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DETERMINANTS OF NEURAL TUBE DEFECT SPINAL BIFIDA IN TIGRAY REGION ETHIOPIA A CASE CONTROL STUDY 2015/16

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ABSTRACT

Background- Spinal bifida is a common congenital malformation in human and is defined as a disorder of the spinal vertebra due to a failure to closure the caudal part of the Neural tube or a baby's spine does not close completely during early pregnancy. Spinal bifida is one of the complex disorder that cause lifelong disability, dependency and it has an impact on the growth and development of a country. However, evidences on the determinants of spinal bifida in Ethiopia are scarce. **Objective:** the main objective of the study wasto identify the determinant factors for development of spinal bifida in Tigray Region. **Methods:** A Case control study was employed and data collection was conducted from Jan to April 2015/16. A convenient sampling technique was used to select the 79 case mothers who delivered in Ayder referral hospital in Mekelle city. As we know the number of cases is limited (i.e. SB is not a common disease) so we can increase the number of controls per case to increase power. The incremental gain after 4 controls per case i.e.316 control mothers was selected. Data collection was conducted by interviewing with structured pre-tested Questionnaire method. Data was entered into SPSS Version 20 and cleaned before analysis. Bivariate and multivariate logistic regression analysis was carried out to see the prediction of each independent factor with the dependent variable. **Results and conclusions**: - In conclusion, the study revealed that determinants of spinal bifida are No intake of iron during pregnancy, History of anemia in the current pregnancy, low intake of milk and milk products, No intake of fruits and vegetables. The mother who did not take iron during pregnancy was 5.74 times more likely to have child with spinal bifida than those who took iron during pregnancy.

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INTRODUCTION

Neural tube defect (NTD) is among the most common human congenital malformations caused by partial or complete failure of fusion in the cranial (e.g., Anencephaly) and spinal regions (e.g. Spinal bifida) of the neural tube. Spinal bifida is a complex disability with many associated, secondary, and chronic conditions that require lifelong medical care. Individuals with spina bifida are living longer with advances in medical care, consequently secondary conditions are more apparent and health care costs to treat Secondary conditions are high. The study conducted in Nigeria also found that a child with SB has a total lifetime cost of 560,000 dollars. Persons with spina bifida, had sedentary lifestyle, thus placing individuals at greater risk of experiencing chronic diseases like Hypertension, deep vein thrombosis, cardiac problems and type-2 diabetes. They can also be easily affected by chronic infections because of their open spine and poor immunity. Globally spina bifida affects 300,000 or more pregnancies annually and 1-3 per thousand infants the prevalence of spina bifida is high and it is the most common neural tube defect in developed countries like in US affecting 3000 or more babies born in the country each year. In Ireland, UK, Netherland, Europe and British Islands the birth-prevalence was 1-4 per 1000 live births. In African countries, including Ethiopia among 1,000 newly born African babies in 2006, one to three have spinal bifida. Even though there is a lack of information in Ethiopia.

In previous studies that are done in different countries, there is a gap of information in developing countries like Ethiopia on its identification of determinant factors of spinal bifida, so this study contributes to assessing determinant factors for development of neural tube defect especially spinal bifida.

The Statement of the problem: Neural tube defect is a very serious defect that include conditions like Spinal bifida (a failure of closure of the neural tube surrounding the spinal cord) and anencephaly (partial absence of the brain). Babies with spinal bifida generally can survive, but may require extensive surgical and medical care and may be permanently disabled. Babies with anencephaly will not survive. In Ethiopia neonatal mortality rate in 2011 was 37 per 1000 deaths thus accounts for 63% of all infant deaths and 42% of all under five deaths which makes the reduction of neonatal mortality critical intervention. From this, 7% of neonatal deaths are caused by congenital abnormalities of which spinal bifida is one of them. So we need to consider babies born with defects. There are also cases in Tigray region. For example, many cases are admitted to Ayder referral hospital neonatal ICU and pediatric ward and a lot of pregnancy cases are terminated in Gynecology ward because of anencephaly and other congenital anomalies. There was no previous studies conducted in Ethiopia about determinants of neural tube defect. Therefore, this study assesses determinant factors of spinal bifida in Tigray, Ethiopia.

The significance of the study: The limited available data on NTD in low and medium income countries (LMIC) indicates the need for additional research that would improve the estimated burden of NTD and recommend suitable aid policies through maternal education on folic acid supplementation or food fortification. Every year, more than 300 000 children are born with NTD worldwide. Thus, this study will provide substantive benefit in designing and implementing strategies and in giving attention in the prevention of this devastating health problem. The present study can help as a baseline for policy makers and programmer as well as for future researchers. In addition, the regional and federal level health service and healthcare managers may use the end result of this paper as a contributing input to improve maternal and child health service.

