A COMPARISON OF THE COST-EFFECTIVENESS OF ALTERNATIVE APPROACHES TO THE TREATMENT OF SEVERELY MALNOURISHED CHILDREN

BY

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ABSTRACT

A longitudinal, prospective and controlled trial was undertaken to identify the most cost-effective treatment for children with severe malnutrition. Children <60% weight-for-height or with oedema aged 12-60 months, were sequentially allocated to i) in-patient treatment ii) day-care treatment iii) domiciliary management after one week of day-care. Institutional and parental costs incurred to reach 80% weight-for-height are compared. The groups were comparable as regards age, sex, nutritional status, presence of infection and socioeconomic status at recruitment. A total of 437 children completed the study. Mortality during treatment was low in all groups (<5%). Although the domiciliary group took the longest to achieve 80% weight-for-height they did so at the lowest overall cost. Day-care treatment approached in-patient care as regards speed of recovery at less than half the total cost, but it was an unpopular option and only 4% gave this as their preference. Although parental costs were highest for the domiciliary group as no food supplements were provided, this was the majority's preference (67%) especially among the group who experienced it.

Children continued to be followed for one year after they reached 80% weight-for-height to determine longer-term progress. Data were collected fortnightly for morbidity and monthly for anthropometry, mortality and relapse rates. All three groups increased in weight-for-height during the year from 80% to 91% on average but no increase was observed in height-for age. There was a high prevalence of infection with an average incidence of 7 diarrhoeal episodes, and 30% presented with acute respiratory infection on more than 3 occasions. Without access to medical care it is likely that many would have relapsed. Only 0.6% however required readmission for severe malnutrition and 1.6% died.

It is concluded that domiciliary management after 1 week of medical care is a cost-effective option for treating severe malnutrition.

TABLE OF CONTENTS

	Page
ABSTRACT	2
TABLE OF CONTENTS	3
LIST OF TABLES	7
LIST OF FIGURES	12
LIST OF PLATES	14
ACKNOWLEDGEMENT	16
CHAPTER 1 INTRODUCTION	19
1.1 Options for nutritional rehabilitation	19
1.2 Review of published literature	21
1.2.1 Hospital treatment of severe PEM	21
1.2.2 Treatment in nutrition rehabilitation centres	26
1.2.3 Nutrition rehabilitation with domiciliary care	33
1.2.4 Comparison of costs of the three management approaches	33
1.2.5 Conclusions from the literature review	36
1.3 The rationale for the proposed study	37
1.3.1 Background	37
1.3.2 Aims, objectives and significance of the study	38
1.3.3 Hypothesis to be tested	39
1.4 Country profile	39
1.4.1 General background	39
1.4.2 Urbanization and urban growth	40
1.4.3 Characteristics of Dhaka slums	41
1.4.4 Health Facilities	42
1.4.5 Nutritional Situation	46
1.4.6 Health care delivery system	46
1.4.7 Nutrition Rehabilitation Centres	48
1.4.8 Nutrition and health care financing and future steps	48

CHAPTER 2 STUDY DESIGN AND METHODS 51
2.1 Location of the study 51
2.1.1 Brief history of the Children's Nutrition Unit 51
2.1.2 Current facilities and activities of the Children's Nutrition Unit 53
2.1.3 Cost of services 54
2.1.4 The beneficiaries 54
2.1.5 Management of patients at the Children's Nutrition Unit 56
2.2 Methods 59
2.2.1 Study Design 59
2.2.1.1 Description of the three groups 59
2.2.1.2 Exclusion and allocations to each group 61
2.2.1.3 Outcomes of interest 62
2.2.2 Calculation of sample size 62
2.2.3 Subjects 64
2.2.4 General management of the subjects 64
2.2.5 Feeding and management of the 3 groups 65
2.2.6 Nutrition and health education for mothers/attendants 68
2.2.7 Data collection 69
2.2.8 Personnel in the research team 82
2.2.9 Recruitment and training of area supervisors and health workers 85
2.2.10 Data quality control 85
2.2.11 Data handling 89
2.2.12 Data analysis 89

CHAPTER 3 RESULTS 90
3.1 Short-term results 90
3.1.1 Demographic, socioeconomic and environmental characteristics 91
3.1.2 Breast Feeding 94
3.1.3 Age and anthropometric status 94
3.1.4 Types of PEM 97

3.1.5 Other nutrient deficiencies 98
3.1.6 Prevalence of infection and intestinal parasites 99
3.1.7 Response to management by the study groups 100
3.1.7.1 Mortality 100
3.1.7.2 Time to reach first oedema-free day 100
3.1.7.3 Time taken to reach 80% wt/ht 100
3.1.7.4 Weight gain and energy intake 101
3.1.7.5 Weight gain and infection 104
3.1.7.6 Weight gain and compliance 106
3.1.7.7 Slow responders in the DCD group 107
3.1.8 Cost to achieve 80% wt/ht by CNU in the 3 groups. 108
3.1.8.1 Total expenditure incurred by CNU 108
3.1.8.2 Combined cost of CNU and parents 109
3.1.9 Age and anthropometric status at the end of the short-term period 111
3.1.10 Brief summary of the findings in the short-term study 112
3.2 Long-term results 114
3.2.1 Socioeconomic status of parents 117
3.2.2 Weight 118
3.2.3 Height/length 119
3.2.4 Anthropometric status at the end of follow-up. 121
3.2.5 Summary of anthropometric status of the 3 groups 125
3.2.6 Morbidity 125
3.2.7 Readmissions and death during the long-term study 131
3.2.8 Catch-up growth and factors affecting it 133
3.2.9 Choice of rehabilitation approach by parents 136

CHAPTER 4 DISCUSSION 138
4.1 Short-term outcomes 138
4.1.1 Defaulting during treatment 138
4.1.2 Prevalence of infection on admission 139
4.1.3 Mortality during treatment 141

4.1.4 Weight gain during treatment 142
4.1.5 Oedema loss and time taken to achieve 80% wt/ht 144
4.1.6 Cost to achieve 80% wt/ht 145
4.1.7 Option preferred by most parents 146
4.1.8 Conclusions and implications 147
4.2 Long-term outcomes. 148
4.2.1 Losses to follow-up 148
4.2.2 Mortality and relapse 149
4.2.3 Growth performance during the long-term 150
4.2.4 Morbidity 152
4.2.5 Morbidity and catch-up growth 153
4.3 Conclusions and recommendations for further research 154
4.3.1 Conclusions 154
4.3.2 Recommendations for further research 155

REFERENCES 157
ANNEX 1 Recipes 183
ANNEX 2 Feeding schedule 185
ANNEX 3 Calorie and protein values 186
ANNEX 4 Diet chart 187
ANNEX 5 Antibiotics, vitamins and minerals 188
ANNEX 6 Data management forms for in-patients and day-care patients (short-term study) 192
ANNEX 7 Data management forms for home visits (short-term study) 218
ANNEX 8 Referral criteria 224
ANNEX 9 Pictorial morbidity calendar (long-term study) 227
ANNEX 10 Morbidity data management forms for home visits (long-term study) 228
ANNEX 11 Data management form for monthly home visits (long- term study) 233
ANNEX 12 Study area zones 236

LIST OF TABLES

	Page
Table 1.2.1 Summary review: nutrition rehabilitation in hospital 1980-93	23
Table 1.2.2 Summary review: Nutrition Rehabilitation Centres	29
Table 1.2.3 Summary review : domiciliary nutrition rehabilitation	34
Table 1.2.4 Comparison of costs of different approaches to treatment of malnutrition	36
Table 1.4.1 Comparison of anthropometric status of children aged 6-72 months in rural and urban areas: Results from 5 surveys	47
Table 2.2.1 Mean duration to achieve 80% wt/ht , weight gain and cost per child /day of 30 in-patients and 30 day- care patients	63
Table 2.2.2 Food items, market price and cost per item/day	79
Table 3.1.1 Proportion completing the short-term study and reasons for non-completion	91
Table 3.1.2 Characteristics of the parents at the start of the study	92
Table 3.1.3 Parental income and family size	93
Table 3.1.4 Location and construction of houses	93
Table 3.1.5. Sources of water supply and types of latrine used	94

Table 3.1.6 Breast feeding history by age and study groups 95

Table 3.1.7 Feeding pattern prior to admission in the three groups 95

Table 3.1.8 Age and anthropometric status on admission in the 3 groups 97

Table 3.1.9 Types of PEM: Wellcome classification 98

Table 3.1.10 Types of PEM: Waterlow classification 98

Table 3.1.11 Other nutrient deficiencies on admission in the 3 groups 99

Table 3.1.12 Prevalence of infection on admission in the 3 groups 99

Table 3.1.13 Prevalence of intestinal parasitic infection 100

Table 3.1.14 Time to reach 80% wt/ht and speed of oedema loss in the 3 groups 101

Table 3.1.15. Mean weight gain and energy intake to achieve 80% wt/ht 101

Table 3.1.16. Weight gains of the 3 groups by weeks of treatment 103

Table 3.1.17 Weight gain, energy intake and family income in the domiciliary group by week of study 104

Table 3.1.18 Frequency of slow, medium and fast weight gains in the 3 groups from day 8 till 80% weight for height was achieved 105

Table 3.1.19 Percent of study weeks when mothers reported illness or poor appetite by rate of weight gain in the DCD group 106

Table 3.1.20 Percentage of study weeks when mothers followed advice on feeding children and weight gain in the DCD group 107

Table 3.1.21 Characteristics of 8 slow responders and others in DCD on admission 108

Table 3.1.22 Comparison of costs (in taka) incurred by CNU in the 3 groups to achieve 80 % wt/ht 109

Table 3.1.23 Total cost (taka) of the 3 groups to achieve 80% weight for height 111

Table 3.1.24 Age and nutritional status of the 3 groups at the end of the short-term period 112

Table 3.2.1 Proportion of cases who completed the long-term study and reasons for non-completion by the 3 groups 115

Table 3.2.2 Comparison of age, anthropometry and socioeconomic characteristics of children who completed the follow-up study with those who did not, or excluded from the analysis 116

Table 3.2.3 Parents' job status and income in the 3 groups during the long-term period 117

Table 3.2.4 Quarterly and total weight gain in kg during the long-term study and from 1-12 follow-up months. 118

Table 3.2.5 Height gain in cm during the long term period: quarterly, 6 monthly and total in the 3 groups 119

Table 3.2.6 Height-for-age distributions(%) by age group at months 0 and 12 of the follow-up 125

Table 3.2.7 Summary of anthropometric status at various stages of the study in the 3 groups 126

Table 3.2.8 Diarrhoea, fever and cough reported by parents (mean±sd) in the 3 groups during the long-term study 127

Table 3.2.9 Frequency distribution (%) of days ill with diarrhoea during the long-term period 128

Table 3.2.10 Health workers' examination of morbidity (% ill) during the long-term period 129

Table 3.2.11 Mothers' response to illness of the child in between visits 129

Table 3.2.12 Age and nutritional status on readmission or prior to death in the long-term study 132

Table 3.2.13 Comparison of age, anthropometry and socioeconomic characteristics of children who completed follow-up with those readmitted or died 133

Table 3.2.14 Average weight (kg) and height (cm) gain with and without diarrhoea in the long term period, all groups combined 134

Table 3.2.15 Average weight gain/month and days with diarrhoea, fever and cough (mean ± sd) 135

Table 3.2.16 Average weight gain and parents' income and job status 136

Table 3.2.17 Preferred type of short-term rehabilitation if parents'could choose (%) 136

LIST OF FIGURES

		Page
Figure 1.	Map of Bangladesh	18
Figure 2.	Map of Dhaka city (study location)	50
Figure 3.1.1	Mean weight (kg) on admission, by age (months) and study group	96
Figure 3.1.2	Speed of oedema loss in the 3 groups, cumulative percent.	102
Figure 3.1.3	Duration days to achieve 80% wt/ht in the 3 groups	102
Figure 3.1.4	Cost incurred by the CNU in the three groups to achieve 80% weight for height	110
Figure 3.2.1	Weight (kg) in the 3 groups on admission,in the short-term and during follow-up for 12 months	120
Figure 3.2.2	Height/length (cm) in the 3 groups on admission, in the short-term and during follow-up for 12 months	120
Figure 3.2.3	Wt/ht on admission, discharge and follow-up months in the 3 groups	122
Figure 3.2.4	Wt/age on admission, discharge and follow-up months in the 3 groups	122

Figure 3.2.5 Ht/age on admission, discharge and follow-up months in the 3 groups 122

Figure 3.2.6 Percentage distribution of wt/ht catagories at 0,1,6 and 12 follow-up months (groups combined) 124

Figure 3.2.7 Percentage distribution of wt/age catagories at 0,1,6 and 12 follow-up months (groups combined) 124

Figure 3.2.8 Percentage distribution of ht/age catagories at 0,1,6 and 12 follow-up months (groups combined) 124

Figure 3.2.9 Frequency of visits to CNU OPD with diarrhoea, fever and pneumonia (diagnosed by physician) during the long-term study 130

LIST OF PLATES

		Page
Plate 1	A typical Dhaka slum (exterior)	43
Plate 2	Interior of a typical slum	43
Plate 3	Communal tube well water supply for drinking and washing	44
Plate 4	Communal stand pipe water supply	44
Plate 5	Hanging or kuccha latrine (communal)	45
Plate 6	Cemented pan or Pucca latrine (communal)	45
Plate 7	Slum population, the main beneficiaries of CNU	55
Plate 8	Rickshaw pullers, the main occupation in Dhaka slums	55
Plate 9	Nutrition education for the mothers/carers	58
Plate 10	Health and hygiene instruction by paramedic	58
Plate 11	A child in the in-patient facility	59
Plate 12	A child in the day-care facility	60
Plate 13	A child in the domiciliary group	60

Plate 14 Weighing child with digital scale 70

Plate 15 Health worker taking height in the field with the two-track board 72

Plate 16 Taking length with the two-track board. 72

Plate 17 Crippled father with his fruit shop 83

Plate 18 Destitute mother of a child in DCD group received a loan 83

Plate 19 Health worker interviewing mother on morbidity and other matters 86

Plate 20 Taking weight at home during follow-up 86

Plate 21 Author with a health worker observing height measurement 88

Plate 22 Author with a study child during her independent visit 88

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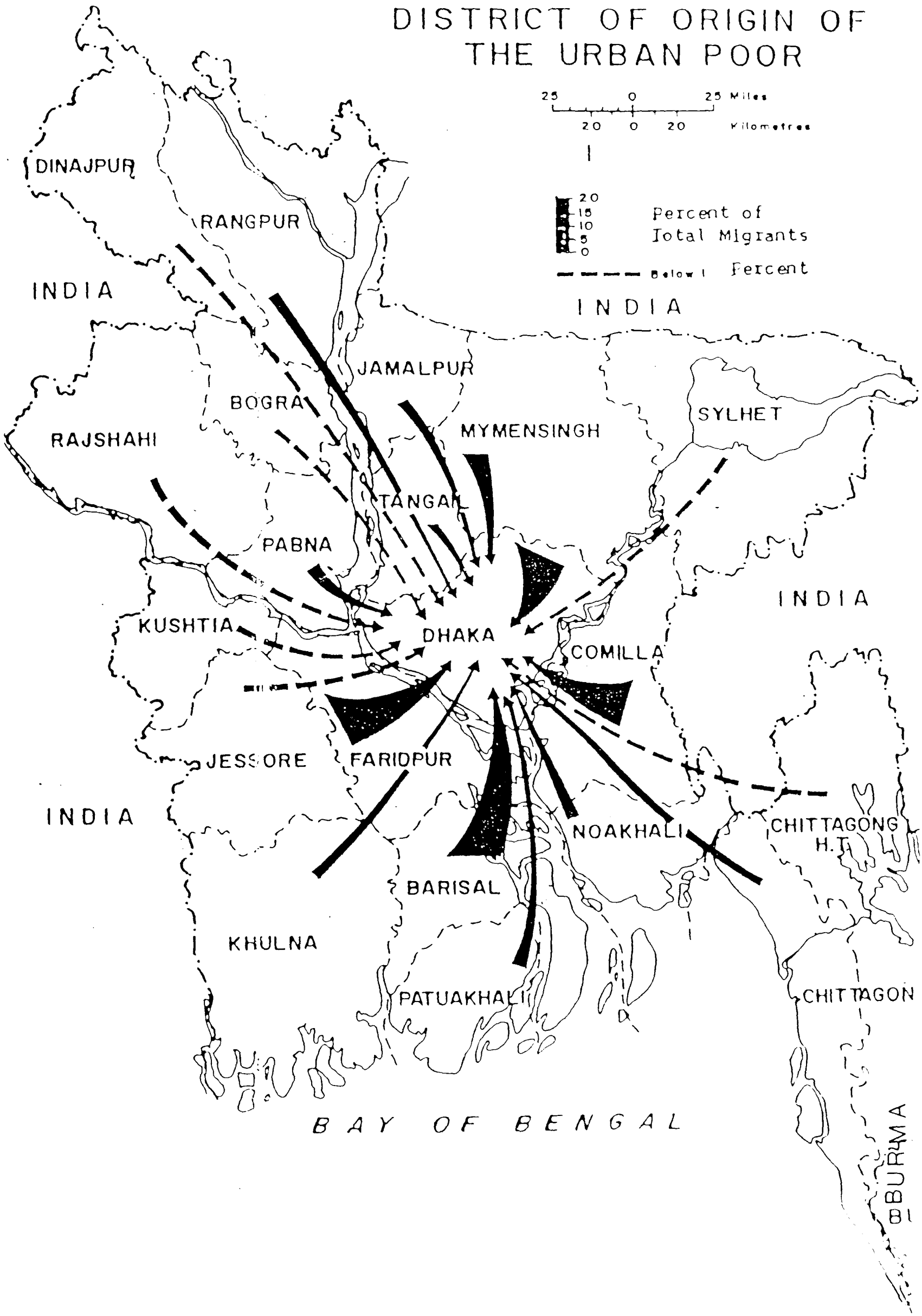
FIGURE 1 MAP OF BANGLADESH



CHAPTER 1. INTRODUCTION

1.1 Options for nutritional rehabilitation

The prevalence of protein-energy malnutrition (PEM) is still very high among children in poorer countries, and even mild forms may have serious consequences. Pelletier [1991] reports that 20-75% of child deaths are attributable to anthropometric deficits and 33-80% of these deaths are associated with mild and moderate forms of PEM rather than severe forms. According to the latest report of UNICEF [1993], malnutrition in its different forms contributes to approximately 50% of the all-cause mortality in young children, and more than 20 million children suffer from severe protein-energy malnutrition and 150 million are underweight.

Despite the advances in methods of treatment, severe PEM cases continue to have high case-fatality in many countries, and the recovery of the survivors is often extremely slow. The appropriate therapy for severe PEM includes management of fluid and electrolyte disturbances, and treatment of systemic and local infections and other complications. This requires close medical supervision. When resources permit, severe PEM accompanied by infection, dehydration etc. should be managed in in-patient facilities [Ramos-Galvan and Calderon, 1965]. Children with severe PEM but no complications or who have partially recovered with in-patient care, can receive treatment in community-based rehabilitation centres or through a home-based (domiciliary) program in order to increase involvement of the family in the treatment, thereby providing an opportunity for non-formal education which could have long-term health benefits. Thus the approaches to treatment fall into 3 broad categories: management in hospitals, treatment in residential or day-care centres, and home-based management. The literature pertaining to each of these categories will be discussed separately in section 1.2.

Historically, severe PEM has been treated in hospitals. Several of the early authors [Gomez et al., 1956; Garrow et al., 1962; Ramos-Galvan and Calderon,

1965] reported high mortality among PEM children treated in hospitals and concluded that age, severity of malnutrition, and the presence of infection and electrolyte imbalance were the important factors in determining mortality. Bengoa [1955] was the first to propose the development of nutrition rehabilitation centres (NRCs). The concept originated because treatment of severe PEM was given precedence and there was less concern for moderate and milder forms of PEM and their prevention. A significant percentage of these untreated milder forms of PEM later deteriorated into severe forms requiring hospitalisation, thus involving costly treatment. Aware of these facts, Bengoa defined the NRC as " a centre organized either with sleeping accommodation for children, or similar to day nurseries or kindergartens where malnourished children either attend for a few hours each day or are kept overnight, the objective of which is to educate the mothers through the nutrition rehabilitation of their children". He proposed that the centres would take children of 3 kinds : a) moderately malnourished b) severely malnourished after discharge from hospital and during their important period of recuperation c) mild to moderate cases of malnutrition who were not progressing satisfactorily as a result of treatment, which included supplementary feeding as outpatients at clinics, hospitals and mother and child health centres. The emphasis was thus on prevention of severe PEM.

In 1971 Cook asked the question " Is hospital the place for the treatment of malnourished children?" and argued that even severely malnourished children should be treated in nutrition rehabilitation centres and he reaffirmed Bengoa's concept of NRCs. He came to this conclusion after reviewing the published literature on the prognosis of children treated under hospital and NRC conditions. He concluded that NRC treatment of malnutrition would provide a higher cure rate, i.e 30-40% of cases fully recovered, as compared to a low cure rate (0-10%) in hospitals. He also reported a higher mortality for hospital-admitted PEM children compared with those in NRCs. Such comparisons, however, overlooked the fact that hospitals were more likely to admit severe cases than NRCs. Nevertheless Cook's conclusion was widely accepted and many NRCs were established worldwide in the 1970s.

The 1970s also saw a move towards home-based management of PEM [Shah et al., 1971], but this has remained the least explored option.

Despite the existence of many rehabilitation programs worldwide, few have been evaluated and virtually no comparative data are available regarding rates of recovery and mortality during treatment, and relapse rates of treated children. As regards cost-effectiveness of the alternative approaches there have been only five studies [Cook, 1971; Beaudry-Darisme and Latham, 1973; Beghin and Viteri; 1973; Cutting and Cutting., 1975; Shah et al., 1971]. In only one was domiciliary management included, yet it has several potential advantages. Thus the question still remains as to where PEM children could best be treated with minimum cost.

1.2 Review of published literature

In this section a brief review of published studies of the 3 options to treatment (hospital, NRC and domiciliary care) is presented focusing mainly on admission criteria, mortality, rate of catch-up growth, relapse rate and cost of treatment.

1.2.1 Hospital treatment of severe PEM

The treatment of severe PEM in hospital has been discussed fully by Staff [1968], Picou et al. [1975], Ifekwunigwe [1975], Suskind, [1975], Alleyne et al. [1977], Waterlow et al. [1978], Ashworth, [1980], WHO, [1981], Picou, [1981], Solomon, 1985], Jackson and Golden [1987], Golden [1988], and Waterlow [1992],

Cook [1971], in his review of 20 published studies between 1956-1969 of hospital rehabilitation, reported mortality of 8-50% , and cited 4 studies having a further mortality of 15-30% and a relapse rate of 23% during the period following discharge. Based on these figures he concluded that "out of every 100 malnourished children admitted in hospital, 11 will die in hospital, 30 at home within 12 months of discharge, 21 will still be suffering severe PEM, 27 will improve and only 3 will be cured". Sadre and Donoso [1969] and Lawless [1966] took a similar position and expressed the view that hospital treatment of PEM was a waste of time and money because of high case-fatality during treatment and high mortality after discharge. King [1978] similarly reported higher mortality rates in

hospitals than in NRCs or domiciliary care, but these comparisons have limited relevance since many of the hospital admissions may have been in a critical condition and less severe cases may have been treated in the community. More recently Waterlow [1992] has reviewed mortality in hospitals and NRCs and concluded that they were not always comparable in the criteria for admission and severity of complications.

It is more than 20 years since Cook questioned whether hospital is the place for treatment of severe malnutrition. Table 1.2.1 summarises more recent data from 1980 onwards for 17 hospitals focusing on age, admission criteria, mortality rate, catch-up growth, duration of treatment, death and relapse during follow-up, and cost per child rehabilitated. Most studies cited are retrospectively analyzed from hospital records. The data indicate that mortality is still unacceptably high in some hospitals (range 4.4-49%) and none had cost data. Other notable features are a) varying admission and discharge criteria b) no consistent way of expressing progress, for example some have reported weight gain as g/kg/day, while others as percent shift from one grade of malnutrition to another c) no follow-up data on morbidity and limited data on post-discharge mortality and relapse rates (three studies).

