CHAPTER 4

FACTORS AFFECTING GROWTH PERFORMANCE OF CHILDREN OF THE REGION†

4.1 Introduction

Health status of an individual is determined by two ecological universes, the internal environment of a person himself / herself and the external environment of the surroundings. The disturbance of the delicate balance between these factors cause disease. Again, out of three ecological factors i.e. agent, host and environment, environmental factors are largely unknown. But, by now, we know the key to the nature, occurence, prevention and control of disease, lies mainly in the environment. Consequently, understanding the importance of environmental sanitation, WHO defines it as the control of all those factors, in man's physical environment which exercise or may exercise a deleterious effect on his physical development, health and survival [1] . Out of many factors, food, water, housing and sanitation are important controllable factors. However, there are many other factors too, which are difficult to control e.g. air pollution, radio active pollution, noise pollution etc. As a matter of fact, this region is devoid of these types of pollution, to date. This study is concentrated on two important factors : drinking water and rearing technology.

The 'term environmental sanitation' is now replaced by 'environmental health'. India is still lagging behind many countries in the environmental health [1]. The basic problems of safe water supply and sanitary disposal of human excreta are still a major health problem in rural India. Since more than 80% of population live in rural India, much of the ill health of these people are due to defective environmental sanitation. Let us now examine the status of North-Bengal region and how does that affect the growth performance of children of the said region.

The source of drinking water for most of the rural people of North-Bengal Terai region is either dugwell or tubewell. The wells are technically of two types i.e. shallow (which taps water from above the first impervious layer) and deep (which taps below the first impervious layer). Most of wells (both dugwell or tubewell) in North-Bengal are of shallow type. Again the dugwells are usually not scientifically made i.e. the brick lining is often absent and hardly ever these wells are covered. Further some of the

† This is based on the publication [Modelling, Measurement and Control, C, vol. 53, no. 2, AMSE Press France, 1995,7-16; Indian Journal of Social and Preventive Medicine, vol. 24, no.4, 1994,159-162] of the author.

wells are above the ground and some at the same level of the ground. The platform around the well is frequently absent and even if it is present, hardly there is any proper drain to carry the spillout water. The hand pump or shallow tubewell are usually located within the dwelling house premises.

In many areas, deep tube wells are installed by either UNICEF or by the Govt. of India. But mostly these are not used for drinking purpose because of the odour and colour of high iron content and also because of less accessibility i.e. they prefer water from wells within their premises.

The second important environmental factor in the rearing technology. This study concentrates on the babies from birth to 12 months of age. It was intended to study the growth performance of breast feed babies as well as babies having supplementary food. It was also intended to draw a comparison between breast feed babies vs. supplementary food feed babies of this region.

4.2. **Materials and Methods (Drinking water)**

72 samples of drinking water from various sources (both tubewell and dugwell) were collected for bacteriological analysis. Out of which 42 samples were taken during post-monsoon period in the month of December (winter season) and 30 samples were taken during pre-monsoon May and June (summer season). Simultaneously, a survey was conducted for diarrhoeal disease in this region. Monthly average admission rate in Paediatrics ward of North Bengal Medical College was compared with rate of admission of diarrhoeal patients in the same ward during the same period. Further a comparison was also made with the children patients attending DTU (Diarrhoea Training and Treatment Unit) during these months. Here it is to be clarified that the patients admitted in the ward were mainly with some complication e.g. severe dehydration, peripheral circulatory failure or having complications like encephalities, PEM with persistent diarrhoea, Haemolytic Uraemic Syndrome etc while children attending DTU were those patients either having no dehydration or having mild to moderate dehydration requiring oral rehydration therepy (ORT) for 4-6 hours.

4.3. The Method of water collection

i) The sterile neutral bottles covered with kraft papers of 230 ml. capacity were taken;

ii) On reaching the source of water, upper part of wrapper was opened to expose the neck of the bottle;

iii) In case of hand pump, the water was allowed to run for five minutes and then the water was taken into bottles. In the case of wells, the bottles were immersed into water to required depth with the help of long string and were filled by jerking out. The bottles were then raised to the surface and were re-stoppered. The paper wrappers were replaced. The samples were sent to the laboratory within two hours of collection.