METHODS AND MATERIALS

Study area and study period: This study was conducted from Nov 2015 to June 2016 and data collection was conducted from Jan to April, 2016 in Tigray Region. According to the report of the 2007 housing and population census, the number of population of Tigray region was 4,314,456. When we see the sex composition of the population, 49.2 % of the populations are males and the remaining 50.2% are females. On the other hand, when we see the population in terms of the settlement, 19.5 % of the population are living in urban areas, whereas 80.5% is living in the rural areas of Tigray region.

Study Design: A community based case control study was employed to obtain primary data to identify determinants of spinal bifida in the Tigray region.

Population: Source of population was all women of reproductive age group from 15-49 years old who gave birth in 2015 and Jan 2016 in the Tigray region. The study populationwas women who gave birth to a child who had spinal bifida and women who gave birth child who had no spinal bifida in 2015 and 2016 January.

Eligibility criteria: Inclusion criteria for cases are mothers who gave birth, infants who had spinal bifida. Inclusion criteria for control mothers who delivered infants who had no spinal bifida. Exclusion Criteria for cases and controls are, mothers with mental problems and chronically ill mothers.

Sampling and Sampling technique: Sample size determination, convenient sampling technique was used to select the 79 case mothers who delivered living spinal bifida babies from one of the teaching referral Hospital, Ayder referral hospital in Mekelle city. Eligible control mothers were who gave live births with no spinal bifida delivered during the same time period. The controls were also selected from the community which was the same residence with cases and went to their residence to collect primary data by the simple random sampling technique. As we know the number of cases is limited (i.e. SB is not a common disease) so we can increase the number of controls per case to increase power. The incremental gain after 4 controls per case i.e.316 control mothers was selected.

Sampling procedure: Ayder referral hospital (ARH) in Mekelle city was selected from Health institutions found in Mekelle because all the cases were referred to ARH to treat in NICU and Pediatric ward.

Data collection procedure: Questionnaire for this study was translated to the local language, Tigrigna by different individuals for its easy understanding and consistency. Questionnaire format was also designed that consists of four parts demographic variables, reproductive variables, variables related to first trimester life style and variables related to maternal nutrition.

Data quality control: Training was given for data collectors and supervisors on how to collect data, interviewing techniques, objective of the study content and application of questionnaires. To ensure quality of data, the Questionnaire was pre-tested at the Quiha Hospital on 5% of the total sample size and necessary corrections were made.

STUDY VARIABLES

Dependent Variable

- Spinal bifida.

Independent Variables

- **Socio-economic and demography** –Maternal age, Marital Status, Religion, Educational status, Family monthly income, Maternal Occupation, Residence, Sex and Birth weight of the newborn.
- **Obstetric history**- Parity, ANC follow up, History of SB, History of recurrent abortion, History of anemia, Family history, History of pregnancy related illness , Birth order and Birth space.
- **Nutritional situation and folic acid supplementation**- Food that comprises folic acid, Low Fruits and Vegetable consumption, high and low carbohydrate intake and Low folic acid supplementation intake.

- **Lifestyle** – Coffee consumption, antiepileptic drug use, stressful life situation, Alcohol intake, cigarette smoking, Indore air pollution,
- **Chronic diseases**- History of obesity, Hypertension, Diabetes and cardiac diseases

Data analysis: The collected data were entered and cleaned in SPSS version 20. Frequencies and percentages were done for categorical variables. Binary logistic regression analysis was carried out using bivariate logistic regression analysis to determine the direction and strength of association between a set of independent variables and the dependent variable (Spinal bifida) and to see which variables were significantly affecting the Spinal bifida at 5% significance level. Finally, those variables which were significant at 5% significance level with the outcome variable (Spinal bifida) were selected for multivariate analysis, and the final model was developed using step-wise backward elimination. Multi-Co linearity was checked using variance inflation factor (VIF) at the cut of value 10. Finally the model will be tested with Hosmer-Lemshew model fitness test.

RESULTS

Background Characteristics of the Respondents: A total of 395 women were participated in the study and the response rate was 100%. The mean and standard deviation of age of cases and controls is the same 28 and 6, respectively. Out of the total study participants 40 (50%) of the cases and 174 (55%) of the controls were in the age group 25-34 years. Regarding their educational level 33 (41.8%) of the cases and 114 (66.1%) of the controls were secondary level of education (See table-1).

