Appendices

APPENDIX I

NTD CASES REPORTED IN THE HOSPITALS IN ERODE TOWN DURING 2000-2004

S. No	Name of the Hospital	2000		2001		2002		2003		2004	
		Total Birth	NTD	Total Birth	NTD	Total Birth	NTD	Total Birth	NTD	Total Birth	NTD
1	Abitha Nursing home	418	2	440	1	412	-	405	1	422	-
2	Anusha Hospital	243	1	214	1	2-10	1	227	1	230	1
3	Aparna Hospital	152	-	146	1	157	-	161	1	153	-
4	Arun Hospital	72	1	79	-	65	-	75	-	73	1
5	Ashwin Hospital	77	-	117	-	167	1	181	2	180	2
6	Bala Clinic	76	-	65	-	72	1	78	-	84	-
7	Baby Hospital	911	3	892	2	875	2	894	3	905	4
8	C.K. Hospital	189	1	189	-	179	1	202	-	188	-
9	C.S.I. Hospital	85	-	97	1	103	1	90	-	110	2
10	Devi Hospital	105	1	95	-	86	-	96	-	93	-
11	Gautham Hospital	73	-	77	1	81	-	83	1	76	-
12	Geetha Hospital	75	-	70	1	81	-	94	1	84	-
13	Geetha Kumaradevi Hospital	84	-	77	-	82	-	88	1	69	-
14	Government Hospital	5967	6	7054	10	6167	8	4875	15	4058	19
15	Gnana Ganesan Hospital	97	-	83	-	88	-	90	-	82	-
16	Illaya Perumal Hospital	310	-	292	1	292	-	275	1	283	1
17	Jaimaruthi Hospital	-	-	-	-	-	-	-	-	587	2
18	Joseph Hospital	87	-	95	1	103	-	89	-	89	-
19	Janet Hospital	840	2	820	3	801	2	811	1	792	1
20	J.J Hospital	70	-	65	-	62	1	65	-	58	0
21	J.P.R Hospital	80	-	101	-	112	0	77	-	89	-
22	Kasthuri Hospital	153	-	151	-	127	1	132	1	136	1
23	KBN Hospital	204	1	210	-	200	2	192	-	175	1

S. No	Name of the Hospital	2000		2001		2002		2003		2004	
		Total Birth	NTD	Total Birth	NTD	Total Birth	NTD	Total Birth	NTD	Total Birth	NTD
24	Keerthana Clinic	105	1	98	-	95	-	90	1	94	-
25	K.G. Nursing home	310	1	323	1	302	-	309	-	320	1
26	Kokila Hospital	795	4	775	6	805	3	746	4	870	5
27	KRN Hospital	48	-	56	-	62	-	57	-	60	-
28	Kumaran Hospital	45	-	57	-	49	-	58	-	51	-
29	Kumarasamy Hospital	45	-	52	-	43	-	40	-	47	-
30	Lakshmi Hospital	75	1	80	-	91	-	82	1	74	-
31	Latha Hospital	92	-	75	-	78	-	72	-	69	-
32	Lotus Hospital	25	-	168	-	168	1	138	1	138	1
33	Malathi Vijayakumar Hospital	241	2	212	-	219	1	224	-	230	1
34	Maragathavalli Hospital	120	1	109	1	128	-	122	-	114	1
35	Maruthi Medical Centre and Hospital	516	2	489	4	516	3	328	4	426	2
36	Meena Pasupathi Surgical Clinic	76	-	72	-	69	1	59	-	64	-
37	MR Hospital	-	-	-	-	62	-	59	-	62	-
38	Naveen Balaji Nursing Home	198	-	192	-	190	1	189	1	202	2
39	Nishanth Hospital	-	-	-	-	-	-	235	1	220	1
40	P.K. Hospital	65	-	70	-	75	-	68	1	73	-
41	P.P. Hospital	-	-	48	-	54	-	52	-	57	1
42	Raja Hospital	50	-	61	-	55	-	44	-	47	-
43	Rajan Dhanalakshmi Nursing Home	110	-	103	1	98	-	107	-	109	-
44	Rathinam Maternity Clinic	140	-	133	1	138	-	127	2	132	1
45	Selvanayaki Hospital	212	1	206	-	203	-	223	2	226	-
46	Senthil Hospital	78	1	72	-	65	1	74	-	71	-
47	S.K. Hospital	195	1	205	-	209	1	211	-	198	1

S. No	Name of the Hospital	2000		2001		2002		2003		2004	
		Total Birth	NTD	Total Birth	NTD	Total Birth	NTD	Total Birth	NTD	Total Birth	NTD
48	SriHareni Hospital	452	1	452	-	511	1	444	-	395	1
49	SriJothi Hospital	195	-	198	-	193	-	193	1	175	1
50	Srimathi Murugesan Hospital	722	-	678	5	678	2	689	4	721	5
51	SriPreethi Hospital	181	-	195	-	184	1	192	-	171	1
52	SriSakthi Hospital	149	-	134	1	153	-	132	-	145	-
53	SriValli Hospital	45	-	53	1	62	1	60	-	58	-
54	S.S. Hospital	330	-	328	1	340	-	317	2	334	-
55	S.Vee Hospital	420	-	398	-	398	1	403	-	385	-
56	Sudha Women and Ferility Centre	754	2	691	1	640	1	702	1	678	-
57	Thangam Hospital	750	2	724	3	735	2	690	1	740	3
58	TPN Hospital	350	2	362	-	401	1	411	2	403	1
59	Universal Hospital	220	-	213	1	206	-	219	1	223	1
60	Vadivu Subramanian Hospital	747	-	642	1	842	2	743	1	767	-
61	Vikram Hospital	112	-	98	1	105	-	108	-	110	1

YEAR WISE INCIDENCE OF NTDs IN ERODE TOWN AS PER MUNICIPAL BIRTH REGISTER

Particulars	2000	2001	2002	2003	2004	Total
Total births*	37,980	38,052	41,957	39,642	39,203	1,96,834
Total NTD births	40	52	44	60	66	262
Incidence /1000 births	1.05	1.37	1.05	1.51	1.68	1.33
3 Yearly Moving average	-	1.16	1.31	1.41	-	-

*** As per municipal birth register**

APPENDIX II

INTERVIEW SCHEDULE FOR NTD AFFECTED PREGNANCIES DURING 2003-2004

1. Name
2. Present age
3. Age during marriage

   < 18 years [ ] 19 – 21 years [ ]

   22 – 30 years [ ] > 30 years [ ]
4. Type of family : Joint / Nuclear
5. Family size :
6. Total monthly income of the family :
7. Educational status :
8. Are you married to your close relative? Yes / No

   If yes, indicate the relationship
9. Obstetric history of the expectant women :

   i) Complications faced in previous pregnancy:

Anencephaly		Meningocele	
Meningomyelocele		Iniencephaly	
Encephalocele		Hydrocephalus	
Cleft foot		Cleft lip	
Any others			

   ii) Parity - I II III IV

   iii) Birth Spacing - 1 year 2 years 3 years 4 years
10. Time of identification of complication :

11. Physiological problems suffered during previous pregnancy:

Vomiting and nausea		Giddiness	
More appetite		Loss of appetite	
Aversion of certain food		Muscle cramps	
Constipation		Back pain	
Hypertension		Odema	
Albuminuria		Frequent urination	
Heart burn		Disturbed sleep	
Indigestion		Fever	
Any others			

12. Psychological problems suffered or those that affected the intake.

Maternal concern about the well being of the baby		Family concern (lack of support)	
Recent adverse life events		Death of a parent	
Marital discord		Young age	
Worry about the sex of the baby		Worry about the time after the baby is born	
Regretted being pregnant		Worry whether the baby will be healthy and normal	
Worry of breast feeding the baby		Occupational stress	
Marital difficulties		Financial problems	
Worry about the existing complication known		Depressed symptoms	
Diminished pleasure in activities		Significant weight change	
Fatigue		Excessive guilty feeling	
Depressed mood			

13. Medical supplements taken

Before conception		III Trimester	
I Trimester		Did not take any supplements	
II Trimester			

If so, what type of supplements

14. Mode of delivery of the previous affected child :

Medical Termination /Normal Delivery /Caesarean/Spontaneous abortion

15. Weeks of gestations of the previous affected child :

16. Expenditure incurred during previous pregnancy :

		Rs.
Medical check up	-	
Medicinal supplements	-	
Scan	-	
Delivery	-	
Food supplements	-	
Any others	-	
Total	-	

17. Survival of the NTD affected child :

Still birth / Less than a day / Less than a week / 2 - 3 months

APPENDIX III

INTERVIEW SCHEDULE FOR WOMEN ASPIRING FOR PREGNANCY

1. Name :
2. Present age :
3. Age during marriage :
4. Type of family :
5. Total monthly income :
6. Educational status of the subject :
7. Type of activity :
8. Type of diet : Veg / Non-veg / Ovo-veg
9. How often do you consume the following foods :

Foods	Daily	Weekly once	Weekly Twice	One in 15 days	Once in a month
Cereals: Bajra					
Jowar					
Wheat flour					
Rice parboiled					
Oat meal					
Pulses and Legumes: Bengal Gram dhal					
Cow pea					
Roasted Bengal gram					
Black gram dhal					
Green gram					
Green gram dhal					
Lentil					
Red gram dhal					
Soya bean					

Foods	Daily	Weekly once	Weekly Twice	One in 15 days	Once in a month
Leafy vegetables : Amaranth					
Cabbage					
Curry leaves					
Mint					
Spinach					
Roots and tubers : Carrot					
Colocasia					
Potato					
Other vegetables: Cluster beans					
French beans					
Ladies finger					
Snake gourd					
Brinjal					
Nuts and oil seeds : Gingelly seeds					
Coconut fresh					
Fruits : Tomato					
Orange					
Meat and meat products:					
Egg duck					
Chicken					
Liver goat					
Milk and milk products : Milk cow					
Buffalo					
Curds					

10. Special supplements taken during pre conceptional period : Yes [ ] No [ ]

If yes Multivitamins tablets [ ] Iron and folic acid [ ]

Folic acid [ ] Calcium and iron [ ]

Any others [ ]

11. Three day recall method (Before counseling)

Day	Early Morning	Breakfast	Lunch	Tea	Dinner
I					
II					
III					

12. Three day recall method (After counseling)

Day	Early Morning	Breakfast	Lunch	Tea	Dinner
I					
II					
III					

13. Weight of the subject :

14. Height of the subject :

15. BMI :

16. Biochemical assessment :

Parameters	Before counseling	After counseling
Serum folate level (ng /ml)		
Haemoglobin level (g /dl)		

17. Scores obtained :

Knowledge scores	Before counseling	After counseling
Scores obtained (out of 20)		

APPENDIX IV

PROCEDURE FOR ESTIMATION OF HAEMOGLOBIN AND SERUM FOLATE

(A) HAEMOGLOBIN BY CYANMETHEMOGLOBIN METHOD

PRINCIPLE

In solution the ferrous ions (Fe^{+2}) of the haemoglobins (Hb) are oxidised to the ferric state (Fe+3) by pottasium ferric cyanide to form methemoglobin. In turn, methemoglobin reacts with the cyanide ions (CN) provided by potassium cyanide to form cyanmethemoglobin, which has the absorbance at 540 nm.

Reagents

a. **Cyanmethemoglobin solution (Drabkin's solution):** Dissolve 0.05g potassium cyanide, 0.200 g potassium ferric cyanide and 0.140g dihydrogen potassium phosphate in 1 L of distilled water. Add 1 ml of Triton X - 100 and mix. Stable for at least 6 months.

b. **Hemoglobin Standard :** Lyophilised human methemoglobin (supplied by Sigma USA). Each vial is equivalent to hemoglobin concentration of 18 g/dl whole blood when reconstituted in 50 ml of Drabkin's solution. Stable for 6 months when refrigerated at 2-6 ^{0}C.

Procedure

Transfer 0.02 ml of blood using a calibrated hemoglobin pipette, into a tube containing 5.0 ml of Drabkin's reagent. Rinse the pipette several times with the reagent. Allow diluted hemoglobin solution to stand for at least 5 min to achieve full colour development. Measure the absorbance at 530 - 550 nm of the unknown sample (A unk) and that of a standard of known hemoglobin content (A std) against a reagent blank.

Calculation

$$\text{Hemoglobin unknown (g/dl)} = \frac{\text{Aunk x con.of Hb standard (g/dl)}}{\text{Astd}}$$

Note

1. Drabkin's solution should be stored in amber coloured bottle. If any precipitate is formed, the reagent should be discarded.

2. Since the dilution is enormous (251 times) accurate measurement of 20 µl of blood is absolutely essential for reproducibility. Hb pipettes must be checked for their accuracy by weighing pure mercury up to the mark.

(B) DETERMINATION OF SERUM FOLATE BY COMPETITIVE IMMUNOASSAY

AIM: To quantitatively measure folic acid in serum using IMMULITE Analyser.

PRINCIPLE

IMMULITE folic acid is a boil competitive liquid phase ligand-labeled, protein binding chemiluminescent essay with insitu immobilization and with an anti-ligand detection system. The solid phase, a polystyrene bead enclosed within an IMMULITE TEST unit is coated with a murine monoclonal antibody specific for folic acid binding protein.