4.4. Data Analysis (Water)

4.4.1. Water samples taken during Post-monsoon on December, 1993

Table 4.1

Places	Source of sample or type of well	Presumptive coliform count (a quantitative test of all coliform bacilli per 100 ml.)	Differential count of foecal coliform organism (Ecoli) per 100 ml.
Damderhat	Dw	90	0
Phansidewa	Dw	35	0
Jyotinagar	Dw	51	0
Kantivita	Dw	161	0
Phansidewa	Tw*	0	0
Phansidewa	Tw*	0	0
Phansidewa	Dw	>180	0
Rupandighi	Dw	>180	0
Rabvita	Dw	24	0
Md Box	Dw	>180	2
Mohipal	Dw	22	0
Kantivita	Tw	35	0
Tufandangi	Tw	0	0
Nayahat	Tw*	0	0
Gange	Tw*	0	0
Lalmohanjote	Dw	>180	0
Lalmohanjote	Tw	11	0
Rajmohanjote	Tw*	0	0
Medicalmore	Dw	54	0
Shibmandir	Dw	92	0
Raja Rammohunpur	Tw*	0	0
Murikhowa	Tw*	0	0
Coochbehar	Dw*	0	0
Gariahati	Tw	0	0
Garubathan	Dw	160	0
Garubathan	Dw	160	50
Garubathan	Dw	90	50
Sahadarganj	Tw	50	0
Debiganj	Tw*	0	0
Madarihat	Tw	14	0
Kumargram	Dw*	0	0
Kumargram	Dw*	2	0
Pahargarh	Tw*	0	0
Pahargarh	Dw	8	3
Madarihat	Tw	6	0
Netajipara	Tw	>180	0
Municipality	Tw	>180	0
Dhupguribazar	Tw*	1	0
Rajmohanjote	Dw	>180	0
Dhupguri (Market)	Dw	>180	0
Sahidgarh high School	Tw	84	0
Maynaguri Old Market	Dw	145	0

[DW - Dug well, TW - Tube well, * - Safe drinking water]

4.4.2. **Water samples taken during Pre-monsoon (May-June), 1994**

Table 4.2

Places	Source of sample or type of well	Presumptive coliform count (a quantitative test of all coliform bacilli per 100 ml.)	Differential count of foecal coliform organism (Ecoli) per 100 ml.
Medical More	Dw	54	5
Sarada Pally	Dw	35	11
St. Joseph More	Dw	161	35
Jesu Ashram	Dw	161	35
Matigaramore	Dw	>180	43
kadamtala	Dw	>180	11
Chiriamore	Tw *	3	0
Durgamore	Dw	>180	5
B. Ed. College	Dw	>180	161
S. S. Primary School	Dw	>180	23
Monijote	Dw	>180	43
Lichupukri	Tw *	0	0
Lichupukri	Tw	17	0
Rabvita	Dw	>180	35
Rabvitamore	Dw	>180	4
Rupamdighi	Dw	>180	9
Rupamdighimore	Tw	>180	35
Baneswarjote	Tw	17	0
Baneswarjote	Dw	>180	7
Phansidewamore	Dw	>180	92
Rajganj Block	Dw	161	7
Fatapukur	Dw *	2	0
Shantipara	Dw	161	5
Jalpaiguri Block	Tw	2	2
Adarsya Nagar	Dw	161	3
Chalsa	Tw	54	0
Baradighi	Dw	>180	9
Bolbari	Dw	>180	18
Chockmolani	Dw	>180	4
Bolbari	Tw	>180	3

[DW - Dug well, TW - Tube well, * - Safe drinking water]