REPRODUCTIVE BEHAVIORS OF RESPONDENTS

From the study participants 76 (96.2%) of cases and 312 (98.7%) of controls attended ANC follow up at nearest health institutions. Out of the total study participants 47 (59.5%) of cases did not take and 248 (78.5%) of controls had taken an Iron during the time of pregnancy.

Looking for their history of recurrent abortion 66 (83.5%) of cases and 305 (96.5%) of controls did not have a history of recurrent abortion. When we assess history of anemia during last pregnancy 51 (64.6%) of cases had history of anemia and 254 (80.4%) of controls had not history of anemia (Table2).

NUTRITIONAL AND SUPPLEMENT INTAKE OF RESPONDENTS

When we assessed their intake of meat or folic acid rich foods most of cases 55 (69.6%) take only on holidays and 129 (40.8%) of the controls take sometime in the month. Regarding intake of milk and milk products most of 50 (60.3%) of cases did not take and 191 (60.4%) of controls had taken milk and milk products daily during the time of pregnancy.

When we compare intake of fruits and vegetables, some 55 (69.6%) of the cases and most 300 (94.9%) of the controls had taken fruits during the time of pregnancy, however vegetables intake was 45 (57%) of cases hadn't and 308 (97.5%) of controls had taken during pregnancy (Table.3).

PRECONCEPTION BEHAVIOR AND FIRST TRIMESTER LIFESTYLE OF RESPONDENTS

From the study participants 70 (88.6) cases and 225 (71.2) of controls, 72 (91.1%) of cases and 247 (78.9%) of controls had taken coffee during pregnancy and before conception, respectively. When we assess the history of stress during pregnancy, most 41 (51.9%) of the cases and 81 (25.1%) of the controls had a history of stress. Regarding the source of energy used to cook food most 71 (89.9%) of the cases and 129 (40.8%) of controls were used wood, from this 68 (86.1%) of cases and 39 (12.3%) of controls had no chimney. On the other side almost all of the study participants 79 (100%) of cases and 315 (99.7%) of controls did not smoke cigarette (Table. 4).

FACTORS ASSOCIATED WITH SPINAL BIFIDA

Bivariate logistic regression analysis was done between dependentand various independent variables to see the association. In the bivariate logistic regression analysis mother's educational level, women's occupation, family monthly income ,birth WT, iron intake during pregnancy,sex of the baby, family history of NTD, history of recurrent abortion, history of anemia in current pregnancy, history of chronic disease, history of pregnancy related disease, fruit intake, vegetable intake, intake of milk and milk products , meat intake, coffee intake before and after conception, source of energy used to prepare food and availability of chimney were significantly associated with the dependent variable spinal bifida at p-value less than 5% (Table 5).Iron intake during pregnancy, history of anemia in the current pregnancy, intake of milk and milk products, intake fruits and vegetables were significantly associated with neural tube defect, spinal bifida, so these factors are determinants of spinal bifida (Table5).

DISCUSSION

The purpose of the study was to identify the determinant factors for development of spinal bifida in Tigray Region. In Bivariate logistic regression Low educational level, mothers occupation, family monthly income, birth weight, iron intake during pregnancy, sex of the baby, family history of neural tube defect , history of recurrent abortion, history of anemia in current pregnancy, history of chronic disease, history of pregnancy related disease, fruit intake, vegetable intake, intake of milk and milk products , meat intake, coffee intake before and after conception, source of energy used to prepare food and availability of chimney were significantly associated with the dependent variable spinal bifida. The study revealed that determinants of spinal bifida are No intake of iron during pregnancy, History of anemia in the current pregnancy, low intake of milk and milk products, No intake of fruits and vegetables. The mother who did not take iron during pregnancy was 5.74 times more likely to have child with spinal bifida than those who took iron during pregnancy. To my knowledge, such results had not reported earlier. So we should encourage women's to take iron during pregnancy and should improve the mother's nutritional status before and during conception. The study also reveals that history of anemia on last pregnancy determines spinal bifida risk. After controlling other variables child born with spinal bifida was significantly associated with a history of anemia in the current pregnancy.