After the sample preparation procedure the patient sample, ligand - labeled folic acid analog and folic acid binding protein are simultaneously introduced into the test unit , and incubated for approximately 30 minutes at 37^0C with intermittent agitation. During this time, folic acid in the sample competes with the ligand - labeled folic acid analog for a limited amount of folic acid binding protein, and the folic acid binding protein is captured by the antibody on the bead (unbound analog is then removed by a centrifugal wash) Incubation cycles: 2x30 minutes.

Specimen collection

Patient must be in a fasting state. For whole blood and red cell folic acid determinations, use fresh heparinisized or EDTA whole blood. Hemolyzed serum samples are inappropriate for analysis.

Volume required

200 mcl of sample-serum is required for the sample pretreatment step. A single determination uses 100 µl of the treated sample : the sample cup should contain at least 250 µl more of the treated sample than the total volume required for the number of folic acid determinations to be performed.

Materials needed

- The barcode labels are needed for the assay.
- Folic acid Test units (LFO I)
- Folic acid Reagent Wedges (LF, LFOB)
- Folic acid adjustors (LFOL, LF)
- Ligand-labeled folate (LLLF)
- Borate-KCN Buffer solution
- Dithiothreitol solution (LDTT)

Preparation of working solution

Samples being tested for folic acid should be pretreated with the working solution described below.

The volumes required in microlitres pre test are tabulated as follows

Borate - KCN Buffer solution	1,000 µl / test
Ligand - labeled Folate	20 µl / test
Dithiothreitol solution	20 µl / test

Sample Pretreatment

1. Pipet 200 µl of each patient's serum into the tubes prepared.
2. Add 1,000 µl of the working solution to all tubes .
3. Loosely cap all tubes and place them in a covered, boiling water bath (100^0C) for 15-20 minutes.

4. Remove the tubes from the boiling water bath,, and cool them in an ambient water bath for 5 minutes.
5. Pipet at least 350 µl of the treated sample to on IMMULITE sample cup.

Treated samples, both serum and whole blood, are stable at room temperature (25-28^{0}C) or refrigerated at 2-8^{0}C for 1 hour prior to assay.

Assay Procedure

Note that for optimal performance, it is important to perform all routine maintenance procedures as defined in the IMMULITE Operator's Manual and for preparation, setup, dilutions, adjustments, assay and quality control procedures.

Visually inspect each test unit for the presence of a bead before loading it onto the system.

Note that both reagent wedges A and B must be loaded on the carousel to run this assay. After sample pretreatment, process the treated sample according to the usual assay procedure (Sample cup must contain at least 250 µl more than the total volume required).

Each sample cup holder containing pretreated sample can be followed by up to four test units.

Calculations

Whole blood and Red cell Results

First calculate the result R in nanograms per milliliter of hemolysate. Then multiply by the dilution factor 21 to obtain the whole blood folic acid concentration, in ng/ml. For an approximate measure of the packed red cell concentration, again in ng/ml, multiply the whole blood folic acid concentration by 100/H, where H is the hematocrit in per cent.

$$\text{Red cell Folic Acid} = 21R \times (100/H)$$

The serum folic acid contribution should be subtracted from the whole blood folic acid concentration before multiplying by 100/H. Using the patient's serum folic acid level S, the exact equation is:

$$\text{Red cell folic acid} = 21R - [S \times (100-H) / 100]) \times (100/H)$$

The term is the square bracket is, however, in most cases so small compared to the term 21R that it may be justifiably neglected.

APPENDIX V

CLINICAL EXAMINATION SCHEDULE

Hair		**Skin**	
Thin		Dry, Rough skin	
Sparse		Discoloured skin	
Dispigmented		**Neck**	
Eyes		Goitre	
Pale conjunctiva		**Legs and Hands**	
Nails		Odema	
Pale		**General symptoms**	
Spoon shaped		Weakness	
Mouth and Gums		Frequent common cold	
Glossitis		Burning feet	
Angular stomatitis		Numbness	
Red, inflamed tongue		Pins and needles	
Bleeding gums		Loss of weight	
Teeth		Poor musculature	
Dental caries			

ய ஆராய்ச்சி கழகம் பரிந்துரைப்
ஒருநாளைக்கு உட்கொள்ள
ிக் அமிலத்தின் அளவு

	வயது	அளவு (மைகி)
	10 -12	70
	13க்கு மேல்	100
கள்	எல்லா வயதினருக்கும்	400
	எல்லா வயதினருக்கும்	150

ாராகும் பெண்கள் போலிக் அமில
ம் உள்ள உணவுப் பொருட்களை
ாடும்.

து முறையாக கர்ப்பம் தரிக்கும்
பிரசவத்தின்போது நரம்பு மண்டலக்
ட்டால் பாதிக்கப்பட்டிருப்பின் 4.0
அமிலத்தை கர்ப்பம் தரிக்கும் மூன்று
ன்பே மருத்துவரின் ஆலோசனை படி
ண்டும். போலிக் அமிலச் சத்து
லோரும் வாங்க இயலும் மலிவு
கிறது.

லம் அதிகம் உள்ள உணவுப்

	அளவு	போலிக் அமிலம் (மைக்ரோகிராம்)
	100 கிராம்	139
	100 கிராம்	147.5
	100 கிராம்	140
	100 கிராம்	133
	100 கிராம்	103
	100 கிராம்	100

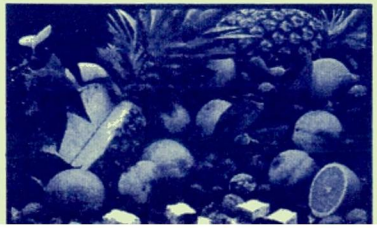
கொத்தவரை	100 கிராம்	144
வெண்டைக்காய்	100 கிராம்	105
கத்தரிக்காய்	100 கிராம்	34
கோவக்காய்	100 கிராம்	59
தக்காளி	100 கிராம்	30
ஆரஞ்சு பழச்சாறு	250 மிலி	136
ஆரஞ்சு பழம்	1	47
முட்டை	100 கிராம்	78.3
ஈரல்	100 கிராம்	220

நரம்பு மண்டலக் குறைபாடு அதிகம் அளவு தாக்கப்படும் நபர்கள்

- வலிப்பை கட்டுப்படுத்தும் மருந்தை உட்கொள்ளுபவர்கள்
- நீரிழிவு நோயால் பாதிக்கப்பட்ட பெண்கள்
- பருமனான பெண்கள்
- பெண்கள் அல்லது கணவரின் உறவு வழியில் நரம்பு மண்டலக் குழாய் குறைபாட்டால் பாதிக்கப்பட்டிருந்தல்
- நெருங்கிய உறவினர் நரம்பு மண்டலக் குழாய் குறைபாட்டால் பாதிக்கப்பட்டிருத்தல்

நரம்பு மண்டலக் குழாய் குறைபாட்டை கண்டறிதல்

- ஸ்கேன் மூலம்
- இரத்த பரிசோதனை மூலம்



குழந்தை நலம் தேசத்தின் வளம்

நலம் தேசத்தின் வளம்

பறுவது என்பது ஒவ்வொரு பெண்ணின்
ஒரு முக்கியமான நிகழ்ச்சி.
நான் ஒரு தாய் மறுபடியும் பிறக்கிறாள்.
ுகாலம் கஷ்டமில்லாமல் தாய்க்கோ,
இழப்பு ஏற்படாமல் இருக்க போலிக்
மாத்திரைகளைக் (Folic acid)
மூன்று மாதத்திற்கு முன்பே எடுத்துக்
டும். போலிக் அமிலச் சத்து நரம்பு
வளர்ச்சிக்கு தேவைப்படுகிறது.
சத்து பற்றாக்குறையினால் நரம்பு
பாதிக்கப் படுகிறது.

க்குழாய் குறைபாடு

ண்டலக் குழாய் குறைபாடு என்பது
ஏற்படும் அலட்சியம் செய்யமுடியாத ஒரு
. இது கருவுற்ற முதல் மாதத்தில் நரம்புக்
பின் குறைபாட்டால் ஏற்படுகிறது. இது
ளை வளர்ச்சி மற்றும் தண்டுவடத்தைப்

க் குழாய் குறைபாட்டின் வகைகள்

லி :
லான மூளை பகுதி, மண்டை ஓடு மற்றும்
இல்லாமல் இருத்தல்

செபலி

பகுதி இல்லாதிருத்தல், தலைப்பகுதி பின்
.

பபிடா

ா பைபிடா (திறந்த வகை)

மையிலோசீல்

டமும் அதைச் சுற்றியுள்ள பாதுகாப்பு

மெனிங்கோசீல்

தண்டுவடத்தின் வளர்ச்சி இயல்பாக இருக்கும். ஆனால் நரம்பு (மெனிஞ்சஸ்) வெளியில் நீட்டிக் கொண்டிருக்கும்

(ஆ) ஸ்பைனா பைபிடா (மூடிய வகை)

ஸ்பைனா பைபிடா ஆகல்டா

ஒன்று அல்லது அதற்கு மேற்பட்ட முதுகெலும்பு பகுதி குறைபாட்டுடனும், மற்றும் மேல்பகுதி மெல்லிய தோலினால் மூடப்பட்டும் காணப்படும்.

மூளை பகுதியில் பை போன்ற பிதுக்கம் ஜவ்வினால் போர்த்தப்பட்டு காணப்படும். மூளையில் நீர் கோர்த்தும் காணப்படும்.

நரம்பு மண்டலக் குழாய் குறைபாட்டின் காரணங்கள்

1. போலிக் அமில குறைபாடு
2. மரபணு திரிபுகளை விளைவிக்கும் மருந்துகள், வலிப்பு மற்றும் கருத்தடை மருந்துகளை உட்கொள்ளுதல்
3. அதிகமாக புகை பிடித்தல் மற்றும் மது அருந்துதல்
4. வெப்பம் அதிகமாகத் தாக்குதல்
5. கர்ப்பகாலத்தில் காய்ச்சல் ஏற்படுதல்
6. மரபணுக்கள் மாறுபடுதல்
7. கர்ப்பகாலத்திற்கு முன் அதிக உடல்பருமன் மற்றும் இரத்தத்தில் இன்சுலின் அளவு அதிகரித்தல்.
8. கர்ப்பகாலத்தில் உணவு கட்டுபாடு மற்றும் நீரழிவு நோய் ஏற்படுதல்.
9. துத்தனாகத்தின் அளவு குறைந்த உணவை உட்கொள்ளுதல்
10. உடல் உழைப்பு இல்லாது இருத்தல் போன்ற

நரம்பு மண்டலக்குழாய் குறைபாட்டுடன் பிறந்த குழந்தைகள் பின்வரும் விளைவுகளை சந்திக்கலாம்.

1. உட்கொள்ளுதலில் சிரமம் ஏற்படல் மற்றும், தொண்டையில் உணவு அடைத்துக்கொள்ளுதல்
2. குரல் கனைப்பு ஏற்படல்
3. உறங்கும் போது மூச்சுத்திணறல் மற்றும் மூச்சடைப்பு ஏற்படல்
4. அறிவுத்திறன் குறைதல்
5. நிமிர்ந்து நிற்க முடியாதிருத்தல்
6. மாறுகண் ஏற்படல்
7. சிறுநீர் கழித்தலை கட்டுப்படுத்த இயலாமை
8. மலச்சிக்கல் ஏற்படல்
9. மறதி ஏற்படுதல்
10. கால் மற்றும் பாதங்களில் உணர்வின்மை
11. அசையமுடியாதிருத்தல்
12. மூளை வளர்ச்சி பாதிப்பு ஏற்படல்
13. சிசுவின் வளர்ச்சியில் குறைவு ஏற்படல்
14. சிசு சிதைவுறுதல் மற்றும் இறந்து பிறத்தல்
15. நரம்பு மண்டலங்கள் பாதிப்படைதல்

நரம்பு மண்டலக்குழாய் குறைபாட்டை தடுக்கும் வழி முறைகள்

1. போலிக் அமில மாத்திரைகளை உட்கொள்ளுதல்
2. போலிக் அமிலம் மிகுதியாக உள்ள உணவுப் பொருட்களை உட்கொள்ளுதல் (கீரை, ஆரஞ்சுப்பழம், பச்சை காய்கறிகள்)
3. போலிக் அமிலச்சத்து சேர்க்கப்பட்ட உணவு வகைகளை உட்கொள்ளுதல் (ரொட்டி, சோளம்,

IDED FOLIC ACID INTAKE

commended intake of folic acid
vomen are given below.

	Age	Amount (mcg)
	10 -12 years	70
	over 13 years	100
	All Ages	400
	All Ages	150

no are planning a pregnancy
4mg (400mcg) folic acid along
h foods. Women with previous
efect affected pregnancies who
for another pregnancy should
(4000mcg) of folic acid daily
onth prior to conception.

