

**Pilot Study to Assess the Antenatal Point Prevalence of Neural Tube Defects and Associated Factors in Pregnant Woman Attending ANC in Ghandi Memorial Hospital in Addis Ababa Ethiopia, August 26-September 10 of 2017**

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## **ABBREVIATIONS**

ANC – Antenatal care

AFP- alpha feto protein

BPD- Biparietal diameter

CRP- Crown rump length

CHD- Congenital heart disease

FL- Femur length

HC- Head circumference

NTD- Neural tube defect

## Abstract

**Introduction:**NTDs are a heterogeneous group of CNS malformation resulting from faulty development of neural tube during one the three embryonic periods. NTD is the second most common congenital malformation following CHD and the most common form of CNS malformation. It encompasses a broad spectrum of CNS malformation spanning from anencephaly which is incompatible with life to minor occult malformation.

NTDs have a global average incidence of 1.6 per 1000 live births, the highest incidence reported in Mexico and England. There is no adequate data on its incidence in Ethiopia but its frequency ranges from 0.77-6.1 per 1000 live births in South Africa<sup>1, 2, 3, 4&5</sup>.

NTD is a multifactorial process resulting from interplay between genetic and environmental factors. There is an increased risk of NTD after affected siblings and in siblings of affected parents<sup>1</sup>. There is also an increased risk in infants of mothers with low serum folic acid level, poorly controlled insulin dependent diabetes mellitus, obesity and maternal intake of anti-epileptic and folic acid antagonist drug especially in the first trimester<sup>1, 11 & 12</sup>.

**Objective:** to assess the point prevalence and the frequency of different types of NTD using routine obstetric anatomic ultrasound scan as well as factors associated with NTD

**Methods:** A hospital based trans cross sectional study was conducted in Ghandi memorial hospital on 84 pregnant women attending ANC from August 26 to September 10 of 2017. The study has included all pregnant women with a gestational age of 18 weeks and above and live pregnancy.

**Result:** The study has included 84 pregnant women all of whom was singleton intra uterine pregnancies. The study participants had an average age of 27.5 years and literacy rate of 99% .The reported monthly average income was 3300 birr. None of them took preconception folic acid supplementation while 71.4% took during first trimester. Thirty six point four percent took medically prescribed medication during first trimester. Two of the fetuses had ananencephaly type of NTD giving point prevalence of 23.8 NTD per 1000 pregnancies.

**Conclusion:** The literacy rate and participants living above the poverty line is much higher than both urban and national average. First trimester; especially, preconception folic acid supplement intake is low in this study but the finding is comparable to similar studies. The point prevalence of NTD is significantly higher than the global and regional averages. All of the studies calculated their incidence as a ratio of live births and did not consider all forms of pregnancy losses and still births. But it is difficult to generalize based on this study findings due to small study population size and facility based study design. Further study is recommended to assess knowledge, attitude and practice of reproductive age women towards folic acid supplement intake. Large population based study is recommended to assess the prevalence and the frequency of different types of NTD.

# CHAPTER ONE

## INTRODUCTION

### 1.1 BACKGROUND

Central nervous system malformation is the second most common congenital malformation after congenital heart disease. NTD results from failure of closure of neural tube with a global incidence of 1 per 1000 live births. It encompasses a spectrum of malformations spanning from the cranium to spine resulting in significant morbidity and mortality <sup>1,2,3,4</sup>.

There is no a single etiologic agent identified as a cause of NTD. But, there is an accumulating knowledge from both laboratory studies on animal models and human epidemiologic studies; that indicted an increased association between NTD and lower maternal serum folic acidlevel, gestational DM and exposure to teratogens <sup>7, 10, 11</sup>.

Various strategies have been implemented worldwide to decrease both the prevalence and severity of NTD using diverse preventive and screeningmeasures. The most effective strategy to date is supplementation of folic acid to women of reproductive age before and during pregnancy. Since its introduction in 1985 folic acid supplementation has decreased the incidence of NTD by half <sup>7, 11</sup>.

There is growing evidence that shows early detection and in utero intervention of fetuses affected by NTD could decrease the severity of non-lethal neurologic impairment caused by the disorder. Early detection could also provide necessary information to the mother to decide on termination of the pregnancy which significantly decrease medical and financial burden on the mother <sup>12</sup>.

There are different screening tests and examinations for intra-uterine diagnosis of NTD which include maternal serum and amniotic fluid AFP (alpha fetoprotein)and ultra sound examinations. But due to different causes that raise AFP level and invasiveness of the procedure, much attention has focused on Ultra sound diagnosis alone or in combination with AFP <sup>12</sup>.

Ultra sound has an overall detection rate of 90% when it is routinely performed between 18-22 weeks of gestation. It can also provide assessment of other associated fetal anomalies <sup>7,12</sup>.

This study is the first part of an ongoing thematic research on NTD and associated factors. The purpose of this study is to determine the point prevalence and the frequency of different forms of both both cranial and spinal dysraphism, as well as, assess different factors associated with NTD.

## 1.2 Statement of the problem and significance of the study

NTD affects around 6 million people worldwide with live birth prevalence of 1-6/1000 live births depending on geographic location and racial difference. The highest prevalence recorded is in Mexico and England<sup>1,2</sup>.