Table 1.Background characteristics of the respondents (n=395)

Variable	Categories	Cases (%)	Controls (%)
	18-24 years	23(2.1)	81(25.4)
Age of mothers	25-34 years	40(50.6)	174(55.1)
	>=35 years	16(20.3)	61(19.3)
	No education	17(21.5)	45(14.2)
Educational level	Primary education	23(29.1)	50(30.1)
	Secondary education	33(41.8)	114(66.1)
	Higher education	6(7.6)	107(33.9)
	Housewife	45(57)	100(31.6)
Occupation	Employer	11(13.9)	108(34.2)
	Farmer and daily laborer	16(20.3)	60(19)
	Merchant and other	7(8.9)	48(15.2)
	300-1000	55(69.6)	79(25)
Family monthly income	1100-2000	20(25.3)	121(38.3)
	>2100	4(5.1)	116(36.7)
	Married	68(86.1)	157(49.7)
Marital status	Unmarried	11(13.9)	159(50.3)
	Orthodox	65(82.3)	274(86.7)
Religion	Others	14(17.7)	42(13.3)
	1-3.99 years	47(59.5)	163(51.6)
Birth space	> 4 years	32(40.5)	153(48.4)
Residence	Urban	59(74.9)	250(79.1)
	Rural	20(25.3)	66(20.9)
	Male	26(32.9)	157(49.7)
Sex of new born baby	Female	53(67.1)	159(50.3)
Birth weight	<2.5Kg	34(43)	41(13)
	>2.5 Kg	45(57)	275(87)

Table 1. Reproductive behaviors of respondents

Variables	Categories	Cases (%)	Controls (%)
	Yes	76(96.2)	312(98.7)
ANC follow up	No	3(3.80)	4(1.3)
	1-3 times	27(34.2)	66(20.9)
Frequency of ANC follow up	4 times	31(39.2)	126(39.9)
	≥5 times	18(22.8)	120(38)
	Yes	32(40.5)	248(78.5)
Iron intake in pregnancy	No	47(59.5)	68(21.5)
	Yes	0(0)	3(0.9)
Preconception iron intake	No	79(100)	313(99.1)
Intake of folic acid in pregnancy	Yes	0(0)	2(0.6)
	No	79(100)	314(99.4)
	Yes	2(2.5)	6(1.9)
History of NTD	No	77(97.5)	310(98.1)
	Yes	12(15.2)	11(3.5)
Family history of NTD	No	64(84.8)	305(96.5)
	Yes	13(16.5)	11(3.5)
History of recurrent abortion	No	66(83.5)	305(96.5)
History of anemia in last pregnancy	Yes	51(64.6)	62(19.6)
	No	28(35.4)	254(80.4)
History of pregnancy related complications	Yes	51(64.6)	21(6.6)
	No	28(35.4)	295(93.4)

The odds of women who have children born with spinal bifida were 6.59 times more likely to have anemia in current pregnancy than those who have no anemia in the current pregnancy. This result is less than the study conducted in Bagdad; that is the highest percentage (83%) of the study sample had anemia during current pregnancy in Bagdad. The possible reason may be Ethiopian government health policy main focus is on maternal and child health. Urban and Rural health extension workers in Ethiopia, which help the main health sector in improving maternal health through home to home assessment and give care to pregnant women to take iron rich foods. Another possible reason may be most of pregnant mothers in Ethiopia check their hemoglobin level when they attend antenatal follow up and gave treatment for anemia if their hemoglobin level decreases. No intake of milk and milk products in pregnancy was also found a significant predictor of child born with spinal bifida in this study. Women's who did not take milk and milk products in the last pregnancy had 18.65 and 30.22 times more likely to determine or to have child with spinal bifida than women who have taken milk and milk products 1-2 times a week and daily, respectively. To my knowledge, such interactions have not been reported earlier.

Another predictor found significant in this study is no intake of fruits and vegetables. At the multivariate level of analysis women who didn't take fruits had 74.6% higher risk to have child with spinal bifida as compared to women who take fruits. After controlling other variables, women who have not taken vegetables had 0.885 times less likely to have child with spinal bifida than women who have taken vegetables. This result is higher than the study conducted in Italy AOR=3.38(1.67-6.82).The possible reasons may be due to socioeconomic, ecological, environmental and cultural difference. Another possible reason might be due to the difference in their lifestyle, the policy of the country and availability of fruits and vegetables.