GROUP

partner with NTD
relative with NTD
n taking medicines for epilepsy
oic acid, Carbanazepine)
n with IDDM
women

OF NEURAL TUBE DEFECT

be defect can be diagnosed by,

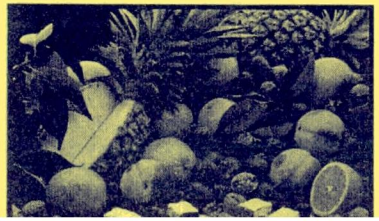
maternal Serum Alpha Feto

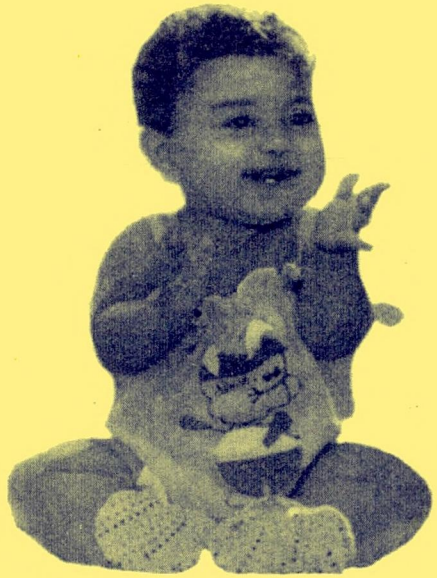
ntesis

4. Checking serum folate level.
5. Checking homocysteine level.

FOODS RICH IN FOLIC ACID

Foods	Serving Size	Folic acid (mcg)
Bajra	100g	45.5
Roased Bengal gram	100g	139
Bengal gram Dhal	100g	147.5
Green gram dhal	100g	140
Cowpea	100g	133
Redgram dhal	100g	103
Soyabeans	100g	100
Spinach	100g	123
Curry leaves	100g	93.9
Mint	100g	114
Cluster beans	100g	144
Ladies finger	100g	105
Brinjal	100g	34
Kovaikkai	100g	59
Tomato	100g	30
Orange juice	250ml	136
Orange Fruit	1	47
Egg hen	100g	78.3
Liver	100g	220





CHILD'S HEALTH IS NATION'S WEALTH

LTH IS NATION'S WEALTH

eed to attain good nutritional
during and after pregnancy to
rnal heath and reduce the risk
ts and chronic disease in their
er adulthood.
be defects are a group of very
defects that arise when the
ils properly to develop into the
nalcord during the first month

EURAL TUBE DEFECTS

naly

of major portion of the brain,
p.

haly

absent, bending of head

fida

dition where one or more of the
orae does not develop properly.

spina bifida

omeninggocele

h the spinal cord and its

Meningocele

Spinal cord develops normally but the meninges protrudes from a spinal opening.

(b) Closed spina bifida (occulta)

One or more vertebrae are malformed and covered by a layer of skin.

3. Encephalocele

These are sac like protrusions of the brain and membranes that cover it through openings in the skull. It is also associated with hydrocephalus.

CAUSES OF NEURAL TUBE DEFECTS

The causes of neural tube defects include,

- Folic acid deficiency.
- Exposure to tetratogenic drugs and medications such as those to treat epilepsy or acne.
- Excessive use of alcohol and smoking.
- Exposure to high temperature.
- Fever during pregnancy.
- Genetic variations.
- Dieting during pregnancy.
- Maternal diabetes, prepregnancy obesity, hyperinsulinemia
- Zinc deficiency

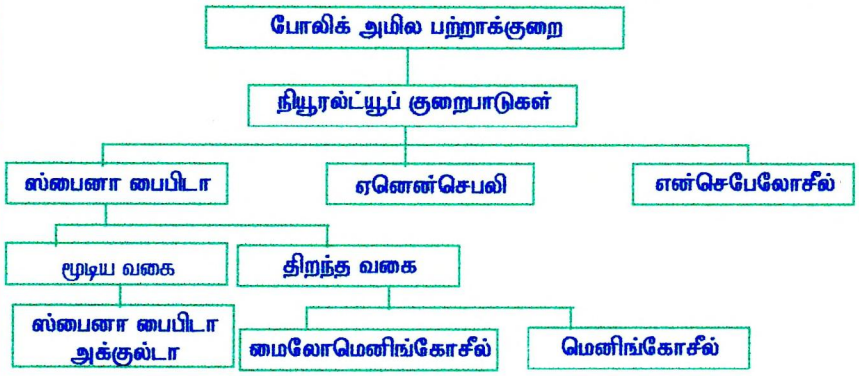
COMPLICATIONS OF NEURAL TUBE DEFECTS

- Difficulty in swallowing and chocking.
- Hoarseness.
- Breath holding and breathing problems during sleep.
- Below average intelligence.
- A sudden muscular contraction.
- Strabismus (sometimes called cross-eyes, wall eye or squint).
- Inability to control urine.
- Constipation.
- Little or no feeling in the legs and feet.
- Inability to move.
- Allergy to latex, natural rubber products used to make objects such as toys and health care supplies.
- Brain changes or damage.
- Intrauterine growth retardation.
- Perinatal mortality.
- Still birth.
- Neurological problems.

PREVENTION OF NEURAL TUBE DEFECT

- Supplementation of folic acid as tablets.
- Intake of folic acid rich foods such as greens, oranges and green leafy vegetables.
- Intake of folic acid fortified food such as

போலிக் அமிலக் குறைபாட்டினால் சிசுவிற்கு ஏற்படும் விளைவுகள



போலிக் அமிலம் மிக அதிக அளவில் காணப்படும் உணவுப் பொருட்கள்

உணவு வகைகள்	மைக்ரோ கிராம் 100 கிராம்
முழுகோதுமை	142.0
காராமணி	69.0
மணத்தக்காளி கீரை	41.0
கரிவேப்பிலை	23.5
அவரைக்காய்	50.0
எள்ளு	51.0
தக்காளி	14.0
கொத்தமல்லி	27.4
முட்டை	70.3
கல்லீரல்	65.5
வெண்டைக்காய்	25.3
நிலக்கடலை	16.0
பசலக்கீரை	51.0

தினசரி தேவைகள்:

கருவுருவதற்கு முன்பு - 0.1 மில்லி கிராம்

கருவுற்ற பின் - 0.4 மில்லி கிராம்

பாலூட்டும் தாய்மார்கள் - 0.15 மில்லி கிராம்

ஒரு தாயின் முதல் குழந்தை நரம்பு மண்டலக் குழாய் குறைபாட்டால் பாதிக்கப்பட்டிருந்தால் அத்தாய் மீண்டும் கருவுருவதற்கு முன்பு தினசரி 4 மில்லி கிராம் போலிக் அமிலம் உட்கொள்ள வேண்டும்.

உங்கள் குழந்தையின் ஆரோக்கிய வாழ்விற்கு ஓர் வழிகாட்டி

ஒரு பெண் கருவுற்ற சமயத்தில் அவளின் தினசரி புரதம், தாது உப்பு மற்றும் வைட்டமின்களின் தேவை சராசரி அளவைவிட அதிகமாகிறது. இவை குழந்தையின் வளர்ச்சிக்கு மிக அவசியம். பெண் கருவுறுவதற்கு முன்பும், கருவுற்ற பின் உட்கொள்ளும் உணவே அவள் குழந்தையின் ஆரோக்கிய வாழ்வை தீர்மானிக்கிறது. எனவே பெண் கருவுற்ற சமயத்தில் நல்ல ஆரோக்கியமான உணவை உட்கொள்ளுதல் மிக அவசியம். குழந்தையின் வளர்ச்சிக்கு அனைத்து சத்துக்களும் மிக அவசியம் என்றாலும் அவற்றுள் மூளை மற்றும் தண்டுவடத்தின் வளர்ச்சிக்கு மிக முக்கியமாக கருதப்படுவது போலிக் அமிலம்.

போலிக் அமிலம்

போலிக் அமிலம் என்பது ஒரு பி.வைட்டமின். ஒரு குழந்தை பிறக்கும் பொழுது, மூளை மற்றும் நரம்பு மண்டலக் குழாய் சம்மந்தப்பட்ட குறைபாட்டைத் தவிர்க்க பெண்கள் கருவுருவதற்கு மூன்று மாதத்திற்கு முன்பே போலிக் அமிலம் உட்கொள்ள வேண்டும். போலிக் அமிலம் மார்பகப் புற்றுநோய் மற்றும் இருதய நோய்கள் வரமால் பாதுகாக்கிறது. போலிக் அமிலச் சத்து மாத்திரைகள் எல்லோரும் வாங்க இயலும் மலிவு விலையில் கிடைக்கிறது. இதை பெண்கள் கருவுருவதற்கு முன்பே மருத்துவரின் ஆலோசனைப்படி உட்கொள்ள வேண்டும்.

போலிக் அமிலத்தின் பயன்கள்

- இரத்த சோகை வராமல் தடுக்கிறது.
- மரபு அணு உற்பத்திற்கு உதவுகிறது.
- இரத்த சிகப்பு அணுக்கள் மற்றும் வெள்ளை அணுக்கள் உற்பத்திக்கும், அவை முழுமையடைவதற்கும் உதவுகிறது.
- மார்பக புற்றுநோய் வருவதை தடுக்கிறது.
- இருதய நோய் வருவதை தடுக்கிறது.
- நரம்பு மண்டல குழாய் வளர்ச்சிக்கு உதவுகிறது.

APPENDIX - VII

QUESTIONNAIRE FOR ASSESSING NUTRITIONAL KNOWLEDGE

1. Folic acid is a _____

   (a) Protein (b) Fat (c) Vitamin (d) Mineral

2. Folic acid comes under which group

   (a) Vitamin A (b) Vitamin B (c) Vitamin C (d) Vitamin D

3. Identify the folic acid rich food.

   (a) Liver (b) Egg (c) Milk (d) Rice

4. Identify the folic acid rich vegetable

   (a) Carrot (b) Cluster beans (c) Ridge gourd (d) Snake gourd

5. Identify the folic acid rich fruit

   (a) Apple (b) Mango (c) Orange (d) Papaya

6. _____ is the green leafy vegetable rich in folic acid

   (a) Spinach (b) Drumstick leaves (c) Amaranth (d) Coriander

7. Folic acid is needed for

   (a) Development of spinal cord (b) Bone development

   (c) Brain development (d) Spinal cord and brain development

8. Neural tube defects is due to the deficiency of _____

   (a) Thiamine (b) Niacin (c) Folic acid (d) Pantothenic acid

9. Normal recommended dietary allowances of folic acid during pregnancy is

   (a) 0.4 mg/day (b) 0.6 mg/day (c) 0.2 mg/day (d) 2mg/day

10. Women with previous neural tube defect affected pregnancy, who are planning for another pregnancy should take

    (a) 0.4 mg folic acid/day (b) 2mg folic acid/day

    (c) 3mg folic acid/ day (d) 4mg folic acid / day

11. Indicate the type of neural tube defect

    (a) Anencephaly (b) Bitot spots (c) Rickets (d) Beri beri

12. What is the ideal time to start folic acid supplementation?

(a) At least one month before pregnancy (b) Second month after pregnancy

(c) First month after pregnancy (d) Third month after pregnancy

13. The percentage destruction of folic acid during cooking

(a) 40-50% (b) 50-60% (c) 30-40% (d) 50-90%

14. Which form of folic acid is more bioavailable?

(a) Processed food (b) Natural food (c) Cooked form (d) Tablet form.

15. Name the suitable food for folic acid fortification

(a) Salt (b) Flour (c) Butter (d) Milk

16. Neural tube defects can be prevented by _____

(a) Intake of folic acid after conception

(b) Intake of folic acid before conception

(c) Intake of iron tablets before conception

(d) Intake of iron tablets after conception

17. Neural tube defects can be diagnosed by _____

(a) Ultra sound scanning (b) Checking serum folate level

(c) Analysis of urine (d) Analysis of blood

18. Folic acid intake is more important during

(a) Pregnancy (b) Lactation (c) Adulthood (d) Infancy

19. Ultra sound scanning can detect neural tube defect at_____ of gestation

(a) 17 weeks (b) 18 weeks (c) 19 weeks (d) 20 weeks

20. Incidence of neural tube defects in India per 1000 live births.

(a) 0.4 - 6 (b) 0.5 - 11 (c) 0.6 - 8 (d) 0.7 - 9

APPENDIX VIII

INTERVIEW SCHEDULE FOR THE EXPERIMENTAL GROUPS

1. Name
2. Present age
3. Age during marriage

   < 18 years [ ] 19 – 21 years [ ]

   22 – 30 years [ ] > 30 years [ ]
4. Type of family : Joint / Nuclear
5. Family size :
6. Educational status :
7. Total monthly income of the family :
8. Are you married to your close relative? Yes / No

   If yes, indicate the relationship
9. Obstetric history of the expectant women :

   i) Age of the mothers at first pregnancy -

   ii) Parity - I II III IV

   iii) Types of birth - Live birth / Still birth / Spontaneous abortion

   iv) Birth Spacing - < 1 year / 1 year / 2 years / 3 years / >3 years

   iv) Complications faced in previous pregnancy:

Anencephaly		Meningocele	
Meningomyelocele		Iniencephaly	
Encephalocele		Hydrocephalus	
Cleft foot		Cleft lip	
Any others			

10. Period of survival of NTD affected child

    Still born / < 24 hours / 1 day / 2 days / < 7 days

11. Physiological problems suffered during previous pregnancy:

Vomiting and nausea		Giddiness	
More appetite		Loss of appetite	
Aversion of certain food		Muscle cramps	
Constipation		Back pain	
Hypertension		Odema	
Albuminuria		Frequent urination	
Heart burn		Disturbed sleep	
Indigestion		Fever	
Any others			

12. Psychological problems suffered or those that affected the intake.

Maternal concern about the well being of the baby		Family concern (lack of support)	
Recent adverse life events		Death of a parent	
Marital discord		Young age	
Worry about the sex of the baby		Worry about the time after the baby is born	
Regretted being pregnant		Worry whether the baby will be healthy and normal	
Worry of breast feeding the baby		Occupational stress	
Marital difficulties		Financial problems	
Worry about the existing complication known		Depressed symptoms	
Diminished pleasure in activities		Significant weight change	
Fatigue		Excessive guilty feeling	
Depressed mood			

