reference		Reference	
Primary	1(0.31)	321(99.69)	2.1	0.567	1.2(0.1324-10.3242)	0.885
Employment status						
Employed	7(1.10)	627(98.90)	2.3	0.221	1.5(0.1990-12.057	0.699
Un employed	10(0.50)	1977(99.50)	Reference		Reference	
Wealth index						
Poor	2(0.2)	998(99.80)	Reference		Reference	
Rich	15(1.53)	967(98.47)	10.3	0.034	1.5	0.749
Residence						
Urban	13(9.49)	124(90.51)	Reference		Reference	
Rural	4(0.16)	2480(99.84)	0.01	<0.001	0.1(0.0053-1.3538	0.079
Marital status						
Married/living together	14(0.58)	2394(99.42)	0.4	0.171	0.9(0.1441-6.6654)	0.983
Divorced/separated	2(1.25)	158(98.75)	Reference		Reference	

The model is appropriately fit with p-value 0.970>0.05

The odds of age group 20-34 is decreased by96% to use CS compared with age>=35 years (AOR 0.04,95%CI 0.0075-0.2291)

Women who were attending higher education was 46 times more likely to use CS compared with illiterate women (AOR 46 ,95%CI2.668-795.3968)

The use of CS in Multipours women (7more) were decreased by99% (AOR0.01,95%CI 0.0004-0.3109) when compared to primipours women

Table 6. Multi-variable binary logistic regression analysis of caesarean section in Amhara region based on socio-demographic and socio-economic characteristics 2011 EDHS

Characteristics	Cesarean section		EDHS 2011			
	Yes N (%)	No N (%)	COR	p-value	AOR(CI)	p-value
Maternal age(years)						
20-34	22(1.20)	1818(98.80)	0.7	0.433	0.04(0.0075-0.2291)	<0.001
>=35	12(1.73)	679(98.12)	Reference		Reference	
Parity						
1	14(3.71)	363(96.29)	Reference		Reference	
2-3	10(1.08	919(98.92)	0.30	0.128	0.17(0.0140-2.0668)	0.162
4-6	8(0.96)	828(99.04)	0.25	0.010	0.04(0.0124-0.1823)	<0.001
7 more	2(0.39)	512(99.61)	0.10	0.042	0.01(0.0004-0.3109)	0.009
Educational status						
No education (Illiterate)	3(0.14)	2144(99.86)	Reference		Reference	
Primary	23(5.24)	416(94.76)	38	<0.001	33(3.7807-302.1602)	0.002
Higher	4(11.43)	31(88.57)	91	<0.001	46(2.668-795.3968)	0.009
Employment status						
Employed	10(1.42)	769(98.58)			0.4(0.0728-2.1828)	0.284
Un employed	24(1.23)	1926(98.77)	Reference		Reference	
Wealth index						
Poor	3(0.23)	1294(99.77)	Reference		Reference	
Middle	5(0.84)	590(99.16)	4.6	0.192	3.9(0.3361-45.4337)	0.272
Rich	26(3.40)	738(96.60)	18.9	0.013	2.8(0.2533-33.1552)	0.387
Residence						
Urban	23(6.23)	346(93.77)	Reference		Reference	
Rural	11(0.48)	2276(99.52)	0.10	<0.001	0.2(0.0352-1.5717)	0.133

Marital status						
Married/living together	32(1.33)	2373(98.67)	1.40	0.764	1.5(0.1767-12.0553)	0.722
Divorced/separated	2(1.01	197(98.99	Reference		Reference	

All independent variables interred in to multi variable logistic regression to control confounding variables. In multivariable binary logistic regression analysis, the model is appropriately fit p-value >0.05(0.892>0.05)(**table 7**).

Based on multi variable analysis in the recent EDHS 2016 year, women who lived in the rural area compared to urban area, the use of CS was decreased by 94.2%(AOR 0.058,95%CI0.0120-0.2807)**(Table 4).**The odds of having CS in women who had 4-6 children decreased by 97.7 %(AOR0.023, 95%CI 0.00237-0.2303) compared with Primiparous women. The odds of having CS in multiparous women (7more children) decreased by 99.52%(AOR,0.0048,95%CI 0.000146-0.162641)compared with Primiparous women. The odds of age group 20-34 years decreased by 95.4%(AOR0.046, 95%CI 0.00536-0.39402) to use CS compared with the age group >=35 years. The was no statistical difference between Para one and Para two-three having CS. There was no significant difference in the odds of, wealth index, employment status, educational status and marital status of having CS(p-value >0.05).