NTD includes a heterogenous group of disorders imposing a wide spectrum of health impacts and economic burden on both the affected child and the family. In its extreme form (anencephaly), it is incompatible with life.

The health complications of the less severe forms of NTD depend on the size and location of the defect and whether the defect is open or closed. If the defect involves the lumbar segment it usually leads to complete or partial paraplegia and difficulty in bowel and bladder sphincter control. Open neural defect may also predispose to development of central nervous system infections like meningitis. The affected child may also develop hydrocephalus with its associated complication before or after surgical treatment of spina bifida secondary to associated Chiari II malformation.

Earlier diagnosis of NTD will give the mother an informed consent to terminate the pregnancy. Some studies also showed early intra-uterine repair has decreased ventriculo-peritoneal shunt from 80 to 40% and improved lower limb motor outcome at 30 months<sup>12</sup>.

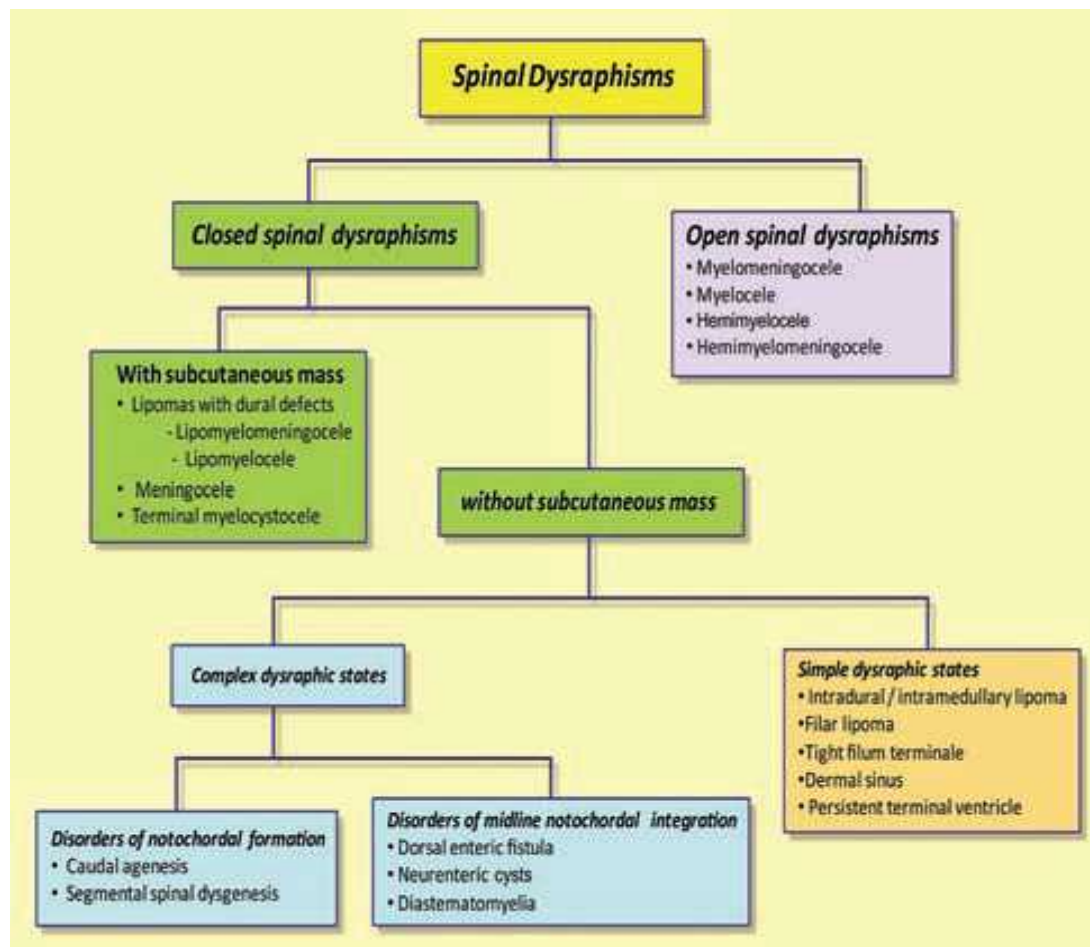
## CHAPTER TWO

### Literature review

Neural tube defect represents a heterogeneous group of disorders resulting from a faulty development of neural tube during one of the three embryonic periods. The three embryonic periods are during gastrulation after 2-3 weeks post conception which involves the intervening mesoderm in the initial bilaminar embryonic disc. The second period is during primary neurulation, during which the neural ectoderm thickens, bend and fold along the midline to form the neural tube. The final period is during secondary neurulation at 5-6 weeks post conception when an additional part of the neural tube is formed posterior to the neural tube resulting in the formation of the conus medullaris and filum terminale <sup>7</sup>.

Neural tube defect is the second most common congenital malformation following CHD and the most common CNS malformation. It has an average global frequency of 1.6 per 1000 live births. The highest incidence is reported in England and Mexico <sup>2,3,4,5</sup>. There is lack of data on its frequency in Ethiopia but it has an estimated frequency in South Africa between 0.77-6.1/1000 live births <sup>5, 6</sup>. The true incidence is thought to be higher but it is difficult to calculate as it includes spontaneous and medical induced pregnancy losses.