13. Time of identification of complication:

14. Medical supplements taken

Before conception		III Trimester	
I Trimester		Did not take any supplements	
II Trimester			

If yes, what type of supplements

15. Mode of delivery of the previous affected child :

Medical Termination /Normal Delivery /Caesarean/Forceps

16. Expenditure incurred during previous pregnancy :

		Rs.
Medical check up	-	
Medicinal supplements	-	
Scan	-	
Delivery	-	
Food supplements	-	
Any others	-	
Total	-	

17. Sex of the baby :

18. Sonogram report :

i). Weeks of gestation -

ii). Foetal Biometrics (mm)

Bi Parietal diameter (mm)		Abdominal circumference (mm)	
Head circumference (mm)		Femur length (mm)	

19. Dietary Pattern

Type of diet - Veg / Non – veg / Ovo – veg

20. How often do you consume the following foods :

Foods	Daily	Weekly once	Weekly twice	One in 15 days	Once a Month
Cereals: Bajra					
Jowar					
Wheat flour					
Rice parboiled					
Oat meal					

Foods	Daily	Weekly once	Weekly twice	One in 15 days	Once a Month
Pulses and Legumes: Bengal Gram Dhal					
Cow pea					
Roasted Bengal gram					
Black gram dhal					
Green gram					
Green gram dhal					
Lentil					
Red gram dhal					
Soya bean					
Leafy vegetables : Amaranth					
Cabbage					
Curry leaves					
Mint					
Spinach					
Roots and tubers : Carrot					
Colocasia					
Potato					
Other vegetables: Cluster beans					
French beans					
Ladies finger					
Snake gourd					
Brinjal					
Nuts and oil seeds : Gingelly seeds					
Coconut (fresh)					
Fruits : Tomato					
Orange					

Foods	Daily	Weekly once	Weekly twice	One in 15 days	Once a Month
Meat and meat products:					
Egg duck					
Chicken					
Liver goat					
Milk and milk products : Milk cow					
Buffalo					
Curds					

21. Special supplements taken in current pregnancy during periconceptional period

i) Folic acid -

ii) Folic acid & multivitamins -

iii) Folic acid & iron -

22. i) Three day recall method (Before supplementation)

Day	Early Morning	Breakfast	Lunch	Tea	Dinner
I					
II					
III					

ii) Three day recall method (After supplementation)

Day	Early Morning	Breakfast	Lunch	Tea	Dinner
I					
II					
III					

23. Information regarding the current pregnancy (Anthropometric measurement) :

i) Weight (kg) : During First visit [ ] Final trimester [ ]

ii) Height (cm) :

iii) BMI(kg/m^2) :

24. Scores obtained:

Knowledge scores	Before counseling	After counseling
Scores obtained (out of 20)		

25. Biochemical assessment :

Parameters	Before supplementation	After supplementation
Serum folate level (ng /ml)		
Haemoglobin level (g /dl)		

26. Sonogram report (Foetal Biometrics at 22nd week of gestation) :

Bi Parietal diameter (mm)		Abdominal circumference (mm)	
Head circumference (mm)		Femur length (mm)	

27. Complications faced during gestation

Hypertension		Dental caries	
Gestational diabetes mellitus		Herpes simplex	
Thyroid problem		Vascular complication	
Neural tube defect		Eclampsia	
Obesity		Intra uterine growth retardation	
Accidents		Bulimia Nervosa	
Chicken pox		Anemia	
Measles		Congenital / anomalies	
Malaria		Epilepsy	
Eye infection		Premature rupture of membranes	
Downs syndrome		Any others	
Gingivitis			

28. Information regarding the newborn

Weeks of gestation	:	
Sex	:	Male / Female
Birth order	:	
Type of delivery	:	Normal / caesarean / forceps

29. Anthropometric measurements of the newborn :

Birth weight of the infants (kg)	-
Crown heel length (cm)	-
Head circumference (cm)	-
Chest circumference (cm)	-
Mid arm circumference (cm)	-

APPENDIX IX

INDIVIDUAL MEAN FOOD INTAKE OF THE SELECTED WOMEN BEFORE COUNSELING

Subjects	Cereals (g)	Pulses (g)	GLV (g)	Other Veg (g)	Roots & tubers (g)	Fruits (g)	Milk & Milk Pdts (g)	Fats & Oils (g)	Sugar & Jaggery (g)	Meat & Fish (g)	Egg (g)
1	316.6	25	26.6	-	48.3	33.3	366.6	20	16.6	25	-
2	283.3	21.6	25	45	78.3	100	283.3	23.3	21.6	20	20
3	270.6	24.7	16.6	3.3	145	83.3	233.3	25	21.6	25	-
4	216.6	21.6	66.6	6.6	116.6	33.3	300.0	23.3	23.3	-	20
5	165	20	6.6	16.6	10	25	383.3	25	20	30	-
6	241.6	20	30.7	40.7	50.3	30.7	250.0	27.3	17.2	25	-
7	266.2	19.2	36.2	45.7	67.2	40.2	313.5	30	21.6	25	-
8	225.9	21.7	38.7	42.3	70.2	32.7	250.2	35.7	27	30	-
9	200.4	28.6	41.2	29.3	38	30.7	300.6	41.2	24	20.2	-
10	170.5	22.2	30.2	32.3	29.7	27.4	293.7	28	18	-	-

INDIVIDUAL MEAN FOOD INTAKE OF THE SELECTED WOMEN AFTER COUNSELING

Subjects	Cereals (g)	Pulses (g)	GLV (g)	Other Veg (g)	Roots & tubers (g)	Fruits (g)	Milk & Milk Pdts (g)	Fats & Oils (g)	Sugar & Jaggery (g)	Meat & Fish (g)	Egg (g)
1	225	39	130	22	82	72	315	20	16.6	30	-
2	170	22	42	31	96	84	320	23.3	21.6	35	-
3	315	20	35	28	52	42	450	25	21.6	25	-
4	175	27	30	42	90	58	300	23.3	23.3	35	-
5	370	21	28	26	98	89	350	25	20	20	-
6	260.3	32	40	55	60.2	70.2	325	27	18.7	20.2	-
7	250.1	30.2	46	62	70.1	80.7	340	28.7	25.7	25	-
8	230.7	30.7	52	65.7	75.2	75.3	380	30.3	19.7	30	-
9	240.7	25	41.2	72.0	42.7	57.6	340	40.6	24.3	-	-
10	210.9	30.7	35.7	48.2	35.2	41.8	300	48.2	27.2	-	20

APPENDIX X

INDIVIDUAL MEAN NUTRIENT INTAKE OF THE SELECTED WOMEN BEFORE COUNSELING

Subjects	Energy (k.cal)	Protein (g)	Iron (mg)	β-carotene (mcg)	Folic acid	
					Total (mcg)	Free (mcg)
1	2024.31	37.95	19.38	615.6	119.09	81.48
2	1969.35	47.58	20.9	789.2	129.1	70.75
3	1940.4	40.20	40.71	931.9	133.8	70.42
4	1756.17	47.70	10.68	990.41	118.9	65.10
5	1432.7	35.27	6.56	991.15	103.6	69.37
6	2032.7	30.2	11.7	842.7	110.1	60.2
7	1951.2	42.5	18.2	806.7	98.4	67.2
8	1970.8	40.1	21.3	602.2	112.4	61.4
9	1756.6	30.2	28.2	746.2	144.9	67.9
10	1670.9	37.2	9.4	678.4	97.2	62.1

INDIVIDUAL MEAN NUTRIENT INTAKE OF THE SELECTED WOMEN AFTER COUNSELING

Subjects	Energy (k.cal)	Protein (g)	Iron (mg)	β-carotene (mcg)	Folic acid	
					Total (mcg)	Free (mcg)
1	2062.98	51.3	31.7	1370.3	190.6	129.2
2	2052.91	52.6	31.3	1020.5	142.6	81.5
3	204.3	42.6	54.0	1035.9	147.6	81.1
4	1822.84	56.4	22.5	949.5	128.9	89.1
5	1466.46	45	10.9	773.2	141.7	66.7
6	2064.7	65.1	21.7	800.7	135.7	72.5
7	1991.3	45.0	18.6	871.2	130.1	67.4
8	2061	44.1	28.1	701.7	130.4	67.0
9	1794	36.1	30.3	801.4	136.2	65.9
10	1747	38.1	19.8	966	147.4	68.7

APPENDIX XI

INDIVIDUAL HEIGHT, WEIGHT AND BMI OF THE SELECTED WOMEM

Subjects	Height (cm)	Weight (kg)	BMI (kg/m^2)
1	150	48	21.3
2	161	62	23.9
3	158	60	24
4	155	43	17.9
5	158	55	22.0
6	158	55	22.0
7	160	60	23.4
8	155	58	24.1
9	155	59	24.5
10	155	55	22.9
11	167	60	21.5
12	153	45	18.3
13	150	50	22.2
14	149	58	26.1
15	135	40	21.9
16	156	55	22.6
17	160	58	22.6
18	153	58	24.7
19	166	55	20
20	154	54	22.7
21	150	58	25.7
22	163	48	18.4
23	154	48	20.2
24	151	60	26.3
25	155	54	22.5
26	163	54	20.3
27	155	60	25
28	163	55	20.7
29	160	56	21.8
30	158	50	20.0
31	161	60	23.1
32	160	59	23.0
33	160	63	24.6
34	154	45	18.9
35	160	50	19.5
36	161	64	24.7
37	158	52	20.8
38	162	48	18.3
39	162	60	22.9
40	162	48	18.3
41	155	50	20.8
42	158	52	20.8
43	155	50	20.8
44	161	64	24.7
45	160	50	19.5
46	154	45	18.9
47	160	63	24.6
48	160	59	23.0
49	161	60	23.1
50	158	50	20.0

APPENDIX XII

INDIVIDUAL SERUM FOLATE AND HAEMOGLOBIN LEVELS OF THE SELECTED WOMEN BEFORE AND AFTER COUNSELING

Subjects	Serum folate levels (ng/ml)		Haemoglobin levels (g/dl)	
	Before	After	Before	After
1	11.88	16.36	9.2	11.2
2	23.45	24.0	14	14.7
3	19.83	23.62	12.8	13.6
4	17.24	20.1	11.8	12.2
5	18.07	19.09	9.6	11.7
6	23.1	24.8	13.3	14
7	21.9	23.6	11.2	11.3
8	6.8	15.7	11.2	11.7
9	5.5	17.2	12.8	13.0
10	5.4	19.7	12.9	13.2

APPENDIX XIII

INDIVIDUAL KNOWLEDGE SCORES OF THE SELECTED WOMEN BEFORE AND AFTER COUNSELING

S.No	Before Counseling		After Counseling	
	No	%	No	%
1	8	40	18	90
2	5	25	18	90
3	7	35	18	90
4	5	25	18	90
5	7	35	19	95
6	5	25	19	95
7	10	50	19	95
8	8	40	17	85
9	2	10	17	85
10	7	35	17	85
11	5	25	16	80
12	6	30	16	80
13	5	25	18	90
14	11	55	18	90
15	10	50	17	85
16	9	45	19	95
17	11	55	19	95
18	8	40	18	90
19	9	45	18	90
20	4	20	16	80
21	6	30	17	85
22	4	20	17	85
23	8	40	18	90
24	8	40	18	90
25	14	70	20	100
26	8	40	17	85
27	4	20	18	90
28	9	45	19	90
29	4	20	18	90
30	3	15	18	90
31	6	30	18	95
32	9	45	19	95
33	1	5	19	95
34	6	30	19	95
35	6	30	19	95
36	6	30	19	95
37	8	40	17	85
38	9	45	18	90
39	11	55	16	80
40	5	25	17	85
41	4	20	17	85
42	6	30	18	90
43	6	30	19	95
44	7	35	19	95
45	2	10	17	85
46	8	40	18	90
47	14	70	20	100
48	10	50	18	90
49	3	15	18	90
50	5	25	19	95

APPENDIX XIV (a)

INDIVIDUAL MEAN FOOD INTAKE OF GROUP A - BEFORE COUNSELING

Subjects	Cereals (g)	Pulses (g)	GLV (g)	Other Veg (g)	Roots & tubers (g)	Fruits (g)	Milk & Milk Pdts (g)	Fats & Oils (g)	Sugar & Jaggery (g)	Meat & Fish (g)	Egg (g)
1	286.6	35.33	-	26.6	43.3	46.6	183.3	118.3	40	-	-
2	283.3	25	26.6	26.6	46.6	60	250	70	30	26.6	-
3	303.3	30	13.3	43.3	83.3	83.3	253.3	60	33.3	25	-
4	180	20	50	23.3	43.3	43.3	200	30	30	23.33	-
5	228.3	35	10	10	48.3	26.6	250	50	30	16.66	-
6	196.6	25	6.66	28.3	23.3	40	200	40	40	16.66	20
7	193.3	43.3	6.6	28.3	48.3	30	183.3	57.6	33.3	-	20
8	183.3	18.3	6.6	38.3	63.3	96.6	216.6	36.6	30	16.6	20
9	218.3	31.6	6.6	41.6	50	76.6	200	41.6	30	13.3	-
10	213.3	43.33	6.6	38.3	43.3	20	183.3	40	30	-	-