Table 7Multi-variable binary logistic regression analysis of caesarean section in Amhara region based on socio-demographic and socio-economic characteristics 2016 EDHS

Characteristics	**Cesarean section**		**EDHS 2016**			
	Yes N (%)	No N (%)	COR	p-value	AOR(CI)	p-value
Maternal age(years)						
20-34	29(2.15)	1319(97.85)	0.82	0.75	0.046(0.00536-0.39402)	0.006
>=35	18(2.69)	651(97.31)	Reference		Reference	
Parity						
1	17(5.17)	312(94.83)	Reference		Reference	
2-3	18(2.61)	672(07.39)	0.48	0.270	0.22(0.0469-1.0335)	0.055
4-6	10(1.59)	620(98.41)	0.29	0.179	0.023(0.00237-0.2303)	0.002
7 more	2(0.47)	421(99.53)	0.084	0.024	0.0.0048(0.000146-0.162641)	0.003

Educational status						
No education (Illiterate)	22(1.45)	1493(98.55)	Reference		Reference	
Primary	16(3.96)	388(96.04)	2.73	0.118	1.02(0.2687-3.9406)	0.966
Higher	9(15.79)	48(84.21)	12.49	0.002	0.61(0.0707-5.2484)	0.648
Employment status						
Employed	22(5.05)	414(94.95)	3.55	0.018	1.86(0.5300-6.3656)	0.332
Un employed	25(1.53)	1611(98.47)	Reference		Reference	
Wealth index						
Poor	12(1.30)	911(98.70)	Reference		Reference	
Middle	5(1.05)	470(98.95)	0.89	0.917	1.1(0.0.1776-6.8283)	0.916
Rich	30(4.45)	644(95.55)	3.55	0.088	0.83(0.1159-5.9770)	0.853
Residence						
Urban	30(11.54)	230(88.46)	Reference		Reference	
Rural	17(0.94)	1795(99.06)	0.076	<0.001	0.058(0.0120-0.2807)	0.001
Marital status						
Married/living together	43(2.19)	1920(97.81)	0.44	0.275	0.34(0.0635-1.8394)	0.2
Divorced/separated	4(4.35)	88(95.65)	Reference		Reference	

5 Discussion

Based on this study educational status, employment status are not associated with CS across all the four EDHS. Wealth index and marital status have no statistical association from with CS in the three survey,2005 ,2011 and 2016 respectively but age and parity has association with CS in 2011 and 2016EDHS as well as age, parity and residence are associated with CS in 2016EDHS.

Based on WHO standard(5-15%), CS is a measure of accesses of basic emergency management of obstetric care in health facility to reduced maternal mortality (6). When low incoming countries like Ethiopia is increased their CS rates to WHO recommended levels, the average MMR(Maternal Mortality Rate)reduced by 62.75 %(16).However, the current study in Amhara region indicated that the rate of CS(2.3%) lies below the WHO standard. From twenty highest maternal death reporting zones from the country , seven were from Amhara region (23).Similar stud done based on EDHS data in Addis Ababa city the rate of CS was higher than WHO standard 24.4% (2). These differences may be due to the fact that Addis Ababa is the capital city of Ethiopia so that private facility, and standard health facility are available, due to this the rate of CS varies among administrative region which indicates unequal accesses of CS service in Ethiopia.

This study showed that women aged >=35 years using a higher CS compared with those of 20-34 years. This is in line with other studies(4). This is due to women in the advanced maternal age are more likely suffer from obstetric and maternal complication than women in the middle maternal age, and this may be contributed to increased CS rate .

Based on this finding, primiparous women had more CS than multiparous women(4-6 and 7more) .This finding was supported by other studies done in Addis Ababa(2), Harar(31) and Pakistan(26).The justification for this finding is that maternal complication like prolonged labour, faller to decent and fetal distress are common risk factor in primiparous women. Further investigation is required in which primipourus women age group is CS common indication for delivery in the region.