Table 1.2.1 Summary review: nutrition rehabilitation in hospital 1980-93

AUTHOR;COUNTRY; YEAR PUBLISHED	AGE AND ADMISSION CRITERIA	MORTALITY (%)	WEIGHT GAIN OR PROGRESS	DURATION	FOLLOW-UP	LATER MORTALITY (%)	RELAPSE (%)	COST PER CHILD
Cooper et al., St.Lucia 1980	0-3 years; all below 75% wt/age and treated 3 groups A,B, and, C.	7 overall A:none B:20 C:80 all deaths were <60% wt/age	Gain as % of expected for initial wt after 6months A+B+C ≤74% wt/age=76%, B:<60% wt/age = 57% B 60-75% wt/age = 82% C:<60% wt/age = 63% C: 60-75% wt/age =78%	6 months	12 months no sig. difference between groups in nut. status	NR	16 overall A: 33% B: 55% C: 12%	NR
Brown et al., Bangladesh 1981	0-10 years; <60% of expected mean wt/age of local standard PEM type:M,K,MK based on McLaren criteria	21	Not reported	NR	Not done	NR	NR	NR
Laditan &Tindimebwa Nigeria 1983	0-108 months; K:72%, MK:16%, M:12	28.1	not reported	18-24 days	NR	NR	NR	NR
Castello et al., Chile 1983	less than 2 years < 2 years:grade III < 1 year:grade II	NR	No change in grade:67% condition declined:21% Improved in grade: 5%	7 weeks	NR	NR	NR	NR
Tolboom et al., Lesotho 1985	Mean age 17 months Wellcome classific: M=37%,K=49%, MK=14%, 86% had infection	25;of which 35% in 48h 62% in the first week.	Increase in % wt/age: M:+13%, K:+3%, MK:+8%	7 weeks	NR	NR	NR	NR

A: Feeding with high energy formula(HEF) till >75% wt/ht achieved.
B: In hospital until regained appetite (minimum intake 150 kcal/kg/day
C: Immediate discharge from hospital and followed later at home (2 children had to stay for 1 week for complication)
Wt= weight; no sig.=no significant; wt/age= weight-for-age; M=marasmus, K=kwashiorkor, MK=marasmic-kwashiorkor. NR=not reported

Table 1.2.1 (Continued) Summary review: nutrition rehabilitation in hospital 1980-93

AUTHOR;COUNTRY; YEAR PUBLISHED	AGE AND ADMISSION CRITERIA	MORTALITY (%)	WEIGHT GAIN OR PROGRESS	DURATION	FOLLOW-UP	LATER MORTALITY (%)	RELAPSE (%)	COST PER CHILD
Khanum et al., Bangladesh 1987	0-10 years(80%<5 yrs); ≤60% wt/ht +/-oedema and or all cases of nutritional oedema, M:18%,MK:61%,K:20% (Wellcome classification)	5.2 of which 60% died in the first 5 days	Oedema free weight gain: 8g/kg/day for M & MK 4g/kg/day for K (mean) went home when 80% wt/ht was reached	3 weeks	not done	NR	NR	NR
Khanum and Kabir., Bangladesh 1989a	Mean age 24 months; ≤60%wt/ht; M:23%,K:14%,MK:63%	5.0 of which 80% died in the first 7 days	went home when 80% wt/ht was achieved and encouraged to return to attend follow-up clinic	3-4 weeks	2 years later 45% followed	1.0	none	NR
Van Roosmalen-Wibenga et al., Tanzania 1986/87	Severe PEM cases, used Wellcome classification for admission.	9 of which 43% died in first week	Increase in : wt/age: + 6.9% wt/ht : + 8.7%	2-3 weeks	87% were followed'	8.0	13.0	NR
Hennart et al., Zaire 1987	2-5 years; M:2%, K:5%, MK:93%	NR	Discharged on the basis of being 'cured'?	10-12 weeks	Followed for 5 years	at 1 yr:10 at 5 yrs:19	NR	NR
Hone et al., Zambia 1987	1-3 years; Wellcome classification	4.4	9g/kg/day	depended on wt.gain	NR	NR	NR	NR
Coulter et al., Sudan 1988	4months-6 years; Wellcome classification K:35%, Mk:27%, M:38%	20 overall, K:19 MK:35, M:14	Not reported	NR	NR	NR	NR	NR

Table 1.2.1 (Continued) Summary review: nutrition rehabilitation in hospital 1980-93

AUTHOR;COUNTRY; YEAR PUBLISHED	AGE AND ADMISSION CRITERIA	MORTALITY (%)	WEIGHT GAIN OR PROGRESS	DURATION	FOLLOW-UP	LATER MORTALITY (%)	RELAPSE (%)	COST PER CHILD
Smith et al., Nigeria 1989	3-36 months; M:16%, K:42%, Mk:42%	31.0*	50g/day; increase in wt/ht: M:+ 8%,K:+ 13%, MK:+ 9%	3 weeks	NR	NR	NR	NR
Mitra et al., Bangladesh 1991	less than 5 years; ≤60% of NCHS wt/age	28.1	Not reported	NR	NR	NR	NR	NR
Khin-Maung-U et al., Burma 1992	1 month-11 years; clinical:M, K, & MK	34.0	Not reported	NR	NR	NR	NR	NR
Christie et al., Jamaica 1992	2-34 months; K:40%,MK:38%,M:16%, UW:6%,(Wellcome classification)	6 (overall) 8 bacterimia	Not reported	NR	NR	NR	NR	NR
Friedland et al., South Africa 1992	age 2-84 months Wellcome classification used; PEM:14% of all admissions. Compared with WN and NGR	PEM:13.3 WN+NGR: 4.1(PEM deaths 2.5 times more)	Not reported	NR	NR	NR	NR	NR
Erinoso et al., Nigeria 1993	0-48 months wellcome classification M=34%, MK=46%, K=30%	49% 75% <1yr	Not reported	NR	NR	NR	NR	NR

* Supplemented with iron in the first week.
M=Marasmus, K=kwashiorkor, MK=Marasmic-kwashiorkor, UW=under weight
WN= well nourished, NGR= Nutritional growth retardation

1.2.2 Treatment in nutrition rehabilitation centres

There was great enthusiasm for NRCs during the 1960s and 1970s following Bengoa's advocacy, but assessment was rarely undertaken. Bengoa prepared criteria for assessment which were: length of time for educating mothers, speed of recovery, relapse rate, the number of new cases of malnutrition in the same family, acceptance of the program by the parents or the community, and cost of the program. Bengoa failed, however, to describe methods for assessing these criteria and the concept of NRCs became unclear. Bengoa recognized several limitations that hindered the success of NRCs [Bengoa, 1964]. They were: first, NRCs, particularly the non-residential NRCs, could not provide care for malnourished children in scattered rural populations; second, mothers' participation was not always satisfactory, because of long distance they have to travel in areas with scattered houses; third, the effective coverage of the centres in relation to need was very small; fourth, the cost was still relatively high and fifth, the children kept under one roof were still susceptible to infection. Consequently Bengoa [1967] restated the objectives of NRCs as follows: "the NRCs can perform a specific function, namely to educate the mothers through the nutritional rehabilitation of their children. This is a modest objective but one of pressing urgency in many countries".

As a result of these criticisms directed towards NRCs, a number of thorough evaluations were carried out in the late 1960s and 1970s in an attempt to validate these reservations and explore further weaknesses [Korte,1974; Beghin and Viteri, 1973; King et al., 1978]. Issues identified as being crucial to their long-term success were the availability and continuity of good medical supervision for severe PEM [King et al., 1978] and the need to emphasise their educational role. This would alleviate the negative concept of a centre, "where only those mothers who 'neglect' their children are admitted" [Korte 1974]. A comprehensive review of a number of NRCs in Uganda, Guatemala , Peru and Haiti revealed some of the problems facing NRCs [Beaudry-Darisme and Latham, 1973]. In Uganda, despite mothers' improved knowledge it was difficult below a certain socioeconomic level to improve growth of children. In Peru, mildly malnourished children were

admitted and preference was given to children over 3 years old in the hope of getting a regular attendance. This criterion was questioned because the most critical period for the child is prior to 3 years of age. In Haiti, 75% of children improved their wt/age, 15% deteriorated while 10% remained unchanged. Some children failed to respond, because they had other health problems which were not likely to improve through nutrition education [King et al., 1978]. In all of the centres evaluated the lengthy period required for recuperation was the major reason for defaulting. The authors concluded that residential NRCs in Uganda and Peru had an advantage in health care by being attached to a hospital whereas NRCs in Guatemala varied widely in health care access between cities and villages, and the mother craft centres in Haiti were mostly rural with very modest access to other health facilities. Therefore, the effectiveness of NRCs was likely to be very variable.

Following the evaluations certain recommendations were made [Beaudry Darisme and Latham, 1973; Beghin and Viteri, 1973; King et al., 1978]. They were: a) a need for nutrition education to stress the importance of protein-rich, high-energy locally available foods b) nutritional practices by parents need to play a larger role in evaluation of NRCs c) development of a system to monitor the health and nutritional status of the children in the long-term d) a means of effectively involving fathers in the rehabilitation process and e) a need for a method to measure acceptance of NRCs in the community.

Since the 1970s, no evaluation has been carried out to reassess the effectiveness of NRCs following these recommendations. Borrel [1993] reported that criteria established to measure the preventive role of NRCs have been neglected in recent studies. Admission and discharge criteria vary widely making comparison difficult and irrelevant. Despite food supplementation, a high drop-out rate is reported indicating parents' inability to attend on a daily basis for an indefinite period of time.

The literature published since 1978 pertaining to NRCs is summarized chronologically in table 1.2.2. Of the 21 NRCs reported here, 8 are residential and 13 are non-residential day-care centres. Important conclusions are that in most

NRCs a) children tend to be less severe and less complicated on admission than children admitted for hospital treatment, although there are no consistent admission criteria b) the method of assessing catch-up growth is very variable, and that without specific discharge criteria it is difficult to assess the duration to achieve recovery c) despite follow-up in 14 of the 21 studies, only five report post-discharge mortality and/or relapses. This indicates a continued lack of interest in the long-term prognosis of the children d) discontinuation of treatment in these studies ranges from 17-30% and mothers frequently abscond which suggests a continuing non-acceptance of NRCs in the community e) only one NRC reported any cost data and f) sample sizes are invariably small.

Bengoa originally proposed that a period of at least 3-5 months is required for nutrition education. However, 11 of the 21 NRCs in table 1.2.2 were evaluated over a period of 6 weeks or less. This shorter duration could be due to a number of factors. First, the duration is strongly determined by the time for substantial weight gain to occur. Only one NRC reported no substantial weight gain [Brown et al.,1980]. Second, mothers become disinterested or are unable to participate for a longer period. Third, the aim in some studies has been specifically to achieve weight gain rather than to improve nutritional awareness [Kraut et al., 1978; Pecoul et al., 1992] or fourth, a shorter duration than that proposed by Bengoa is adequate to improve nutritional awareness.

For evaluation purposes, the relapse data are questionable since these rates are generally based on those who present themselves for follow-up, hence contributing an unrepresentative figure [Stanton et al., 1987]

Table 1.2.2 Summary review: Nutrition Rehabilitation Centres

AUTHOR;COUNTRY; YEAR PUBLISHED	AGE AND ADMISSION CRITERIA	MORTALITY (%)	WEIGHT GAIN OR PROGRESS	DURATION	FOLLOW-UP	LATER MORTALITY (%)	RELAPSE (%)	COST PER CHILD
Kraut et al., Tanzania 1978	2-6 years; 70-80% wt/age(moderate malnutrition)	NR	Average gain from 77 to 81% wt/ht 12% reached 95%wt/ht	88 weeks	not done	NR	NR	NR
Brown et al., Zaire 1980	5-24 months; 95% <80%wt/ht, 5%>80% wt/ht	NR	No significant weight gain compared to controls	12 weeks	After 12 months no change in wt/ht	NR	NR	NR
Lamptey et al., Philippines,1980**	Mean age 28.6 months M:73%, K:16%,MK:11% mean wt/age:51.1%	mean 6.8 NW:8.4 NH:4.3	28g/day, increase of 7.2% wt/age, no sig. difference between NW and NH	5.5 wks NW:4.7 NH:9.8	After 9m wt/age 68.5%	12.4	overall: 23	NR
Ramprasad et al., India 1980 **	grade I:13%, (Gomez) grade II:33% grade III:54%	5.6	70-95g/day	4-6 weeks	After 14 weeks	NR	NR	NR
Roy et al., India 1980**	Grade I:3% (Gomez) grade II:17% grade III: 80%	NR	18-52g/day without oedema 7-36g/day with oedema	4-6 weeks	45% followed, normal wt/age:20 %	3.0	NR	NR
Ojofeitimi et al., Nigeria 1980	9 months to 4 years 33% diarrhoea and vomiting	3.0	At 2 wks:21-28g/day; at 8 wks:9-14g/day; at 12 wks:15-30g/day	12 weeks	After 9 months	NR	NR	NR

M=marasmus, K=kwashiorkor, MK= marasmic-kwashiorkor (Wellcome classification) wt/ht=weight-for-height, wt/age= weight-for-age, NR=not reported.
NW=hospital based 'nutri-wards'; NH= community based 'nutri-huts' ** residential NRC's

Table 1.2.2 (Continued) Summary review: Nutrition Rehabilitation Centres

AUTHOR;COUNTRY; YEAR PUBLISHED	AGE AND ADMISSION CRITERIA	MORTALITY (%)	WEIGHT GAIN OR PROGRESS	DURATION	FOLLOW-UP	LATER MORTALITY (%)	RELAPSE (%)	COST PER CHILD
Huseini et al., Indonesia 1982	6-36 months; 72:<60% wt/age, 5:60-89% wt/age;(M:72 MK:31, K: 5)	16.6	Unchanged: 31%; mild to moderate PEM:50%; normal: 10%	24 weeks	Done	NR	NR	NR
Ogbeide et al., Nigeria 1984	Majority 1-2 years; K:37%, MK:33%, M:30% by Wellcome classification	NR	No criteria for improvement mentioned	NR	After 6 months	15.3	NR	NR
Castillo et al., Chile 1983 *	Age < 2 years; < 2 years: grade III, < 1 year : grade II,	NR	73% of grade II improved (improvement in grades)	NR	NR	NR	NR	NR
Glatthaar et al., South Africa 1986	7-36 months; ≤72% wt/age + oedema ≤79% with oedema and <95% wt/ht;(less severe)	12.0	change in Nut. status: (a) wt/age:Int gp:8.7%; C:7.8% wt/ht :Int gp:9.8%; C:8.8% ht/age:Int gp:-1.0%;C:1.0%	12 months	NR	NR	NR	NR
Etherington et al., Papua New Guinea 1987**	Mean age 17 months; mean wt/age 55%	None	10 % increase in wt/age	5 weeks (1-18)	10 months later, 80% wt/age	NR	NR	NR
Stanton et al.; Bangladesh 1987	1-5 years; 39%: <75% wt/age, 52%: <85% wt/ht.	NR	Upto 3 weeks: 21g/day upto 5 weeks: 23g/day	3-5 weeks	10 months later	NR	NR	NR

** residential NRC; Nut. Status=nutrition status;
(a): Int gp= Intervention group (with nutrition education), C=control group(without nutrition education).
M=marasmus; K=kwashiorkor; MK= Marasmic-Kwashiorkor;
wt/age=weight-for-age; wt/ht=weight-for-height; ht/age=height-for-age.

Table 1.2.2 (Continued) Summary review: Nutrition Rehabilitation Centres

AUTHOR;COUNTRY; YEAR PUBLISHED	AGE AND ADMISSION CRITERIA	MORTALITY (%)	WEIGHT GAIN OR PROGRESS	DURATION	FOLLOW-UP	LATER MORTALITY (%)	RELAPSE (%)	COST PER CHILD
Gillam., Nepal 1989 **	< 2 years; ≤60% wt/age 60-80% + oedema Wellcome classification	4.3	Not reported	2.6 weeks	NR	NR	NR	NR
Heikens et al., Jamaica 1989	Age 3-36 months; <80% wt/age, no oedema without infection	1.2(HES)*	Total gain: HES*:8.4g/day, HC*:8.1g/day; 19% needed hosp.admission	6 months	Not done after 6 months	NR	NR	NR
Jovanovic et al., Angola 1990	3 months-8 years; M:28%, K:54%,MK:18% Wellcome classification	None	Reached 80% wt/ht	3 weeks	55% followed	NR	5	NR
Asokumar et al., Nigeria 1991	0-3 years; comparison of healthy & malnourished children based on Wellcome class.	NR	14g/day	10 weeks	NR	NR	NR	NR
Macintyre et al., South Africa 1991**	Grade III or living far away from NRC; 13% had oedema	NR	31 ± 48g/day	2 weeks	12 months later, 8% followed	No deaths	NR	NR
Asokan et al., South India 1992	Grade III (Gomez classification)	NR	Grade I: 12% grade II: 56%	12 months	Followed-up to find drop-outs	NR	NR	NR

* HES= high energy supplementation; HC= health care (without supplementation)
Hosp=hospital; ** residential NRCs

Table 1.2.2 (Continued) Summary review: Nutrition Rehabilitation Centres

AUTHOR;COUNTRY; YEAR PUBLISHED	AGE AND ADMISSION CRITERIA	MORTALITY (%)	WEIGHT GAIN OR PROGRESS	DURATION	FOLLOW-UP	LATER MORTALITY (%)	RELAPSE (%)	COST PER CHILD
Pecoul et al., Niger 1992**	6-29 months; 42% <-4sd wt/ht	14.4 60% in week 1	46% recovered, 14.4% discharged without recovery	3 weeks	68% followed for 3-18m	NR	none	NR
MacIntyre et al., South Africa 1992	Average age 16m Mostly refd from hosp. Wellcome classification: M = (26%) K = (11%) MK = (4%) Under wt= (59%)	NR	Most lost oedema in hosp Weight gained 42g/day	12 days	After 12m 69% traced	none	4%	NR
Fronazak et al., Bangladesh 1993	6-59 months; MUAC <120mm or wt/ht 60-79% NCHS standard non-complicated cases	NR	Average increase in wt/ht: 15% and wt/age: 13%	3 weeks	Followed monthly for 12m,no trace:39%, readmission: 2.5%	NR	13%	Institutional cost was US$ 140*

* institutional cost excluding 31% referrals and 2.5% readmissions
** residential NRC

1.2.3 **Nutrition rehabilitation with domiciliary care**

Shah et al. [1973] in a comparative evaluation observed that mothers who had experienced domiciliary management of their children had better understanding of infant feeding than mothers of children treated in hospital. Few studies of domiciliary management are available and these are reviewed in table 1.2.3. Again there are inconsistent admission and discharge criteria. Although follow-up was done in most of the studies, post-treatment outcomes (growth, mortality, relapse) are not reported. Food supplements were given in the majority of the 10 studies reviewed, but in only one study were children followed after the food supplement was withdrawn [Gueri et al., 1985]. There has been no attempt to study the long-term effectiveness of the domiciliary approach except by Shah et al. [1978]. Cost data are available for four studies.

1.2.4. **Comparison of costs of the three management approaches**

During the 1970s there were 4 reviews which compared the costs of rehabilitation of malnutrition in hospital and in NRCs [Cook, 1971; Beghin and Viteri, 1973; Beaudry-Darisme and Latham, 1973; Cutting and Cutting, 1975], and 1 study which compared the costs of hospital with domiciliary management [Shah et al.,1971].

Cook [1971] reviewed costs in 4 studies in hospitals (in Jordan, Iran and Jamaica) and 8 in NRCs (7 in Haiti and 1 in Uganda). Estimated hospital costs ranged from £40-1000 to rehabilitate a malnourished child and the time taken ranged from 20 days to 4 months. In Haiti the estimated cost to rehabilitate a malnourished child in NRCs ranged from £7-10, and in Uganda the estimated cost was £27. No attempt was made to consider children of similar severity, and the end point of treatment is unclear. Thus, although it appears that NRCs were more cost-effective than hospitals, it is not possible to determine what proportion were actually rehabilitated. The findings from the other reviews, comparing estimated costs of hospital and NRC management, are summarised in table 1.2.4.

Table 1.2.3 Summary review : domiciliary nutrition rehabilitation

AUTHOR;COUNTRY; YEAR PUBLISHED	AGE AND ADMISSION CRITERIA	MORTALITY (%)	WEIGHT GAIN OR PROGRESS	DURATION	FOLLOW-UP	LATER MORTALITY (%)*	RELAPSE (%)*	COST PER CHILD
Shah et al.,India 1971	7-35 months; all K wt/age: <60%=6, 60-75% =6, 68.8% <65% wt/age	none	At 6 months 40% wt.gain at 35 months 84% wt.gain Oedema free:at 5 weeks	7-33 months	NR	none	none	Rs9.9 Inst. Rs 36.0 parents
Khare et al., India 1976	0-5 years wt/age:< 60%= 66%, wt/age:61-70%=25% wt/age:71-80%=9%	none	Oedema free in 8 weeks; change in grade: <60%wt/age:43% 61-70:38%, 71-80%:19%	NR	15 months follow-up	NR	6%	Rs 7.4 Inst. Rs 16.0 parents
Cooper et al., St.Lucia 1980	0-3 yrs; all <75% wt/age	11.1	68% of expected wt/age	12 months	after 12 months	NR	12%	NR
Kumari et al., India 1982	0-5 years; second & third degree PEM using Indian growth standard	none	86% improved in wt/age, 11% remained same, 3% deteriorated.	5 months-1 year	upto 1year	NR	NR	NR
Verkley et al., Kenya 1983	A (NS):<65% wt/age;† B (no NS) 65-75%wt/age	1.8	A (with NS):+ 5% wt/age B (no NS): + 3% wt/age	6 months	At 16 wks and 39wks	NR	NR	NR
Rao MN., India 1984	<60% wt/age, grades III and IV, 64% with illness	1.3	At 6 wks grade I: 52% at 12 weeks grade I: 74%	6-12 weeks	NR	NR	2.6	NR

* During follow-up
† NS: Nutrition supplement
Inst= Institutional cost.

Table 1.2.3 Continued summary review: Domiciliary nutrition rehabilitation

AUTHOR;COUNTRY; YEAR PUBLISHED	AGE AND ADMISSION CRITERIA	MORTALITY (%)	WEIGHT GAIN OR PROGRESS	DURATION	FOLLOW-UP	LATER MORTALITY (%)*	RELAPSE (%)*	COST PER CHILD
Tandon et al., India 1984	0-6 years; <60% wt/age; 80-85% with complications	3(overall) <3 years 3.8 3-6 yrs 1.4	85% children reached grade I(75-89% wt/age) 4% deteriorated	6-12 weeks	98% followed-up	NR	NR	NR
Gueri et al., Trinidad 1985	< 5 years wt/age: <60%:s=16.9%,u=14.3%† 60-69:s=50.8%'u=39.3% ≥70% :s=32.2%,u=46.4%	NR	weight gain: s=1109g; u=879g wt/age change: s=4.5%; u=2.8% 13% needed hosp.trtm.	16 weeks	4 months after suppl. & superv. stopped.	NR	wt/age <60%: s=13% u=0%	cost by the centre: s=$76.8 us u=$22.5 us
Jansen and Verkley., Kenya 1986	FS < 65% wt/age NS ≤ 75% wt/age Harvard standard	None	Increase of 5.2% wt/age; weight gain: 4.2g/day	visited every 2-4 weeks for 6 months	Followed at 16 weeks	NR	NR	NR
Fernandez-Concha et al., Peru 1991	Mean age 18 months grade II and III Gomez	2	No increase in wt/ht at 3 months. 7% referred to hospital for treatment	12 months	At 1,3,6,9, 12 months to observe	NR	NR	Institutional cost $ 20.8 us

† s= supplemented (suppl) with food and supervised (superv) for 4 months;
u= supplemented with food and unsupervised.
Hosp.trtm=hospital treatment.
* During follow-up
FS= food supplementation
NS= no supplementation

Again no attempt was made to consider children of similar severity and it is possible that children differed in the extent of their rehabilitation. Nevertheless, indications are that although NRC rehabilitation tended to take 2-4 times longer than hospital treatment, it was typically half the cost. Comparative costs of domiciliary management with hospital treatment are confined to a single study in India [Shah et al.,1971]. Although this study had the same limitations as described above, the results shown in table 1.2.4 suggest that domiciliary management may be the most cost-effective approach.

Table 1.2.4 Comparison of costs of different approaches to treatment of malnutrition

Country	Authors/year published	Hospital		NRCs		Ratio of costs
		duration	costs/child*	duration	cost/child*	
Uganda (1 hospital and 1 NRC)	Beaudry-Darisme and Latham, 1973	2 weeks	117	6 weeks	77	1.5
Uganda (1 hospital and 1 NRC,urban)	Beghin and Viteri, 1973	120 days	840	78 days	225	4.0
Guatemala (1 hospital and 9 NRCs)	Beaudry-Darisme and Latham, 1973	2 months	438	8 months	213	2.1
Haiti (1 hospital and 7 NRCs)	as above	2 months	720	6 months	72	10.0
India (1 hospital and 4 NRCs)	Cutting and Cutting, 1975	4 weeks	Rs 60	8 weeks	Rs 31	1.9
India (1 hospital and 1 domiciliary)	Shah et al., 1971	3 weeks	Rs 503	5 weeks	Rs 36	14.8

* in US $ except Indian studies

1.2.5 **Conclusions from the literature review**

Conclusions regarding the effectiveness of alternative approaches to the treatment of PEM are clearly inappropriate at the present time, because of differences in admission criteria, severity of malnutrition, life-threatening complications and infection. These differences not only influence case-fatality but also the rate of recovery. Because of inconsistent discharge criteria, longer-term mortality and

relapse rates are difficult to compare. Moreover, because of lack of follow-up in many studies it is not known whether the three approaches differ in their long-term effectiveness.

As regards costs, there are very few estimates of the comparative costs of rehabilitation, and of these, all look at institutional costs. Except in one Indian study, there are no estimates of parental costs. There is a disappointing lack of information on morbidity, mortality, rates of growth and progress after discharge. Therefore, there is a need to carry out a comprehensive well designed study that looks at cost- effectiveness to rehabilitate both in the short-term and long-term. With this in mind a two-phase study was planned to compare the cost-effectiveness of three alternative approaches to the treatment of severely malnourished children in one centre in urban Dhaka, Bangladesh.