Table 2: Nutritional intake of respondents

Variables	Categories	Cases (%)	Controls (%)
	No intake	15(19)	4(1.3)
Meat intake	Only on holidays	55(69.6)	72(22.8)
	Sometimes in month	69(7.6)	129(40.8)
	Daily, 1-5times a week	3(3.8)	111(35.1)
	No intake	50(63.3)	20(6.3)
Milk and milk products	Only in holiday, Sometimes in month	13(16.5)	94(29.7)
	1-2 times a week Daily, 3-5times a week	11(13.9) 5(6.3)	11(3.5) 191(60.4)
	No intake	5(6.3)	18(5.7)
Legume intake	Sometime in month	51(64.6)	60(19)
	1-2 times a week	23(29.1)	201(63.6)
	Daily	0(0)	37(11.7)
	No intake	51(64.6)	32(10.1)
Red teff intake	Sometime in month	18(22.8)	59(18.1)
	1-2 times a week	5(6.3)	56(17.7)
	Daily, 3-5times a week	5(6.3)	169(53.5)
	No intake	3(3.8)	6(1.9)
Bread intake	Sometime in month	34(43)	26(8.2)
	1-2 times a week	33(41.8)	67(21.2)
	Daily, 3-5times a week	9(11.4)	217(68.7)
	No intake	78(98.7)	252(79.7)
Sweet potato intake	Sometime in month	0(0)	44(19.3)
	1-2 times a week	0(0)	14(4.4)
	Daily, 3-5times a week	1(1.3)	6(1.9)
	No intake	14(17.7)	11(3.5)
Potato intake	Sometime in month	41(51.9)	39(12.3)
	1-2 times a week	24(30.4)	260(82.3)
	Daily, 3-5times a week	0(0)	6(1.9)
	No intake	4(5.1)	10(3.2)
Cereal intake	Sometime in month	34(43)	73(23.1)
	1-2 times a week	38(48.1)	175(55.4)
	Daily, 3-5times a week	3(3.8)	58(18.4)
	No intake	54(74.7)	36(11.4)
Barely intake	Some times in month	6(7.6)	78(24.7)
	1-2 times a week	8(10.1)	124(39.2)
	Daily, 3-5times a week	6(7.6)	78(24.7)
	No intake	75(94.9)	57(18)
Honey intake	Some times in month	0(0)	110(34.8)
	1-2 times a week	3(3.8)	88(27.8)
	Daily, 3-5times a week	1(1.3)	61(19.3)
	No intake	66(83.5)	77(24.4)
Pasta and macaroni	Some times in month	8(10.1)	86(27.2)
	1-2 times a week	5(6.3)	149(47.2)
	Daily, 3-5times a week	0(0)	4(1.3)
Fruit intake	Yes	55(69.6)	300(94.9)
	No	24(30.4)	16(5.1)
	Only on holiday	7(29.2)	42(13.3)
Frequency of fruit intake	Sometimes in month	10(41.7)	71(23.6)
	1-2 times a week	7(29.2)	174(57.8)
	Daily, 3-5times a week	0(0)	14(4.7)
Vegetable intake	Yes	34(43)	308(97.5)
	No	45(57)	8(2.5)
Frequency of Vegetable intake	Some times in month	21(60)	37(11.9)
	1-2 times a week	13(37.1)	243(78.4)
Multivitamin intake	Daily, 3-5times a week	1(2.9)	30(9.7)
	Yes	0(0)	30(9.5)
	No	79(100)	286(90.5)

Table 3: Preconception, first-trimester lifestyle and history of chronic diseases ofrespondents

Variables	Categories	Cases (%)	Controls (%)
Coffee intake in pregnancy	Yes No	70(88.6) 9(11.4)	225(71.2) 91(28.8)
Frequency of coffee intake in pregnancy	1-3 Cup daily ≥4 cups daily	24(33.3) 48(66.7)	146(58.9) 102(41.1)
Coffee intake before conception	Yes No	72(91.1) 7(8.9)	247(78.9) 66(21.1)
Frequency of coffee intake before conception	1-3cup daily	21(30)	145(64.4)
	>4 cups daily	49(70)	80(35.6)
Stress in pregnancy	Yes No	41(51.9) 38(48.1)	81(25.1) 234(74.3)
	Stressful situation	28(71.8)	13(15.1)
Level of stress	Medium stress	6(15.4)	34(39.5)
	Sometimes	5(12.8)	39(45.3)
Factory or garbage container near house	Yes No	7(8.9) 72(91.1)	30(9.5) 286(90.5)
Intake of alcohol during pregnancy	Yes No	32(40.5) 47(59.5)	87(28.2) 221(71.8)
Intake of alcohol before conception	Yes No	37(46.8)42(53.2)	113(35.8) 203(64.2)
Cigarette intake before and after conception	Yes No	0(0) 79(100)	1(0.3) 315(99.7)
Source of energy used to cook food	Wood	71(89.9)	187(59.2)
	Electric	8(10.1)	129(40.8)
Availability of Chimney	Yes No	2(2.5)	146(46.2)
	No need	68(86.1) 9(11.4)	39(12.3) 131(41.5)
Anticonvulsant drug intake	Yes No	0(0) 79(100)	4(1.3) 312(98.7)
History of chronic disease	Yes	8(10.1)	11(3.5)
Do you have DM?	No	71(89.9)	305(96.5)
	Yes No	3(3.8) 76(96.2)	3(0.9) 313(99.1)
Do you take DM medication?	Yes No	3(3.8) 76(96.2)	1(0.3) 315(99.7)
Do you have history of fever?	Yes No	0(0) 79(100)	30(9.5) 286(90.5)