NTD encompasses a broad spectrum of disorder ranging from severe malformation incompatible with life like anencephaly to minor occult malformation. It is broadly classified as cranial or spinal dysraphism, resulting from cranial and spinal neural tube closure defects, respectively. Cranial dysraphism includes anencephaly, crania bifida occulta and encephalocele. Spinal dysraphism is further classified as open or closed dysraphism <sup>7</sup>. The detailed classification is presented in the next diagram .



Graph 1: types of spinal dysraphism

Isolated NTD is a multi-factorial process resulting from interplay between genetic and environmental factors. The risk of NTD for a second sibling increases three fold after a first affected sibling and 10 times in siblings of affected individuals. There is a high prevalence of NTD in certain populations of Egypt, Arab Palestinians, Oman and Saudi Arabia where inter-familial marriage accounts for 20-50% of inter sexual marital unions. The high prevalence might suggest the possible genetic contribution for NTD development<sup>7</sup>.

There is also an increased risk after certain maternal conditions like poorly controlled insulin dependent diabetes mellitus (OR 11.5), anti-epileptic medication (valproic acid, carbamazepine), therapy with folic acid antagonist and maternal obesity (OR 3.5)<sup>7, 10, 11</sup>.

The most important environmental factor with a significant effect to date is pre and post conception maternal folic acid deficiency. Currently, food fortification

and supplementation has led to a significant reduction in primary incidence as well as incidence in high risk mothers by as much as 70% <sup>7,11</sup>.

Ten to twenty percent of NTDs occur as part of a syndrome. The known associated syndromes include chromosomal anomalies like trisomy 13, 18 and partial aneuploidy, Waardenberg syndrome, Amniotic band syndrome, Currarino syndrome and Joubert syndrome <sup>7</sup>.

In the 1980s first trimester maternal screening program for open neural defect became available using maternal serum  $\alpha$  protein (MSAFP). But there was no universally agreed cut of value and it could also be positive with other malformations like abdominal wall defect. This necessitated the need for a second confirmatory test either between 16-18 or 18-21 weeks of gestation using either using amniocentesis or 18-21 weeks ultra-sound scanning. The maternal serum  $\alpha$  protein test cannot also inherently detect closed neural tube defects.

Amniocentesis is also used for testing AFP and Acetyl cholinesterase for screening open NTD though commonly used for karyotyping in high risk pregnancies. But the procedure is invasive with a risk of 1 in 300 pregnancy loses. Besides, both screening methods do not provideadequate information about theoverall structural anomalies<sup>12</sup>.

Due to its efficacy, safety and low coast 18-21-week routine antenatal anatomicultrasound scanning became the standard screening modality with a detection rate of as high as 90% <sup>7, 10</sup>. In a study done in the Netherlands in 2001, the optimum time for antenatal ultrasound diagnosis was between 18-21 weeks of gestational age (post conception) with a diagnostic yield of 94%. The same study has indicated the diagnostic yield will drop to 76% if it is done in the first trimester <sup>8</sup>. It also has an added advantage for detection of other associated congenital anomalies of the fetus.

In a retrospective study done in France to assess the association between posterior fossa malformation and NTD between 11-13 weeks gestation. They found intra-cranial lucency (IL), loss of cisterna magna and posterior displacement of brain stem to occipital bone at mid-sagittal brain found a diagnosis rate between 50-90% <sup>9</sup>.

In another study, lemon shape of the frontal bone, microcephaly, low BPD for gestational age, sacral irregularity and banana sign were found to have a high diagnostic rate as indirect signs for diagnosing NTD <sup>13</sup>.

There is no adequate study done in Ethiopia to assess the prevalence and factors associated with NTD. The main objective of this study is to determine the point prevalence of neural tube defect and frequency of different forms of spinal and cranial dysraphisms using antenatal obstetric ultrasound anatomic scan as well as to assess the association of known risk factors and NTD.

## CHAPTER THREE

### General Objective

- To estimate the point prevalence of neural tube defect in the study population

### Specific Objective

- Calculate the point prevalence of NTD
- To determine the frequency of different types of NTD
- Analyze the association of NTD with different known risk factors

## **CHAPTER FOUR**

### **METHODS AND MATERIALS**

#### **4.1 Study area and period**

The study was conducted at Ghandi Memorial Hospital, Addis Ababa Ethiopia.

The study period was from August 26-September 10 2017 G.C

#### **4.2 Study design**

Trans sectional study was employed

#### **4.3 Population**

##### **4.3.1 Source Population**

All pregnant women who come for routine ANC follow up during the specified period

##### **4.3.3 Study Population**

All pregnant women who are at 18 weeks and above of gestational age during the study period

##### **4.3.4 Inclusion criteria**

All pregnant women who are 18 weeks and above of gestational age during the study period

##### **4.3.5 Exclusion criteria**

- All pregnant woman who are below 18 weeks of gestation during the study period
- All pregnancies with intra uterine death confirmed by ultrasound signs

##### **4.3.5 Sampling technique and sample size**

Consecutive sampling technique was used

The sample was determined by the formula of sample size estimation i.e.

$$n = \frac{Z^2 P(1-P)}{d^2}$$

Where n=the minimum sample size required

P = expected prevalence of NTD- 0.1%

d= margin of error tolerated – 0.02

Z= level of stastic confidence – 95%

$$N = \frac{1.96^2 * 0.1 * 0.9}{0.02^2} = 864$$

#### 4.4 Data collection

Data was collected and filled by a senior obstetric resident using trans abdominalultrasound scanning.