1.3 The rationale for the proposed study

1.3.1. Background

Nutrition surveys have consistently reported a high rate of malnutrition among most people in Bangladesh and particularly among children below 5 years. According to the 1985-1986 national nutrition survey [Bangladesh Bureau of Statistics, 1987], 57.6% of rural Bangladeshi children aged 6-71 months and 44.1% of urban children of the same age were stunted, and 16.8% of urban and 14.7% of rural children were wasted. For the rural and urban children combined, 35.2% had a height-for-age below -3 standard deviations (sd) and were thus classified as severely stunted. A further 30.2% were moderately stunted (height-for-age -2 sd to - 3 sd) [Bangladesh Bureau of Statistics, 1991]. These data are broadly similar to those in other national surveys dating back to 1976, suggesting that the nutritional situation is not improving and that malnutrition remains one of the major causes of mortality in children in Bangladesh. Children with severe PEM, particularly those with complications, are medical emergencies and require immediate treatment in order to prevent death, and initiate the recovery process.

preventive health measures are required. Therefore, affordable facilities (both by the country and by parents) need to be created in order to provide the necessary services, taking into account the cost-effectiveness of different approaches offered. So far, the effectiveness of the different approaches to nutritional rehabilitation and the much needed comparative economic costs of treatment of severe PEM have not been evaluated in any country in a scientifically rigorous manner. Considering the demand on Government and non-governmental agencies in Bangladesh to treat many thousands of severely malnourished children, such comparative information would be of great value.

1.3.2 Aims, objectives and significance of the study

The aim of the study

The overall aim is to identify the most cost-effective approach for the management of severe protein-energy malnutrition.

The objectives are:

1. To assess mortality and rate of recovery of children suffering from severe PEM during rehabilitation in the short-term, that is, until ≥80% of the NCHS median weight-for-height (wt/ht) is reached after oedema loss, with 3 different approaches to treatment.

2. To evaluate the cost of the three types of management of PEM in the short-term period, including the opportunity cost incurred by the parents.

3. To compare in the 3 treatment groups growth, morbidity, mortality and relapse rate in the long-term, that is during the 12 months after reaching 80% wt/ht.

Significance of the Study

The study will be invaluable in the context of Bangladesh where the prevalence of severe protein-energy malnutrition is high, demanding appropriate cost-effective

intervention. The study will also provide much needed information about the feasibility of domiciliary management of severe PEM not only in Bangladesh but also in regional and global contexts, especially in developing countries where the prevalence of PEM is high.

The long-term follow-up of growth, morbidity, mortality and relapse rate, will provide invaluable information to address the question of long-term effectiveness of the 3 types of management of severe PEM.

The study seeks to overcome the methodological weaknesses inherent in all the previous studies which have attempted to compare effectiveness, and will be the first to compare three alternative approaches in a single location.

1.3.3 **Hypothesis to be tested**

The hypothesis underlying the research to compare alternative approaches of management of severe PEM is:

Children from poor families with severe protein-energy malnutrition can recover satisfactorily in their home environment following an initial one week period of intensive management and that this is the most cost-effective approach.

To test this hypothesis, a longitudinal prospective and controlled study was undertaken. Three groups of severe PEM cases were treated either as hospitalised patients or on a day-care basis comparable to NRCs, or with domiciliary care preceded by 1 week of day-care. Cost-effectiveness is taken as the total cost to achieve 80% weight-for-height.

The study was carried out in Dhaka, Bangladesh and the next section in this chapter describes briefly the country profile in relation to the study.

1.4. **Country profile**

1.4.1 **General background**

Bangladesh is a riverain tropical country, a deltaic land situated in the south eastern region of south Asia (Figure 1). This area was under Muslim rule for five and a half centuries before passing into British hands in 1757 A.D. During British rule it was part of the British Indian province of Bengal and Assam. In August

1947 it gained independence along with the rest of India and formed a part of Pakistan and was known as East Pakistan. Bangladesh emerged as an independent country on March 26, 1971 after a 9-month war of liberation against Pakistan. One hundred and eight million people live in an area of 55,599 square miles (143,998 sq.km) [Bangladesh Bureau of Statistics, 1991] The country's economy is based on agriculture but 53% of the population are landless and 80% are below the poverty line. It is one of the least developed countries in the world with a GDP per caput of US $180 [Bangladesh Bureau of Statistics, 1991].

The literacy rate is only 29 percent, with female literacy being even lower at 18% [Centre for Urban Studies, 1990; Bangladesh Bureau of Statistics, 1991]. Most of the women work unpaid in their households and have no decision-making power. The infant and under-five mortality rates per thousand live births are 100 and 180 respectively. The prevalence of protein-energy malnutrition (PEM) is very high and has been almost the same for the last 2 decades, that is 35% of all children under 5 are severely stunted and another 30% are moderately stunted. About two-thirds of all children are under-weight and more than 14% are wasted. Only 6.6 % of 23 million children are of normal weight-for-age according to the Gomez classification [Bangladesh Bureau of Statistics 1991].

Life expectancy at birth for both sexes combined is 55.9 years, with a slightly higher figure for males (56.4 years versus 55.4 for females). The male: female population ratio is 55.6:52.4.

1.4.2 **Urbanization and urban growth**

The level of urbanization in Bangladesh is one of the lowest in the world. Approximately 20% of its 108 million people live in urban areas [Bangladesh Bureau of Statistics, 1991]. However if the absolute size of the urban population is considered, Bangladesh stands remarkably high. In fact the total urban population of Bangladesh was nearly 22 million in 1990, which is higher than the total population of some 92 countries of the world .

Although the level of urbanization is low, the speed of urban growth is high, with an annual rate ranging from 7 to 11 percent in recent years. At this rate the urban

population of Bangladesh will more than double by the end of the century. By the year 2000, it is anticipated that over 26% of the country (or 37 million people) will live in urban areas. Most of the growth in the cities of Bangladesh has resulted from in-migration and not from natural growth [Centre for Urban Studies, 1990]. As landlessness and poverty increase in rural areas, people leave their villages and move to the cities in search of work.

According to the Bangladesh Bureau of Statistics [1991], 43.9% of the civilian population above 10 years of age are employed. Out of the employed civilian population, only 9.4% are female. About 77% of men in urban Dhaka are regularly employed, the most common occupation being rickshaw pulling. In contrast about 25% of women among the urban poor are employed, mostly as domestic servants or garment workers [Islam et al., 1986; Islam and Khan, 1988]. Dhaka, the capital city of Bangladesh, where the study was carried out, covers an area of 202 square miles (522 sq.km) with a population of 6 million [Bangladesh Bureau of Statistics, 1991; Centre for Urban Studies, 1990]. About 60% of the population of Dhaka live below the poverty level 1, that is, earn less than taka 2600/month (local currency, 60 taka = £ 1 during the study period) and about 30% live below the poverty line 2, earning < taka 1724/month [World Bank, 1987]. The World Bank further estimates that by the year 2010, 40% of urban people in Bangladesh will be below poverty level 1 and 25% below level 2. Those in poverty level 2 are also termed the 'hardcore poor.'

1.4.3 Characteristics of Dhaka slums.

The Centre for Urban Studies and their consultative group defined the urban poor as: " people who cannot afford to meet the basic needs/requirements with their own incomes" [Islam et al 1988]. In 1981 the total number of slums and squatter settlements was 771 which had grown to 1125 by 1989 [Centre for Urban Studies 1990].

The floor space available per family of 2-3 adults and 2-3 children for sleeping, cooking, sitting and eating is 10-20.5 sq.ft. [Islam, 1986; Haque, 1989]. Most of the slum dwellers are rent payers (48.9%), some are owners (41.1%) and others

(10%) are occupants of free land owned by Government or semi- government. Plates 1 and 2 show one of the many slums in Dhaka city.

Thirty percent of the slum dwellers are connected to a gas supply from the landlords' residence, and 55% have electricity which is mostly supplied from illegal/unauthorized connections from the street. Over 50% use water from municipal stand pipes or community tube-wells (plates 3 and 4) or from a nearby pond/ditch or river, and 87% use community toilets (plates 5 and 6).

1.4.4 **Health Facilities**

The country's inadequate health facilities are 50% dependent on foreign aid [Government of Bangladesh, 1990]. In total, 875 hospitals with a total bed capacity of 33,376 are available, giving a bed: patient ratio of 1:3347, and a physician: patient ratio of 1: 5762. The total expenditure on health by the Government of Bangladesh, including family planning and nutritional activities, is only 4.6% of the total budget. Per caput government expenditure on health and family planning is tk 73.

Medical care and health facilities for slum dwellers are almost non-existent, because the Government of Bangladesh does not have a specific urban health policy, unlike the rural areas. There is also a remarkable disparity in resource allocation between urban and rural areas. This is reflected in the doctor: patient ratio which is 1:65,000 in rural areas and 1:900 in urban Dhaka. However the hospital bed:population ratio is similar in both situations. The enormous disparity between the urban elite and the urban poor in the slums is reflected by infant and young child mortality and morbidity differences.

Plate 1 . A typical Dhaka slum (exterior)

Plate 2. Interior of a typical slum

Plate 3. Communal tube well water supply for drinking and washing

Plate 4. Communal stand pipe water supply

Plate 5. Hanging or kuccha latrine (communal)

Plate 6. Cemented pan or Pucca latrine (communal)

Two estimates of infant mortality (152 and 182 per thousand live births) reported in urban slums are well above the national average of 100 per thousand live births [Centre for Urban Studies, 1990], and the 1-4 year child death rate in urban slums is nearly 10 times the national average [Ashrafuddin, 1987; Das, 1989; Bangladesh Bureau of Statistics, 1991]. Compared with the general situation in urban areas, the infants in slum communities are extremely vulnerable to disease and death. In general, communicable diseases arising from the poor environment, overcrowding and poor personal hygiene are the most prevalent diseases of the urban poor [Rahman, 1985; Rahman, 1987; Begum,1988a]. The most prevalent are : diarrhoeal diseases, respiratory infections, scabies, helminthiasis, measles and tuberculosis. Children of the poor are more vulnerable to disease than the adults.

1.4.5. **Nutritional Situation**

According to UNICEF [1992] only 5% of the population at present consume adequate quantities and quality of food. The poorest spend 75 - 80% of their total household income on food and generally consume less than 80% of their calorie requirement.

Although stunting is a nationwide problem, wasting also prevails reflecting acute malnutrition particularly among the urban poor with a rate of more than 11 percent [Bangladesh Bureau of Statistics, 1991]. Findings from 5 major surveys of anthropometric status are given in Table 1.4.1.

1.4.6. **Health care delivery system**

Since independence, the government has been consistently pursuing a policy for providing essential minimal health care to all, particularly to those who are underprivileged. Successive health plans have emphasized Primary Health Care (PHC) as the key approach. The Third Five Year Plan (1985-90) therefore was based on the PHC concept to meet the goal of " Health for all by the year 2000" [Government of Bangladesh, 1985]. The levels of service delivery consist of : a) home and community level, b) union level, c) upozila level d) district hospitals and e) national/tertiary referral level.

Table 1.4.1 Comparison of anthropometric status of children aged 6-72 months in rural and urban areas: Results from 5 surveys

Indicators	INFS	HKI		BBS	
	1981-82	1982-83	1990	1985-86	1989-90
Stunting(<90% ht/age)	%	%	%	%	%
National	57.3	-	49.5	56.1	51.1
Rural	-	42.0	48.8	57.6	52.2
Urban	-	-	51.2	44.2	42.3
Wasting (<80% wt/ht)					
National	20.0	-	11.3	8.1	8.6
Rural	-	6.0	10.9	8.2	8.8
Urban	-	-	16.8	6.9	7.3
MUAC:(<12.5cm)					
National	-	-	13.4	14.4	10.4
Rural	-	10.0	11.9	14.9	11.0
Urban	-	-	16.8	9.9	8.5

Adapted from Bangladesh Bureau of Statistics Child nutritional status survey 1989- 1990
INFS= Institute of Nutrition and Food Science
HKI= Helen Keller International
BBS= Bangladesh Bureau of Statistics

The five tier health care system focuses on delivering health care mainly to rural areas [Director General Health Services, 1985; Begum, 1988b].
Theoretically, the urban poor and slum dwellers have access to all the public health facilities such as urban dispensaries, hospitals etc, but in reality very little is available to them. Compared to the demands, these facilities are meager and the expenditure involved in transport, long waiting times and in the end no service, turn them to local healers and quacks. The health planners focusing on health needs of the rural population, have as yet failed to recognize the urbanization process and the accompanying constant stream of rural to urban migration in the country. The health needs of the large section of the population living in the urban slums have consequently been neglected.

1.4.7 Nutrition Rehabilitation Centres

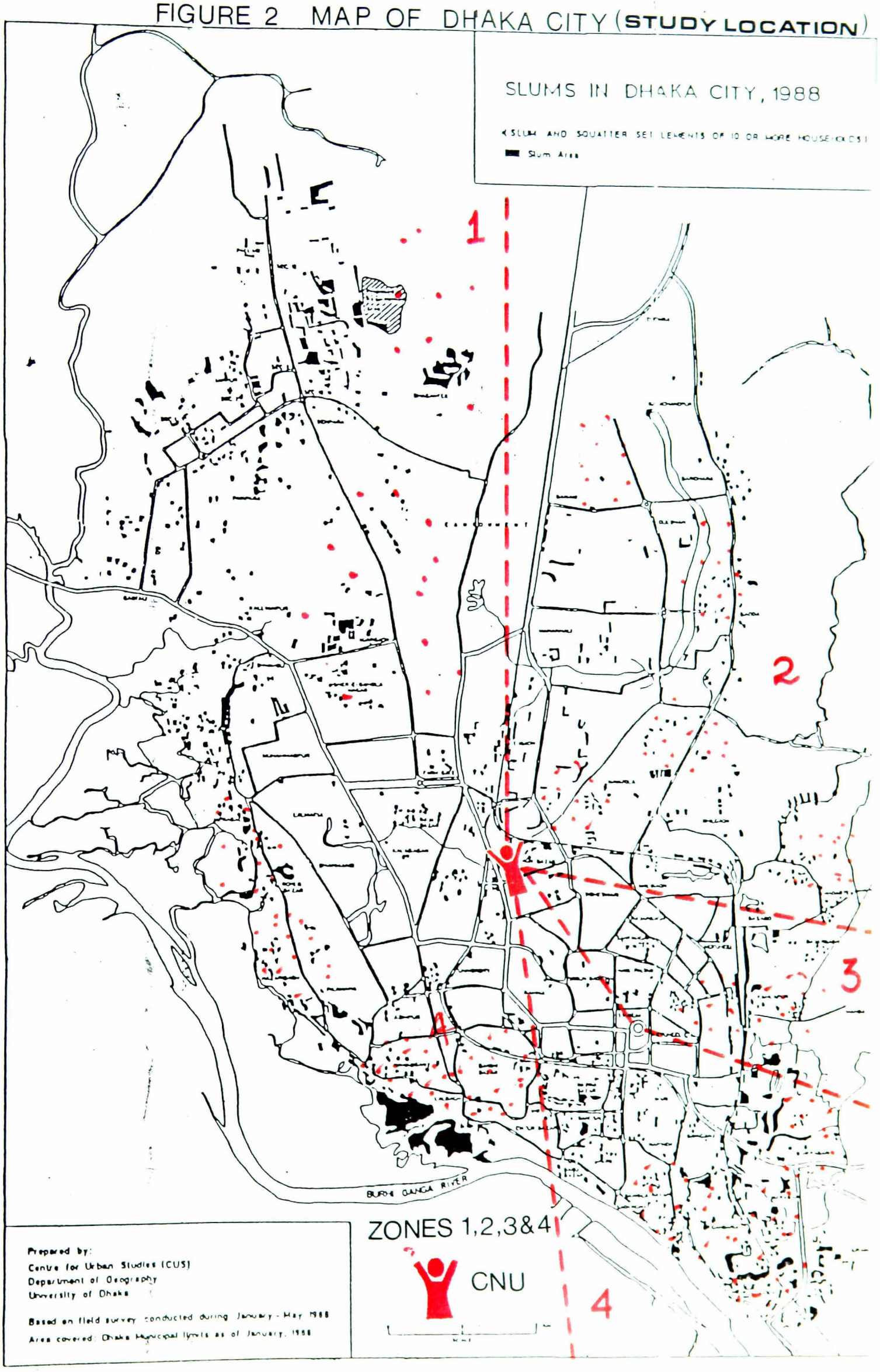
Recognizing the magnitude of the nutritional problem in Bangladesh, a comprehensive public health nutritional program was undertaken during the Third Five Year Plan to improve the nutritional status of children. As hospitals could not provide sufficient beds to treat severe malnutrition, the program included establishing 20 child nutrition units to serve as feeding and rehabilitation centres for severely malnourished in selected rural health care complexes [Government of Bangladesh, 1990]. Information is not available as to whether these centres ever functioned but they are reported to have been closed down due to high drop-out rates.

1.4.8 Nutrition and health care financing and future steps.

The Government of Bangladesh's objective for the Fourth Five Year Health Plan is to continue PHC but to give more emphasis to human resource development, prevention, control and treatment of major communicable and non-communicable diseases, and to improve nutritional status of the population, particularly of mothers and children [Ali, 1990]. It is not clear whether the plan to reduce moderate and severe malnutrition among those under 3 years old by 50%, to reduce the prevalence of wasting and to reduce the present rate of 35-50% low birth weight by 50% by the year 2000, will be part of the Fourth Five Year Plan or whether it is a separate programme. There is, however, a negligible change in the budget allocation for health and family planning [Government of Bangladesh, 1992]. Nevertheless, two major steps to fulfil these commitments have been formulated: a) a community based nutrition program has been planned by the National Institute of Public Health and Nutrition and b) the World Bank [1993] is proposing a rural based vertical project 'Bangladesh Integrated Nutrition Project', under the ministry of health. The project will last for 5 years during which one supplementary snack will be provided daily on the spot for i) children <3 years who are 'growth faltering' and the duration will be for 3 months. ii) pregnant and lactating mothers for 6 months to 1 year. The package will also offer education on family planning, health and nutrition and there will be a referral system for severe illnesses. However, this proposal is viewed by sceptics as highly ambitious and impractical. Bangladesh is not short of health and social programmes. The

effectiveness and coverage of these are limited by skills and attitude of the workers and the levels of support provided to them. The health sector has already a number of vertical programmes, such as the extended program of immunization (EPI), family planning, vitamin A supplementation, Iodine supplementation, traditional birth attenders' training program etc. A question of integrating family planning and health, a seemingly obvious move has already been addressed as one means of rationalising service provision. The wisdom of imposing another vertical project on this already complex health structure needs to be closely examined, not only for its potential management implications but also because the concept of the supplementary feeding programme raises important issues concerned with dependency and long-term sustainability.

FIGURE 2 MAP OF DHAKA CITY (STUDY LOCATION)



CHAPTER 2 STUDY DESIGN AND METHODS

2.1 Location of the study

The study was carried out in the Children's Nutrition Unit (CNU) which was established in 1975 by the Save The Children Fund (SCF) and is the only one of its kind in the country. It is situated in the central area of Dhaka city, the capital of Bangladesh (figure 2 page 50). Dhaka has a population of 6-7 million [Bangladesh Bureau of Statistics, 1991].

2.1.1 Brief history of the Children's Nutrition Unit

CNU was established as a response to the entry into Dhaka of large numbers of people in search of food and work following the closure of Government camps set up during the 1974 floods. SCF had been working in these camps and the need to continue the work was evident after the camps had closed and people shifted to areas around Dhaka railway station and camps around the outskirts of the city [Save The Children Fund, 1974]. SCF decided to open a small unit to try and save some of the children who were dying from severe malnutrition. At the same time, foreseeing the possibility of an acute nutritional crisis occurring in Bangladesh, the Johns Hopkins Centre for Medical Research and Training (JHUCMRT) indicated an interest in cooperating with SCF to develop a nutrition research unit for pre-school children and pregnant and lactating mothers. This was agreed and the unit was known as the Nutritional Research Unit (NRU) [Save The Children Fund, 1975]. The NRU was set up in the former League of Red Cross Headquarters, in a two-storey, 16-room building in the heart of Dhaka. At the outset there were four main areas of activity, namely:

Out-patient and day-treatment centre capable of handling 150 patients daily . The out-patient department (OPD) concentrated on malnutrition and associated diseases, immunizations, scabies and family planning. The day-treatment centre was for children too sick for out-patient care but who did not need hospitalisation.

These patients received two meals plus a snack and went home daily at 4 pm till sufficiently recovered to attend OPD.

An in-patient department (IPD) designed for 20-40 severely malnourished patients, to be given intensive nutritional therapy for 30 days or more as needed for sufficient recovery to be sent home.

Nutritional studies to determine the effects of malnutrition on the patients' immune response and to study the relationship between nutrition and infectious diseases. From the beginning the NRU kept comprehensive patient records so that basic data such as age ,weight, height and other pertinent information could be extracted, compiled and correlated. By 1977 a metabolic unit had been established to obtain baseline data on nutritional disorders in Bangladesh, and laboratory facilities were established to support this unit.

Educational programmes for mothers of children in either in-patient, OPD or day-care departments to receive instruction in hygiene and child care, dietetics and family planning. Training activities were also extended to non-unit medical personnel so as to make the NRU part of the training programme for nursing students and all levels of health workers. Under the agreement between SCF and JHUCMRT, day-to-day care in the unit was to be the responsibility of SCF and its staff, and research activities were to be conducted by JHUCMRT in association with scientific and medical personnel of the Bangladesh Medical Research Council. At this stage there were three expatriate doctors from JHUCMRT at the unit as advisers, with two other expatriates (one nurse and an administrator) from SCF.

In early 1978, JHUCMRT withdrew and the emphasis of the unit changed more towards training and community-based activities, and it was renamed the Children's Nutrition Unit. The day-treatment facilities for severely malnourished children remained but non nutritional medical cases were excluded due to lack of funds. In August 1978, follow-up home visits to former in-patients were introduced. Training was now provided for various institutions including the Institution of Nutrition and Food Science (INFS) and the Institution of Public Health and Nutrition (IPHN), and for medical students from Dhaka Medical College and Sir Salimullah Medical

College. During this period, the need was identified for more appropriate premises and facilities if the CNU was to cope with its expanding work programme and to capitalise on its increasing status as a specialist centre for training doctors and other workers engaged in the study and care of children with malnutrition. An in-patient facility of 40 beds was seen as inadequate. A need for expansion was indicated. Considerable doubts, however, were expressed about whether SCF had the funds to provide these facilities. In the event, acknowledgement of the unique nature of the unit, agreement that there was insufficient recognition (in Bangladesh) of the importance of malnutrition as an underlying cause of many diseases, the unit's poverty focus, and its value as a training institution, led SCF to agree to continue its commitment to the unit.

The CNU moved into its purpose-built premises in June 1988 with provision for laboratory facilities, but continued to utilize x-ray facilities from outside. Day-care facilities to treat malnourished children (on a daily basis for 9 hours a day) were introduced in 1984 initially as a pilot project in the old premises. In the new facilities a separate purpose-built area was allocated for the day-care, having a capacity to handle 30 patients a day. The reasons for having a day-care facility were the following:

1. It would act as a "halfway treatment" after being in IPD for a week, so making beds available for acutely ill cases.
2. For parents who do not want to go to or stay long in IPD.
3. For less severe cases, thus sparing IPD beds for more serious cases.
4. For training purposes for those groups of trainees who will not have in-patient facilities in their health centres, for example staff in rural and semi-rural health posts.

2.1.2 **Current facilities and activities of the Children's Nutrition Unit.**

These are:- A. treatment and prevention of the immediate causes of malnutrition, including:

1. in-patient curative care for severely malnourished children in its 60-bed wards,

2. a day-care feeding and treatment centre for less severe malnourished cases and those who do not want to go to or remain long in IPD. The facilities have a capacity to handle about 30-40 patients a day.
3. an out-patient department for sick and well children and mothers, including immunization, family planning, ante-natal care, and health and nutrition education, and
4. a community-based programme providing preventive activities in 12 slum communities;

B. a training programme for Government and NGO staff in Bangladesh and other NGO staff from the region;

C. research activities on therapeutic, dietary, social and economic factors, aimed at improving the treatment and prevention of malnutrition.

2.1.3 Cost of services

CNU has an annual budget which in April 1990-March 1991 amounted to 10.5 million taka (£ 160,000), of which 50% was spent on salaries, 30% on running costs (including maintenance and supplies), about 15% on training, and 5% on research [SCF, 1990]. CNU has a staff of 95, including 7 doctors, 16 nurses (12 in IPD), 4 administrative staff, and domestic staff.

2.1.4 The beneficiaries

Sixty percent of the attenders who come to CNU are brought by their mothers who have heard about it by word of mouth and 40% are referrals from other teaching and general hospitals. The OPD is open to all children aged 0-10 years from the under-privileged community of the main catchment area, the urban slums. Of the children attending the OPD (average 150/day), 90% come from the overcrowded slums (plate 7) of the city and the rest come from further afield. Fathers of most children are rickshaw pullers (tricycle peddlers, plate 8), and others are mostly day labourers , market porters or temporarily employed or unemployed. Most mothers, if working , are domestic servants, or garment factory workers. Their combined monthly average income is about taka 800 (£13) . Only 12% of the mothers and

27% of the fathers are literate [Khanum, 1985] , and average size of the family is 5.1.

Plate 7. Slum population, the main beneficiaries of CNU

Plate 8. Rickshaw pullers, the main occupation in Dhaka slums

2.1.5 Management of patients at the Children's Nutrition Unit

After registration in OPD, children are weighed and measured and those who are oedematous and/or < 60% of the Harvard median weight-for-height with any complication (infection, dehydration etc) are admitted to the CNU either in the 60-bed in-patient unit or in the day-care unit when an informed consent for routine treatment procedures is signed by the parents or caretaker. Admitted children are fed 2-hourly for the first few days, then 6-hourly with locally available and affordable food items during the period of catch-up growth. **Feeding for week 1** (acute phase) is half-strength dried skimmed milk, 2-hourly round the clock, usually from a cup (about 80-100 ml/kg/day) and/or rice-based cooked food three times a day and 2 snacks as preferred. The aim is to provide approximately 100-120 kcal/kg/day and 2-3g protein/kg/day (see recipes and feeding schedule in Annexes 1-4). Anorexic children are fed by nasogastric tube.