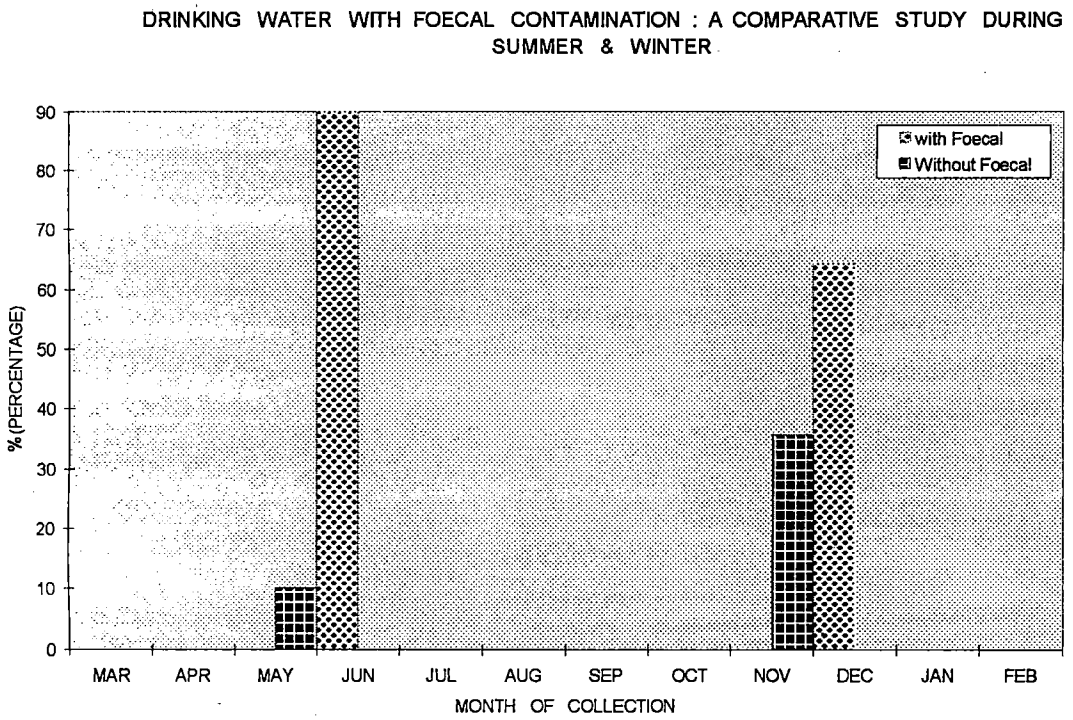

Fig. 4(A)

4.5 **Criteria of Safe Water as per WHO** [2]

The purpose of standard is to minimise all the known health hazards, since it is obviously impossible to prevent all pollution. The WHO has published two sets of standards for drinking water - the International standards [2] and European standards [3]. The International standards set out the minimal water quality requirements that are consistent with health protection and attainable by every country at present. The European standards are higher than the minimal ones specified in International standards. The recommended standards in India are those set out by the Indian Council of Medical Research [4] based on International standards.

"Ideally all samples taken from the distribution system should be free from coliform organism. In practice this standard is not always attainable and the following standard for water collected in the distribution system is therefore recommended :

1) Throughout any year, 95% of samples should not contain any coliform organisms in 100 ml.;
2) No sample should contain Ecoli in 100 ml.;
3) No sample should contain more than 3 coliform organisms per 100 ml.; and
4) Coliform organisms should not be detectable in 100 ml. of any two consecutive samples".