Another factor observed in this study was place of residence has association with cesarean section. Urban resident women were more likely to use CS compared with rural resident

women. This study is consistent with the study done inFelegeHiwotReferal hospital (36), Harar (31) ,as well as the study conducted in Arba-minich(37). The reason for this finding may be accessibility and availability of CS service in urban area may have an effect on its utilization. Women in urban areas are relatively better which can influence the affordability of CS.

From the total, 8.58% of women delivered by CS in public sectors. This finding contradicts other studies, private CS was higher than public sector ((2),(31),(26)).In the region majority of CS done in public sector. This is may be due to two reasons. Firstly "since the government of Ethiopia offer free service for CS delivery, the women preferred public sector". Secondly although there are some private sectors which provide CS service, most of them are in metropolitan city likeBahir Dar,Gondar and Dessie which are not accessible for much of the women in the region.

Employment status is not associated with the use of CS in this study. This finding is supported by other studies done in different place (2).Because of the government of Ethiopia delivered free service started from pregnancy up to 45 days post partum period, every service related with pregnancy including free ambulance service in both urban and rural area, whether the women had work or not in any organizations had equal opportunity for free CS delivery.

Wealth index(poor ,middle and rich) has not associated with CS. This study supported by the study done in Harar(31). This finding is contradicted majority of other studies(2).. This could be because of the government of Ethiopia adopted free service delivery to pregnant women in order to achieve health sector transformation plane by 2020 G.C to reduced maternal mortality from 412-199/1000 live birth. So that every pregnant woman has equaled chance to access the use of CS irrespective of Economical status.

Educational status of women in Amhara region is not associated with the use of CS. This is supported by other study done in Harar(31). But this finding contradicted the studies done in Addis Ababa and Pakistan(37)respectively . This may have several reasons, among the health extension program implemented in Ethiopia ,promoting and providing family health service and health education and communication was one component which implemented at the community level, health extension worker provided house to house health education ,integrated family health training for house hold leader and women, this informal education may have equal

chance to built awareness regarding complication of delivery and there management in the health facilities.

6. Strength and Limitation of the study

The strength of these studies is used to sampling weight for every analysis and the analysis is based on demographic and health survey standard guideline. This study use high quality standardized national and regional representative demographic and health survey data

Although it does have limitation. This analysis was restricted to the last birth which occurring during the five year preceding the survey. The other year not included in the analysis this could have introduced selection bias. Due to community based study, this study lacks information regarding clinical indication of CS and clinical factors not assessed. The EDHS data collected for other indicator of rather than CS due to this small number of out came variables the CI is wider for the categories of each survey.

7. Conclusion

The rate of CS in Amhara region is below WHO standard. Among socio-demographic factors, parity, maternal age and residence are associated with CS. The rate of CS increased when maternal age increased whereas it decreased with increased parity. The rate of CS is increased in urban resident women than rural resident women.

8. Recommendation

For regional government

- The regional government should improve the rate of CS as WHO standard to reduced maternal mortality rate as a regional level.
- The government should expand CS set up in the rural area to overcome disparities between urban and rural residence.
- The government should motivate private facilities below the metropolitan cities in order to make opportunities to choose quality health service among private or public facilities.

Fore researchers

- Further studies required to identify CS association with younger or older age primiparis women and why
- Further institutional based studies required in district hospital level which is nearest to rural community to identify clinical factors associated with CS.

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10. Appendixe1 Assurance of Principal Investigator

I, the under signed declared that this is my original work, has never been presented in this or any other University, and that all the resources and materials used for the research have been fully acknowledged

Principal investigator :ShumetKassaw (BSC in Public Health)

Signature ----------

Date----------

11.Appendixe2 Approval sheet

APPROVAL OF THE FIRST ADVISOR

1st Advisor: Mr. Taye Abuhay (BSC, Assistant professor in Biostatistics)

Signature----------

Date----------

APPROVAL OF THE SECOND ADVISOR

2nd Co-Advisor Mr. KassawmarAngaw (BSc, Assistant professor in Epidemiology and Biostatistics)

Signature----------

Date----------

APPROVAL OF INTERNAL EXAMAINER

Internal examiner name ……

Signature……..

Date ……..