From week 2 (rehabilitation phase), the amounts given are 120-150 ml/kg/day or more of full-strength dried skimmed milk 6-hourly for children < 2 years and/or cooked solid food 3 times a day and two snacks. For children > 2 years, 3-4 solid meals and 2 snacks are given ad libitum. The aim is to provide 150-200 kcal/kg/day and 3-4g of protein/kg/day (see feeding schedule Annex 2).

All patients receive broad- spectrum antibiotics on admission, infections are later confirmed through laboratory investigation and treated as appropriate. Besides treatment of infections with antibiotics, multivitamins,electrolytes (potassium chloride, magnesium sulphate), riboflavin, folic acid and high potency vitamin A capsules and zinc are given routinely. Oral iron in the form of ferrous sulphate in appropriate doses is given from the second week (see annex 5 for doses). All children are weighed daily (without clothes 1 hour before a meal) for the first week, then on alternate days for the next two weeks. Height/length and mid upper arm circumference (MUAC) are measured on admission and on discharge. They are usually discharged when 75-80% wt/ht is reached (which takes about 3 weeks).

Children below one year of age are followed-up in the OPD clinic once a week for 3 months, twice a month for 1 year and once a month for another year. For

older children follow-up is twice a month for 6 months and once a month or once in two months for 1 year. For TB patients follow-up is twice a month till the treatment is completed and in the case of non-attenders, by home visiting.

In addition to general management described previously, all children below 2 years of age receive measles vaccine routinely on admission. Unimmunised children are started with DPT, oral polio vaccine and BCG in week 2 if they are of immunisable age and the immunization schedule is completed later during follow-up. Attendance in follow-up clinics varies from year to year depending on local circumstances. In 1993, follow up was comparatively better for younger children, that is 60% of ex-inpatients who were <1yr attended follow-up clinics for 9 months; whereas follow-up for older children during the same period was 45%. Among the younger children followed, 81% and 67% respectively received second and third doses of DPT and oral polio vaccines. Of the TB patients 73% attended to continue treatment. The number of home visits increased slightly in 1993 compared with the previous years [SCF, 1993].

In the OPD, both preventive and curative treatment are given to all children. In addition, mothers receive family planning , ante-natal services, and health and nutrition education. Education instruction for mothers includes cooking demonstration with locally available, affordable and acceptable nutritious food items (plate 9). These sessions are usually conducted by mothers of in-patients and simple messages on feeding, health and hygiene, and general child care are conducted by paramedics in the OPD (plate 10). A group of 10-12 mothers attend the 15-minute sessions while waiting to be attended by the OPD doctor or paramedics. In-patient mothers also join with the OPD mothers in the instruction sessions. There are also sessions for fathers of in-patients during visiting hours covering similar themes as for the mothers.

The out-patient department operates 5 days/week from 8 am to 4 pm. About 50,000 children are seen annually in OPD of which 25 -30% are new cases and others are revisits. The in-patient section operates 24 hours everyday, including admission of emergency cases. The annual admission in IPD is about 1000 severely malnourished children with multiple complications and for day-care about 250 annually. Mortality rate varies from 3-7% .

Plate 9. Nutrition education for the mothers/carers

Plate 10. Health and hygiene instruction by paramedic

2.2 Methods

2.2.1 Study Design

The purpose of the study was to identify the most cost-effective approach for the management of PEM. Three types of treatment were compared in a longitudinal prospective study.

2.2.1.1 Description of the three groups

In-patient (IP)- these children received treatment as in-patients (plate 11) in the usual way. They were admitted with their mothers and were resident throughout the treatment period until their wt/ht reached 80% of the NCHS median.

Day-care (DC)- these children were admitted to the day-care facilities where they attended with their mothers (plate 12) (and immediate younger or older sibling when applicable) on a daily basis for 9 hours (8 am to 5 pm) 6 days a week until 80% wt/ht was reached.

Domiciliary care (DCD) - This was a new group introduced for the purpose of the study. Children in this group were admitted as day-care patients for 7 days (± 2 days). Thereafter they were visited at home by specially trained health workers every week for 1 month, then twice a month until the children in this group achieved 80% wt/ht (plate 13).

Plate 11. A child in the in-patient facility

Plate 12. A child in the day-care facility

Plate 13. A child in the domiciliary group

2.2.1.2 Exclusion and allocations to each group

Children were sequentially allocated to the three groups until the desired sample size was achieved. For administrative convenience, allocation was made on a rotational basis such that recruitment to each group occurred every third day. The initial sequence was randomly determined.

Exclusions - Since there is no experience concerning the management of severely malnourished children with multiple infections in the home, clinical consideration demanded that certain precautions must be taken if children were to be sequentially assigned to treatment groups. Very young children (less than 12 months of age) were excluded as they were considered a high mortality risk if domiciliary management should prove unsuccessful. Children who were critically ill were also excluded as it was felt they would need more than 7 days close medical supervision. Those likely to recover particularly slowly were also excluded, as were those who came from far away. The exclusions are summarized below:

1) less than 12 months of age or over 60 months.
2) severely anaemic (packed cell volume less than 20%) needing blood transfusion and cases with severe dehydration.
3) diagnosed as having tuberculosis (TB).
4) critically ill (eg meningitis, encephalitis or other cerebral lesion, haemolytic anaemia) and needing prolonged hospitalisation.
5) come from impractical long distance more than 10 kilometers which would limit participation of those allocated to the day-care group and would present logistical difficulties for weekly follow-up of the domiciliary group.
6) children with congenital or metabolic disorders.

Children recruited to one group and subsequently transferred to another group for example at the request of the parents, were dropped from the study. All exclusions and transfers received full CNU care as usual.

The eligible children who were between 12-60 months of age residing within 10 kilometers of the CNU and were oedematous and/or 60% or less wt/ht of the NCHS median were admitted for treatment in one of the 3 groups.

2.2.1.3 Outcomes of interest

The study was divided in two phases; they were:

a. Short-term - covering the time from the day of admission till 80% wt/ht was achieved. The main outcome variables in this period were mortality, speed of recovery, weight gain (g/kg/day), energy intake (kcal/kg/day) and the institutional and parental costs to rehabilitate each child.

b.Long-term - This period began from the day after reaching 80% wt/ht and continued for the following 12 months. The main outcome variables of interest in this period were: gain in weight and length/height, morbidity, mortality and relapse rates.

2.2.2 Calculation of sample size

The calculation for the sample size was confined to that required to have a 90% power of detecting a significant difference at the 5% level in cost effectiveness among the treatment groups in the short-term, as we did not anticipate any significant difference in cost-effectiveness thereafter. To determine the required sample size the following formula was used [Kirkwood 1988].

$$n = \frac{(u+v)^2 (s_1^2 + s_2^2)}{(x_1 - x_2)^2}$$

n = minimum sample size

u = 90% power of achieving a significant result (u = 1.28).

v = 5% significance level (v = 1.96)

s_1 s_2 = standard deviations

x_1-x_2 = difference between means

The cost estimate was based on current (1990) average costs for in-patient and day-care patients to achieve the discharge criterion of 80% wt/ht, using the data shown below but excluding children who would be ineligible for the study (TB patients, those seriously ill etc). The costs given below were calculated from case histories of 30 in-patient children and 30 day-care patients, and included food, medicine,

laboratory tests, services, transport (fuel costs), administrative overheads etc excluding capital costs and opportunity cost.

Table 2.2.1 Mean duration to achieve 80% wt/ht , weight gain g/kg/day and cost per child /day of 30 in-patients and 30 day-care patients

Type of rehabilitation	Mean days (± sd) taken to reach 80% wt/ht	Mean weight gain (±sd) g/kg/day	Cost/child/day (tk) mean± sd	Total cost /child(tk) mean ± sd
In-patient	24 ± 13	8 ± 6	201 ± 55	4835 ± 1914
Day-care	28 ± 11	6 ± 4	55 ± 11	1545 ± 921

There were 2 estimates:

Estimate 1 - for this estimate , the costs for IP and DC from table 2.2.1 were taken.

	Taka ± sd
In-patient	4835 ± 1914
Day-care	1545 ± 921

Estimate 2

Usual CNU practice was that the most severely ill children were channelled into the in-patient facility. In the study design, eligible children were to be randomly assigned to the 3 groups. Anticipating the possible effect of reducing the average treatment cost (by sharing the number of severe cases) in IP and increasing those of DC a second estimate was therefore calculated as follows:

	Taka ± sd
In-patient	3050 ± 1250
Day-care	2050 ± 1050

Based on the mean costs of treatment for in-patients and day-care patients, a minimum of 100 children per group was considered sufficient to detect a 15-20% reduction in cost for treatment in the domiciliary group (90% power, 5% significance level). Approximately fifty percent more cases were added to the estimated numbers in each group anticipating losses to follow-up, late exclusions (TB) and drop-outs.

2.2.3 **Subjects**

During the first phase of the study (December 1990-November 1991) a total of 1332 severely undernourished children aged between 4 months and approximately 10 years were admitted to CNU. After meeting the inclusion criteria, 573 cases were sequentially allocated to the 3 study groups, that is 200 each in IP and DC and 173 in DCD. There were further exclusions, dropouts and some deaths and finally 437 children (173 in the in-patient, 134 in day-care and 130 in domiciliary care) achieved 80% wt/ht. They then proceeded to the second phase of the study and were followed at home every fortnight for morbidity surveillance and every month for anthropometric measurements for a period of one year.

2.2.4 **General management of the subjects**

After registration at OPD their weight in kilograms, length/height in centimetres and mid-upper arm circumference (MUAC) in millimetres were measured. Each child in each group was given an identification number and each child was known by that number throughout the study period. They were admitted with their mothers and a pre-coded questionnaire (annex 6) was filled to obtain background information such as socio-cultural-economic data, morbidity and feeding history, and other relevant data which might have contributed to cause PEM or may influence weight gain during follow-up. Parents signed the usual consent form (annex 6 page 208) .

All children received a thorough physical examination by a physician to look for signs of nutrient deficiencies and complications. Broad-spectrum antibiotic that is,

ampicillin 50mg/kg/day was given routinely to all patients on admission to cover for both gram-positive and gram-negative organisms. For in-patients this was given intramuscularly for the first three days then orally for 7 days. DC and DCD received oral ampicillin for 10 days. Laboratory investigation was carried out to detect specific infections and their antibiotic sensitivity. This included routine blood (total and differential white blood cell count, packed cell volume (PCV) and total protein), urine and stool examination; bacteriologic culture of urine by suprapubic tap, blood, wound swab and laryngeal swab for acid-fast bacilli, and chest X-Ray. All identified infections were treated as appropriate. The clinical condition of the children was assessed daily to look for signs of heart failure, disappearance of oedema etc by a physician (annex 6 page 209). In addition, intake-output charts, and records of pulse, respiration and temperature were maintained by the nurses. Further laboratory examination, particularly total protein, packed cell volume and full blood count, was performed weekly. Re-investigations of blood, urine, stool and blood examination for malaria were carried out in cases of non-response to treatment and unexplained fever.

TB was diagnosed if two or more of the following conditions were present: a) fever of more than 4 weeks duration; b) history of contact with adult TB patient; c) persistent palpable cervical glands, d) positive reaction to Mantoux test after 72 hours (≥ 10mm) in absence of BCG; e) pneumonia not responding to antibiotic, f) weight gain <3g with >150 kcal/kg/day in absence of any infections; g) positive chest X-ray suggestive of TB; h) exaggerated BCG reaction within 7 days and i) blood in sputum with presence of acid-fast bacilli.

2.2.5 **Feeding and management of the 3 groups**

In-patient (IP)

These children received routine treatment as in-patients till they achieved 80% wt/ht when they were discharged. During the first week they were fed 2-hourly half-strength dried skimmed milk 80-100 ml/kg/day (100 ml of half-strength milk =

75 kcal and 1.5g of protein) together with energy-dense low-cost local staple foods, consisting of rice, dhal (lentils) and pulses, vegetables and meat and snacks, which were given 5-6 times daily (annexes 1 and 2). The aim was to provide 100-120 kcal/kg/day and protein 2-3g/kg/day. Food was cooked salt-free at this stage. From week 2, for those under 24 months a full diet consisting of 3 cooked meals, 4 milk feeds (120-150ml/kg/day of full-strength dried skimmed milk, 100ml=100 kcal and protein 3g) and 2 snacks/day were given. Older children received six solid feeds ad libitum without the milk feeds. The aim was to provide 150 -200 kcal/kg/day in the second and subsequent weeks (see annex 2). Breast fed babies continued to receive breast milk. (This was omitted from the energy calculation). In addition to this feeding scheme, high potency vitamin A capsules were given (200,000 international units) on admission and when 80%wt/ht was reached. A daily amount of ferrous sulphate (4 mg/kg/day) was given from week 2. Multi-vitamin drops, potassium chloride (5 -6 meq /kg/day) magnesium sulphate (1 -2 meq/kg/day), riboflavin 5mg and folic acid 5mg were also given daily throughout their stay. Mothers or their substitute (eg if the mother was ill, or working, or dead) stayed with the patients throughout their stay. Some mothers came and went if they had a breast fed child at home.

Day-care (DC)

Children in this group were admitted to the day-care facilities where they attended with their mothers on a daily basis for 9 hours from 8 a.m to 5 p.m , 6 days a week. The immediate younger or older sibling of the patient was allowed to accompany the mother and both received food from the centre. They received 2 hourly milk feeds (80-100 ml/kg/day) from the time of arrival till they left in the evening and 4 cooked meals (rice pudding, rice, meat and vegetable mixture and rice and dhal) and a snack in week 1. From week 2 the milk feeds were increased to 120-150ml/kg/day and fed 4 times at the Unit. Four cooked meals and 1 snack were given ad libitum as for the in-patients. In addition to feeding, children received high potency vitamin A capsules, potassium chloride, magnesium

sulphate, multivitamins, folic acid and ferrous sulphate (folfe-tab) and riboflavin as in IP.

Mothers were advised to give at least 3 further feeds at home in the bowl and cup supplied by CNU. These were one plate (340g) of rice+dhal+pumpkin and 2 milk feeds (180ml each time) in week 1, and in week 2, two plates of rice+dhal and rice pudding and one cup of milk. For the weekend (Fridays) mothers/carers were advised to feed at least 4 cups of milk and 4 plates of solid foods (rice+dhal+veg or meat, and rice pudding). All medications were given between 8 am and 5pm at CNU, except for those who received 6,8 or 12 hourly doses of antibiotics. In those cases the last dose was given by the mother, they were also provided with the other medicines (including KCl and MgSO4) to take home for the weekends.

Domiciliary (DCD)

These children were initially admitted as day-care patients and thus received identical treatment to the DC group during this time. They went home on the 8th day, or on the 6th or 7th day if they had begun to eat well (that is, had eaten 3 consecutive recommended meals for 3 out of 5 days, without force feeding) and any infections identified had been treated. If the child was not eating well on the 8th day he/she was kept for a further 1 or 2 days, but no more. If a child on the 10th day was considered too sick to send home, the child was transferred to IP and dropped from the study. Poor appetite alone did not preclude discharge, but if poor appetite persisted at home the child was readmitted in IP for investigation and dropped from the study. Multivitamins and ferrous sulphate were continued at home till 80% wt/ht was reached and a prophylactic dose of high potency vitamin A was given when 80% wt/ht was reached.

Parents were advised to give an energy-dense diet in adequate amounts for catch-up growth. Mothers were provided with a bowl holding 340g when full and a cup holding 180 ml. Both containers were marked to show the helpful partition. Parents were asked to feed 3 cooked meals, 2 snacks and 3-4 milk feeds using the cup and bowl supplied. Food recommended for daily consumption was:

1 full bowl of rice pudding, one bowl of rice+dhal+vegetable mixtures, one bowl of rice + dhal or potato + mashed vegetable, with meat or fish if affordable to be cooked with oil, and snacks like chappati + dhal or chappati+ milk, banana, other seasonal fruits. The aim was to provide 150-200 kcal/kg/day and approximately 3-4g protein/kg/day.

Mothers were supervised regularly by well-trained health workers who visited once a week for the first month, then every fortnight until 80% weight/height was reached. In cases where oedema persisted after the first month, weekly visits continued till the child was oedema free. For the domiciliary group, separate forms were designed (annex 7) to monitor weekly progress, 24 hour food intake of the child by dietary recall on the visit day, and cost of the child's food. Besides the teaching sessions in the CNU, instructions were continued at home including the general cleanliness of the living premises. Supplementary food was not provided from CNU or anywhere else for any of the groups.

Physical examination during the home visit included: checking for fever, dehydration, anaemia, oedema, any sign of vitamin A deficiency, throat, mouth, ears and skin. They were referred to CNU if: children did not gain weight for 2 consecutive visits, had persistent diarrhoea, dehydration, pneumonia, persistent fever, infected scabies, throat or middle ear infection, xerophthalmia, jaundice or poor appetite (for definitions and referral criteria see annex 8). If the child was ill, he/she was either visited by the physician or the child was brought to the centre by parents for consultation.

2.2.6. Nutrition and health education for mothers/attendants

Mothers or attendants of all study children while at the CNU received the usual CNU instruction by the paramedics in child care, emphasising nutrition and health promotion. The instruction followed a structured format covering specific aspects each day such as: importance of breast feeding, adequate and frequent feeding from the family pot along with breast milk, importance of immunization, prevention of night blindness and diarrhoeal diseases, advantages of a small family and motivation for family planning, instruction on personal hygiene and health of the

family in general. They also attended and participated in practical cooking demonstrations in OPD. The duration for each session on child care was 20 minutes and the cooking demonstration was for 15-20 minutes, totalling 40 minutes daily for 6 days/week.

In addition to the usual health and nutrition education, mothers/attendants of the study children particularly those in the DCD group who had to feed the children at home from the 8th day and DC mothers who had to provide 2-3 meals daily and all meals on Fridays received special instruction on feeding. This differed from the usual cooking demonstration for all. As they were going to feed severely malnourished children at home without any supplementation from outside, they were taught to cook affordable menus (emphasising use of oil to make food energy dense) and number of times and amount to be fed each time in the cup and bowl supplied, and were advised to feed their other children and the rest of the family adequately within their means. As a practical exercise, ingredients were supplied and they were asked to cook and prepare food themselves for the whole family, keeping in mind the special needs of the malnourished child. They were grouped according to number of family members. Samples of food mixes from these exercises and the recommended food mixes to be fed at home were sent to ICDDRB for bomb calorimetry twice during the study period.

2.2.7. **Data collection**

Anthropometric measurements

Weight for height is used as the main criterion for admission to CNU as it is considered a good measure of mortality risk. The major advantage of using wt/ht is that it is age and race independent [Newmann,1979]. Therefore, wt/ht was used for admission and discharge for the study. Anthropometric measurements were compared with the National Centre for Health Statistics (NCHS) reference values [Hamil et al., 1979; WHO, 1986].

Weight Portable electronic scales (Soehne 20kg × 10g) were used. The scales were standardized with 3 known constant weights (2 kg, 5kg and 7 kg) every day before starting to weigh the children. Batteries were removed and kept separately before leaving for fieldwork. The weight of the pan was adjusted to zero before the child was weighed. Children were weighed nude sitting, standing or lying (plate 14). The same type of weighing scale was used at CNU and for home visiting. Children were weighed daily in CNU one hour before a meal at the same time of the day. Measurements were made by the same person except on Fridays and holidays. DCD children were weighed weekly at home. All groups were weighed every month after they reached 80% wt/ht for 1 year for the long-term study. Standard techniques for measurements were used [WHO, 1983]

Plate 14. Weighing child with digital scale

Height

Length or height was measured to the nearest 0.1 cm. A locally made portable "two track" length/height board was used which was interchangeable for recumbent and standing measurements. Children 24 months of age and above were measured standing. After removing shoes if they had any, the child stood on the flat surface in front of the scale with feet parallel and with heels, buttocks,

shoulders and back of head touching the upright flat wooden board. The head was comfortably erect and relaxed in the horizontal plane, with the arms hung loosely at the sides. The head piece, a wooden block, was gently lowered crushing the hair and making contact with the top of the head (plate 15).
For children under two years of age and those who could not stand, recumbent length from crown to heel was measured. The infant was laid on the board with head firmly against the fixed head board and the eyes looking vertically.The knees were extended with firm pressure by the mother or an assistant and the feet were flexed at right angles to the lower legs (plate 16). The sliding foot piece was moved to obtain firm contact with the heels and the length read to the nearest 0.1 cm. Height/length was measured in duplicate by the same person and the mean of 2 measures was taken. A difference of less than 5mm was acceptable.

MUAC was recorded weekly for IP and DC until 80% wt/ht was reached; and weekly for the DCD group for the first month at home and then fortnightly until they reached 80% wt/ht. MUAC was measured to the nearest millimetre by using plastic-coated fibre-glass tapes. A standard technique was followed [Jelliffe and Jellife, 1969] and accuracy was maintained by frequent re-training.

Age - The cultural pattern in the country is such that the mothers can only remember the 'Bengali' month of birth, more so if there is an event of importance before or after birth, for example flood, big storm, religious festival, death/assassination of head of state etc. There are 12 months in the Bengali calendar, and six seasons. The Bengali new year corresponds to April 14 of the English calendar. The Bengali calendar is very widely used and the new year is celebrated with traditional spirit by people of all classes. In this study it was possible to establish the month and the year in which the child was born. Age was recorded to the nearest month. Example : if the mother recalled that the child was born in February 1989 and the child was seen on 11 November 1991, the age of the child was calculated to be 20 months; and if seen on the 18 November 1991 the child's age was recorded as 21 months.

Plate 15. Health worker taking height in the field with the two-track board

Plate 16. Taking length with the two-track board.

In both the short-term and long-term phases of the study, rate of weight gain was an outcome measure. Rate of height/length gain was also an outcome measure in the long-term study. These outcomes were calculated as follows:

a) Weight gain - During the short-term period weight gain was calculated weekly and also for the whole duration from admission to 80% wt/ht. During the long-term period, weight gain was calculated monthly, quarterly, half yearly, and for the whole year of study.

Weight gain was expressed as g gained/kg body weight/day.
For example the weight gain in week 1 was calculated as

$$\text{weight gain(g/kg/d)} = \frac{(\text{weight day 8-weight day 1}) \times 1000 \div 7}{(\text{weight day 8} + \text{weight day 1}) \div 2}$$

Weight gain for the whole duration of the short-term study was calculated as:
weight gain(g/kg/day)=

$$\frac{(\text{weight when 80\% wt/ht reached-weight day 1}) \times 1000 \div \text{duration days}}{(\text{weight when 80\% wt/ht reached} + \text{weight on day 1}) \div 2}$$

In the long-term study, weight gain for the follow-up month 1, for example was calculated as:
weight gain (g/kg/day) =

$$\frac{(\text{weight month 1 - weight when 80\% wt/ht reached})\times 1000 \div 30}{(\text{weight month 1} + \text{weight when 80\% wt/ht reached}) \div 2}$$

b) Height/length gain was calculated during the long-term study every month, quarterly, half yearly and for the whole year, and expressed as cm/month. For example:

$$\text{Height gain in month 1} = \frac{(\text{Height month 1-height when 80\% wt/ht reached})}{(\text{height month 1} + \text{height when 80\% wt/ht reached})\div 2}$$

Energy intake - In the short-term phase of the study, energy intake was an outcome of interest. The gross energy values of major food items and food mixes given on a regular basis were measured using bomb calorimetry at the International Centre for Diarrhoeal Disease Research, Bangladesh; the gross energy value per 100g for each cooked food offered was then converted to metabolisable energy [Acheson et al., 1980]. Energy values of less frequently used food items such as peanuts, egg, and banana were derived from food composition tables [Gopalan, et al., 1981]. Total energy consumed daily was calculated from the total daily consumption of foods. Energy intake was calculated as kcal/kg/day for which a separate record sheet was maintained for each child (see annex 4). Energy intake was expressed as kcal/kg/day = total daily energy intake ÷ weight in kg.

Information on energy intake for the DCD group was collected weekly at home by the health workers. Consumption was estimated from 24-hour recall, for example how many bowls and cups of the recommended food the child had eaten from the same time of the previous day, for example if the health worker arrived at 12 noon, the recall was from 12 noon of the previous day. The approximate amount was totalled and total calories estimated from the food composition tables.

An example of a 24-hour calorie intake is shown below:

Food	Amount consumed	kcal/bowl/cup/piece	Total (kcal/day)
Rice	3 bowls (1 bowl=340g)	318	954
Dhal	1 cup (1 cup =180 ml)	165	165
Chappati	2 (1 = 60g)	100	200
pumpkin	½ bowl (1 bowl=340g)	85	42

Total calorie consumed = 1361 (954+165+200+42)

Child's weight that day = 7.11 kg

Energy intake kcal/kg/day = 1361 ÷ 7.11 = 191

Mortality and speed of recovery were two further outcomes of interest. Speed of recovery was taken as the number of days from admission until 80% wt/ht was reached.