4.6 Incidence of Diarrhoeal Diseases (North Bengal Region)

Table 4.3

Month	No. of total admission	Patient admitted with Diarrhoeal diseases	Patients attending Diarrhoea Training and Treatment unit
Jan	164	35	62
Feb	207	27	45
Mar	318	26	116
Apr	277	70	173
May	274	49	329
Jun	327	92	196
Jul	305	53	138
Aug	290	47	151
Sep	346	48	22
Oct	301	36	191
Nov	213	20	67
Dec	223	23	65

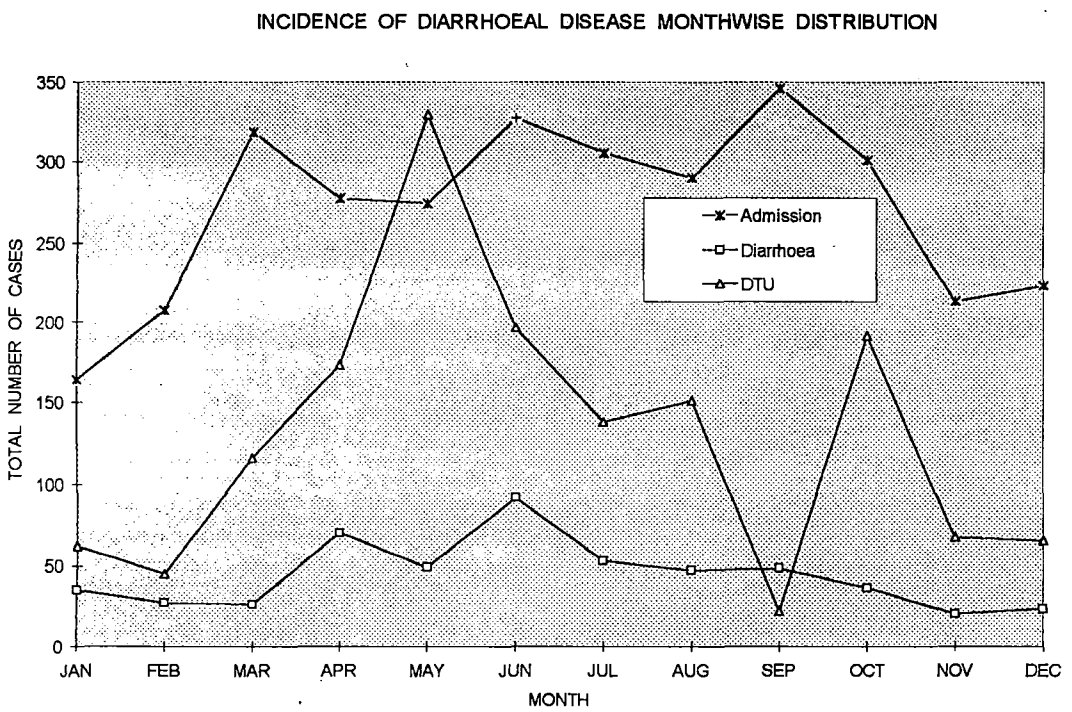

Fig. 4(B)

4.7. Materials and Methods (Rearing technology)

775 babies from birth to 12 months of age and 1876 babies from 12 months to 60 months of age were included in the study belonging to Rural Terai area of Darjeeling district of India. Details of food intake in various ways were taken by questionnaire method. The types of food e.g. breast feed, supplementary food; along with its quantity and quality were asked in detail.

4.7.1. Rearing technologies

4.7.1.1. Incidence of breast feeding from references [5]

Table 4.4

PLACE OF STUDY	BREAST FEEDING
a) Amritasar :	99% at birth, 80% more than 6 months, 82% more than 12 months, Weaning at 6-12 months of age 62%.
b) Delhi :	Initially 100% (at birth) Weaning between 6-12 months 37% urban, 4.5% semiurban and 2.1% rural
c) Bombay :	Initially 100% , 64% wholly and 25% mainly for 3 months, 72% can still at 12 months.