A 2014 sonoscape ultra sound machine with curvilinear and transvaginal transducer with a band width of 5-12 MHZ was used for the examination.

Multiple fetal planes including; axial, sagittal and coronal planes, were employed to further characterize and confirm the result.

A low exposure and examination time was employed as low as reasonably achievable. At all times the MI (mechanical index) and TI (thermal index) was followed not pass the maximum recommendation.

#### 4.5 Data quality control

In order to assess the quality of the questionnaire pretest data collection and briefing to data collecting senior resident was done.

Quality control of the ultra sound will be done every day before data collection started.

#### 4.6 Data analysis and interpretation

The data was checked for clarity and completeness. It was fed and analyzed by using SPSS version 20.0 computer software. The data is summarized using table and graphs. The result is compared with different regional and global studies. Stastically significant association between different variable has been assessed using a confidence interval of 95%.

## 4.7 Variable

### Dependent variable

- Age, gestational age, educational level and monthly income

### Independent variables

- Folic acid intake, NTD, Craniorachischisis, Anencephaly, Encephalocele, Myelocele, Myelomeningocele, Hemimyocele, Hemimyelomeningocele, Lipomyelocele, Lipomeningocele, Myelocystocele, Meningocele, Diastematomyelia, Neuroenteric cyst and Tethered spinal cord

## 4.8 Operational definition

- The last thoracic vertebra that bears a rib is assumed as twelfth thoracic vertebra
- Gestational age is rounded to the lowest nearest week when it has additional one to three days and to the higher nearest week when it has additional four to six days

## 4.9 Ethical considerations

The purpose and goals of the study as well as methods of data collection was objectively explained and their informed consent was taken before the beginning of data collection for each pregnant mother. During the data collection privacy of the study participant was maintained and any piece of information was kept confidential and anonymity of the study participant maintained by not recording names. A written formal letter from department of Radiology and Ethical approval letter from Ethical committee was obtained and submitted to both Medical director office and ANC clinic of Ghandi memorial hospital before commencing the data collection process.

## 4.10 The anticipated limitations

Lack of experience about the Ultrasound imaging appearance of different types of NTD

## 4.11 Plan of disseminating study finding

After the formal preparation of the final report the copy of the report will be given to Radiology department, CHS, publishing and...etc.