Morbidity was another major outcome of interest during the long-term study as presence of infection might limit weight gain. Data were collected by interviewing mothers twice a month in conjunction with a pictorial calendar. This was designed to cover 30 days with pictures of children with diarrhoea (defined as mothers' reporting of "patla paikhana" which is the local word for diarrhoea of more than 3 liquid stools in 24 hours), vomiting, cough, fever, eye infection, ear infection and passing worms. These calendars were given to mothers of all groups at the end of the short-term period to report illness in-between the fortnightly visits by health workers for the following 12 months. The mothers recorded morbidity daily on the calendar. These were reviewed fortnightly at home by the health workers. One morbidity calendar was supplied to the mother/attendant every month (annex 9). Every day the mother had to make a mark on the sheet (even when the child was well); for example, if the child was discharged on a Monday, the mother was asked to put a cross inside the relevant circle from Tuesday onwards. They were encouraged to fill in the sheet at night before going to sleep. The cross entered on Tuesday thus described the state of health from the time of discharge (usually in the afternoon). As most mothers could not read or write, a picture of a mosque was stamped on all Fridays on the form, counting from the day discharged. Friday is the Muslim prayer day and was used as the landmark to help check the days of illness. Mothers were supplied with rubber and pencil.

To check the reliability of the data, at each home visit mothers/attendants were asked if the child was well in the last 14 days. If the mother said the child was unwell, then the nature of the problem(s) and duration was noted (annex 10). All children were examined routinely by the health workers for any sign of infection. After examination of the child, the health workers noted the findings at the end of the morbidity record form (annex 10). The mother's verbal report was verified with the marked report on the calendar. Mother's recall and calendars agreed for

80% of episodes. When this did not agree, recall was accepted as they may have possibly forgotten to mark the calendar. An episode was defined as one separated by 2 or more disease free days. If the children were found unwell for example with pneumonia, the children were referred to CNU to consult the OPD physician for confirmation of diagnosis and necessary treatment. The same referral criteria were used as for domiciliary management in the short-term study.

The calendar was field-tested during the short-term study. The calendar had to be redesigned twice during field testing for easy recognition of the symptoms. All mothers were familiarized with the seven illnesses on the calendar prior to the start of the long-term study so that they could mark the illnesses appropriately.

Mortality and readmission during the long-term period

The other outcome variables of interest during the long-term study were mortality and readmission among the children. When deaths were reported, the health workers noted the cause and place of death by interviewing the mothers. The children were readmitted as in-patients or day-care if they reverted back to severe PEM, that is those who became oedematous and/or < 60% of the NCHS median wt/ht with or without complication. Non-PEM cases were also readmitted if they were medical emergencies. They were dropped from the long-term study if readmitted in another study group; for example if a child from the DCD group was readmitted in IP, or IP in DC or DCD.

The data on anthropometry during the long-term study, mortality, readmissions and socio economic status of the parents which might influence growth were collected once a month (annex 11) on a pre-coded questionnaire.

Costs of treatment - One of the major objectives of the study was to compare the costs incurred to achieve 80% wt/ht in the 3 rehabilitation schemes.
Types and methods of costing were discussed with three economists. They were Dr.Anne Mills London School of Hygiene and Tropical Medicine [1990]; Dr. Younus of the Gramin Bank, Bangladesh [1991]; Mr. Martin Surr of ODA [1992].

Later, during data analysis, costing was further discussed with two health economists. They were Sara Bennett, London School of Hygiene and Tropical Medicine [1993] and Julia Watson, ODA [1993]. Standard procedures for calculating cost-effectiveness were followed [Horton and Claquin 1983; Drummond and Stoddard 1985; Mills and Drummond 1987; Mills, 1985a; Mills, 1985b; WHO., 1988]. The costs were categorized as: 1) Costs incurred by the CNU, 2) costs incurred by parents.

1. Costs incurred by CNU

The major costs taken into consideration were (i) capital costs: eg buildings, equipment, beds, linen, and vehicle costs; (ii) operating costs: eg, electricity, gas, detergents; (iii) costs of staff services: salaries of all categories of staff,including doctors, nurses, home-visit costs for the DCD group, laboratory staff, cleaners, guards, auxiliaries and administrative staff (altogether 95 staff during the period of study) and percent of their time allocated to each study group; (iv) cost of daily essentials or utilities: food for patients, water, medicine, laboratory tests, food for mothers/attendants of in-patients and day-care patients and siblings of day-care patients.

Costs were calculated as follows:

Buildings The capital cost of the building which was built in 1986-88 was taka 30 million. Assuming the life of the building is 30 years (1988 - 2017,life range), the depreciation (straight line method) will be taka 1 million/year

Thus the capital expenditure per year is taka 1,000,000.

The total number of patients admitted between December 1990 - November 1991 was 1470, therefore building cost per child per year= 1,000,000 ÷ 1470 = 680.27 tk

Building cost per child per day = 680.27 ÷ 365 = tk 2.

Operating costs- True costs from two 6-monthly bills were taken (December 1990-May 1991, and June 1991- November 1991) and the costs for water, electricity, gas, detergents and soaps etc were calculated. Costs were distributed as percentages used in IP, DC, OPD and other departments and were

divided by the number of children attending. The percentage of costs for each commodity was distributed in each of the departments according to consumption in the following manner: water; 70% for IP, 15% for DC, 15% for OPD. Electricity: 70% IP, 10% DC, 20% OPD. Gas: 65% IP, 25% DC, 10% OPD. Similarly, transport (fuel) cost and cost for detergents were taken from 2 six monthly bills and calculated on the same principle as above.

Cost for staff services, including the administrative staff, was calculated as number of staff assigned in each group and their percent of time given to each group . Accordingly their salaries and also support costs such as utilities, stationeries etc were divided by the number of child days.

Food for children at CNU The true costs of cooked food given to the children were calculated. Costs of 100 millilitres, 100 grams and per piece were worked out and amounts taken by each individual child were totalled and costed. Market prices of each food item were monitored weekly. For foods of more than one item, costs were calculated as in the following example for half strength dried skimmed milk:

Ingredients	cost (tk)
DSM 80g	9.44
oil 60g	1.96
sugar 167g	5.03
2 litres	16.43

tk/100ml = 0.823

The ingredients for different food mixtures with costs and energy and protein contents are given in annex 6 (pages 210-214).

Cost of child's food at home for the DCD group. This was taken on the basis of approximate consumption which was recorded by 24h recall every week. Health workers took a 24h recall of food items fed to the child. The quantity of major food items eaten was assessed by the number of bowls and cups consumed. Market prices of usual food items were assessed weekly. An illustration of the cost of the recommended food items is shown in table 2.2.2.

Table 2.2.2 Food items, market price and cost per item/day

		Recommended /day		
Food items	cost(taka)	amount/day	quantity/day	cost/day
Milk(if not breast fed)	18/L	2 cups	360 ml	6.48
Rice	13/kg	2 bowls	126g dry	1.63
Dhal (lentil)	28/kg	1 cup	63g dry	1.75
wheat for chappati	10/kg	2 piece	120g dry	1.20
oil (soya bean)	30/L	3 spoons	15ml	0.45
Pumpkin	4/kg	¼ bowl	85g	0.34
other vegetables	3/kg	¼ bowl	85g	0.25
Banana	1/piece	1 piece	-	1.00
sugar	28/kg	4 spoons	20g	0.56

Food for mothers/carers/siblings. During their stay at CNU, food was costed on the basis of consumption. For IP mothers, foods allocated are rice 250g, dhal 40g, oil 15ml, and wheat 300g per day. The total cost of the above ingredients remained the same from December 90 - April 91 and was taka 7.14/day. This cost increased to tk 7.78 during the month of May to July 91. In addition, vegetables were also provided. Their cost fluctuated a great deal and the total food cost for IP mothers was typically around taka 8/day.

For mothers in the day-care facility (DC & DCD), foods allocated were: rice 250g, dhal 40g, and oil 15ml. The total cost of these ingredients was typically around 4 taka. When the cost of vegetables is included the total food costs to day-care mothers was typically around tk 6/day. If any sibling stayed, he/she would share food with the mothers or eat from the demonstration kitchen and no additional cost was made.

Cost of medicine. The unit cost (a unit may be a tablet, drop, milligram, millilitre) of each medicine was calculated (see annex 6 page 215-216). The unit was chosen for convenience of cost calculation to maximize accuracy. To find the cost/child of a particular medicine, the total doses received by the patient were multiplied by the unit cost. For example, if the patient received ampicillin 4000 mg in 10 days and the cost of 1 mg (unit cost) is tk .01, then the cost of treatment is 4000x01 = tk 40.00. Similarly if the patient received 10 iron tablets in 10 days, and the cost of 1 tablet=tk 0.114,then the medication cost tk 0.114 x 10 = tk 1.14. The total cost of medicine was calculated by adding the costs of all the medicines received by the patient.

Cost for laboratory tests. The costs for laboratory tests were taken from those charged by government hospitals. These were: a) unit cost for packed cell volume (PCV) taka 20, plasma protein tk 30, total and differential white blood cell count tk 20, blood culture tk 100, urine culture tk 100, routine urine stool and blood examination tk 268, and chest radiography tk 30 per exposure (annex 6 page 217)

Cost for staff services . For the financial year April 1990 - March 1991, the costs were as follows:

1. Inpatient department (IP). The total salary paid to staff working only in IP was taka 289,353.80 per month. Considering that IP ran to full capacity, (that is 60 children at any one time) the cost/child/day : 289,353.80 divided by (60x30) = tk.160.75.

2. Day-care centre. Total salary paid to staff in day-care was taka 27,811 per month. If day-care accommodates 25 children daily, the cost per child per day was 27,811 divided by (25x30) = 37.08.

3. Outpatient Department (OPD). The total salary paid to staff of OPD was tk. 82,221.00 per month. The average number of patients passing through OPD per day was 125. Hence the cost per child per visit was tk.82,221.00 divided by (125x30) =22.00

For the financial year April 1991 - March 1992, there was an increase in salary during this period. For IP the salary cost/child/day rose from 160.75 to 181, for day-care from 37.0 to 42.17, and for OPD from 22 to tk.25.28 .

2.Costs incurred by parents

Expenses undertaken by parents were mainly transport, wage loss for working mothers who stayed with the child, payment to neighbours for looking after the family and cost for child's food at home in DCD and DC groups. Transport expenses and wage loss are described below. Food costs were estimated in the manner described earlier. For the DC group, the parental food costs were based on the quantities of food they were advised to give at home (3 feeds and more on Fridays). For the DCD group, parental food costs were calculated on the basis of the 24-hour food recalls undertaken weekly. Proportion of parents' expenditure for the child was calculated as: expenses for the child x100 ÷ house hold income. Food which came from the village home, or was received as gifts from relatives and neighbours, or in exchange for work were given a monetary value and included in the cost; but the monetary value was not added to the household income.

Transport cost was recorded when they arrived at CNU and any further costs by the father when he visited were also recorded. For the DC and DCD groups, transport costs to and from CNU were recorded daily. Transport costs of the DCD group were also counted if the children were referred and brought to CNU for treatment.

Wage loss - Mothers were asked if they worked during the week prior to hospitalization, number of days worked and how much they had earned. The daily loss for coming and staying with the child was calculated and recorded. Similarly for the day care and domiciliary groups, if the mother had a job, wage loss was recorded. Parents' wage loss for the DCD group was counted also if the child was brought to CNU for treatment. All the costs were added and the total parental cost to rehabilitate the child up to 80% wt/ht was calculated.

2.2.8. **Personnel in the research team**

There were altogether 13 people in the research project. The team consisted of

a) the author who served as project supervisor.

b) 1 physician to assist the author with the medical matters and training of the health workers.

c) 1 data entry clerk (statistician)/ field supervisor, who kept the schedule for the health workers visits, organized transport for supervisory visits, carried out surprise visits to check if the health workers visited, checked coding forms (after every visit of the health workers) with the project supervisor, and entered data in the computer with the software D-base 3+ while double checking the coded information manually.

d) 2 area supervisors. They served as health workers but were also responsible for day-to-day supervision of the field work such as assisting the field supervisor in preparing the visit schedule to each child for the whole year, providing stationery, checking and standardizing the measuring equipment, managing any problem arising in the field of his/her area such as problems with local leaders or uncooperative parents. They also helped parents in coping with severe financial crisis. For example there was one child in DCD whose mother died and the father did not have a job because he was crippled by a road traffic accident. The area supervisor arranged a loan for him to run a street fruit shop (plate 17). This worked well and he could pay back the loan in 10 months. There were two destitute mothers who needed financial assistance. One had no trace of her husband, had 3 small children to be fed, and if she took a job all will suffer. This mother was provided with a loan to set up a hawkers shop in front of her hut (plate 18).

The other mother was a young widow with 2 children who lived with her mother. Her mother became blind and could not work so she (patient's mother) was given a loan to buy and sell glass bangles.

Plate 17. Crippled father with his fruit shop.

Plate 18. Destitute mother of a child in DCD group received a loan

e) 8 health workers- They interviewed mothers on admission and filled the social history form , recorded weight, length/height and MUAC and also filled form 1 of the admission record (Annex 6), form for DCD (annex 7) during the short-term study and kept day-to day information on patients' treatment, food intake and energy intake and cost, parents' transport cost etc. They were responsible for arranging mothers' special instruction sessions for the study including understanding and filling of the morbidity record form. A 4-member team among them carried out the home visits for the DCD group weekly and biweekly till this group reached 80% wt/ht.

The study area was divided into 2 major areas, the North and the South from the CNU and 4 major zones (annex 12), the north west, north east, south west and south east. Each zone on average had 15 union areas (administrative blocks). The health workers were allocated areas in the same zone according to convenience. There were 3-member teams for IP and DC and a 4-member team for DCD including the 2 area supervisors. Their starting point was at CNU where they interviewed mothers, recorded information, monitored the children and went home with the mother/attendants to know the area and the place, so that when they went home the health workers were already familiar in that area. Each area was covered by 3 health workers, 1 for each treatment group.

During the long-term study the health workers visited the children in their allocated area twice a month to record morbidity data (plate 19) and once a month for anthropometry, that is during the second morbidity visit, for a period of 1 year. Each health worker prepared a yearly calendar for each child and the visits were scheduled accordingly. Parents were informed of the date of the next visit during the previous visit and the time of the visits was adjusted according to convenience of the parents. When the parents were not found, extra visits were made for 2 consecutive days. For the anthropometric measurements, health workers carried a portable height/length board and digital weighing scale (plate 20) and arm band for MUAC. They interviewed mothers or carers and filled form 2A and 2B (annex 10, 11).

Besides interviewing and examining the child and filling up coding forms, health workers played a vital role as sympathetic and supportive social workers. They were patient listeners of family problems which they tried to solve as much as they could. In some circumstances they were successful in convincing wayward fathers who later took care of the family. In cases of working mothers, health workers communicated with their employers and explained why they needed extra holidays. Thus they were able to gain the trust and the confidence of the parents' and the community leaders.

2.2.9 **Recruitment and training of area supervisors and health workers.**

On November 12, 1990 ten health workers including the 2 area supervisors were recruited for the project. Most of them were inexperienced in community orientated health work or field work. They were graduates or undergraduates and some had teaching experience in schools. These were selected from an initial intake of 18. Two weeks theoretical training was organized drawing instructors from Helen Keller International (M.H Patwary), National Institute of Preventive and Social Medicine (Dr. S. Tahera) and CNU. Emphasis was given especially to anthropometric measurement, anthropology, research methodology, examination of patients , identification of nutritional problems, interviewing and filling up of questionnaires. This was followed by practical training for two weeks. They interviewed mothers in OPD and on admission and filled the social history form , recorded weight, height/length and MUAC and also filled form 1 of the admission record. At the end of the training period, a one and half hour theoretical test and half a day practical test were given and the 10 best performers were selected out of 18.

2.2.10 **Data quality control**

The health workers were trained in the proper methods of using the measuring apparatus and the weighing scales, and were taught to adjust the scales regularly before each measuring session. Variation within and between health workers was minimized by continued practice of weighing, measuring heights and MUAC.

Plate 19. Health worker interviewing mother on morbidity and other matters

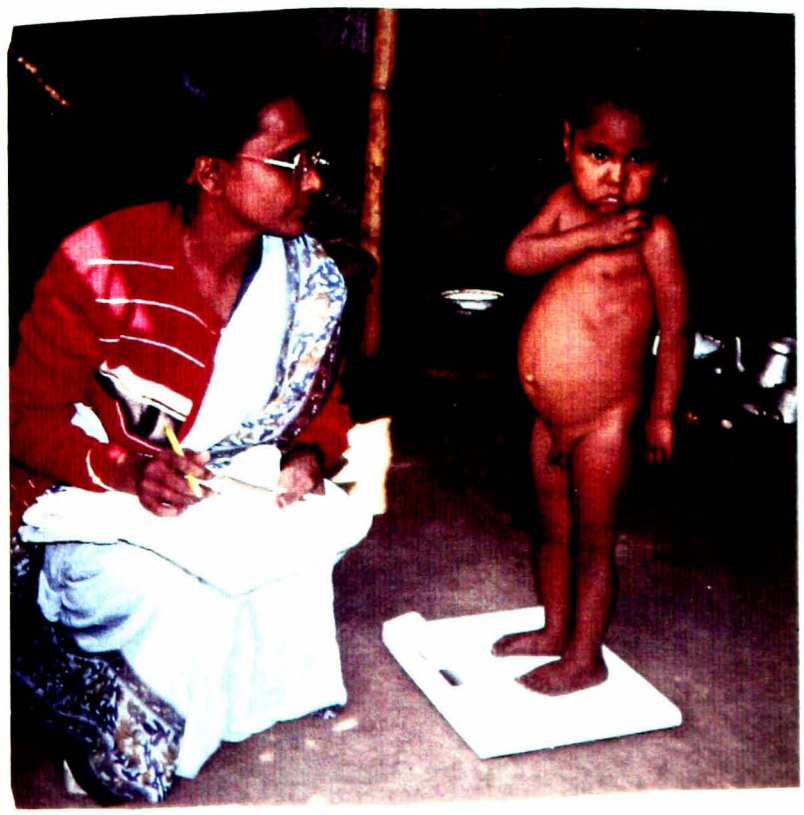


Plate 20. Taking weight at home during follow-up.

Ten children were weighed and measured twice by 8 health workers, 2 area supervisors, and the author, and a series of calculations were carried out for accuracy and precision [WHO, 1983]. At monthly intervals, intra- and inter-observer reliabilities were re-tested and repeated until an acceptable standard was reached. MUAC in particular has the disadvantage of high measurement error. However accuracy was maintained by frequent re-training with weekly then monthly practicing to check intra- and inter-observer variation. This was achieved by measuring the same child's MUAC by 2 or 3 health workers in one group and rotating the groups. In this way intra-observer variation of ≤2mm and inter-observer variation of ≤4mm was accepted.

During the study period, the author visited the homes of at least 10 children with each health worker to observe how they interviewed mothers, took measurements (plate 21) and examined children. She also re-visited a similar number of children's homes (plate 22) to interview mothers and record measurements independently to maintain maximum accuracy throughout. Examples of the author's check list follows:

Author accompanied Health worker yes/no

If no:

Mother has morbidity sheet yes/no

Has the advice been understood? yes/no

Can mother recollect advice ? yes/no

Is advice appropriate ? yes/no

Does verbal response tally with morbidity calendar yes/no

If yes (accompanied) following actions were observed:

Mother at ease with the health worker yes/no

Good interview techniques yes/no

Deals with problems yes/no

Good communication skill yes/no

Observant of the surroundings. yes/no

Percent agreement on follow-up questions was calculated in the following way: number agreeing x 100 ÷ number of questions.

Plate 21. Author with a health worker observing height measurement

Plate 22. Author with a study child during her independent visit

2.2.11 **Data handling**

All data were coded by child's ID number, and by the day month and year of visit. During the long-term study all groups had 24 visits and therefore there were 24 forms with biweekly follow-up data. Data of all children in each group who completed the short-term study and all those from follow-up visits were entered in the microcomputer software programme using the package D-base 3+. Data collection forms were checked for accuracy first by the field supervisor and by the author prior to entry into the microcomputer.

All the children who completed the short-term study and started the long-term study were expected to receive 24 morbidity visits in 12 months. As there were some missing visits, only those cases who completed 75% of the visits, that is, more than 18 out of 24, were included in the analysis after making necessary adjustment in the following way: outcome measurement (example days of diarrhoea) x number of visits expected ÷ number of visits completed eg : diarrhoea morbidity x 24 ÷ 18. All of those who completed ≥75% of the morbidity visits were found to have completed all 12 of the expected anthropometric measurements. Thus no further adjustments were required for analysing the growth data.

2.2.12 **Data analysis**

Data were checked and verified for range and consistency and analyzed at the London School of Hygiene and Tropical Medicine using the Statistical Package for Social Sciences (SPSS/PC+) version 4. The anthro software package was used to obtain anthropometric indices based on the NCHS reference population. Harvard Graphics was used for graphs and Word Perfect for tables and text. Results are presented as medians, means, standard deviations and proportions. Analysis of variance and chi-square tests were used for statistical significance tests. A p value of < 0.05 was accepted as significant.

CHAPTER 3. RESULTS

In designing this study it was decided to evaluate the three approaches to treatment both in the short-term , that is the period from admission until reaching 80% wt/ht, and long-term. The main outcomes of interest in the short-term were speed of recovery and economic costs, and in the long-term period , they were growth performance and morbidity. The long-term period started from day 1 after reaching 80% wt/ht and continued for the next 12 months during which health workers visited the homes of the children in all groups twice a month. Data presented in this first section are the results of the short-term period, including descriptions of the children studied.

3.1 Short-term results

Between December 1990 and November 1991, a total of 1332 severely malnourished children were admitted to the Children's Nutrition Unit, of whom 573 (43%) met the inclusion criteria for this study. The eligible patients were sequentially allocated to the three treatment groups, as described in section 2.2.1.2 resulting in an allocation of 200 in-patients (IP), 200 in day-care (DC), and 173 in the domiciliary group (DCD). Table 3.1.1 shows the proportion of children who completed the short-term study and reasons for non-completion in the three groups. During treatment 43 children were diagnosed as having TB and 27 received blood transfusion and were therefore excluded from the study and 23 died. Exclusion rates were simililar in the 3 groups, both at recruitment and subsequently. A further 43 children discontinued in their groups and were dropped from the study, leaving 437 patients (76.3% of those recruited, 32.8% of total admitted patients) who completed the short-term period, that is,173 in IP, 134 in DC and 130 in DCD. The discontinuation rate was much higher in the day-care group than in IP or DCD because of parents' inconvenience to attend every day for 3 -4 weeks. They were dropped from the study but not from treatment. Sex distribution was similar in the three groups.

Table 3.1.1 Proportion completing the short-term study and reasons for non-completion

	IP	DC	DCD	Total
Number allocated	200	200	173	573
Late exclusions/losses:	% (n)	% (n)	% (n)	% (n)
TB	5.5 (11)	6.0 (12)	11.6 (20)	7.5 (43)
Blood transfusion	3.5 (7)	5.0 (10)	5.8 (10)	4.7 (27)
Parents dropped out	1.0 (2)	17.0 (34)	4.0 (7)	7.5 (43)
Death during treatment	3.5 (7)	5.0 (10)	3.5 (6)	4.0 (23)
Completed study	86.5 (173)	67.0 (134)	75.1 (130)	76.3 (437)
Boys	50.3 (87)	47.8 (64)	40.0 (52)	46.5 (203)
Girls	49.7 (86)	52.2 (70)	60.0 (78)	53.5 (234)

Figures in parentheses are number of children.

3.1.1 **Demographic, socioeconomic and environmental characteristics.**

Tables 3.1.2-3.1.5 describe demographic,socioeconomic and environmental characteristics of the 3 groups. The variables are comparable between groups. In most cases the parents were alive (mothers 93.0%, fathers 84.4%). mothers were mostly housewives (75%), few mothers had a regular job (25%) and most fathers were rickshaw pullers (57%) or day labourers (19%). Only 17% of mothers and 44% of fathers could read and write (table 3.1.2).

Table 3.1.2 Characteristics of the parents at the start of the study

Parents'status	IP N = 173	DC N = 134	DCD N = 130	TOTAL N = 437
MOTHER:	%	%	%	%
Alive	94.8	94.0	92.3	92.8
Deserted	1.7	3.0	5.4	2.3
Dead	3.5	3.0	5.4	3.9
Occupation:				
housewife	75.2	76.7	74.0	75.3
had a job	24.8	23.3	26.0	24.7
Mother literate	18.0	19.4	16.0	17.4
FATHER:				
Alive	86.2	83.6	83.1	84.4
Deserted	9.8	16.4	15.4	13.5
Dead	5.0	0.0	1.5	2.1
Occupation:				
rickshawpuller	53.3	62.3	56.6	57.0
day labourer	20.8	10.5	23.9	18.6
petty trader	14.3	18.4	10.6	14.4
service	9.7	7.0	7.1	8.1
Father literate	46.2	38.0	46.9	44.0

Chi-square test not significant between groups

Overall, the mean family income was 1406 taka /month, of which 21% was spent as house rent (see table 3.1 3). The average family size was 5.3 (2.4 adults and 2.9 children). Almost 90% lived only in one room. In most cases the child was the last born. Most lived in slums (53.0%) in the metropolitan city area and in little towns (39.2%) just outside the metropolitan area, and a minority (7.8%) were squatters in the construction sites. Most houses had corrugated iron roofs (66%) with mud floor (78%) (table 3.1.4).