4.7.1.2. Incidence of breast feeding from our present study in North-Bengal region.

Table 4.5

AGE	FEEDING
0-1 Months	66.20% of babies getting only breast milk, 33.80% of babies getting breast milk along with significant supplementary milk feeds upto 1 month (diluted milk).
1-3 Months	43.42% of babies getting only breast milk, 56.58% of babies getting breast milk along with significant milk feeds (diluted milk).
3-6 Months	28.69% of babies getting only breast milk, 36.88% of babies getting breast milk along with significant supplementary milk feed (diluted milk), 32.79% sothi*, sago and barley and 1.64% weaning (mashed bananas, and rice gruel).
6-9 Months	15.44% of babies getting only breast milk, 25.73% of babies getting breast milk along with significant supplementary milk feed (diluted milk), 31.62% sothi*, sago, barley and 27.21% weaning (puffed rice, biscuits, suji and rice) along with milk feed.
9-12 Months	5.62% of babies getting only breast milk, 3.44% of babies getting breast milk along with significant supplementary milk feed (diluted milk), 23.44% of sothi*, sago and barley, 67.50% weaning (rice gruel, puffed rice, dal, suji, biscuits) along with milk.

(* Locally available and very well acceptable and cheap food available on commercial packets prepared from local vegetable TIKUR (CURCUMA LEUCORRHIZA) belonging to Zingiberaceae species).

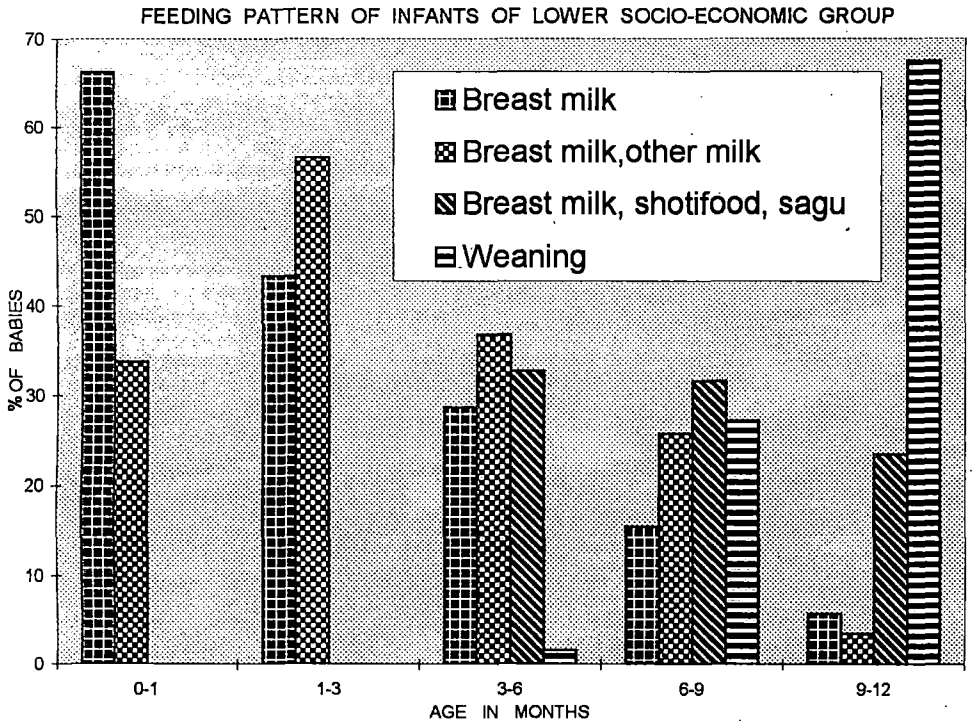
FEEDING PATTERN OF INFANTS OF LOWER SOCIO-ECONOMIC GROUP
Breast milk
Breast milk,other milk
Breast milk, shotifood, sagu
Weaning
% OF BABIES
70
60
50
40
30
20
10
0
0-1
1-3
3-6
6-9
9-12
AGE IN MONTHS

Fig. 4(C)