INDIVIDUAL MEAN FOOD INTAKE OF GROUP A - AFTER COUNSELING

Subjects	Cereals (g)	Pulses (g)	GLV (g)	Other Veg (g)	Roots & tubers (g)	Fruits (g)	Milk & Milk Pdts (g)	Fats & Oils (g)	Sugar & Jaggery (g)	Meat & Fish (g)	Egg (g)
1	270	20.3	13.3	33.3	40	43.3	216.6	66.6	40	25	20
2	253.3	10	13.3	26.6	56.6	83.3	233.3	66.6	30	33.3	20
3	256.67	33.3	23.3	46.6	38.3	61.6	200	56.6	40	13.3	-
4	251.6	36.67	20	50	63.3	90	233.3	71.66	30	0	20
5	245	25.0	20	46.6	70	70	183.3	56.6	36.6	26.6	0
6	213.3	40.6	26.6	20	63.3	56.6	250	63.33	30	0	0
7	226.7	23.3	10	30	46.6	90	233.3	70	36.6	25	20
8	233.3	63.3	20	33.3	46.6	81.6	183.3	56.6	30	0	0
9	228.3	30	20	43.3	57.3	91.6	183.3	46.6	30	33.3	0
10	200	30.6	10	41.6	46.6	83.3	216.6	53.3	40	33.3	20

APPENDIX XIV (b)

INDIVIDUAL MEAN FOOD INTAKE OF GROUP B - BEFORE COUNSELING

Subjects	Cereals (g)	Pulses (g)	GLV (g)	Other Veg (g)	Roots & tubers (g)	Fruits (g)	Milk & Milk Pdts (g)	Fats & Oils (g)	Sugar & Jaggery (g)	Meat & Fish (g)	Egg (g)
1	226.6	30	33.3	33.3	40	70	216.6	70	20	-	-
2	225	58.3	-	10	51.6	23.3	250	23.3	21.6	-	-
3	236.6	25	-	33.3	86.6	33.3	266.6	33.3	31.6	20	-
4	223.33	40	20	16.6	26.6	66.6	250	66.6	36.6	-	-
5	226.6	16.6	10	20	81.6	43.3	266.6	43.3	33.3	30	20
6	226.6	21.6	13.3	10	48.3	30	150	30	33.3	33.3	-
7	220	31.6	-	28.3	43.3	56.6	166.6	56.6	30	-	20
8	210	15.0	6.6	8.3	50	60	166.6	60	30	13.3	20
9	211.6	30	-	43.3	20	43.3	150	43.33	30	-	-
10	226.6	36.6	-	40	38.3	70	150	70	30	-	-

INDIVIDUAL MEAN FOOD INTAKE OF GROUP B -AFTER COUNSELING

Subjects	Cereals (g)	Pulses (g)	GLV (g)	Other Veg (g)	Roots & tubers (g)	Fruits (g)	Milk & Milk Pdts (g)	Fats & Oils (g)	Sugar & Jaggery (g)	Meat & Fish (g)	Egg (g)
1	231.6	40.6	26.6	33.3	66.6	63.3	233.3	66.6	33.3	-	-
2	258.3	23.3	20	36.6	53.3	70	200	81.6	30	33.3	20
3	226.6	40	0	43.3	63.3	60	200	80	30	0	20
4	236.6	30	20	30	60	66.6	250	65	36.6	13.3	0
5	231.66	23.3	16.6	35	55	73.3	233.3	55	36.6	33.3	20
6	215	36.6	20	36.6	36.6	76.6	200	48.3	30	33.3	0
7	236	26.6	16.6	38.3	65	60	183.3	55	41.6	30	20
8	221.66	20	23.3	38.3	60	56.6	200	58.3	40	25	20
9	223.33	35	13.3	35	65	40	183.3	56.6	46.6	23.3	0
10	250	48.3	10	40	70	36.6	216.6	65	33.3	0	0

APPENDIX XIV (c)

INDIVIDUAL MEAN FOOD INTAKE OF GROUP C-BEFORE COUNSELING

Subjects	Cereals (g)	Pulses (g)	GLV (g)	Other Veg (g)	Roots & tubers (g)	Fruits (g)	Milk & Milk Pdts (g)	Fats & Oils (g)	Sugar & Jaggery (g)	Meat & Fish (g)	Egg (g)
1	200	30	10	20	53.3	51.6	250	43.3	30	-	-
2	196.6	36.6	-	26.6	70	96.6	250	56.6	30	-	12.0
3	215	45	-	46.6	18.3	53.3	200	66.6	30	-	-
4	246.6	41.6	10	30	63.3	53.3	300	80	30	-	-
5	258.3	35	53.3	13.3	86.6	73.3	291.6	83.3	48.3	-	-
6	210	32	10	23.3	36.6	46.6	216.6	50	30	-	-
7	210	23.3	-	30	13.3	30	183.3	43.3	30	23.3	12
8	240	38.3	10	30	36.6	46.6	216.6	61.6	36.6	-	-
9	215	25	-	25	40	73.3	166.6	48.3	33.3	20	20
10	200	30	-	16.6	43.3	30	150	43.3	30	23.3	-

INDIVIDUAL MEAN FOOD INTAKE OF GROUP C - AFTER COUNSELING

Samples	Cereals (g)	Pulses (g)	GLV (g)	Other Veg (g)	Roots & tubers (g)	Fruits (g)	Milk & Milk Pdts (g)	Fats & Oils (g)	Sugar & Jaggery (g)	Meat & Fish (g)	Egg (g)
1	228.6	38.3	23.3	30	70	46.6	250	53.3	33.3	0	20
2	233.3	35	13.3	33.3	70	80	225	56.6	36.6	0	20
3	230	33.3	20	43.3	65	60	216.6	50	30	16.6	0
4	230	56.6	13.3	58.3	75	73.3	300	55	46.6	0	0
5	233.3	25	23.3	46.6	43.3	66.6	216.6	65	30	13.3	20
6	228.3	40.6	20	40	50	53.3	200	63.3	36.6	0	0
7	233	36.6	36.6	33.3	63.3	53.3	233.3	61.6	30	20	0
8	220	28.3	13.3	40	36.6	66.6	200	50	40	20	20
9	235.3	25	23.3	53.3	65	76.6	216.6	53.3	33.3	16.6	20
10	226.6	23	10	30	63.3	70	216.6	50	36.6	16.6	20

APPENDIX XV (a)

INDIVIDUAL MEAN NUTRIENT INTAKE OF GROUP A - BEFORE COUNSELING

Subjects	Energy (K.Cal)	Protein (g)	Fat (g)	Iron (mg)	Beta-carotene (mcg)	Folic Acid		Vitamin C (mg)
						Free (mcg)	Total (mcg)	
1	2552.8	69.8	89.94	13.7	376.4	69.0	203.8	27.3
2	2135.1	52.0	91.8	13.4	1495.1	69.5	136.1	41.5
3	2146	55.3	88.3	8.5	429.6	63.2	126.03	51.2
4	1826.9	47.8	62.3	10.9	777.8	45.1	152.7	24.9
5	1833.4	56.4	64.2	12.4	802.7	95.1	164.5	40.4
6	1661.6	40.7	44.7	13.5	631.7	45.3	113.27	74.3
7	1802.2	39.9	30.5	17.4	966.9	56.6	94.6	24
8	1977	36.4	33.9	21.5	809	41.3	71.4	33.1
9	1736.3	22.4	40.7	16.7	572.1	40.7	107.6	25.4
10	1794.6	40.7	38.2	19.8	1073.7	69.2	123.8	35.2

INDIVIDUAL MEAN NUTRIENT INTAKE OF GROUP A - AFTER COUNSELING

Subjects	Energy (K.Cal)	Protein (g)	Fat (g)	Iron (mg)	Beta-carotene (mcg)	Folic Acid		Vitamin C (mg)
						Free (mcg)	Total (mcg)	
1	2642.6	70.4	86.5	19.5	752.9	77.1	236.15	28.2
2	2021.8	56.6	89.2	16.6	865.8	72.9	132.5	46.4
3	2113.4	59.3	72.8	12.6	663.6	65.8	158.5	55.2
4	1859.8	61.4	65.5	13.6	799.4	51.8	135.4	46.2
5	1982.7	60.6	64.9	15.3	1277.4	95.2	163.6	58.3
6	2032.1	56.3	46.9	16.3	616.4	70.9	140	50.5
7	2208.1	44.5	42.83	17.5	620.4	57.6	63.9	42.7
8	1938.1	39.3	46.1	12.5	982.5	49.1	118.8	30.6
9	1826.3	41.7	41.8	16.4	817.6	60.7	103.5	48.3
10	1847.8	45.9	52.5	15.3	1378	73.9	109.8	64.03

APPENDIX XV (b)

INDIVIDUAL MEAN NUTRIENT INTAKE OF GROUP B - BEFORE COUNSELING

Subjects	Energy (K.Cal)	Protein (g)	Fat (g)	Iron (mg)	Beta-carotene (mcg)	Folic Acid		Vitamin C (mg)
						Free (mcg)	Total (mcg)	
1	1504.9	39.3	50.64	14.0	1269.4	81.8	121.42	61.5
2	1877.7	77.9	72.5	6.87	507.8	48.2	124.8	33.5
3	2156.5	57.6	88.2	9.6	396.1	56	159.2	39.7
4	1840	41.2	73.2	11.6	536.5	83.8	126.3	34.3
5	1941.3	46.2	69.9	17.9	920.1	80.2	120.1	37.8
6	1744.1	38.0	67.2	16.1	721.4	77.7	89.6	43.4
7	1772.9	38.4	55.1	14.3	1083.7	82.4	110.7	47.6
8	1863.7	47.5	63.6	12.2	644.4	68.9	96.7	33.8
9	1672.8	39.3	50.4	13.8	338.8	38.6	87.2	32.1
10	1849.56	41.9	19.13	14.8	839.5	63.3	112	45.7

INDIVIDUAL MEAN NUTRIENT INTAKE OF GROUP B - AFTER COUNSELING

Subjects	Energy (K.Cal)	Protein (g)	Fat (g)	Iron (mg)	Beta-carotene (mcg)	Folic Acid		Vitamin C (mg)
						Free (mcg)	Total (mcg)	
1	1751	44.7	54.5	15.8	1505.2	110.4	155.9	86.1
2	1965.6	71.6	62.9	12.4	614.8	58.4	111.3	45.4
3	2248.9	61.1	87.1	12.2	498.5	61.7	154.6	52.8
4	1986.7	31.9	61.8	20.5	468.8	95.1	172.6	55.6
5	2029.6	69.9	61.9	19.6	762.3	91.5	199.2	52.7
6	1865.3	52.9	75	18.4	1069.6	77.6	162.5	62.3
7	1860.9	54.1	73.3	14.8	1075.9	92.7	117.1	52.13
8	1864.6	55.4	65.1	14.1	1097	91.8	151.8	72.5
9	1491.7	56.4	63.5	16.3	553.6	47.0	136.1	40
10	1909.2	52.5	66.7	20.4	991.4	68.0	145.8	55.7

APPENDIX XV (c)

INDIVIDUAL MEAN NUTRIENT INTAKE OF GROUP C - BEFORE COUNSELING

Subjects	Energy (K.Cal)	Protein (g)	Fat (g)	Iron (mg)	Beta-carotene (mcg)	Folic Acid		Vitamin C (mg)
						Free (mcg)	Total (mcg)	
1	1595.5	43.2	54.2	11.3	651.4	62.7	103.4	21.4
2	1765.3	48.3	40.5	12.8	676.2	79.8	149.2	33.8
3	1839.5	47.03	71.27	12.8	1347.4	104.6	156	19.1
4	2114.4	53.97	71.24	22.1	769.3	86.2	123.6	32.7
5	2376.8	54.1	46.99	10.8	1624.1	77.5	104.8	74.2
6	1621.2	40.5	58.7	12.2	574.4	82.0	144.9	55.0
7	1624.3	35.8	53.5	13.6	512.1	60.6	107	35.9
8	1647.8	38.0	67.2	13.7	331.2	72.5	100.1	31.37
9	1811.6	38.8	54.9	14.1	542.3	74.9	141.7	44.63
10	1837.3	59.5	44.6	16.7	647.5	83.86	112.0	47.1

INDIVIDUAL MEAN NUTRIENT INTAKE OF GROUP C - AFTER COUNSELING

Subjects	Energy (K.Cal)	Protein (g)	Fat (g)	Iron (mg)	Beta-carotene (mcg)	Folic Acid		Vitamin C (mg)
						Free (mcg)	Total (mcg)	
1	1694.2	52.7	66.2	14.3	1018.6	63.7	130.1	35.8
2	1827.2	53.8	69.4	16.6	683.3	79.5	163.6	54
3	2007.4	60.6	71.2	15.0	845.2	106.8	159.8	34.9
4	2116.6	55.5	40.2	18.2	830.8	96.8	162.7	65.7
5	2183.4	61.1	59.3	14.3	860.9	86.1	140.4	63.9
6	1704.6	40.8	44.8	14.7	783	84.7	118.0	65.8
7	1715.3	46.7	62.5	17.4	645.5	61.4	125.6	48.9
8	1873.5	53.5	57.8	16.4	751.5	289.8	128.4	57.6
9	1858.6	54.6	54.9	18.1	612.8	83.6	99	59.3
10	1871.3	65.9	46.2	17.9	750.9	87.4	118.2	66.9