Table 3.1.3 Parental income and family size (mean ± sd)

	IP N = 173	DC N = 134	DCD N = 130	Total N = 437
Parents'income (tk/month)	1396 ± 636	1461 ± 571	1363 ± 897	1406 ± 707
House rent tk/month	209 ± 177	302 ± 173	287 ± 138	266 ± 162
No.of children in the house	3.0 ± 1.3	2.7 ± 1.4	2.9 ± 1.4	2.9 ± 1.4
No.of adults in the house	2.3 ± 0.8	2.5 ± 0.7	2.4 ± 0.9	2.4 ± 1.4

60 taka= £1 approximately
Chi-square not significant

Table 3.1.4 Location and construction of houses (%)

	IP N = 173	DC N = 134	DCD N = 130	Total N = 437
Location:				
slums	57.2	50.7	50.8	53.0
town	35.9	41.8	40.0	39.2
squatters	6.9	7.5	9.2	7.8
Type of roof:				
corrugated iron	72.3	56.0	69.2	66.4
straw or bamboo	27.7	44.0	30.8	33.6
Type of floor:				
mud	76.9	81.3	75.4	77.8
concrete	17.3	14.9	14.6	15.8
bamboo or wood	5.8	3.7	10.0	6.4

Chi-square not significant

Water supply was mostly from communal sources. All used either tube-well water (59.3%) or stand pipes(40.7%) for drinking. Latrine facilities were also communal (table 3.1.5).

Table 3.1.5 Sources of water supply and types of latrine used (%)

	IP N = 173	DC N = 134	DCD N = 130	Total N = 437
Water source: for drinking				
Tube well	64.7	51.4	58.2	59.3
Stand pipe	35.3	48.6	41.8	40.7
For bathing & washing:				
Tube well	51.4	50.7	45.3	49.4
stand pipe	30.6	38.8	40.0	38.2
Pond/ditch/river	18.0	10.5	14.0	12.4
Type of latrine:				
pucca (cemented pan)	52.8	61.2	55.4	55.8
Pit or hanging latrine	47.2	38.8	44.6	44.2

Chi-square not significant

Tables 3.1.6-3.1.13 describe the children as regards their breast feeding history, age, nutritional status and types of infection present on admission.

3.1.2. **Breast Feeding**

Of those less than 24 months of age, 62.4% were still breast fed (table 3.1.6). Among older children, 17% were still breast fed . Overall 7.5% of younger and 4% of older children were never breast fed. The mean age at which supplementary food was introduced was 6 months ± 6 (range, 1-12 months). Food was withheld during the present illness among 47% of cases (Table 3.1.7).

3.1.3. **Age and anthropometric status**

Of the total cases, 48% were between 12-23 months. The mean age of children was 27 ± 18 months. Although children in the DCD group were a little older, the difference was not significant (table 3.1.8).

Figure 3.1.1 shows the mean weight by age and treatment group on admission.

Table 3.1.6 Breast feeding history by age and study groups (%)

Feeding pattern	IP N = 173	DC N = 134	DCD N = 130	Total N = 437
Age group 12-23 months:	N=88	N=68	N=54	N=210
still breast fed	58.0	66.2	63.0	62.4
stopped at 3-11 months	18.5	11.8	26.0	18.7
stopped at 12-23 months	14.9	14.7	0.0	9.4
never breast fed	5.5	7.3	9.0	7.5
missing	3.3	0.0	2.0	2.0
Age group 24-60 months:	N=85	N=66	N=76	N=227
still breast fed	15.3	19.5	15.7	16.7
stopped at 3-11 months	5.7	6.0	12.0	7.9
stopped at ≥ 12	67.4	68.0	65.7	67.0
never breast fed	5.7	2.0	4.0	4.0
missing	5.7	4.5	2.6	4.4

Chi-square not significant

Table 3.1.7 Feeding pattern prior to admission in the three groups

Feeding status	IP N = 173	DC N = 134	DCD N = 130	Total N = 437
% withheld food during present illness	48.4	41.0	37.0	46.7
Age (months) when other foods introduced	5 ± 6	6 ± 6	7 ± 5	6 ± 6

Table 3.1.8 also shows the anthropometric indices as percentages of the NCHS reference median. These indices were comparatively low in all the groups. There was a large range of values (weight 2.75 - 13kg, height 55 - 106cm, MUAC 62 - 130mm, % NCHS wt/age 29 - 80, wt/ht, 51 - 100, and ht/age 66 - 95 Z-scores, wt/age -7.29 - -0.81, wt/ht -4.76 - 0.0, ht/age -8.23 - 0.35). Weights have not been adjusted for oedema, and consequently the ranges in wt/ht and wt/age are overestimates.

Figure 3.1.1 Mean weight (kg) on admission, by age (months) and study group

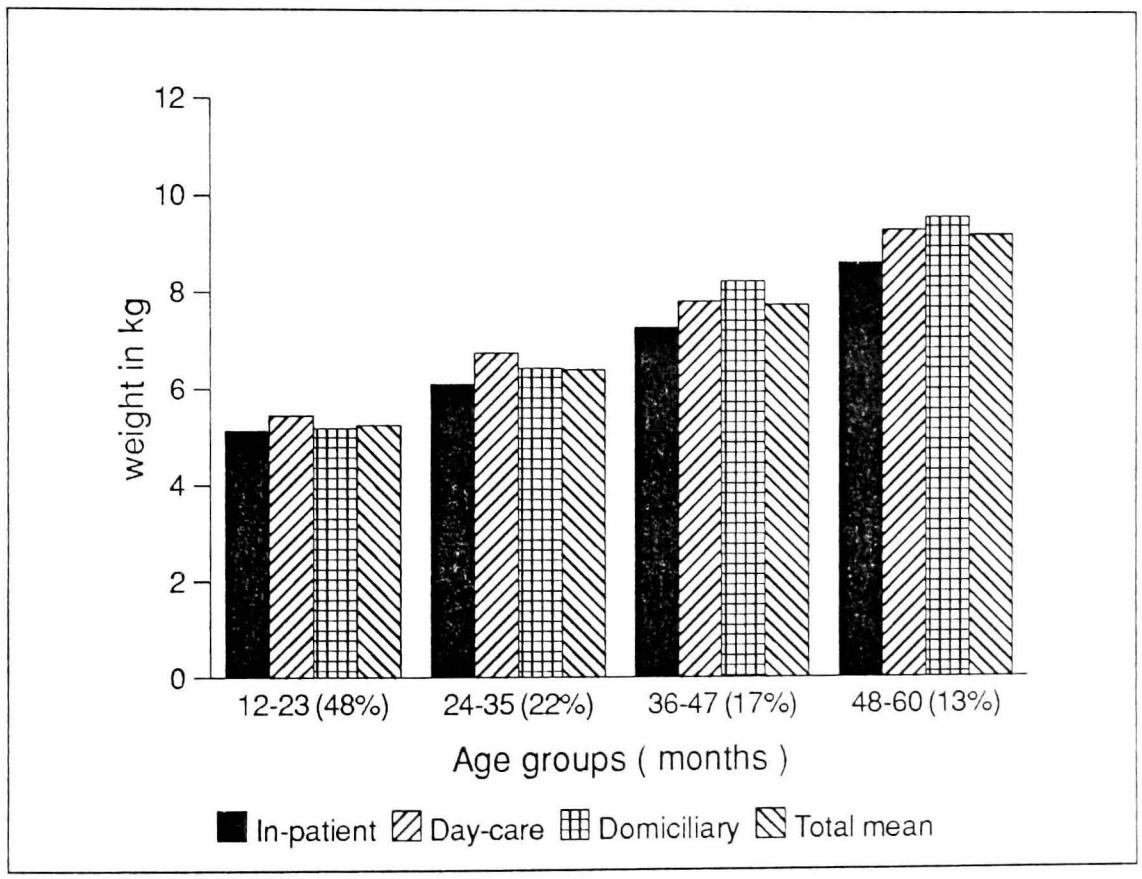


Table 3.1.8 Age and anthropometric status on admission in the 3 groups (mean ± sd)

	IP N = 173	DC N = 134	DCD N = 130	Total N = 437
Age (months)	25 ± 13	26 ± 13	29 ± 8	27 ± 18
Weight (kg)	6.3 ± 1.6	6.6 ± 1.9	6.8 ± 2.0	6.4 ± 1
Height (cm)	72.0 ± 7.8	72.5± 8.3	73.0 ± 10.5	72.9 ± 8.3
MUAC (mm)	100 ± 13	103 ± 14	102 ± 12	101 ± 13
Wt/ht (%NCHS)	67 ± 7	72 ± 8	71 ± 7	70 ± 8
Wt/age (%NCHS)	48 ± 9	52 ± 10	51 ± 9	50 ± 9
Ht/age (%NCHS)	83 ± 5	83 ± 6	83 ± 6	83 ± 5
Wt/ht (z-score)	-3.2 ± 0.7	-2.7 ± 0.8	-2.8 ± 0.7	-2.9 ± 0.8
Wt/age (z-score)	-4.8 ± 0.9	-4.5 ± 0.9	-4.5 ± 0.8	-4.6 ± 0.8
Ht/age (z-score)	-4.2 ± 1.4	-4.2 ± 1.4	-4.2 ± 1.3	-4.2 ± 1.3

3.1.4 **Types of PEM**

The prevalence of marasmic-kwashiorkor was 82.8%, kwashiorkor 15.1% and marasmus 2.1% according to the Wellcome classification [Lancet editorial, 1970] (table 3.1.9). By the Waterlow classification [Waterlow, 1972] (table 3.1.10),the majority were classified as wasted and stunted (78%), wasted alone were 11.2% and stunted alone were 10.8%; all groups included oedematous children.

Table 3.1.9 Types of PEM: Wellcome classification

	IP N = 173		DC N = 134		DCD N = 130		Total N = 437	
	%	n	%	n	%	n	%	n
Marasmic-kwashiorkor	87.9	152	75.4	101	83.8	109	82.8	362
Kwashiorkor	10.4	18	21.6	29	14.7	19	15.1	66
Marasmus	1.7	3	3.0	4	1.5	2	2.1	9

Chi-square not significant

Table 3.1.10 Types of PEM: Waterlow classification

	IP N = 173		DC N = 134		DCD N = 130		Total N = 437	
	%	n	%	n	%	n	%	n
Wasted and stunted (Wt/Ht <70% Ht/Age < 85%)	80.9	140	79.1	106	80.0	105	80.3	351
Wasted alone (Wt/Ht < 70%)	12.7	22	9.7	13	10.8	14	11.2	49
Stunted alone (Ht/Age < 85%)	6.4	11	11.2	15	8.5	11	8.5	37

NB All groups included oedematous children.
Chi-square not significant

3.1.5. **Other nutrient deficiencies**

These were also comparable in the 3 groups (Table 3.1.11). A high prevalence of xerophthalmia (44%) was observed.

Table 3.1.11 Other nutrient deficiencies on admission in the 3 groups

	IP N = 173	DC N = 134	DCD N = 130	Total N = 437
Xerophthalmia (%)	43.4	46.3	42.3	43.9
Angular stomatitis(%)	31.6	27.6	27.7	28.9
Anaemia(PCV < 30%)	33.7	29.1	26.9	29.9
PCV % (mean±sd)	29 ± 4	29 ± 4	30 ± 3	29 ± 3
Total protein(g%)	4.7±1.1	4.6±1.2	4.6±1.0	4.6±1.1

3.1.6 **Prevalence of infection and intestinal parasites**

There were no significant differences in the proportion of infections in the study groups (table 3.1.12 and 3.1.13). A history of measles 1-3 months prior to admission was very striking in all the groups (overall 58%). Overall, 2.1% of cases had no infections, 13% had one, 24.7% had two and 60.2% had more than 2 infections. There was no significant difference in the presence or number of infections in the 3 groups .

Table 3.1.12 Prevalence of infection on admission in the 3 groups (%)

Infections	IP N=173	DC N = 134	DCD N = 130	Total N= 437
Diarrhoea with dehydration	67.1	66.7	60.0	64.8
Diagnosed measles on admission	12.7	9.0	10.8	11.0
History of measles 1-3 months before admission	46.8	51.5	41.5	46.7
Upper respiratory infection	34.0	32.8	34.6	33.0
Lower respiratory tract infection	20.2	16.7	23.1	20.0
Upper & lower respiratory infection	17.3	24.6	17.7	19.7
Skin infection	34.7	30.6	28.5	31.6
Urinary tract infection	10.4	17.9	20.0	15.6
Middle ear infection (otitis media)	15.0	11.9	15.4	14.4
Conjunctivitis	9.8	9.7	10.8	10.1
Septicaemia (diagnosed clinically)	8.0	10.1	7.5	8.5
Septicaemia (confirmed by +ve blood culture)	2.0	3.7	1.8	2.5

Table 3.1.13 Prevalence of intestinal parasitic infection (%)

Infections	IP N = 173	DC N = 134	DCD N = 130	Total N = 437
Entamoeba histolytica	21.4	26.9	28.4	25.4
Ascaris lumbricoides	23.7	23.9	24.6	24.0
Trichuris trichuria	18.0	22.1	28.0	22.0
Hookworm	2.9	0.7	3.1	2.0
Giardia	1.2	3.0	0.8	1.6

3.1.7 **Response to management by the study groups**

3.1.7.1. Mortality- Of the initial 573 eligible children, 23 children (4%) died. The difference was not significant among the treatment groups. All deaths occurred within 6 days of admission, the majority within the first 48 hours (16). Cause of death in most cases was respiratory infection (15), others died of diarrhoea with dehydration (7) and road traffic accident (1) from DCD group while going home from CNU. Those who died had poorer nutritional status (mean 64% wt/ht, 47% wt/age) on admission compared with survivors.

3.1.7.2. Time to reach first oedema-free day -Most became oedema-free by the end of week 2 (mean 12 days in IP and 14 days in DC) (table 3.1.14). DCD took longer to become oedema-free (mean 21 days). Figure 3.1.2 shows the cumulative frequency of speed of oedema loss in the 3 groups. A small percentage continued to lose oedema beyond 30 days (DC and DCD). The medians of the 3 groups were 10, 12 and 19 days for IP, DC and DCD respectively. Differences in the speed of oedema loss were significant between groups ($p < 0.001$). Analysis was based on the median values because data were collected at unequal intervals in DCD after week 1 (that is daily in IP and DC and weekly in DCD) using non-parametric median tests.

3.1.7.3. Time taken to reach 80% wt/ht- Mean duration to achieve 80% weight for height was 23 days in IP, 28 days in DC and 44 days in DCD (table 3.1.14) .

Figure 3.1.3 shows cumulative frequencies of duration days in the 3 groups. The medians for the 3 groups were 18, 23 and 35 days for IP,DC and DCD respectively. Differences in the time taken to reach 80% wt/ht were highly significant ($p < 0.0001$). Again analysis was based on median values.

Table 3.1.14 Time to reach 80% wt/ht and speed of oedema loss in the 3 groups (Mean ± sd)

	IP N = 173	DC N = 134	DCD N = 130
Duration days to achieve 80% wt/ht	23 ± 10	28 ± 18	44 ± 31**
Oedema free days since admission	12.4 ± 6.1	14.3 ± 9.6	21.3 ± 11.5*

** $p < 0.0001$

* $p < 0.001$

3.1.7.4. Weight gain and energy intake - The overall mean weight gain of the 3 groups from admission till 80% wt/ht was achieved was slower in DC and DCD than for IP and is consistent with their lower energy intakes (table 3.1.15). These differences were highly significant ($p < 0.001$ by anova). Although DC and DCD appear to have similar energy intakes, weight gain in DC was higher than in DCD. Energy intake in DCD was based on 24- hour dietary recall at home and is thus less reliable than the intake data for the IP and DC groups, and therefore slight over estimation is possible.

Table 3.1.15. Mean weight gain and energy intake to achieve 80% wt/ht

	IP N = 173	DC N = 134	DCD N = 130
Energy intake kcal/kg/day	174 ± 30	144 ± 37	141 ± 40*
Weight gain g/kg/day	11 ± 7	6 ± 6	4 ± 4*

* $p < 0.001$ (analysis of variance)

Figure 3.1.2 Speed of oedema loss in the 3 groups, cumulative percent.

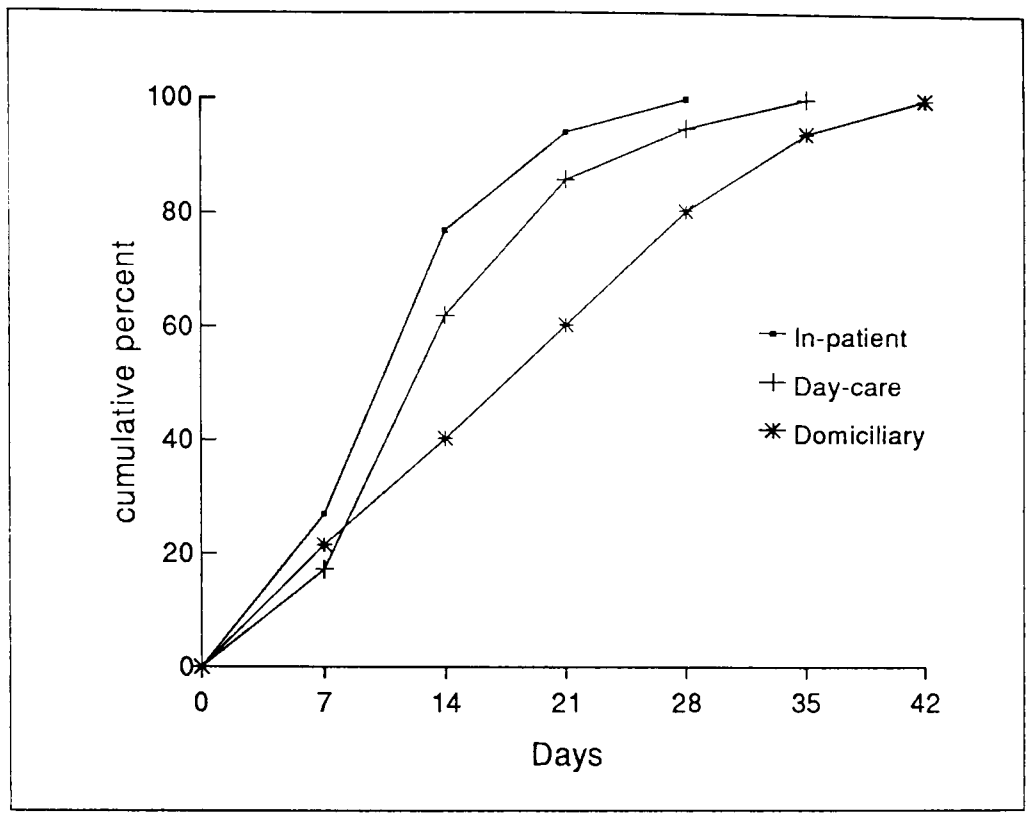
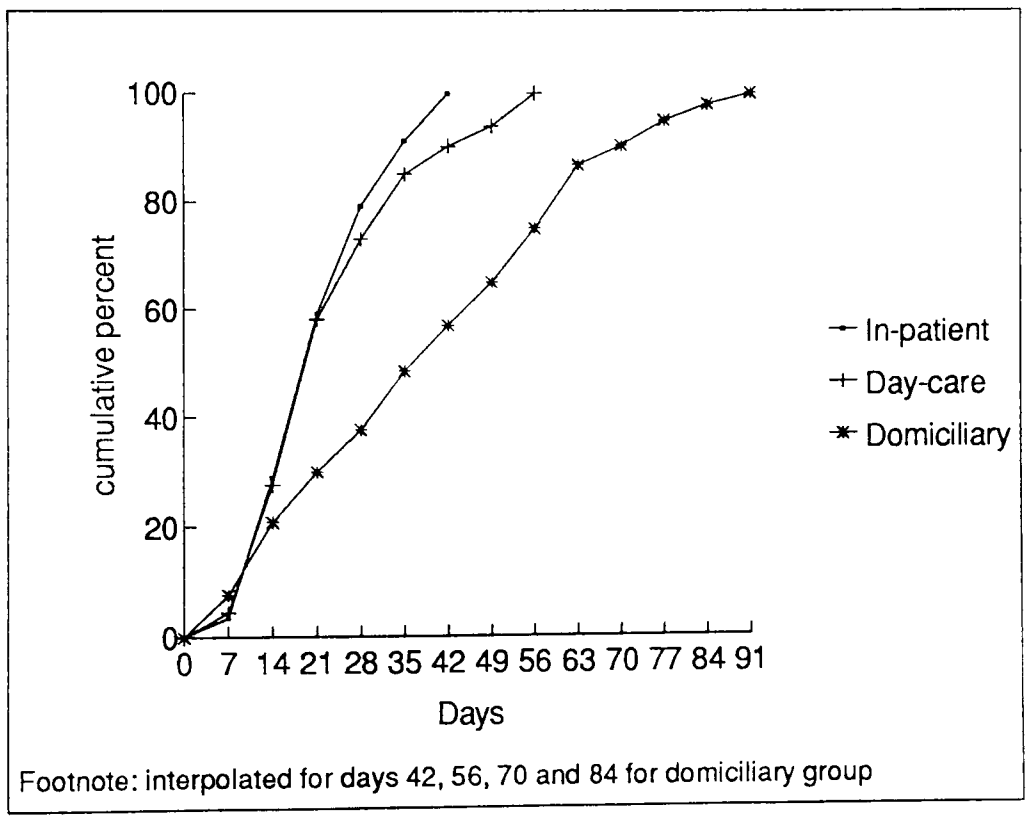


Figure 3.1.3 Duration days to achieve 80% wt/ht in the 3 groups



Mean weight gains for the three groups by week of treatment are shown in table 3.1.16. In week 1 when the DC and DCD groups were receiving treatment at CNU as day-care patients, their mean weight gains were 6.0 and 5.4g/kg/day respectively, whereas the IP group gained 9.6g/kg/day on average. By week 4, more than half the IP children had reached 80% weight-for height. Those who remained as in-patients in weeks 4-7 tended to be the youngest (mean age 20 months) and most wasted of their group (mean weight 5.3kg, wt/ht 65%, MUAC 92 mm) and their mean weight gain exceeded 7g/kg/day. Similarly in the DC group, more than half the children had reached 80% wt/ht by week 4 but the mean weight gains for the remaining children were always below 7g/kg/day in weeks 4-7. Thus the longer recuperation for some children in the DC group was, at least in part, a direct consequence of their consistently slower rate of weight gain, compared with the IP children. For the DCD group, average weight gains were consistently below 6g/kg/day.

Table 3.1.16 Weight gains (g/kg/d) of the 3 groups (mean ± sd) by weeks of treatment

Weeks (days)	IP N = 173	DC N = 134	DCD N = 130
week 1 (days 1-7)	9.63 ± 10.72	5.98 ± 8.81	5.37 ± 7.0
week 2 (days 8-14)	10.81 ± 6.9 n = 145	5.81 ± 7.89 n = 107	4.22 ± 8.74 n = 96
week 3 (days 15-21)	6.01 ± 6.87 n = 103	4.27 ± 7.43 n = 92	2.29 ± 6.34 n = 95
week 4 (days 22-28)	9.51 ± 6.85 n = 71	6.68 ± 5.90 n = 52	3.54 ± 6.21 n = 84
week 5 (days 29-35)	7.68 ± 3.58 n = 57	3.3 ± 5.11 n = 36	3.29 ± 6.63 n = 76
week 6 (days 36-42)	9.17 ± 6.57 n = 18	5.33 ± 6.35 n = 26	5.20 ± 6.84 n = 60
week 7 (days 43-49)	8.8 ± 6.57 n = 10	2.51 ± 6.36 n = 14	5.21 ± 9.02 n = 39

Since the DCD group were being rehabilitated at home from week 2 onwards, their data were examined to test whether income was constraining energy intake and hence weight gain. Table 3.1.17 shows that there was no correlation between mean family income and mean energy intake.

Table 3.1.17 Weight gain, energy intake and family income in the domiciliary group by week of study

Weeks	weight gain g/kg/day (mean ± sd)	energy intake kcal/kg/day (mean ± sd)	mean family income in taka /week
1 (n = 116)	5.37 ± 7.01	133 ± 72	194 ± 133
2 (n = 96)	4.22 ± 7.01	139 ± 74	214 ± 134
3 (n = 95)	2.29 ± 6.34	148 ± 73	221 ± 121
4 (n = 84)	3.54 ± 6.21	172 ± 102	238 ± 186
5 (n = 76)	3.29 ± 6.61	141 ± 72	403 ± 300
6 (n = 60)	5,20 ± 6.84	170 ± 88	389 ± 305
7 (n = 39)	5.21 ± 9.02	166 ± 73	394 ± 376
8 (n = 22)	4.26 ± 6.83	173 ± 63	305 ± 210
9 (n = 17)	1.41 ± 0.70	127 ± 52	281 ± 187
10 (n = 15)	1.59 ± 0.88	138 ± 86	280 ± 188
11 (n = 11)	0.88 ± 0.62	143 ± 47	407 ± 261
12 (n = 9)	0.21 ± 0.77	131 ± 76	341 ± 237

NB figures in parentheses are numbers of children each week who remained <80% wt/ht.

3.1.7.5 Weight gain and infection.

In order to subject the data to statistical analysis, the children were categorised into slow, medium and fast gainers (table 3.1.18). The first week was excluded because of oedema loss. The results show that in the DCD group, most children were in the slow gain group (50.8%). In the DC group most cases were in the medium weight

gain group (56.0%) and in IP the majority were in the fast gain group (59.0%). These differences among the groups were highly significant ($p < 0.0001$) (table 3.1.18).