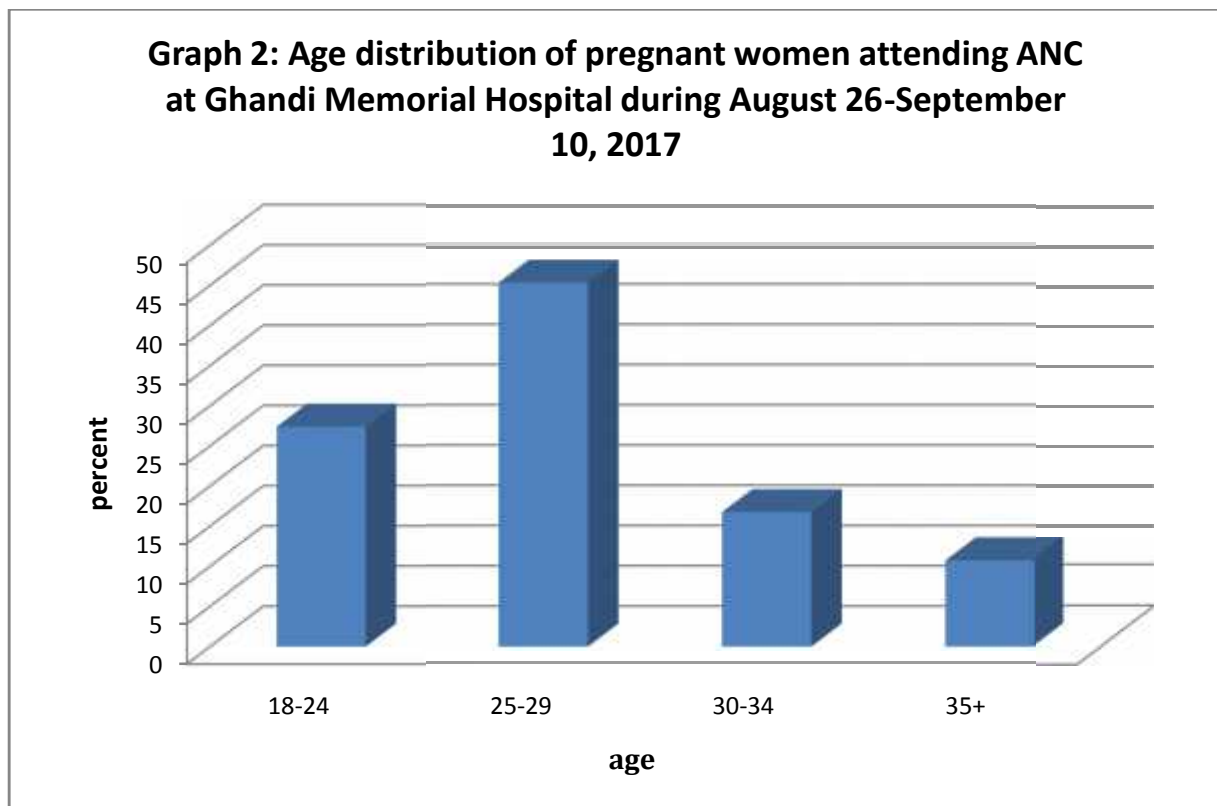
## CHAPTER FIVE

### RESULT

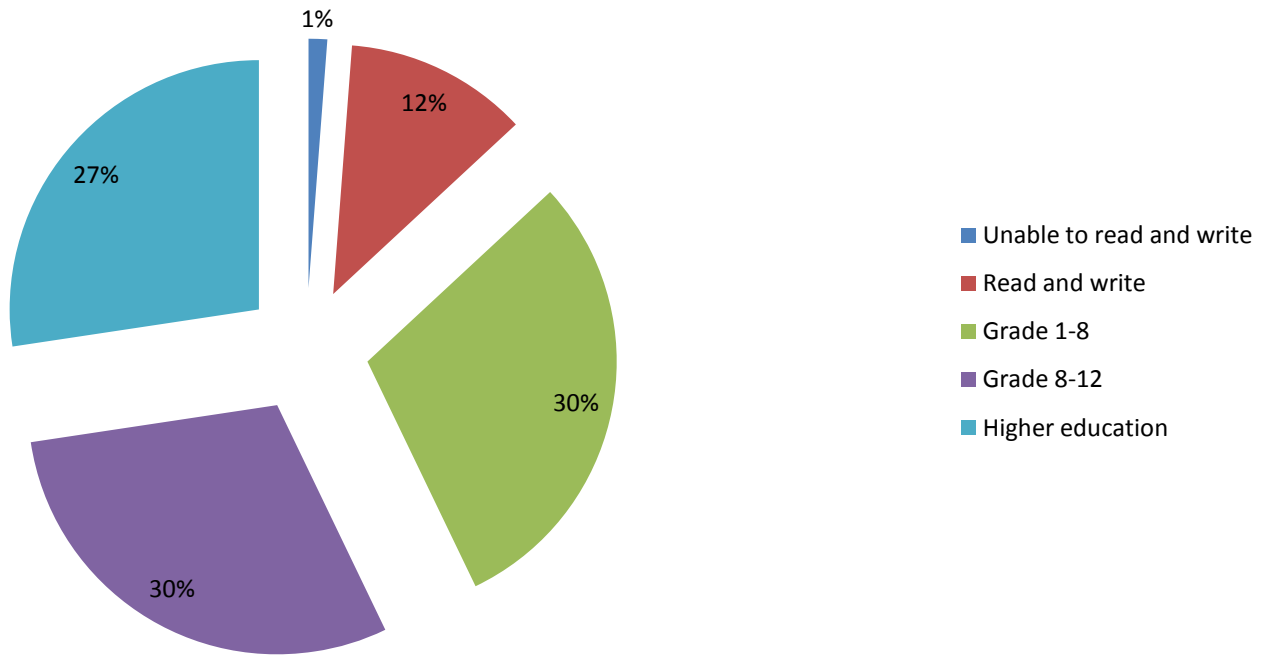
#### 4.1 Socio-demographic characteristics

The study has involved 84 voluntary pregnant women who visited Gandhi memorial hospital in the study period which gives a respondent rate of 9.7%. The age range of participants ranges from 18 to 38 years, the majority of whom were between 18-30 years of age (72.6%). The mean ages of participant were 27.5 years.