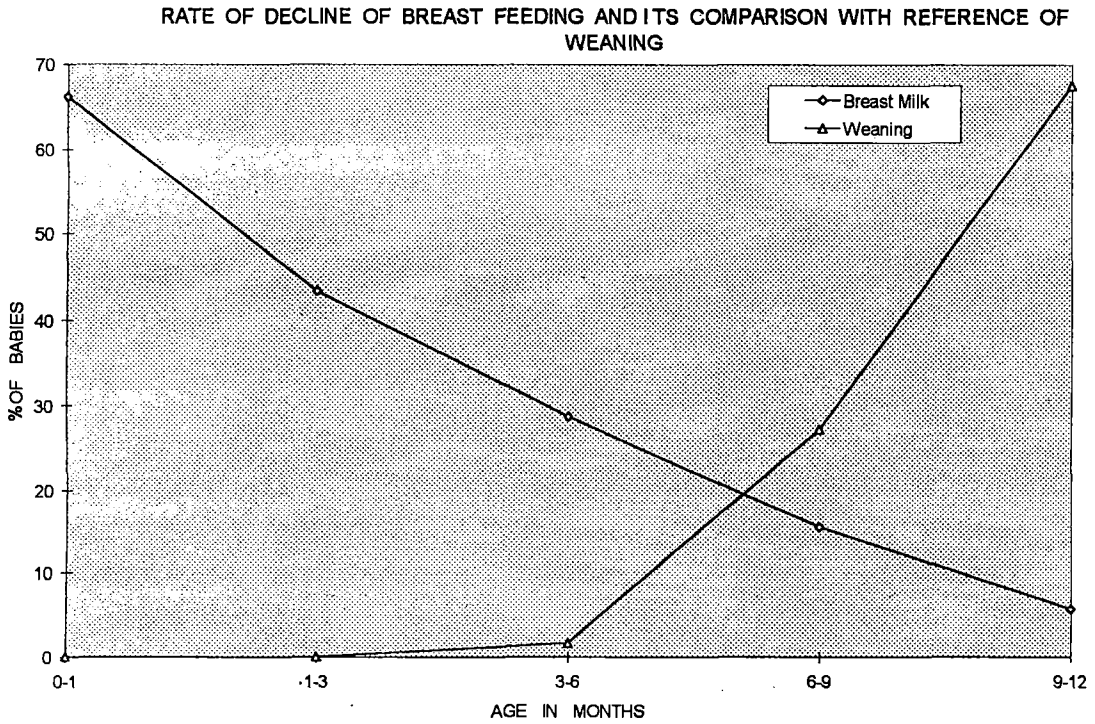
RATE OF DECLINE OF BREAST FEEDING AND ITS COMPARISON WITH REFERENCE OF WEANING
Breast Milk
Weaning
%OF BABIES
70
60
50
40
30
20
10
0
0-1
1-3
3-6
6-9
9-12
AGE IN MONTHS

Fig. 4(D)

4.7.1.3. Children's diet from 12 months to 60 months

Table 4.6

AGE	CHILDREN'S DIET FROM 12 MONTHS TO 60 MONTHS
12-36 Months	17.99% of babies getting only sago, barley and sothi ; 45.15% of babies getting only breast milk along with weaning (rice, dal, vegetables etc. family diet); 36.38% of babies getting breast milk along with weaning (rice, dal, vegetables etc.) upto 36 months.
36-60 Months	3.06% of babies getting only breast milk; 1.80% of babies getting sago; 16.11% babies getting shoti *, barley; 39.78% of babies getting breast milk and 39.25% of babies getting diluted milk along with weaning (rice,dal, vegetables etc. family diet) upto 60 months.

The babies we included in our study belonged to rural India. Most mothers were uneducated, still among them we found that the incidence of breast feeding is 66.2% from 0 to 1 month of age which further decreases to 43.42% at 3 months and 28.69% at 6 months knowing fully well that the mothers can feed her baby completely on her breast upto 6 months of age; a very disappointing observation. Further we found that the substitutes are over diluted cow-milk and sometimes tinned food. As the cow-milk and tinned food are costly for mothers, to satisfy the baby's hunger, they prepare some cheap substitutes like shoti (locally available food) and sometimes sago. Here it should be mentioned that the amount of shoti and sago is very less and they cook it in larger volume of water and feed the babies.