Table 3.1.18 Frequency of slow, medium and fast weight gains in the 3 groups from day 8 till 80% weight for height was achieved

Weight gain group	IP N = 173	DC N = 134	DCD N = 130
	% (n)	% (n)	% (n)
Slow	6.9 (12)	26.1 (35)	50.8 (66)
Medium	34.1 (59)	56.0 (75)	36.9 (48)
Fast	59.0 (102)	17.9 (24)	12.3 (16)

$p < 0.0001$ by chi square test

slow = <3.5 g/kg/day
medium = 3.5-9 g/kg/day
fast = > 9 g/kg/day
averaged from day 8 to 80% wt/ht

DCD were the slowest weight gainers. As the service was unsupervised and children could be sick between visits, the possibility of infection limiting weight gain in the DCD group was examined. The DCD children were categorised as to whether they gained above or below 5g/kg/d, averaged for each week of study from day 8 until 80% wt/ht was reached. The percentage of weeks when mothers reported illness or poor appetite was calculated (table 3.1.19). For weeks when infection or poor appetite was present there was an increase in the percentage of weight gains <5g/kg/d.

Table 3.1.19 Percent of study weeks when mothers reported illness or poor appetite by rate of weight gain in the DCD group (total number of study weeks = 547)

Mothers reported illness	% of study weeks when illness was reported	% of study weeks with weight gain g/kg/day	
		< 5	> 5
No illness reported	62.0	57.7	42.3
Illness reported:			
Diarrhoea	37.0	69.9	30.1
Fever	25.1	67.4	32.6
Respiratory infection (fever, cough and respiratory distress)	8.2	82.2	17.8
Diarrhoea and fever	10.5	71.9	28.1
Diarrhoea and respiratory infection	11.7	73.4	26.6
Diarrhoea,fever + respiratory infection	7.5	80.8	19.2
Poor appetite	19.3	81.7	18.3

3.1.7.6. Weight gain and compliance. In order to see whether inability to follow advice might be associated with slow weight gain in the DCD group, a similar analysis was performed regarding frequency of feeding and the quantity of food given (see table 3.1.20). For weeks when advice was not followed, there was a higher percentage of weight gains <5g/kg/d.

Table 3.1.20 Percentage of study weeks when mothers followed advice on feeding children and weight gain in the DCD group

Advice on feeding	% of study weeks when mothers following advice on feeding was reported	% of study weeks with weight gain g/kg/day < 5	>5
Frequency			
Followed advice on number of times to feed	84.1	56.0	44.0
Did not follow advice (could not afford)	15.9	76.1	23.9
Amount			
had no problem with amount to feed each time	63.0	55.7	44.3
Child refused	24.8	68.6	31.4
Could not afford	12.2	68.8	31.2

3.1.7.7 Slow responders in the DCD group. There were 8 children in the domiciliary group who took longer than 120 days (5 months) to reach 80% wt/ht. Their parents' mean weekly income was 375 taka which was comparable with the average. Energy intake was 130 kcal/kg/day, and their mean weight gain was < 2g/kg/day. Diarrhoea, fever and respiratory infection however were reported for 78.0% 72.2% and 80.1% of study weeks respectively for these children. Their anthropometric and other relevant characteristics compared with children who took less time to achieve 80% wt/ht are given in table 3.1.21. Slow responders were also slightly younger than average, and their nutritional status was particularly low by all parameters on admission.

Table 3.1.21 Characteristics of 8 slow responders and others in DCD on admission

Characteristics on admission	Slow responders n = 8	Rest of the children n = 122
Mean age (months)	23 ± 8	29 ± 6
Mean weight (kg)	5.7 ± 0.6	6.8 ± 0.8
MUAC (mm)	96 ± 9	102 ± 8
Height (cm)	69 ± 3	73 ± 3
Wt/Ht %NCHS	67 ± 5	71 ± 6
Wt/Age %NCHS	47 ± 6	52 ± 7
Ht/Age %NCHS	82 ± 6	83 ± 5
Wt/Ht Z-score	-3.24 ± 0.74	-2.8 ± 0.7
Wt/Age Z-score	-5.12 ± 0.66	-4.5 ± 0.8
Ht/Age Z-score	-4.60 ± 1.63	-4.2 ± 1.3

3.1.8. **Cost to achieve 80% wt/ht by CNU in the 3 groups.**

3.1.8.1 Total expenditure incurred by CNU- The mean cost in each group was taka 6238 in IP, 2373 in DC and 1175 in DCD (table 3.1.22). Staff services were very high in IP and the differences in most categories of expenditure between the groups were highly significant ($p < 0.0001$).

Figure 3.1.4 shows the proportion of different expenses by CNU in IP, DC and DCD. The major proportion of the cost for each group was the staff services followed by laboratory investigation including chest radiography.

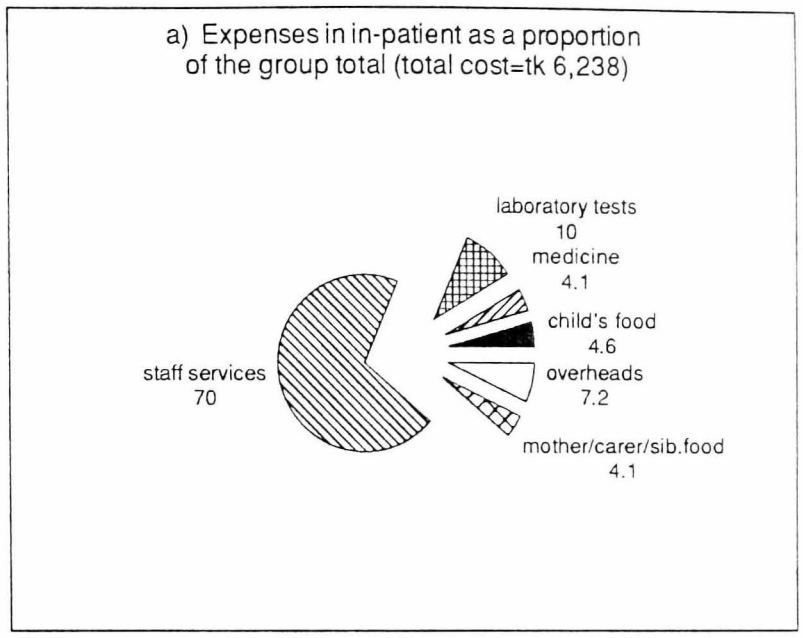
Table 3.1.22 Comparison of costs (in taka) incurred by CNU in the 3 groups to achieve 80 % wt/ht (mean ± sd)

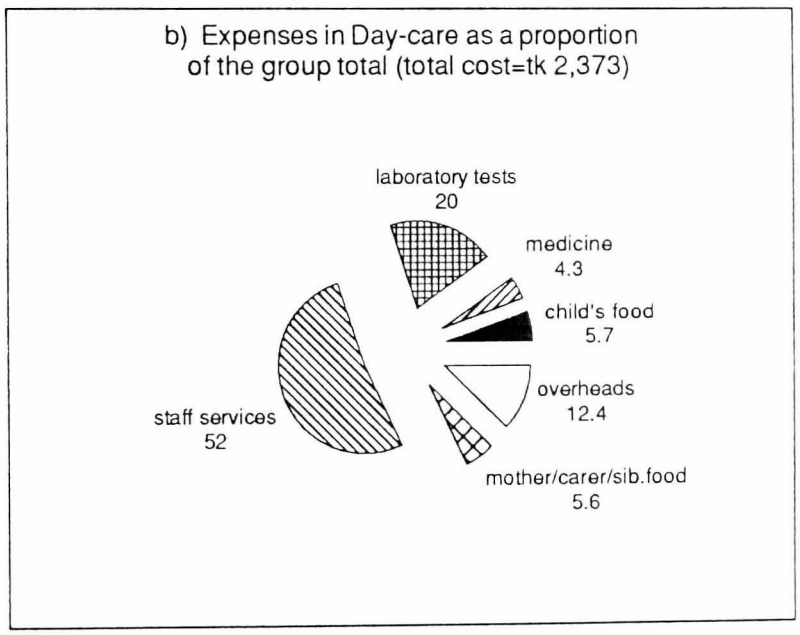
Category	IP N= 173	DC N = 134	DCD N= 130
Child's food	277 ± 144	116 ± 72	44 ± 16
Medicine cost	250 ± 167	100 ± 108	73 ± 50
laboratory tests	506 ± 124	462 ± 113	373 ± 101
X - Rays	30 ± 5	30 ± 5	30 ± 2 ns
Staff services	4291 ± 1908	1222 ± 829	415 ± 70
Mother/carer/sibling food as appropriate	136 ± 122	108 ± 69	54 ± 8
Overheads including capital cost	748 ± 340	335 ± 191	186 ± 53
Total	6238 ± 2386	2373 ±1099	1175 ± 322

(anova, $p < 0.0001$)
ns= not significant
£1 = 60 taka (local currency)

3.1.8.2 Combined cost of CNU and parents- Parents' expenditure in the groups were tk 125 in IP (mainly fathers' transport cost and working mother's wage loss), 177 in DC (transport cost for mother and child and wage loss) and 377 in DCD (child's food cost, wage loss and some transport cost when visited CNU for medical reason). The combined costs to achieve 80% wt/ht are shown in table 3.1.23. When considering the total CNU costs, IP treatment cost 2.6 times more than the DC and 5.3 times more than the DCD. Considering the combined CNU and parental costs, the differences are 2.5 and 4.1 times higher respectively. Although the DCD group took longer to achieve 80% wt/ht, they did so at a much lower cost per child. Parental costs, however, were substantial in the DCD group, representing a quarter of the weekly income. The monetary value of food fed to the child which came from the village, or as gifts from relatives and friends, or received in exchange for work was included in calculating the parental expenses but was not added to the household income. The parental costs as a percentage of weekly income may therefore slightly overestimate the financial demand on the family.

Figure 3.1.4 Cost incurred by the CNU in the three groups to achieve 80% weight for height (proportion of group total)





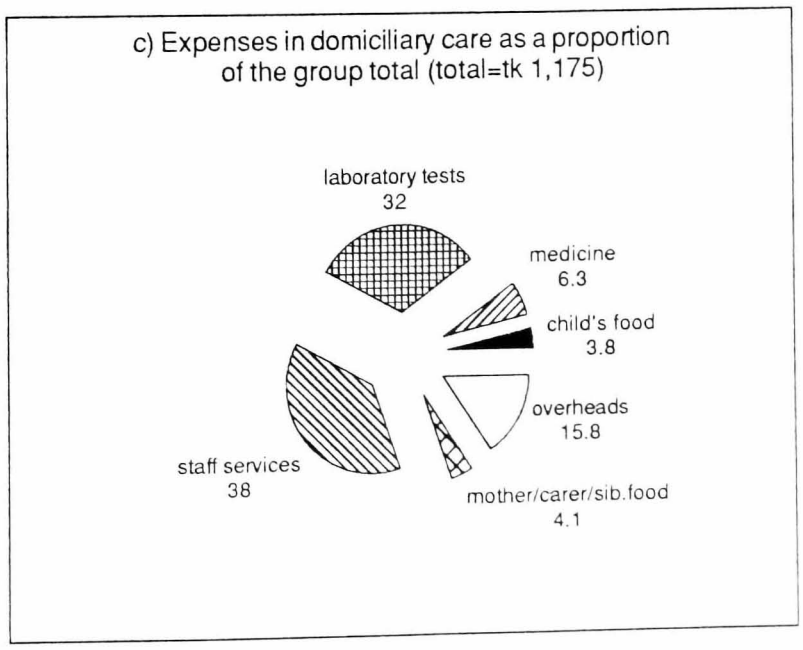


Table 3.1.23 Total cost (taka) of the 3 groups to achieve 80% weight for height (mean ± sd and proportion)

	IP N = 173	DC N = 134	DCD N = 130
Mean duration of treatment (days to reach 80% wt/ht)	23 ± 10	28 ± 16	44 ± 24
Cost incurred by CNU/child	6238 ± 2386	2373 ± 1099	1175 ± 322
Parents' cost (food, wage loss, transport etc)	125 ± 148	177 ± 164	377 ± 249
Total cost per child	6363 ± 2386	2517 ± 1172	1552 ± 387
Total cost /child/day	276 ± 35	90 ± 42	35 ± 37
Parents' cost/child/day	5 ± 6	6 ± 6	10 ± 6 ns
Proportion of parents'income spent on the child during rehabilitation[1]	8.9	12.1	26.6 *

anova, $p < 0.0001$ between groups, except where indicated

* chi-square, $p < 0.01$

[1] see text for comment

3.1.9 Age and anthropometric status at the end of the short-term period-

Table 3.1.24 summarises the nutritional status at the end of the short-term period. The mean age in the DCD group is higher (31 months ± 16), because of the longer duration taken by the DCD group to achieve 80% wt/ht. It can be seen that the final wt/ht exceeds 80%. This is due to the fact that height was measured weekly and wt/ht can overshoot the 80% target between measurements.

Table 3.1.24 Age and nutritional status of the 3 groups at the end of the short-term period (mean ± sd)

	IP	DC	DCD
Anthropometric status	N = 173	N = 134	N = 130
Age(months)	26 ± 13	27 ± 13	31 ± 16
Weight (kg)	7.5 ± 1.7	7.5 ± 1.8	7.9 ± 1.8
Height (cm)	72.3± 7.8	72.7± 8.2	75.1± 10.3
MUAC (mm)	112 ± 10	113 ± 11	113 ± 8
Wt/ht (%NCHS)	82 ± 2	83 ± 2	83 ± 3
Wt/age (%NCHS)	60 ± 7	59 ± 8	59 ± 8
Ht/age (%NCHS)	83 ± 5	83 ± 5	82 ± 6
Wt/ht (z-score)	-1.6 ± 0.4	-1.7 ± 0.4	-1.7 ± 0.3
Wt/age(z-score)	-3.7 ± 0.8	-3.8 ± 0.8	-3.8 ± 0.8
Ht/age (z-score)	-4.2 ± 1.3	-4.3 ± 1.3	-4.4 ± 1.3
Total protein g%	7.3 ± 0.3	7.0 ± 0.9	6.1 ± 1.0
PCV %	30 ± 3	31 ± 3	30 ± 3

NB Total protein and PCV of DCD was done on day 8.

3.1.10 **Brief summary of the findings in the short-term study.**

Severely malnourished children who received domiciliary care preceded by one week of careful medical supervision recovered more slowly than similar children who were treated as in-patients or day-care patients, but mortality was not affected. More mothers reported problems in achieving the target amounts of food than in the frequency of feeding. In 38% of study weeks, DCD children were reported to

have illness during the rehabilitation period spent at home. Although the DCD group took longest to achieve 80% wt/ht, they did so at the lowest cost to CNU. Parental costs were, however, highest for this group, but nevertheless few mothers (4%) discontinued in contrast to 17% of day-care mothers. Parental satisfaction is explored further in section 3.2. At the end of the short-term period, all groups showed no improvement in height for age. However, an average duration of 32 days, (all groups combined) probably was too short to observe a substantial height spurt among these severely wasted and stunted children.

In conclusion domiciliary treatment in the short-term was the most cost-effective approach. It is important however, to also examine the longer term outcome to determine how sustainable is the nutritional status and whether there are any differences in growth pattern, morbidity, mortality and relapse rates in the different treatment groups. These issues are addressed in the long-term phase of the study and reported in section 3.2.

3.2 Long-term results

Children who completed the short-term study were followed at home for one year. This was done for two main reasons. First, to determine whether the improvement achieved during the treatment period was sustained, and whether their subsequent progress differed according to their initial group allocation. Second, to study morbidity, relapse, and mortality in these children, as some earlier studies have reported high rates of relapse and mortality following discharge from hospital and also no data are available on morbidity. In a previous study from the CNU, only 46% of in-patients could be traced two years after discharge. Although 85% of those traced had shown further improvement in their nutritional status and only 1% had died, the fate of the untraced 54% was not known [Khanum and Kabir, 1989]. Vital information on the long-term prognosis of children treated at CNU was therefore lacking.

In the long-term study, the main outcomes of interest were growth, morbidity, mortality, readmissions and relapses. The long-term period started from day 1 after completion of the short-term study and continued for the following 12 months. Although all the children who completed the short-term study were expected to receive 24 follow-up visits during the long-term study period, by the end of the year some children were untraceable, some were found intermittently and a few died. Although adjustments can be made in the analysis for those with incomplete data, it was considered preferable not to make assumptions about those who had many missing visits. Thus only those with 75% or more of the morbidity follow-up visits (≥18 out of 24) were analysed (see section 2.2.11). Table 3.2.1 presents the proportion of children who completed the long-term study together with losses to follow-up, exclusions from analysis, deaths and readmissions. Overall 76.7% completed the long-term follow-up. Drop-out and intermittent attenders were higher in IP than in the other groups. Only 68.3% of IP completed the study compared with 82.9% in DC 81.6% in DCD.($p < 0.05$).

Table 3.2.1 Proportion of cases who completed the long-term study and reasons for non-completion by the 3 groups

	IP		DC		DCD		Total	
No. completed short term and started long term phase	173		134		130		437	
	%	(n)	%	(n)	%	(n)	%	(n)
Completed long term	68.3	(118)	82.9	(111)	81.6	(106)	76.7	(335)
Drop-outs (no trace)	11.5	(20)	3.7	(5)	6.1	(8)	7.5	(33)
Exclusions: TB	1.8	(3)	0.7	(1)	0.0	(0)	0.9	(4)
Excluded from analysis†	13.3	(23)	9.7	(13)	8.5	(11)	10.8	(47)
Readmission	1.7	(3)	1.5	(2)	2.3	(3)	1.8	(8)
Died	3.4	(6)	1.5	(2)	1.5	(2)	2.3	(10)

† received < 75% of follow-up visits therefore excluded from analysis

Data were further analysed (all groups combined) to examine whether the children who did not complete the study were different from the ones who did, particularly their sex and some selected socioeconomic conditions, such as parental separation, mother's job status, family income, temporary city dwellers (squatters) etc. For this purpose the children were categorized into i) those who completed follow-up, ii) excluded from analysis due to missed visits, and iii) drop-outs or no trace. There was no difference in anthropometric status either on admission or on discharge between them. Table 3.2.2 shows some of the characteristics and there was no difference in any of the social aspects between these categories.

Table 3.2.2 Comparison of age, anthropometry and socioeconomic characteristics of children who completed the follow-up study with those who did not, or excluded from the analysis

	completed follow-up N = 335	received <75% of follow-up visits N = 47	drop-out or no trace N = 33
On initial admission :	mean ± sd	mean ± sd	mean ± sd
Age (month)	26 ± 13	29 ± 16	23 ± 11
Weight (kg)	6.4 ± 2.0	6.5 ± 0.9	5.9 ± 1.8
length/ height (cm)	72 ± 8	73 ± 9	71 ± 7
MUAC (mm)	102 ± 13	100 ± 11	98 ± 14
Wt/ht %NCHS	70 ± 7	69 ± 8	68 ± 9
Wt/age %NCHS	51 ± 9	50 ± 10	49 ± 9
Ht/age %NCHS	83 ± 5	83 ± 6	84 ± 4
Other characteristics (%)			
male	47.5	44.6	40.5
female	52.5	55.4	59.5
Birth order (mean ± sd)	2.7 ± 1	2.7 ± 2	3 ± 1
Percent living in 1 room	90.0	95.0	100.0
Father lives with family	85.0	82.0	80.0
Mother lives with family	93.6	96.0	92.0
Mother employed	27.7	25.0	26.0
Income (tk/month) (mean ± sd)	1026± 585	1251± 540	1438± 900
Living in slums	57.4	52.3	55.0
Squatters	5.0	6.0	5.0
Duration (days) to achieve 80% wt/ht (mean ± sd)	32 ± 32	33 ± 30	28 ± 13
No.of instruction sessions during short-term (mean ± sd)	21 ± 8	17 ± 5	19 ± 10

Anova and chi-square tests were not significant

3.2.1 Socioeconomic status of parents

The three groups were comparable socioeconomically both at recruitment (section 3.1.1) and during the long-term period. Table 3.2.3 shows parents' job status and income during the year of follow-up.

Table 3.2.3 Parents' job status and income in the 3 groups during the long-term period (mean ± sd)

Parents'job status	IP n = 118	DC n = 111	DCD n = 106
No. of days employed father worked	312 ± 279	324 ± 268	338 ± 283
% of time father worked	85.6 ± 76.5	88.8 ± 73.5	92.6 ± 77.7
No. of days employed mothers worked	120 ± 214	157 ± 251	154 ± 236
% of time mother worked	32.9 ± 58.6	43.0 ± 68.8	42.2 ± 64.7
Total income taka/month	1036 ± 696	1022 ± 527	1020 ± 533

The main outcome of interest in the long-term was growth performance which included attained weight, weight gain, attained height and height gain, and these are described below.

3.2.2 **Weight**

Mean weights at the end of the long-term study were 9.8, 9.8 and 10.3 kg for IP,DC and DCD respectively (range 6-16kg). The attained weight every month from admission to the end of the study shows an upward trend in all groups (figure 3.2.1). The reason why DCD has a higher attained weight is that they are slightly older, having taken longer to complete the short-term phase.

Weight gain- The overall weight gain during the long-term period averaged 2.9 kg (range 0.67-5.0 kg) for the 3 groups combined. Weight gain was also calculated in kg in 3-month periods and as g/kg/d averaged over the 12 months. Quarterly weight gains were similar in all groups (table 3.2.4) except for quarter 1, when IP had a lower weight gain than DC and DCD and the difference was significant ($p<0.05$). Mean weight gain over the 12 months was 0.99 g/kg/day (range 0.19 - 6g/kg/day) and was similar in all groups.

Table 3.2.4 Quarterly and total weight gain in kg during the long-term study and in g/kg/day from 1-12 follow-up months

Period	IP (n=118) mean ± sd	DC (n=111) mean ± sd	DCD (n=106) mean ± sd
Quarter 1	0.59 ± 1.00	1.00 ± 0.96	0.94 ± 0.86*
Quarter 2	0.86 ± 2.90	0.66 ± 2.50	0.48 ± 0.70
Quarter 3	0.68 ± 0.77	0.59 ± 0.76	0.60 ± 0.66
Quarter 4	0.69 ± 0.76	0.76 ± 0.64	0.70 ± 0.66
Total wt gain (kg)	2.82 ± 1.12	3.01 ± 0.98	2.72 ± 1.13
Total wt gain(g/kg/d)	1.00 ± 2.00	1.00 ± 1.50	0.87 ± 1.49

* $p< 0.05$ by Anova

3.2.3 **Height/length**

The attained mean heights at the end of the long-term study were 79.5 cm in IP, 79.8 cm in DC and 81.8 cm for DCD (range 63-107cm). A similar upward trend in attained height/length was observed in the 3 groups. Heights of the DCD group remained slightly higher than the other 2 groups throughout, but the difference was not significant (figure 3.2.2).

Height gain- Mean height gain over the 12 months was 6.9 cm (range 2.5-12cm) for the 3 groups combined. Height gain in the first six months was quite similar in DCD and DC but lower in IP (table 3.2.5) but the difference was not significant (p= 0.06). Height gain in the second 6-month period was similar in all groups.