APPENDIX XVI

INDIVIDUAL ANTHROPOMETRIC MEASUREMENTS OF THE EXPERIMENTAL GROUPS

S. No	Group A				Group B				Group C			
	Preconceptional weight (Kg)	Weight in III trimester (Kg)	Height (cm)	BMI (kg/m^2)	Preconceptional weight (Kg)	Weight in III trimester (Kg)	Height (cm)	BMI (kg/m^2)	Preconceptional weight (Kg)	Weight in III trimester (Kg)	Height (cm)	BMI (kg/m^2)
1	50	60	153	21.4	51	62	150	22.6	50	58	152	21.6
2	52	60	152	22.5	47	56	152	20.3	49	59	150.5	21.5
3	53	62	153	22.6	55	64	154	23.2	45	55	148.9	20.2
4	57	65	154	24.1	49	58	148.6	22.2	38	50	150	16.8
5	57	60	149	22.9	42	53	151	18.4	52	61	151	22.8
6	48	57	148	21.9	46	57	150	20.4	58	65	150.8	25.5
7	54	65	151	23.7	43	54	152	18.6	49	57	149	22.1
8	53	64	150	23.5	48	58	153	20.5	48	57	149	21.6
9	60	67	154	25.3	45	56	149	20.3	52	61	151.6	22.6
10	42	53	154	17.7	53	64	154	22.3	50	59	152	21.6

APPENDIX XVII

INDIVIDVAL KNOWLEDGE SCORES OF THE EXPERIMENTAL GROUPS BEFORE AND AFTER COUNSELING

Subjects	Group A				Group B				Group C			
	Before		After		Before		After		Before		After	
	Score	%	Score	%	Score	%	Score	%	Score	%	Score	%
1	4	20	17	85	4	20	17	85	7	35	16	80
2	7	35	17	85	6	30	17	85	7	35	16	80
3	5	25	17	85	8	40	18	90	5	25	19	95
4	6	30	19	95	8	40	17	85	7	35	17	85
5	4	20	18	90	7	35	18	90	7	35	19	95
6	6	30	19	95	7	35	19	95	6	30	18	90
7	7	35	19	95	9	45	18	90	7	35	18	90
8	8	40	17	85	9	45	20	100	8	40	18	90
9	6	30	16	80	11	55	18	90	7	35	18	90
10	8	40	17	85	12	60	17	85	4	20	18	90

APPENDIX XVIII

INDIVIDUAL HAEMOGLOBIN LEVELS OF THE EXPERIMENTAL GROUPS BEFORE AND AFTER COUNSELING

Subjects	Group A		Group B		Group C	
	Before (g/dl)	After (g/dl)	Before (g/dl)	After (g/dl)	Before (g/dl)	After (g/dl)
1	8.6	9.0	8.0	9.0	7.9	9.5
2	8.9	9.2	8.6	9.4	9.0	10.4
3	8.3	9.0	11.2	12.4	10.1	11.0
4	9.8	10.2	11.0	11.4	8.5	11.5
5	9.9	10.1	9.1	10.4	9.2	12.1
6	10.2	12.1	9.4	9.9	10.4	11.7
7	10.0	10.2	8.9	10.0	11.3	12.4
8	9.4	11.0	9.4	11.0	8.2	10.8
9	9.0	11.2	10.2	12.2	8.6	10.7
10	9.6	10.4	11.3	12.4	9.2	11.6

INDIVIDUAL SERUM FOLATE LEVELS OF THE EXPERIMENTAL GROUPS BEFORE AND AFTER COUNSELING

Subjects	Group A		Group B		Group C	
	Before (ng/ml)	After (ng/ml)	Before (ng/ml)	After (ng/ml)	Before (ng/ml)	After (ng/ml)
1	2.7	18	3.2	15	4.5	10.1
2	3.0	17.2	4.8	13	5.6	12.2
3	2.4	15	7.8	14.2	7.8	14.0
4	5.0	10	6.2	16	5.7	11.0
5	5.2	11.2	7.2	17.7	6.5	12.7
6	6.8	15.1	7.0	18	9.2	16.7
7	6.0	12.7	5.5	19.7	8.7	19.5
8	5.1	11.2	6.0	12.4	4.9	11.1
9	4.3	12.7	5.6	12.1	5.4	12.7
10	5.2	13.1	4.4	13.4	6.0	11.8

APPENDIX XIX

INDIVIDUAL FOETAL BIOMETRICS AT 22nd WEEK OF PREGNANCY

Subjects	Group A				Group B				Group C			
	BPD (mm)	HC (mm)	AC (mm)	FL (mm)	BPD (mm)	HC (mm)	AC (mm)	FL (mm)	BPD (mm)	HC (mm)	AC (mm)	FL (mm)
1	56	209	185	39.1	57.5	210	188	41	58.9	206.2	190.2	41
2	58.5	209.6	193.8	41.6	57.4	203.7	189.2	41.5	57.3	211	192.4	40
3	57.4	211	186	39.7	56.9	204.1	186	40.5	57.8	210	185	39.7
4	57.4	204.5	190	40	57	212	190	41.8	58	204.2	186.7	39.2
5	58.2	218	192.7	41	58.4	205	190.5	41.9	58.2	205.6	187	40.6
6	58.2	206.1	186.7	39.5	58.6	212	192.4	41.5	56.8	204.6	186	40.8
7	58.1	207.2	188	41.7	58.7	208	187.3	40	57.4	210	186.2	39.7
8	58.2	204.2	185.9	40.4	58.2	207.6	186.2	40.8	56.8	211.7	187.2	41.3
9	57.3	210.5	186	41.1	58.7	209.3	187	41.2	57	212	189.3	41.3
10	56.9	203	184.2	39	58.8	210.2	192.6	38.5	58.5	209.7	185.6	40.8

BPD-Bi Parietal Diameter ; HC-Head Circumference ; AC-Abdominal Circumference ; FL-Femur Length.

APPENDIX XX

INDIVIDUAL ANTHROPOMETRIC MEASUREMENTS OF THE NEWBORNS

Subjects	Group A					Group B					Group C				
	BW Kg	CHL cm	HC cm	CC cm	MUAC cm	BW Kg	CHL cm	HC cm	CC cm	MUAC cm	BW Kg	CHL cm	HC cm	CC cm	MUAC cm
1	2.8	49.9	33.1	32.3	10.4	2.8	50.1	33.4	32.2	10.4	2.8	46.5	33.2	32.1	10.7
2	2.75	49.8	32.9	31.8	10.5	3.1	49.7	33.1	32.2	10.3	2.9	46.2	33	31.6	10.2
3	3.0	50.1	33.7	32.7	11.0	2.6	48.2	32.9	31.3	10.1	3.1	50	36	31.8	11.7
4	2.9	50.7	34	32.8	10.2	3.5	52	37	35	11.9	3.0	49	34	32	11.0
5	2.5	59.8	32	32.9	10.8	3.0	49.4	33.4	32.1	11.0	3.25	48	36.2	31.9	10.2
6	3.0	51.0	33.1	32.2	10.8	2.75	47.2	32.7	31.9	10.7	3.0	45.2	34.7	32	9.0
7	2.9	49.9	32.9	31.6	10.2	3.0	49.7	34.3	32	11.2	2.75	46	33.6	30	8
8	2.75	48.1	32.4	31.1	10.7	3.1	46.4	32	31	10.8	2.6	46.4	33.1	31.4	9.4
9	3.0	50.1	33.4	32.4	10.1	3.12	51	34	31.2	12.1	2.7	45	32.4	30.1	9.8
10	3.1	49.6	33.4	32.6	9.4	2.9	48.1	33.1	32	10.4	3.25	47	36	31.7	10

BW - Birth Weight; CHL - Crown Heel Length; HC - Head Circumference; CC - Chest Circumference; MUAC - Mid Upper Arm Circumference

The Ind. J. Nutr. Dietet., (2007), 44, 124

EFFECT OF PERICONCEPTIONAL COUNSELING ON SERUM FOLATE LEVELS OF WOMEN PLANNING PREGNANCY

PONNE, S.[1] AND LAKSHMI, U.K.[2]

(1. Department of Nutrition and Dietetics, Maharaja College for Women, Perundurai - 638 052, 2. Department of Food Science and Nutrition, Avinashilingam University for Women, Coimbatore - 641 043)

(Received 14th November, 2006)

Introduction

Adequate nutrition before and during pregnancy has greater potential for a long term health impact than it does at any other time. A woman who has been well nourished before conception begins her pregnancy with reserves of several nutrients so that the needs of the growing foetus can be met without affecting her health. Infants who are well nourished in the womb, have an enhanced chance of entering life in good physical and mental health.

Maternal micronutrient deficiency has been related to adverse fetal effects. Neural Tube Defects (NTDs) are the most common of the central nervous system malformations. Folic acid deficiency can lead to NTDs. The primordial cells of neural tube close within the first 21 to 28 days of life. Development then rapidly progresses during the first trimester of pregnancy. The main types of NTDs are spina bifida (including meningomyelocele and meningocele), anencephaly (including craniorachischisis) and encephalocele[1]. There is significant geographic variation in the prevalence of NTDs world wide. The prevalence of NTD from different parts of India has been reported to vary from 0.5 to 11 per 1000 live births[2] .

Maternal periconceptional use of folic acid has been found to reduce the risk of both recurrent and occurrent NTDs[3]. All women of reproductive age especially who are planning for pregnancy should be aware of the need for folic acid and its periconceptional use[4]. The thrust of educational strategies are required to promote the use of periconceptional folic acid[5]. Hence an attempt has been made to study whether periconceptional counseling on folic acid improves the folate status of prospective women.

Materials and Methods

Fifty married women between the age group of 20-30 years aspiring to have first child and willing to cooperate were selected for the study from Erode town. Their socio economic profile, food habits, dietary pattern and medicinal supplements taken during

84 per cent were married at an age of 21-25 years. It was also observed that a majority of 62 per cent belonged to joint family system. As far as income was concerned, 72 per cent belonged to low and middle-income group based on HUDCO classification[7]. Only 24 per cent had monthly income above Rs. 10,000. With regard to educational status, 42 per cent were post graduates, 20 per cent each were under graduates or studied upto high school level and the remaining 18 per cent had studied up to higher secondary level. About 62 per cent of the women were involved in sedentary work and the remaining were agricultural labourers involved in moderate activity. None of them was involved in heavy manual labour.

Food habits and dietary pattern

Among the selected subjects, a majority of 88 per cent were non vegetarians, however the general frequency of consumption of non vegetarian foods was once in a week and the amount was less than 100 g. Regarding the consumption pattern of cereals rich in folic acid, rice was the main staple food and wheat was consumed twice a week by 42 subjects. Jowar and oat meal were rarely consumed only during summer season, once in 15 days by 15 subjects and three subjects respectively. The commonly consumed folic acid rich pulses were Bengal gram dhal, red gram dhal and roasted Bengal gram dhal by 36, 43 and 27 subjects respectively. Folic acid rich pulses such as

TABLE - II
Mean Food Intake of the Selected Subjects

(N=10)

Foods (g)	RDA	Before counseling		After counseling		t value
		Mean ± S.D	Percentage deficit / excess	Mean ± S.D	Percentage deficit / excess	
Cereals	300	235.70 ± 49.39	-21.43	244.80 ± 60.64	-18.4	0.33^{NS}
Pulses	30	22.40 ± 2.87	-25.33	27.76 ± 5.92	-7.46	2.52*
Vegetables	300	123.30 ± 47.2	-58.9	163.3 ± 34.42	-45.6	2.06*
Fruits	100	43.66 ± 25.91	-56.34	67.06 ± 16.65	-32.94	2.39*
Milk	300	287.40 ± 38.11	-4.2	342.00 ± 44.98	+14.0	2.30*
Fats and oils	20	27.88 ± 6.36	+39.4	29.14 ± 8.73	+ 45.7	0.58^{NS}
Sugar & Jaggery	20	21.09 ± 3.25	+5.45	21.87 ± 3.28	+ 9.35	0.60^{NS}
Egg/meat/chicken/fish	30	25.02 ± 3.74	-16.6	27.52 ± 5.94	-8.26	0.25^{NS}

*Significant at five per cent level

NS - Not Significant

TABLE - IV
BMI Values of the Selected Subjects **(N=50)**

Classification	BMI	Number	Percentage
CED (Grade II)	16.0 - 17.0	-	-
CED (Grade I)	17.0 - 18.5	4	8
Low Normal	18.5 - 20.0	7	14
Normal	20.0 - 25.0	36	72
Obesity (Grade I)	25.0 - 30.0	3	6
Total		50	100

Mean food intake

Table II shows the mean food intake of the selected subjects before and after counseling.

The mean intake of all the foods by the selected subjects assessed through three day recall survey increased after counseling. However such an increase was statistically

TABLE - V
Mean Haemoglobin and Serum Folate Levels of the Selected Subjects
(N=10)

Biochemical parameters	Before counseling		After counseling	
	No	%	No	%
Haemoglobin level (g/dl)				
Normal (<12)	5	50	6	60
Mild (10-12)	3	30	4	40
Moderate (7-10)	2	20	-	-
Mean ± SD	11.88± 1.58		12.66 ±1.21	
t value	3.49*			
Serum folate levels (ng/ml)				
Acceptable (>6.0)	8	80	10	100
Medium (3.0 - 5.9)	2	20	-	-
Mean ± S.D	15.32 ± 7.31		19.42 ± 5.53	
t value	3.34*			

* Significant at five per cent level

In the present study it is found that, nearly 50 per cent of the selected subjects had normal haemoglobin levels, 30 and 20 per cent were categorized under mild and moderate anemia respectively before counseling[11]. However after counseling the haemoglobin levels of the subjects improved and no one was found in moderate category. Further, the mean haemoglobin levels of the selected subjects increased after counseling and the differences were statistically significant at five per cent level.