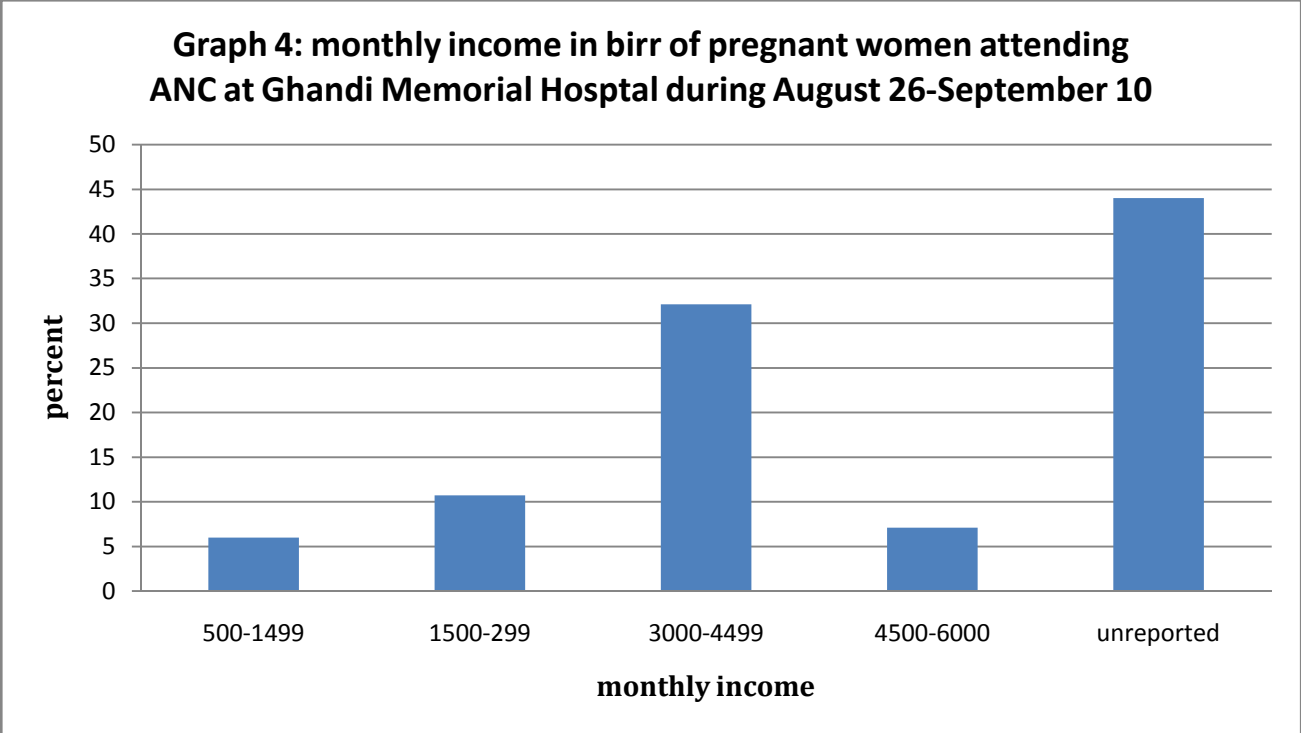
More than half of the mothers were educated up to the level of primary and secondary school (59.6%) and 27% had achieved a higher education. Only one of the participants was unable to read and write giving a literacy rate of 99%.



**Graph 3: Educational level of pregnant women attending ANC at Ghandi Memorial Hospital during August 26-September 10**



Forty four percent of respondents are not willing to inform their monthly income. From more than half of the respondents who reported their income, the average monthly income was 3300 birr per month with a difference of 4800 birr between the upper and lower reported income.



**4.2 Background clinical information**

Slightly more than seventy percent of participants took folic acid supplement in the first trimester of current pregnancy. Of whom, 63.33 % took for three month while 16.7% and 20% took for two and one months, respectively. Twenty five percent of pregnant mothers who did not take the supplement from the total 28.6% were in the age category between 18-30 years of age. But, no statically significant association was observed between age and folic acid intake with a P value of 0.09 (95% confidence interval). Nineteen percent of participants who did not take folic acid had achieved educational level between grade 1-8 but no statically significant association was observed between literacy rate oreducational level and folic acid supplement (P-value 0.105 and 0.07, respectively with confidence interval of 95%).There was also no statically significant association between income status and folic acid intake after excluding non-responders (p-0.088).

Folic acid intake %	Yes			No	Total
	1month	2month	3month		
	14.3	11.9	45.2	28.6	100
Total	71.4				

Table 1 folic acid supplement intake during first trimester among pregnant women attending ANC at Gandhi Memorial Hospital during August 26-September 10, 2017

Age		Folic acid intake (percent)	
		Yes	No
18-24	%within category	56.5	43.5
	%total	15.5	11.9
25-29	%within category	71.6	28.9
	%total	32.1	13.1
30-34	%within category	92.9	7.1
	%total	15.5	1.2
35+	%within category	77.8	22.8
	%total	8.3	2.4
Total		71.4	28.6

Table 2: 1<sup>st</sup> trimester folic acid supplement Vs. age among pregnant women attending ANC at Gandhi Memorial Hospital during August 26-September 10, 2017

Educational level		Folic acid intake (percent)	
		Yes	No
Unable to read and write	%within category	0	100
	%total	0	1.2
Read and write	%within category	80.5	20
	%total	9.5	2.4
Grade 1-8	%within category	36	64
	%total	10.7	19
Grade 8-12	%within category	92	8
	%total	27.4	2.4
Higher education	%within category	87	13
	%total	23	3.6
Total		71.4	28.6

Table 3: 1<sup>st</sup> trimester folic acid intake Vs. Educational level among pregnant women attending ANC at Ghandi Memorial Hospital during August 26 and September 10, 2017

Monthly income status (birr)		Folic acid intake	
		Yes	No
500-1499	%within category	0	100
	%total	0	10.6
1500-2999	%within category	88.9	11.1
	%total	17	2.1
3000-4499	%within category	81.5	18.5
	%total	46.8	10.6
4500-6000	%within category	100	0
	%total	12.8	0
Total		76.6	23.4

Table 4: 1<sup>st</sup> trimester folic acid intake Vs. Income status among pregnant women attending ANC at Ghandi Memorial Hospital during August 26 and September 10, 2017

None of the pregnant mothers had taken preconception folic acid supplement.

Three of the pregnant mothers reported a background chronic medical illness. Two of them has chronic bronchial asthma and took salbutamol puff intermittently. One has a chronic hypertension for four years and took unspecified medication.