Usual pattern of weaning is around 6 months and it is found that at 6 to 9 months, 27.21% babies get weaning food. Though the amount of weaning food is very less, complementary food is still over diluted cows milk, shoti, sago and sometimes barley.

We find that at around 9 to 12 months 5.62% of the babies are still totally on breast milk but the weaning has been started in 67.5% children, rest of babies are still getting shoti, barley and sago. Now, here it must be clarrified that the weaning foods in this area are usually rice gruel, bananas and sometimes biscuits. Between 1 to 3 years of age, 39.89% children get the family diet consisting of rice, dal and vegetables along with breast milk. But 42.17% of the children get diluted milk and only rice as the supplementary food but still 15.93% of children are getting less nutritious food, like sago, barley and shoti food along with some amount of rice.

A small percentage of children get only milk diet (1.92%) between 3 to 5 years of age. We find the similar pattern of continuing of breast feeding, 39.32% children getting continuous breast feeding along with family diet consisting of rice, dal and vegetables. 15.39% of children who are not getting breast milk are being fed with

sothi, sago and barley as substitutes of breast milk. 38.81% of children get diluted milk along with rice, rest 5.94% of babies are getting only complete family diet. So, from all these studies we can make out that till 5 years of age, these rural mothers like to feed their children mainly on milk and what they think better as milk substitute and only partially feed them with adult family diet.

4.8. **Results and Discussions**

4.8.1. **Water study**

From the result, it can be shown that the incidence of diarrhoeal disease start rising from April onwards and the incidence is quite high in the month of April, May, June, July and then gradually falls during winter season.

Now, comparison of this study with bacteriological analysis of drinking water from various sources from different places for the same Terai region shows a high bacteriological contamination during summer. During summer, out of 30 samples, only 3 samples (10%) were safe for drinking purpose whereas during winter 15 samples (35.71%), out of 42, were suitable for drinking purpose.

Thus, even during winter, many of the sources of drinking water are not suitable for drinking purpose.

The diarrhoea is a common but potentially serious illness during early childhood. The child suffers on an average 10-15 episodes of diarrhoea in first 5 years of life. Of these 3-5 occur in the first year of life [6]. Diarrhoea has shown a significant impact on different developing countries.

Even a brief episode of diarrhoea leades to the loss of 1-2% body weight per day [6]. Infants and children in many areas of developing countries are sick for about 15-20% of time with diarrhoeal illness [7]. Thus over the time, even the creeping deficit associated with mild illness can accumulate to become a major nutritional defficiency.

From the current study, we may interpret that in North Bengal Terai region, the poor source of drinking water has got a definite negative role on health status of the children. It causes high frequency of diarrhoeal episodes amongst children in this region, thus a pull back on their full potentiality of growth performances. Also from this study it can be interpreted that the bacteriological contamination rate of drinking water is significantly high during pre-monsoon season.

4.8.2. **Rearing technology**

It is well recognised that while genetic factors determine the ultimate growth potential of an individual, such potential can find its full expression only when there are no environmental constraints on growth. Various workers from different parts of the country have worked to find out the reference standard values of growth which showed marked differences from North to South, from East to West. Perhaps this is because of the fact that, in few studies, the growth performance had been studied in urban areas and few studies were conducted in rural or semi-urban areas.

Moreover, in India, there are wide regional differences with respect to dietary pattern, and thus perhaps the regional differences in the developing society reflect the result of environmental factors more than genetic variations. Further, in this study we have discussed the dietary pattern of the children which showed a marked decline in breast feeding specially in this region.

Infants grow at different rates at different ages and in part influenced by nutrition. Calorie intakes of approximately 115 kcal/kg/day for the first 6 months and 105 Kcal/kg/day for next 6 months have been reported to satisfy the needs of the healthy infants on the first year [8]. Protein intake should be 1.6 gms. to 2.3 gms. per 100 Kcal/kg/day provided the protein is of higher quality approching that of human milk and the balance of the calorie should be distributed between fat and carbohydrate [9].