The serum folate levels of 20 per cent of the subjects were in the medium risk group and the remaining had acceptable levels before counseling[12]. After counseling all the subjects had acceptable levels of folic acid. The mean value of serum folate level before counseling was 15.32 ± 7.1 ng/ml and it increased to 19.42 ± 5.53 ng/ml, three months after counseling. This increment was statistically significant at five per cent level. The results obtained from this study are comparable with the results of De Weerd *et al*[13].

Statistical analysis of haemoglobin level and serum folate level of the selected subjects indicated that counseling during periconceptional period helped remarkably in raising the levels of these nutrients.

Nutritional knowledge of the selected women

The level of knowledge on folic acid of the selected subjects before and after counseling is given in Table VI.

It may be inferred from the findings that before nutrition education, about 50 per cent of the subjects had low baseline knowledge, 46 per cent had medium level of knowledge and only 4 per cent had high level of knowledge on folic acid. However after, counseling the knowledge scores of all the subjects were improved and were found to be more than 67 per cent.

Summary and Conclusion

The study findings revealed that counseling improved the periconceptional haemoglobin and serum folate status and is proved to be beneficial for the women planning pregnancy. In addition counseling also improved their food intake and selection of folic acid rich foods. It was also observed that the knowledge scores of the selected women on folic acid improved significantly after counseling. Prevention of birth defects could be achieved by public campaigns such as the existing national programmes on HIV and goitre control. Premarital examination of folate status could identify the risk group requiring folate supplementation.

REFERENCES

1. Heljic, S., Nikadic and Bajric, S. Neural tube dysraphism meningomyelocele and related disorders. *Med.Arch.*, 2002, **56** (3 suppl), 5-7.

The Ind. J. Nutr. Dietet., (2006), 43, 272

INCIDENCE OF NEURAL TUBE DEFECTS IN ERODE TOWN

PONNE, S.* AND LAKSHMI, U.K.**

*(*Department of Nutrition and Dietetics, Maharaja College for Women, Perundurai - 638 052.*

***Department of Food Science and Nutrition, Avinashilingam Deemed University, Coimbatore - 641 043)*

(Received 27th April, 2006)

Introduction

Women need to attain good nutritional status before, during and after pregnancy to optimize maternal health and reduce the risk of birth defects and chronic disease in their children in later adulthood. Neural Tube Defects (NTDs) are the most common congenital malformation in Indian population[1]. NTD has been the subject of more studies than any other congenital anomaly not only because of the ease with which this disorder can be detected, but also because of their importance as a cause of fetal death and malformation where strong interaction between environmental and genetic factors in causation has been documented[2].

Wide variation in the incidence of NTD has been reported from different countries and regions. The prevalence of NTD has been reported to vary from 0.5 - 11 per 1000 birth[3]. In general the prevalence in Northern States namely Punjab, Haryana, Delhi, Rajasthan, UP and Bihar has been much higher (3.9 - 9.0 per 1000) compared to other parts of the country[4]. With 1.2 lakh births registered in Chennai alone every year, the 2.7 per 1000 neural tube defect rate translates to nearly 300 children born with an abnormality[5].

The present study is based on births which occurred during five year period, from 2000-2004, in selected hospitals of Erode, a town in North Tamil Nadu from where no study has been conducted to estimate the incidence rate of NTD. The purpose of the study is to analyse the pattern of incidence of NTD at Erode during the period 2000-2004.

Materials and Methods

The data reported in the study was derived from 60 selected private hospitals and one Government hospital of Erode town. The hospitals were selected from the list of hospitals registered under Indian Medical Association, Erode chapter. The selected hospitals were considered representative of the Erode populations, since they are located at important areas of the town. All the hospitals are well equipped with obstetric facilities. The primary source of data was the labour room register which is maintained by the hospitals. The details of all births are entered in this register within 24 hours of birth.

A monthly random checkup was carried out from 2000 onwards.

The data have been analysed by the three year moving average method to delineate year to year variation. Annual incidence rates (per 10,000 live births) for neural tube defects identified during 2000-2004 associated with fetal death were calculated as

$$\frac{\text{Number of infants with selected congenital anomaly}}{\text{Number of live births}} \times 10{,}000$$

Further incidence rates of different types of NTD were also calculated. Occurrence of specific birth defect is assumed to be a rare event following Poisson distribution, confidence interval (CI) were calculated for each rate. The F test has been applied in order to determine statistically significant differences among different rates of NTD in Erode town. An attempt was also made to analyse the trends of NTD in Erode town using linear regression model.

Results and Discussion

Incidence of NTD in Erode town

The year wise incidence of NTDs in selected hospitals of Erode town from 2000 to 2004 is presented in Table I. It is evident from the Table that among 95,735 live births and still births during five year period, there were 262 babies with NTDs with an incidence of 2.74 per 1000 births. Year wise data on incidence of NTD have been analysed by three years moving average method to delineate year to year variarion. There was no evidence for a declining trend of the incidence of NTD at Erode town over the last five years.

Incidence of different types of NTD in Erode town

The number of different types of NTD affected children (new borns) among the selected hospitals of Erode town during the study period is presented in Table II.

TABLE I
Year wise Incidence of Neural Tube Defects in Selected Hospitals in Erode Town

Details	2000	2001	2002	2003	2004
Total births	19336	20083	19744	18297	18275
Anencephaly	12	20	21	21	28
Spina bifida					
a) Meningomyelocele	7	10	8	14	15
b) Meningocele	15	18	11	24	19
Encephalocele	6	4	4	1	4
Total NTD births	40	52	44	60	66
Incidence per 1000 births	2.06	2.59	2.23	3.28	3.61
3 yearly Moving average	-	2.29	2.70	3.04	-

Prevalence of NTDs shows wide variation by geographic location, both within and between countries. Also, the distribution of the types of NTDs can vary between regions[6]. It is evident from the Table that among the reported NTD cases, the annual incidence rates per 10,000 live births for anencephaly was the highest (10.65), followed by meningocele (9.08), meningo-myelocele (5.68) and encephalocele (1.94) during the study period. The annual incidence rates for anencephaly (6.21 in 2000 to 15.32 in 2004) and meningomyelocele (3.62 in 2000 to 8.21 in 2004) increased and the trend nearly doubled over the period whereas meningocele showed a fluctuating trend (5.57 in 2000 to 13.12 in 2003) and annual incidence rates of encephalocele showed a decreasing trend of 3.10 in 2000 to 0.55 in 2003 during the study period. 'F' test revealed that there is no significant difference in the reported NTD cases in Erode town over the years.

Rates of NTD by demographic factors

The annual incidence rates of reported NTD cases in Erode town over the 5 years in total have been analysed by demographic factors like gender, age, literacy and delivery factors like parity, weeks of gestation and birth weight are presented in Table III.

Gender

Table III shows that 72 per cent of the anencephaly cases, 59 per cent of meningomyelocele cases and 52 per cent of meningocele cases were female supporting the fact that the feminine gender is highly vulnerable to maternal assaults. It is also seen that a maximum of 63 per cent of encephalocele cases only were male during the study period revealing the gender superiority. Infant sex influences the risk for NTDs. The current data are in accordance with the literature that females are more likely than males, to have anencephaly and spina bifida[7]. A case control study reported that about 70 per cent of the children with anencephaly were female and 60 per cent of the children with spina bifida were females[8]. Potential explanations for the preponderance among females include differences between the sexes in embryonic development, susceptibility to teratogenic insult and spontaneous abortion rates[9]. But statistical analysis through F test revealed that by gender there is no significant difference in the reported NTD cases in Erode town.

Age

Analysis of Table III revealed that all the four types of reported NTD cases have a tendency towards an increasing incidence with maternal age of 20-29 years and a decreasing trend in the incidence after 30 years. The analysis also reveals that the maximum rate of incidence was higher in the age group of 20-24 years followed by 25-29 years in all the four types of NTDs. There are literatures available to support the association between maternal age and the incidence of NTDs. The incidence of NTD affected pregnancy decreased with increased maternal age[10,11]. Age wise classification of total number and incidence rates of reported NTD cases during the study period is presented in Table III. The F test reveals that there is significant difference in the reported

TABLE II
Total Number and Incidence Rates of Reported Neural Tube Defects Cases in Erode Town (2000-2004)

Year	Neural Tube Defects											
	Anencephaly			Spina bifida						Encephalocele		
				Meningomyelocele			Meningocele					
	N	Rate[1]	95% CI[2]	N	Rate[1]	95% CI[2]	N	Rate[1]	95% CI[2]	N	Rate[1]	95% CI[2]
2000	12	6.21	2.7-9.72	7	3.62	0.94-6.30	15	7.76	3.84-11.68	6	3.10	0.62-5.58
2001	20	9.96	5.59-14.33	10	4.98	3.41-6.55	18	8.96	4.83-13.10	4	1.99	0.04-3.94
2002	21	10.64	6.10-15.18	8	4.05	1.24-6.86	11	5.57	2.28-8.86	4	2.03	0.02-4.04
2003	21	11.48	6.58-16.38	14	7.65	5.61-9.69	24	13.12	7.89-18.35	1	0.55	0-1.62
2004	28	15.32	9.66-20.98	15	8.21	6.09-10.33	19	10.39	5.72-15.06	4	2.19	0.04-4.34
Total	102	10.65	6.59-12.71	54	5.64	4.87-6.41	87	9.08	7.17-10.99	19	1.94	1.06-2.82
F.value - 0.60[NS]												

[1]Rate per 10;000 live births; [2]95% Confidence Interval (CI) for rates;
NS - Not Significant

NTD cases among the different age groups in Erode town at five per cent level.

Literacy

Low maternal education is an important predictor in having a child with neural tube defects[12]. Table III presents the distribution of the type of NTD according to the maternal education based on the data obtained in the Erode town. It is inferred from Table III that all the four types of reported NTD cases in Erode town had a tendency towards decreasing incidence with maternal education. The higher incidence rates were noticed among women with secondary school educational level in all the four types of reported NTD cases. The prevalence rates of NTD were found to be less among women with undergraduate or postgraduate education. The statistical analysis using F ratio reveals that there is a significant difference among the different levels of maternal education and reported NTD cases in Erode town at five per cent level.

Rates of NTD by delivery factors

Parity

Parity is the number of pregnancy a woman has experienced prior to one under consideration. Table III shows the total number and incidence rates of NTDs by parity during the study period. It is evident from Table III that the incidence rates of reported NTD cases, decreased with parity in all the four types during the study period. A very high incidence of NTD is reported among first para of pregnancy followed by second para[13]. A meta analysis looking at the risk of NTD with parity revealed that pregnancy with higher parity were more likely to have a spina bifida.

TABLE III
Rates of NTD by Demographic Factors

Particulars	Anencephaly			Spina bifida						Encephalocele			F value
				Meningomyelocele			Meningocele						
	N	Rate[1]	95% CI[2]	N	Rate[1]	95% CI[2]	N	Rate[1]	95% CI[2]	N	Rate[1]	95% CI[2]	
Total	102	10.65	8.59-12.71	54	5.64	4.87-6.40	87	9.08	17.17-10.99	19	1.94	1.06-2.82	
Gender of NTD babies													
Male	29	3.03	1.93-4.13	22	2.29	1.34-3.24	42	4.39	3.06-5.72	12	1.25	0.54-1.96	0.74[NS]
Female	73	7.63	5.88-9.38	32	13.34	2.18-4.49	45	4.70	3.32-6.07	7	0.73	0.58-0.88	
Maternal Age (years)													
<20	2	0.21	0-0.50	2	0.21	0-0.50	0	0	0	0	0	0	
20 - 24	49	5.12	3.69-6.55	27	2.82	1.75-3.88	52	5.43	3.96-6.9	10	1.04	0.4-1.68	
25 - 29	37	3.86	3.23-4.49	20	2.09	1.17-3.01	28	2.92	1.84-4.0	8	0.84	0.26-1.42	5.38*
30 - 34	8	0.84	0.67-1.01	1	0.10	0-0.3	5	0.52	0.07-0.9	1	0.10	0-0.3	
>34	6	0.63	0.13-1.13	4	0.42	0.01-0.83	2	10.21	0-0.05	0	0	0	
Literacy level													
Primary	2	2.19	11.26-3.12	4	0.42	0.01-0.83	9	10.9	0.33-1.55	1	0.10	0.03	
Secondary	50	5.22	3.78-6.66	30	3.13	2.01-4.25	48	5.0	3.6-6.42	9	0.94	0.33-1.55	
Higher Secondary	17	1.78	0.94-2.62	10	1.04	0.4-1.68	11	1.15	0.48-1.82	4	0.42	0.01-0.83	5.31*
U.G	14	1.46	0.7-2.22	8	0.84	0.26-1.42	17	1.78	0.94-2.62	4	0.42	0.01-0.83	
P.G	0	0	0	2	0.21	0-0.50	2	0.21	0-0.50	1	0.10	0-0.3	
Parity													
0	48	5.01	3.62-6.42	35	3.66	2.45-4.87	49	5.12	3.69-6.55	11	1.15	0.48-1.82	
1	35	3.66	2.47-4.85	13	1.36	0.63-2.09	26	2.72	1.68-3.76	7	0.73	0.58-0.88	4.61 *
2	15	1.57	0.78-2.36	5	0.52	0.07-0.97	12	1.25	0.55-1.95	1	0.10	0-0.3	
3+	4	0.42	0.01-0.83	1	0.10	0-0.3	0	0	0	1 0	0	0	

Table Contd...