Table 4: **Association between dependent and independent variables of the study participants**

Variables	Category	Spinal bifida		COR (95% CI)	AOR (95% CI)
		Yes, N (%)	No, N (%)		
Family monthly income	300-1000	55(41.0%)	79(59%)	1	
	1100-2000	20(14.2%)	121(85.8%)	20.19(7.034-57.96)*	1.972(0.329—11.807)
	≥2100	4(3.3%)	116(96.7%)	4.793 (1.59-14.448)*	3.081(0.601-15.782)
Sex of new born baby	Male	26(14.2%)	157(85.8%)	1	
	Female	53(25.0%)	159(75.0%)	0.497 (0.296-0.834)**	0.907(0.295-2.788)
Iron intake in pregnancy	No	47(40.9%)	68(59.1%)	1	
	Yes	32(11.4%)	248(88.6%)	5.357(3.174-9.039)*	5.743(1.751-18.8)***
History of recurrent abortion	Yes	13(54.2%)	11(45.8%)	1	
	No	66(17.8%)	305(82.2%)	5.461 (2.344-12.73)*	1.078(0.125-9.323)
History of anemia	Yes	51(45.1%)	62(54.9%)	1	
	No	28(9.9%)	254(90.1%)	7.462 (4.357-12.78)*	6.596(1.93-22.55)***
	No intake	50(71.4%)	20(28.6%)	1	
Milk and milk products	1-2/ week	13(12.1%)	94(87.9%)	95.5 (34.15-267.04)*	18.651(3.78-92.2)***
	Only in HD	11(50%)	11(50%)	5.28(1.829-15.257)**	3.688(0.744-18.289)
	Daily	5(2.6%)	191(97.4%)	38(11.285-129.308)*	30.228(3.5126.4)** *
Fruit intake	No	55(77.5%)	16(22.5%)	1	
	Yes	24(7.4%)	300(92.6%)	42.969 (21.5-86.08)*	5.746(1.28-25.86)***
	Yes	34(9.9%)	308(90.1%)	1	
Vegetable intake	No	45(84.9%)	8(15.1%)	0.02 (0.009- 0.045)*	.115(0.017-0.757)***
Coffee intake in pregnancy	Yes	70(23.7%)	225(76.3%)	1	
	No	9(9.0%)	91(91%)	3.146 (1.508-6.56)**	3.429(0.327-35.967
Coffee intake before conception	Yes	72(22.6%)	247(77.4%)	1	
	No	7(9.6%)	66(90.4%)	2.748 (1.208-6.25)**	1.072(0.082-14.046)
Source of energy used to cook food	Electric	8(5.8%)	129(94.2%)	1	
	Wood	71(27.5%)	187(72.5%)	0.163 (0.076-0.351)*	6.013(0.043-840.041)
	No	68(63.6%)	39(36.4%)	1	
Chimney	Yes	2 (1.4%)	146(98.6%)	25.38(11.613-55.46)*	16.314(0.119-2245.4)
	No need	9(6.4%)	131(93.6%)	0.199 (0.42-0.094)**	0.235(.002-33.527)

NB. The numbers with an asterisk (*) showed that the statistical significant association between dependent and independent variables at p-Value *< 0.000, **< 0.002, ***<0.05

Conclusion and Recommendation

Determinants of neural tube defects are No intake of iron during last pregnancy, history of anemia during last pregnancy, low intake of milk and milk products, No intake of fruits and vegetables.

Recommendation

- Encourage pregnant mothers to attend ANC and encourage iron intake during pregnancy.
- Encourage intake of fruits and vegetables.
- Identify and treat anemia in pregnant women as early as possible.
- Encourage intake of milk and milk products or intake of folic acid rich foods like meat.
- Further studies should be done with large sample and broad area.

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