Thirty six point nine percent of the respondents took a medically prescribed medication in the first trimester of current pregnancy. An overwhelming percent took antibiotics (86.7%) but none of them were unable to recall the specific type of the medication.

Medication taken		Frequency	Percent
Yes	Antibiotic	26	31
	Salbutamol	2	2.4
	Antacid	2	2.4
	Anti-hypertensive	1	1.2
	Total	31	36.9
No		53	63.1

Table 5: Non pregnancy supplement medication taken during 1<sup>st</sup> trimester of current pregnancy among pregnant women attending ANC at Gandhi Memorial Hospital during August 26-September 10, 2017

### 4.3 Obstetric Ultrasound

All of the pregnancies in the study were alive, singleton and intra uterine. The gestational age of the fetuses during the study period as determined by the average of BPD, FL and HC were: 23.8%- 22-27, 55.9%- 28-35 and 20.3%- 36-40 weeks of gestation.

Two of the fetuses (gestational age of 26 and 30 weeks) had NTD which were anencephaly types of cranial bifida in this study giving a calculated point prevalence of 2.38% or 23.8 NTD per 1000 pregnancies.

There is no significant association between folic acid intake and anencephaly with a P value of 0.022. There is also no significant association of NTD/anencephaly with age, educational level and monthly income with P value of 0.821, 0.391 and 0.989, respectively.

Gestational age(weeks)	Frequency	Percent
22-27	20	23.8
28-31	27	32.1
32-35	20	23.8
36-40	17	20.3
Total	84	100

Table 6: Gestational age in weeks among pregnant women attending ANC at Gandhi Memorial Hospital during August 26-September 10, 2017

## CHAPTER SIX

### DISCUSSION

The 99% literacy rate and the 30% who finished primary school as well as 57% who reached secondary school and higher education; it appears that these figures are well above the central statistical agency report of 79.7% literacy rate of women aged between 15-49 years in Addis Ababa in 2011<sup>14</sup>. The discrepancy might be due to the small sample size of the study, high health seeking behavior of literate women or lack of recent update by the agency since the report is published seven years ago.

Ten point six percent of the participants who reported their monthly income were living below poverty line. The result is significantly higher than both the national (31%) and urban (25.7%) average at baseline poverty of 1.9 USD per day of the 2014 World Bank poverty assessment<sup>15</sup>.

Different studies have shown the preventive effect of folic acid both on NTD and other congenital anomalies as well as its nutritional value. Despite this none of the study participants took folic acid supplementation before conception. There is a similar trend worldwide. In Uganda, among pregnant women attending ANC both with and without previous child with NTD none of them took preconception folic acid supplement<sup>16</sup>. A study done at the Queen Mary University of London also showed a similar trend in which only one third of pregnant women took preconception folic acid supplementation<sup>17</sup>. The most important factor contributing for the low practice in all the studies could be the high rate of unplanned pregnancies which was around 37.5% in Addis Ababa<sup>18</sup> but further study is required to assess knowledge, attitude and practice of women of reproductive age toward folic acid supplement.

More than two third (71.4%) of pregnant women reported that they took folic acid supplement for 1-3 month during the first trimester of current pregnancy. There was no statically significant association between folic acid intake and age, educational status and monthly income level. The result is significantly higher than the national average of 47%<sup>19</sup>. But it was similar to studies done in Akaki sub-city of Addis Ababa (65%)<sup>19</sup> and Karthoum-Sudan (60%)<sup>20</sup> which might be due to a similar study population. In both studies there was a significant association between folic acid intake and education.

The point prevalence of NTD (23.8 per 1000 pregnant mothers) in the study was much higher than from worldwide and averages elsewhere, such as Tanzania, Saudi Arabia and South Africa which is 1.6, 30.2, 14.6 and 35.4 per 1000 live births, respectively<sup>1, 2 &21</sup>. In all of these studies, there were statically significant association between folic acid intake and NTD. All of these studies calculated the prevalence of NTD as a ratio of live births which might lower the result since it did not take into account pregnancy losses and still births with NTD are excluded from the calculation. Besides, the small study population and an obstetric referral center based study design of this study might have contributed for both the higher prevalence rate and lack of association with folic acid intake. Spina bifida also accounts for more than half of the prevalence in most of above mentioned studies. The difference could be due to lack of experience of Ultrasound imaging appearance of spina bifida and difference in study population.

### **Limitation of the study**

The number of pregnant women attending ANC follow up in Ghandi memorial hospital was smaller than the calculated sample size. Lack of experience in ultrasound imaging appearance of different types of NTD was another limitation of the study.