If we look at the growth velocity curve of reference studies, it is apparent that after delivery the new born infants grow faster than just before birth to catch up faltering which occurs during this period. This results in a marked irregularity of growth velocity during the perinatal period [10]. The growth velocity is as high as 186 to 199 gms/week in first 1 to 3 months and then 126 to 144 gms/week between 3 to 6 months of post-natal period [11].

Now from our present study, we can find that growth velocity rate, though high in first months of age (explaining the high catch up quality of the baby to compensate the intra-uterine growth retardation) it starts falling from 4.5 months. There is always a tendency to pick up the optimum level of growth whenever they were given better food both in terms of quality and quantity. Unfortunately, these children never received the optimum calorie in their diets. Infact this deprivation in calorie intake starts from early months of age. After 15 months the weight velocity remains almost static. But, by this time their weight have markedly lowered. The similar features are observed on the height velocity. The height increment per month plotted against age known as velocity chart have been constructed for normal boys and girls by Tanner [12]. Height velocity chart of NCHS data are also available. When compared with NCHS data, present data shows fluctuations upto 12 months of age after which upto 60

months of age, the fluctuations are minimal. From these studies we may belive that the children of low socio-economic status are always trying to catch up the growth of its maximum but because of nutritional factors and other environmental constraints growth velocity remains suppressed. Again this is apparent that growth velocity rate is maximum during infancy provided the babies are taken proper care during this period.

From the growth acceleration and retardation curves (fig. 3.5(A) and fig. 3.6(A)) one can also find a direct relation between dietary pattern and growth. Whenver there is a fall in breast feeding and the supplementary food is of poor quality (i.e. shoti and sago) there is retardation in growth velocity. At around 10-11 months where the supplementary food is of better quality e.g.,. rice gruel, there is acceleration in growth velocity.

If we put these values (both for affluent children and present study) on WHO [13] growth chart (fig. 3.7), we find the affluent Indian children are near the topmost line (which is again 50th percentile for boys of NCHS value [14]) and that of present study are near the lower reference curve (i.e. 3rd percentile for girls of NCHS data [14]) upto 12 months of age and there after it is much below 3rd percentile. Therefore, our approach should be to improve the growth performance of the children of low socio-economic condition by improving their environment.

In the rest part of the thesis, it is now proposed to present the development of a knowledge based consultation system / expert system for monitoring purpose.

References

1. J. E. Park. and K. Park. Text Book of Preventive and Social Medicine. Banarsidas Bhanot; Jabalpur, India, 1991, 367-429.

2. WHO. International Standards for drinking water. Geneva, 1971.

3. WHO. European Standards for drinking water. Geneva, 1970.

4. Indian Council of Medical Research. Manual of standards of quality for drinking water, Spl. Rpt; Ser 44, 1975.

5. Achar's Text book of Pediatrics. 3rd ed. Nutrition and nonnutritional disorder; 56.

6. O. P. Ghai. Essential of Pediatrics. 2nd ed. Diarrhoea in early childhood; 186.

7. WHO. Diarrhoea training unit. Director's guide and teaching materials. Epidemiology and Etiology of acute Diarrhoea; 1988, E-46.

8. Food and nutrition board. Recommended dietary allowances. 9th ed. National Academy of Science; Washington D. C. 1980.

9. A. Lewis Barness. Nutrition for Healthy Neonates. Nestle Nutrition Workshop Series; 7, 1983, 36.

10. J. M. Tanner. Foetus into man : Physical growth from Conception to maturity. Open Books, London, 1978, 37-51.

11. J. M. Tanner and R. H. Whitehouse. Archives of disease in childhood. 51,1976, 170-179.

12. J. M. Tanner. Physical growth and development. In J. O. Forfar. ed. Text book of Paediatrics. G. C. Arneil. Churchill Livingstone; Edinburgh, 1973.

13. WHO. The growth chart, WHO, Geneva. 1986.

14. J. E. Park and K. Park. Park's Text Book of Preventive and Social Medicine. 13th ed., 311.