Particulars	Anencephaly			Spina bifida						Encephalocele			F value
				Meningomyelocele			Meningocele						
	N	Rate[1]	95% CI[2]	N	Rate[1]	95% CI[2]	N	Rate[1]	95% CI[2]	N	Rate[1]	95% CI[2]	
Weeks of gestation													
<24	23	2.40	1.42-3.38	8	10.84	0.26-1.42	5	10.52	0.07-0.97	12	0.21	0-0.50	
25 - 28	22	2.29	1.34-3.24	13	1.36	0.62-2.1	12	1.25	0.55-1.95	7	0.73	0.58-0.88	
29 - 33	13	1.36	0.63-2.09	11	1.15	0.48-1.82	3	0.31	0-0.64	3	0.31	0-0.64	1.08[NS]
33 - 36	21	2.19	1.26-3.12	141	1.46	0.1-2.22	47	4.91	3.51-6.31	6	0.63	0.13-1.13	
37 - 40	23	2.4	1.42-3.38	8	0.84	0.67-1.01	20	2.09	1.18-3.0	1	0.10	0-0.3	
Birth Weight (leg)													
0.5 - 1.0	12	1.25	0.55-1.95	4	0.42	0.01-0.83	1	0.10	0-0.3	12	0.21	0-0.05	
1.1 - 1.5	21	2.19	1.26-3.12	7	0.73	0.58-0.88	10	1.04	0.4-1.68	5	0.52	0.07-0.9	
1.6 - 2.0	34	3.55	2.36-4.74	21	2.19	1.26-3.12	12	1.25	0.55-1.95	4	0.42	0.01-0.83	
2.1 - 15	22	2.30	134-3.26	15	1.57	0.78-2.36	25	12.61	1.59-3.63	6	0.63	0.13-1.13	1.29[NS]
2.6 - 3.0	11	1.15	0.48-1.82	7	0.73	0.58-0.88	37	3.86	2.62-5.1	2	0.21	0-0.50	
>3.0	2	0.21	0-0.50	0	10	0	2	0.21	0-0.05	0	0	0	

NS - Not Significant

* Significant at 5 per cent level

1. Rate per 10,000 live births

2. 95% Confidence Interval (CI) for rates

defect than those with lower parity [14]. This was not observed for other types of NTD. NTDs were less frequently seen among women who had more than three gestations ($p = 0.007$)[13]. There are differences in findings between researchers with regard to parity and NTD prevalence. On statistical analysis, it was noted that there was a significant difference between the types of NTD and parity at five per cent level.

Weeks of gestation

Table III reveals the incidence of reported NTD cases by weeks of gestation in Erode town. About 22.5 per cent of children with anencephaly, 14.8 per cent of children with meningomyelocele, 5.7 per cent of children with meningocele and 10.5 per cent of children with encephalocele were delivered before the 25th week of pregnancy. A woman pregnant with a child with severe birth defect is likely to deliver early. NTD rates may be higher with lower gestational age at delivery[15,16]. The data available from Erode town support this observation (Table III). The analysis of F ratio revealed that there is no significant difference between annual incidental rates of reported NTD cases and weeks of gestation at five per cent level.

Birth weight

Birth weight is of course, closely associated with gestational age. Table III presents the total number and incidence rates of reported NTDs by birth weights in Erode town from 2000 to 2004. It is inferred from the Table that except 1.96 per cent of children with anencephaly, all the other types of NTD children had birth weight below 3 kg. There is a higher rate of NTD defects among the children delivered with low birth weight. This suggests that NTDs are a likely cause of

TABLE IV
Estimated Rates per 10,000 live births of NTD in Erode Town During 2005-2010

Year	Anencephaly	Neural Tube Defects		Encephalocele
		Spina bifida		
		Meningomyelocele	Meningocele	
2005	16.62	9.23	11.97	0.97
2006	18.59	10.41	12.91	0.64
2007	20.56	11.59	13.85	0.31
2008	22.53	12.77	14.79	-0.02
2009	24.50	13.95	15.73	-0.35
2010	20.47	15.13	16.67	-0.68

Trend equation for Anencephaly : $Y_A = 4.80 + 1.97$ (x)
Trend equation for Meningomyelocele : $Y_M = 2.15 + 1.18$ (x)
Trend equation for Meningocele : $Y_M = 6.33 + 0.94$ (x)
Trend equation for Encephalocele : $Y_E = 2.95 - 0.33$ (x)

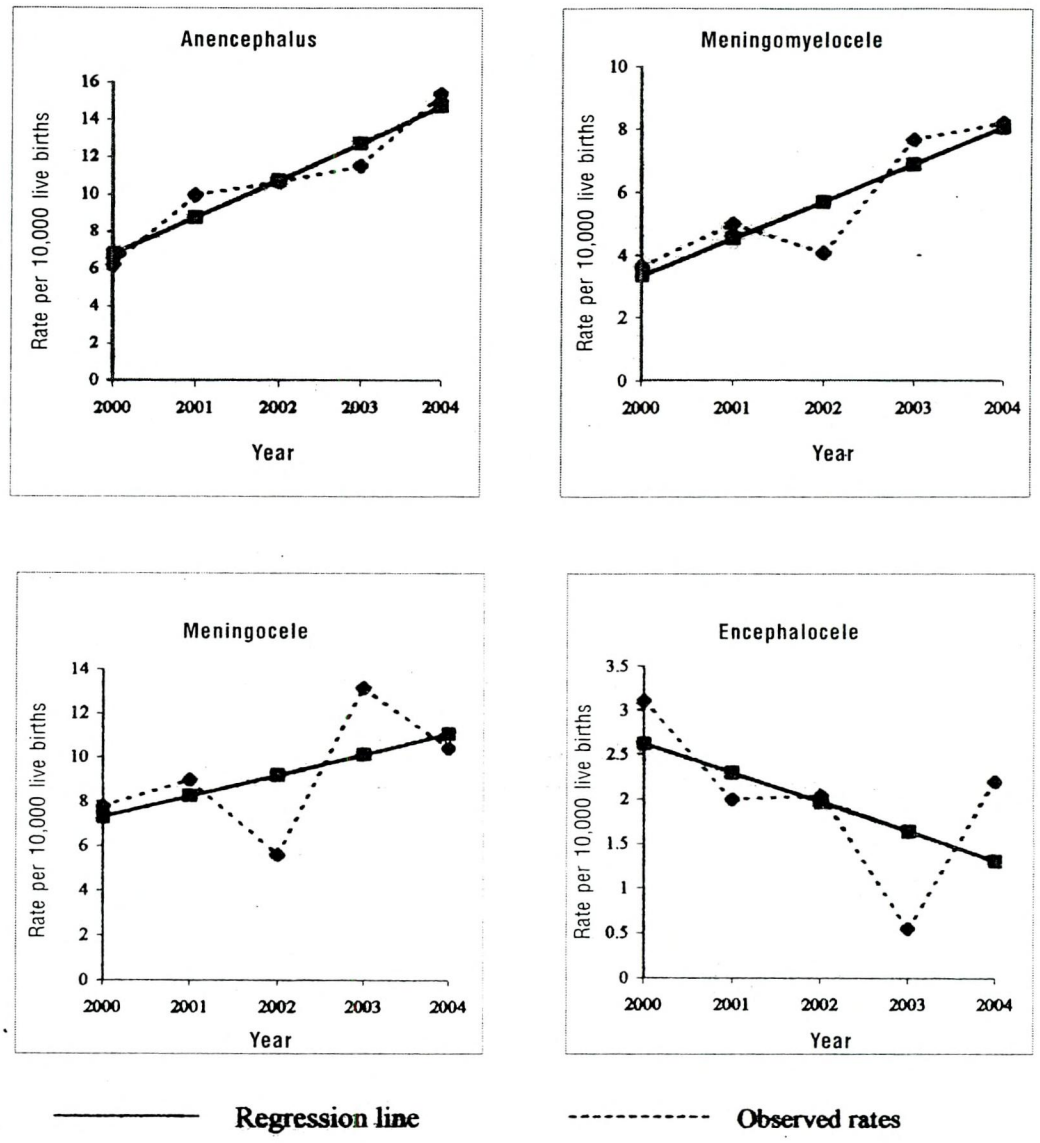


Figure I

Trends in the reported incidence rates of NTD per 10,000 live births, 2000-2004

early miscarriage. NTD rates may be higher with low birth weight[8,11]. The analysis of F ratio showed that the difference between NTD cases and birth weight in Erode town are not significant at five per cent level.

Analysis of trends of NTD in Erode town

Trends in NTD rates in Erode town were modeled using linear regression for the year 2000-2004. Figure I shows the results of a trend analysis for anencephaly, meningomyelocele, meningocele and encephalocele. The rate of anencephaly has significantly increased by an average of 1.97 each year. The rate of meningomyelocele has increased by an average of 1.18 each year. Similarly the rate of meningocele also has increased by an average of 0.94. But the rate of encephalocele has decreased each year by 0.33 in Erode town during the study period.

Forecast of rates of NTD for the period 2005-2010

Table IV shows the projection of the incidence rates of various types of NTDs in Erode town during the period 2005-2010. It is evident from the Table that the incidence rate of anencephaly, meningomyelocele and meningocele were 20.47, 15.13 and 16.67 respectively in the year 2010 whereas, the incidence rates of encephalocele was found to decrease year after year.

Summary and Conclusion

From the above study, it can be concluded that the incidence rates of NTD was found to be 2.74 per 1000 live births in Erode town over the five year period. The trend of incidence rate of NTD was found to increase year after year except encephalocele.

REFERENCES

1. ICMR, Multicentric study of efficacy of periconceptional folic acid containing vitamin supplementation in prevention of open neural tube defects from India. *Ind. J. Med. Res.*, 2000, **112**, 206-211.
2. Sharma, A.K., Upreti, M., Kamboj, M., Mehra, P., Das, K., Misra, A., Dhasmana, S. and Agarwal, S.S. Incidence of neural tube defects of Lucknow over a 10 year period from 1982-1991, *Ind. J. Med. Res.*, 1994, **106,** 223-226.
3. Sharma, J.B. and Gulati, N. Potential relationship between dengue fever and neural tube defects in a northern district of India, *Ind. J. Obstet., Gynecol.*, 1992, **39**, 291-295.
4. Verma, I.C. Burden of genetic disorders in India, *Ind.J. Pediat.*, 2000, **36**(3), 47-48.
5. Suresh, S. Folic acid supplementation should start before conception, *The Hindu, science / technology*, dated March 3, 2005.
6. Forrester, M.B. and Merz, R.D. Epidemiology of neural tube defects, Hawaii 1986-1997. *Med. J.*, 2000, **341,** 323-329.

7. Fornaff, J.E., Egler, T. and Shen, T. Prevalence of neural tube defects in Illinois, 1989-2002. Epidemiological report series 04:02 Spring field, IL. Illinois Department of Public Health, 2004, 1-25.

8. Whiteman, D., Murphy, M., Hey, K., 0' Donnell, M. and Goldacre, M. Reproductive factors, subfertility and risk of neural tube defects : a case study based on the Oxford Record linkage study register. *Amer. J. Epidemiol.*, 2000 ,**152** (9), 823-828.

9. Little, L. and Elwood, J.M. Epidemiology of neural tube defects. Reproductive and Perinatal Epidemiology, Kiley M.Ed. 1991. CRC Press, Boston.

10. McDonnell, R.J., Johnson, Z., Delaney, V. and Dack, P. East Ireland 1980-1994; Epidemiology of Neural Tube Defects. *J. Epidemiol. Community Health,* 1999, **53** (12), 782-788.

11. Owen, T.J., Halliday, J.L. and Stone, C.A. Neural tube defects in Victoria, Australia, Potential contributing factors and Public Health implications, *Aust. New Zealand J. Pub. Health,* 2001, **24**(6), 584-589.

12. Farley, T.F., Hambidge, S.J. and Daley, M.F. Association of low maternal education with neural tube defects in Colorado, 1989-1998, *Public Health,* 2002, **116,** 89-94.

13. Aquiar, M.J., Campos, A.S., Aguiar, R.A., Lana, A.M., Magalhaes, R.L. and Babeto, L.T. Neural tube defects and associated factors in liveborn and still born infants, *J. Pediatr.,* (Rio T), 2003, Mar-Apr, 79(2), 105-106.

14. Vivira, A.R. Birth order and Neural tube defects. A reappraisal. *J. Neurological, Sci.*, 2004, **217**(1), 65-72.

15. Rasmussen, S.A., Moore, C.A., Paulozzi, L.J., and Rhodenhiser, E.P. Risk for birth defects among premature infants; A population based study. *J. Pediat.*, 2001, **138**, 668-673.

16. Shaw, G.M., Todoroff, K., Carmichael, S.L., Schaffer, D.M. and Selvin, S. Lowered weight gain during pregnancy and risk of neural tube defects among off spring. *J. Epidemiol.*, 2001, **30,** 60-65.