## CHAPTER SEVEN

### CONCLUSION AND RECOMMENDATIONS

#### Conclusion:

The point prevalence of NTD in this study is 23.8 per 1000 pregnant women which is significantly higher than worldwide and regional average. Anencephalic type of cranial bifida accounted for 100% of NTD. 70.1% of pregnant women in the study population took folic acid supplement during first trimester. The literacy rate of study population was 99%. 10.9% who reported monthly income lived below the poverty line. There was no statistically significant association between NTD and folic acid intake during first trimester. There was also no statistically significant association between folic acid intake during first trimester and age, educational level and monthly income

#### Recommendations

- Due to small study population size of this study and low respondent rate; it is difficult to generalize. Since it is a part of an ongoing thematic research, further large scale study is recommended to assess the prevalence of NTD and specific prevalence of the different types of cranial and spinal dysraphism.
- Further assessment of knowledge, attitude and practice of reproductive age women towards folic acid intake both during pre-conception and post-conception periods should be done. Different strategies should be implemented based on the recommendation of the study to achieve maximum adherence of pregnant women toward folic acid intake

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# ANNEXES

## ADDIS ABEBA UNIVERSITY CHOLEGE OF HEALTH SCIENCES

### SCHOOL OF MEDICINE DEPARTMENT OF RADIOLOGY

#### A QUESTIONNAIRE ON ASSESMENT OF LATE FIRST TRIMESTER NEURAL TUBE DEFECT

##### A, Contact information

1, Card number \_\_\_\_\_ 2, Mobile number \_\_\_\_\_

B, Socio demographic data

1, Name \_\_\_\_\_ 2, Age \_\_\_\_\_

3, Educational Level:

a , Unable to read and write  b, read and write  c, grade 1-8

c, grade 8-12  c, higher education

4, monthly income in birr \_\_\_\_\_

##### B, Background clinical information

1, Did you take folate or any supplement containing folic acid? Yes  No

2, If yes to above, Duration of intake (month) a, before conception \_\_\_\_\_ b, after conception \_\_\_\_\_

3, Do you have any chronic medical illness? Yes  No

4, If yes to above question, specify

a, type of illness \_\_\_\_\_ b, duration of the illness \_\_\_\_\_

4, Did you take any medication after conception? Yes  No

5, If yes to above, describe

a, type of the medication \_\_\_\_\_ b, dose: per day and for how long \_\_\_\_\_

6, Do you have previous child affected by neural defect? Yes  No

7, if yes how many \_\_\_\_\_

8, Do you have any close relative affected by neural tube defect? Yes  No

C, Obstetric ultrasound 9-12 weeks

1, No of intra-uterine pregnancy \_\_\_\_\_

2, Gestational age using CRP length, for each fetus if multiple \_\_\_\_\_

3, Is there is any cystic mass besides the yolk sac?      Yes       No

4, Is trans cranial lucency visible?      Yes       No

5, Is the cystema magna effaced?      Yes       No

D, Obstetric ultrasound result between 18 -22 wks

1, Gestational age BPD\_\_\_\_ FL\_\_\_\_ HC\_\_\_\_ , if multiple for each pregnancy

2, Head circumference size (mm)\_\_\_\_\_

3, Is the supra orbital skull vault formed? Yes  No

4, If no to above,

a, cerebral parenchyma absent  present but disorganized

b, is there is any spinal defect in continuity? Yes  No

c, if yes to above, length of spinal defect ( in terms of number of spine)\_\_\_\_\_

5, If yes to 3 or if the skull vault is well formed describe, describe the shape of frontal bone

a, oval  b, concave anterior or lemon shaped

6, Lateral ventricle atrium size at the level of thalamus (mm), Right \_\_\_\_ Left \_\_\_\_

7, Third ventricle size: slit like\_\_\_\_ if dilated (mm)\_\_\_\_\_

8, Shape of posterior horn of lateral ventricle

Right, a, pointed  b,round  Left, a, pointed b, round

9, Cereberal cortex: a, normal  b, abnormal

10, If abnormal specify the type of abnormality

11, Trans cerebellar diameter (mm) \_\_\_\_\_

12, Clivus supra-occipital angle \_\_\_\_\_

13, Cerebellar shape: a, normal  b, crescent shape

c, other, specify\_\_\_\_\_

14, Cysterna magna: a,Normal appearing  b, Effaced

15, Herniation of cerebellar tonsil below foramen magnum: Yes  No

16, Is there is any spinal defect Yes  No

17, If yes to above,

- a, Anterior  b, Posterior   
b, Cervical  Thoracic  Thoraco-lumbar  Lumbar  Lumbo-sacral   
c, Is the overlying skin a, intact  b, defective

18, Is there is any overlying cystic mass in communication with spinal canal through the defect

Yes  No

19, If yes to above,

- a, size of the sac (mm) length\_\_\_\_ width\_\_\_\_ and AP diameter\_\_\_\_  
b, Contents of the sac- anechoic  Contains neural tissue   
c, Underlying spinal cord appears Normal  b, tethered  c, flattened   
d, Is there is sign of syringomyelia? Yes  No   
e, If yes, Location\_\_\_\_\_ Length (no. of spinal vertebra)\_\_\_\_\_

20, Is there a soft tissue mass posterior to spine? Yes No

21, If yes to above,

a, Size (mm)- Length\_\_\_\_ Width\_\_\_\_ AP\_\_\_\_

22, If yes to 16 or if there is any spinal defect,

a, is a communication between the mass and spinal canal Yes  No

23, If yes to 22, the underlying spinal cord appears- a, normal  b, tethered  c, flattened

24, Level of conus medullaris a, at or above L3  b, below L3

25, If the spine is normal for above anomalies, Is there is sign of isolated spinal cord tethering?

Yes  No