Table 3.2.5 Height gain in cm during the long term period: quarterly, 6 monthly and total in the 3 groups

Period	IP (n=118) mean ± sd	DC (n=111) mean ± sd	DCD (n=106) mean ± sd
Quarter 1	1.4 ± 0.8	1.7 ± 1.0	1.6 ± 0.9
Quarter 2	1.5 ± 0.9	1.9 ± 0.9	2.0 ± 1.0*
Quarter 3	1.6 ± 0.9	1.8 ± 0.8	1.7 ± 0.9
Quarter 4	1.8 ± 1.5	1.8 ± 0.9	1.7 ± 1.0
First 6 months	2.9 ± 1.4	3.6 ± 1.3	3.8 ± 1.5
Second 6 months	3.5 ± 1.9	3.6 ± 1.3	3.5 ± 1.5
Total ht gain (cm)	6.4 ± 2.6	7.2 ± 2.3	7.3 ± 2.3

* p = 0.06 (analysis of variance)

Figure 3.2.1 Weight (kg) in the 3 groups on admission,in the short-term and during follow-up for 12 months

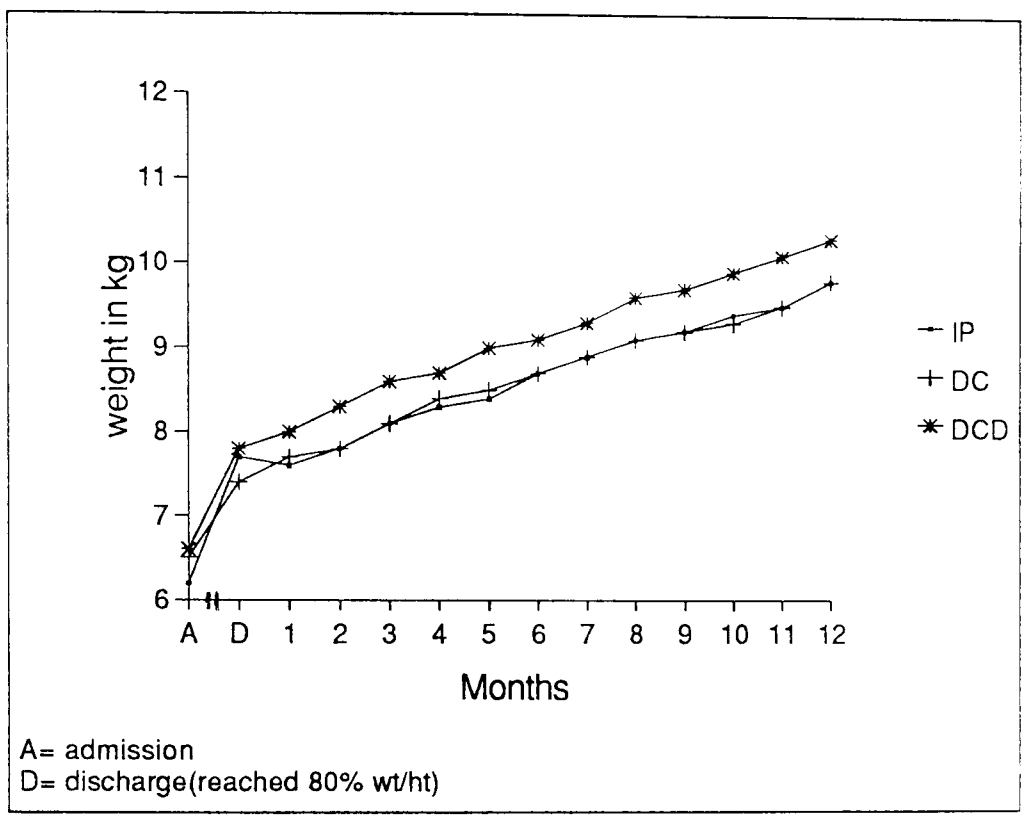
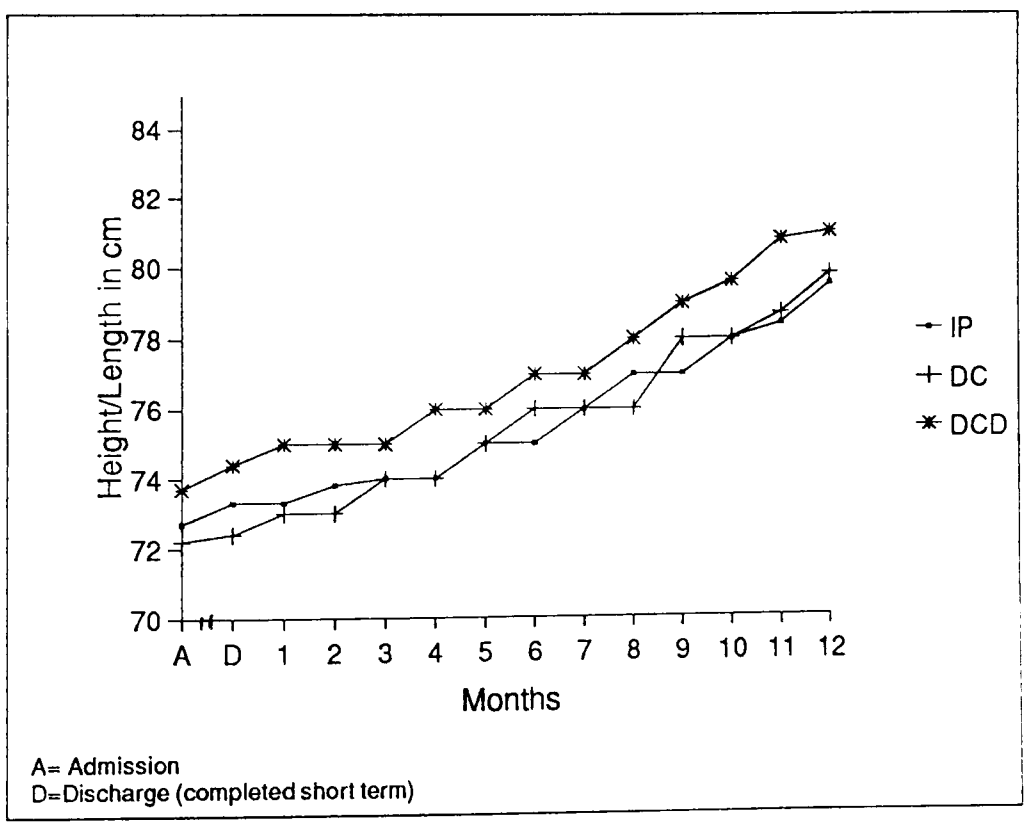


Figure 3.2.2 Height/length (cm) in the 3 groups on admission, in the short-term and during follow-up for 12 months



3.2.4 **Anthropometric status at the end of follow-up.**

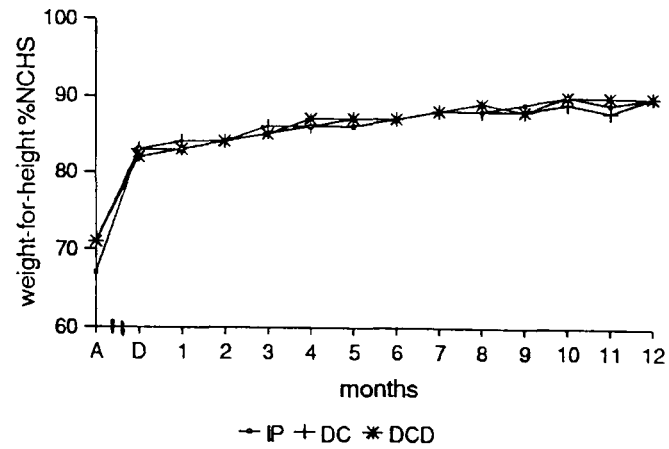
Weight-for-height - Attainment of 80% wt/ht was the discharge criterion for the short-term period, that is, all the children had to achieve 80% wt/ht before they became eligible for the long-term follow-up. The mean wt/ht at month 12 was 90.8 % of the NCHS median (IP 91.0%, DC 90.5% and DCD 90.7%) (range 79-116%). The corresponding Z-scores were -0.90, -0.94, -0.93 respectively. Figure 3.2.3 shows wt/ht from admission to month 12 of the long-term study. A similar upward trend was observed in all groups.

Weight-for-age - The mean wt/age in month 12 in all groups combined was 67.4% of the NCHS median (IP 66.8%, DC 67.3%, DCD 67.3%) (range 45-101%). The corresponding Z-scores were -3.11, -3.09, and -3.05 respectively. A similar upward trend in all the groups was observed from admission onwards (figure 3.2.4).

Height for age- The mean ht/age in month 12 was 83.8% of the NCHS median (IP 83.9%, DC 83.8% and DCD 83.7%), (range 69-103). The corresponding Z-scores were -4.25, -4.09, and -4.07 respectively. Although there was a difference in mean height of 6.9 cm during the year, there was no change in the ht/age curve from initial admission to the end of the long-term period. The pattern was similar in the 3 groups (figure 3.2.5).

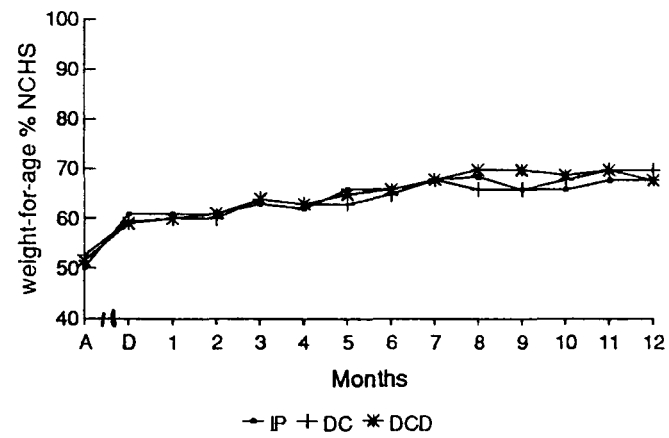
Thus although there was a progressive upward trend over the year in weight-for-height and weight-for-age in all groups, no trend was observed in height-for-age in any of the groups.

Figure 3.2.3. wt/ht on admission, discharge and follow up months in the 3 groups



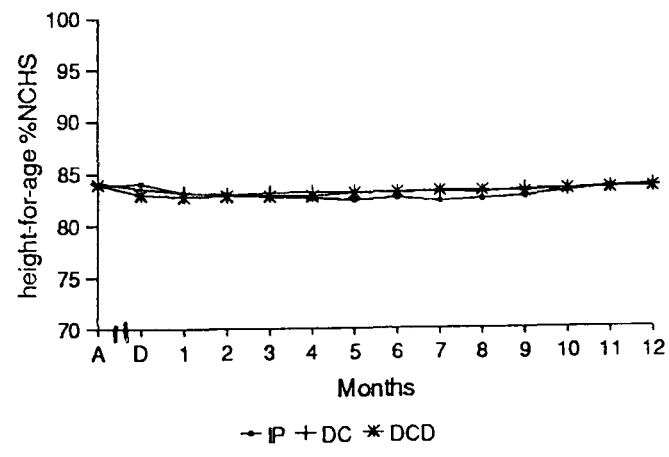
A= admission
D= discharge (reached 80% wt/ht)

Figure 3.2.4 wt/age on admission, discharge and follow-up months in the 3 groups



A= admission
D= discharge (reached 80% wt/ht)

Figure 3.2.5 ht/age on admission, discharge and follow-up months in the 3 groups



A= Admission
D=Discharge (completed short term)

Having seen the overall improvement in wt/ht and wt/age, during the 12 months of follow-up, the next step was to explore further the extent to which these mean values were masking some very poor performers. Figure 3.2.6 gives the wt/ht data disaggregated into 4 categories for months 0, 1, 6 and 12. It can be seen that for the 3 groups combined there is a progressive reduction in the proportion of children <85% wt/ht over the 12 months of follow-up, whilst the proportion of children >95% wt/ht increases progressively during this period. A similar pattern is seen for wt/age, although approximately one-quarter of the children remain less than 60% wt/age after 12 months (figure 3.2.7). Most of these children had a wt/age of less than 50% on admission. Little shift in the distribution of ht/age is discernible over the 12 months (figure 3.2.8).

Some researchers are of the opinion that there is only a small 'window of opportunity' during which catch-up in linear growth can occur [Martorell et al., 1986] and have suggested that the window is 'shut' by 3 years of age. To explore this hypothesis, the children were categorized into 4 age groups at month 0 of the follow-up, and the distributions of ht/age at month 0 and month 12 were compared. The results do not support this hypothesis (table 3.2.6). Further analysis showed that from month 0 to month 12, a negative change was observed in mean height-for-age (-0.7%) in those who were less than 48 months of age compared to the children ≥ 48 months who showed a positive change (1.45%), which again is opposite to the view of those who advocate closure of the 'window of opportunity' in older children. This difference between the younger and older age groups in the shift in ht/age was highly significant ($p < 0.001$).

Figure 3.2.6 Percentage distribution of wt/ht catagories at 0, 1, 6, and 12 follow-up months (groups combined)

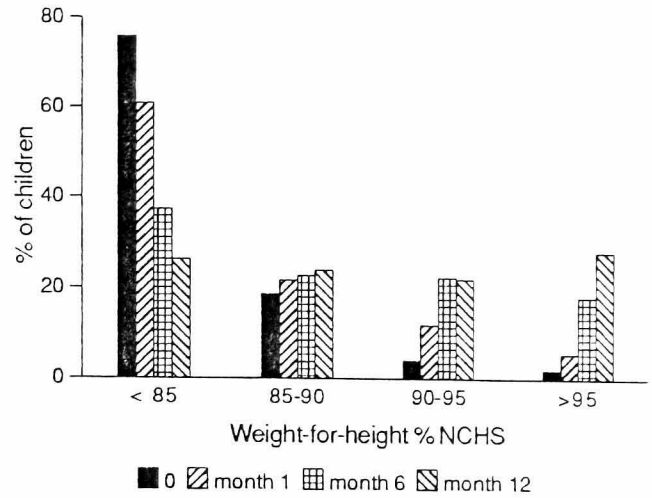


Figure 3.2.7 Percentage distribution of wt/age catagories at 0, 1, 6 and 12 follow-up months (groups combined)

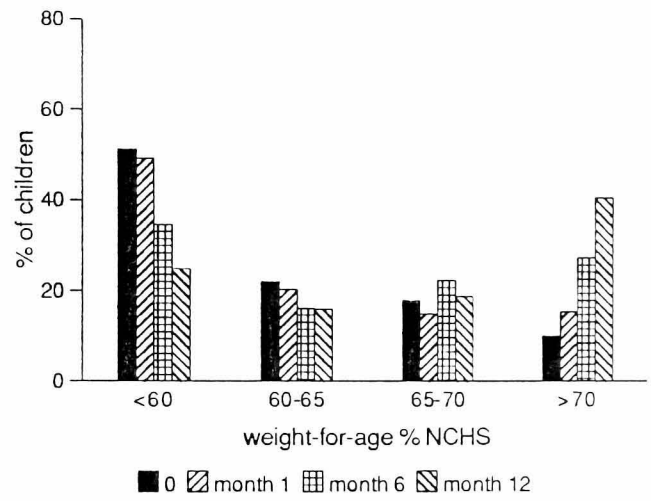


Figure 3.2.8 Percentage distribution of ht/age catagories at 0, 1, 6 and 12 follow-up months (groups combined)

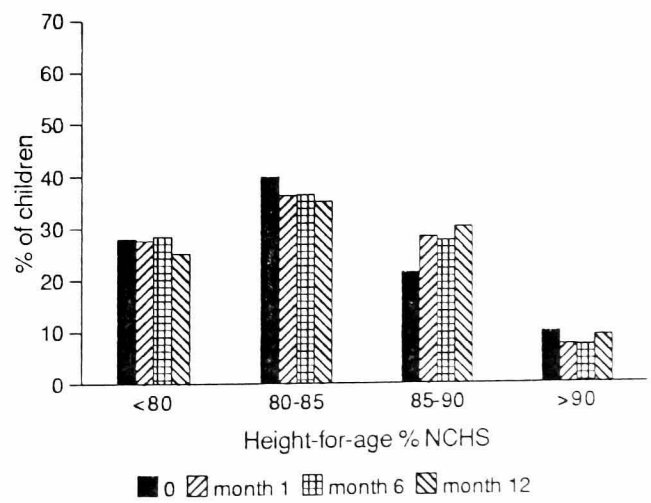


Table 3.2.6 Height-for-age distributions(%) by age group at months 0 and 12 of the follow-up

	Age month 0 of follow-up							
Ht/age %NCHS	≤ 23 months n = 156		24-35 months n = 71		36-47 months n = 53		≥48 months n = 44	
	month 0	month 12	month 0	month 12	month 0	month 12	month 0	month 12
<80	17.4	16.7	32.9	40.8	24.1	30.2	22.7	20.5
80-85	28.6	35.5	32.9	31.0	46.3	39.6	45.5	36.4
85-90	34.2	37.8	28.9	23.9	18.5	20.8	22.7	25.0
>90	19.8	10.0	5.3	4.2	11.1	9.4	9.1	15.9

Chi square test for association between age group and ht/age group:
Month 0 $P < 0.01$, Month 12 $p < 0.01$

3.2.5 **Summary of anthropometric status of the 3 groups**

Anthropometric indices at the various stages of the study are summarised in table 3.2.7. There were no differences in any of the anthropometric indices among the three study groups. Thus the long-term growth performance of the children was unaffected by the particular type of treatment they had received initially.

3.2.6 **Morbidity**

This was one of the major outcomes of interest in the long-term study. Information on infections was analyzed separately for illnesses reported by parents between visits and findings from the health workers' physical examination on the visit day. Table 3.2.8 shows the findings from the parents' reporting of illnesses.
Diarrhoea was reported in 91.9 % of children during the year of the follow-up. The total number of days children suffered diarrhoea ranged from 1- 234 days. There was no difference in the incidence of diarrhoea in the 3 groups. Fever and cough was reported in 96.4% of children. Fever and cough were reported less frequently in the DCD group than in the other two groups and the difference was significant (Anova $p < 0.03$).

Table 3.2.7 Summary of anthropometric status at various stages of the study in the 3 groups

	IP N = 118 mean ± sd	DC N = 111 mean ± sd	DCD N = 106 mean ± sd
Age (months):			
admission	26 ± 14	25 ± 13	28 ± 15
achieved 80% wt/ht	27 ± 14	26 ± 13	30 ± 16
after 1 year	39 ± 13	38 ± 13	42 ± 15
Weight (kg):			
admission	6.29 ± 1.76	6.54 ± 2.0	6.65 ± 2.0
achieved 80% wt/ht	7.73 ± 1.81	7.46 ± 1.89	7.83 ± 2.0
after 1 year	9.88 ± 2.03	9.46 ± 2.06	10.3 ± 2.3
Height (cm):			
admission	72.7 ± 8.2	72.2 ± 8.5	73.7 ± 9.9
achieved 80% wt/ht	73.3 ± 8.1	72.4 ± 8.4	74.4 ± 9.7
after 1 year	79.5 ± 8.0	79.8 ± 8.5	81.8 ± 9.3
MUAC (mm):			
admission	101.6 ± 13.6	103.8 ± 14.3	102.7 ± 12.2
achieved 80% wt/ht	113.2 ± 11.0	113.1 ± 12.1	113.7 ± 8.8
after 1 year	138.2 ± 11.7	136.6 ± 11.7	139.6 ± 10.3
weight/height%NCHS			
Admission	68.9 ± 7.7	72.4 ± 8.3	71.6 ± 6.9
Achieved 80% wt/ht	82.5 ± 2.0	83.0 ± 3.0	83.5 ± 3.0
After 1 year	91.0 ± 9.4	90.5 ± 8.1	90.7 ± 8.8
Weight/age %NCHS:			
Admission	50.1 ± 9.6	52.6 ± 9.9	51.5 ± 8.3
Achieved 80% wt/ht	60.9 ± 8.3	59.4 ± 8.4	59.0 ± 7.7
After 1 year	66.8 ± 10.7	67.3 ± 10.0	67.3 ± 9.9
Height/age %NCHS:			
Admission	83.9 ± 5.7	84.1 ± 5.3	83.9 ± 4.8
Achieved 80% wt/ht	83.7 ± 5.5	83.5 ± 5.1	83.0 ± 4.8
After 1 year	83.9 ± 5.5	83.8 ± 4.6	83.7 ± 5.0

Table 3.2.8 Diarrhoea, fever and cough reported by parents (mean±sd) in the 3 groups during the long-term study

	IP n = 118	DC n = 111	DCD n = 106
Diarrhoea:			
number of days	37 ± 42 (0-231)	35 ± 38 (0-234)	28 ± 37 (0-232)
% of time	9.5 ± 10.6 (0-60)	9.3 ± 10.0 (0-61)	7.4 ± 9.1 (0-57)
no. of episodes	7.3 ± 6.8 (0-30)	7.1 ± 6.1 (0-28)	5.7 ± 5.5 (0- 25)
duration each episode (days)	4.9 ± 2.0 (2-14)	4.8 ± 2.2 (2-17)	4.6 ± 1.5 (2-10)
Fever: (no diarr, no cough)			
number of days	36 ± 28 (1-143)	36 ± 30 (0-207)	27 ± 20* (0-131)
% of time	10.7± 7.1 (0-40)	10.1±10.4 (0-46)	7.3 ± 7.3* (0-36)
Cough: (no diarr, no fever)			
number of days	92 ± 57 (0-210)	92 ± 55 (0-200)	54 ± 37* (0-180)
% of time	25.0 ± 16.6 (0-75)	25.0 ± 15.2 (0-65)	15 ± 10.2* (0- 60)
Fever and cough			
number of days	46 ± 37 (0-80)	46 ± 35 (0-100)	27 ± 29* (0-75)
% of time	12.6 ± 15.2 (0-43)	12.6 ± 15.0 (0-45)	7.5 ± 10.2* (0-30)

* $P < 0.03$ between groups by analysis of variance
Figures in parentheses are ranges.

To examine further if there was any difference among the groups in the presence or absence of diarrhoea, the children were categorised as having no diarrhoea or having low, medium or high prevalence. Table 3.2.9 shows that there was no significant difference in the pattern of diarrhoea among the three groups.

Table 3.2.9 Frequency distribution (%) of days ill with diarrhoea during the long-term period

	IP N = 118	DC N = 111	DCD N = 106	Total N = 335
No diarrhoea	6.8	6.3	11.3	8.1
low	39.0	38.7	39.6	39.1
medium	27.1	24.3	25.5	25.7
High	27.1	30.7	23.6	27.1

Chi-square not significant

low= 1-20 days
medium= 21-42 days,
high= more than 42 days

Health workers' findings on examination

During the fortnightly visits for morbidity data collection, health workers examined children for signs of infection. They referred those with major illness such as diarrhoea with moderate dehydration, severe dehydration, pneumonia, unexplained and repeated episodes of fever, ear or throat infection, lack of weight gain for 2 consecutive visits or loss of weight, and loss of appetite. Findings from the health workers' examination are shown in table 3.2.10. Out of over 10,000 examinations, illness was found in 35%. Of these, health workers referred 44.2% to the CNU. Presence of xerophthalmia was unexpected, but was reported mostly in those with diarrhoea or high fever who did not attend CNU after referrals. No difference in morbidity on examination was found among the three groups. Diarrhoea and fever were the most common problems diagnosed. Other problems were poor appetite, and poor growth.

Mothers' response to illness in between health workers' visits

Morbidity data were further analysed in order to assess the measures undertaken by parents in response to infection occurring between the health workers' visits and also to assess if there was any difference in the actions taken by the 3 groups. No difference was observed between the groups (table 3.3.11). When illness was reported, 27.0% had visited CNU and 52% took no action.

Table 3.2.10 Health workers' examination of morbidity (% ill) during the long-term period

	IP n = 4,128	DC n =3,248	DCD n = 3,112	Total n =10,488
Illness found	33.0	38.9	33.2	35.0
Percent refd. to CNU	47.2	45.4	39.6	44.2
Distribution of referrals (%):				
diarrhoea	16.7	15.5	12.0	14.7
pneumonia	9.3	8.0	6.5	8.1
fever	18.3	13.0	11.0	14.0
poor appetite	10.5	11.1	12.0	11.2
skin infection	12.3	12.6	11.5	12.2
ear infection	9.8	10.3	12.8	11.0
throat infection	7.0	7.7	10.1	8.2
eye infection	6.5	7.4	5.7	6.5
reported passing worms	4.2	5.6	7.3	5.7
xerophthalmia	2.0	2.6	2.7	2.4
oedema	0.3	0.2	0.4	0.3
other reasons	3.1	6.0	8.0	5.7

n = number of fortnightly examinations

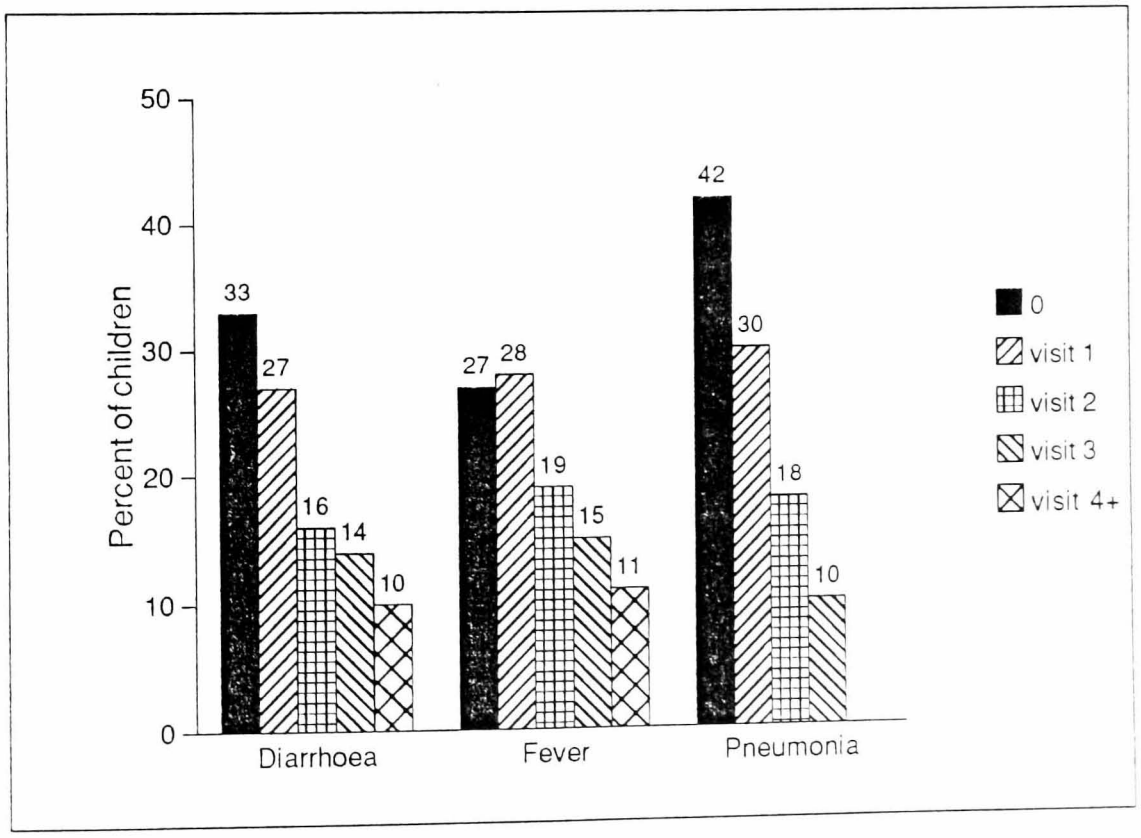
Table 3.2.11 Mothers' response to illness of the child in between visits (%) (n = number of illness episodes)

	IP n=1,508	DC n=1,085	DCD n=989	Total n=3,581
Did not do anything	56.2	50.2	52.0	52.0
Attended CNU	25.3	32.4	26.7	27.0
Used home remedy	18.2	17.0	21.8	18.7
Went to faith healer	0.1	0.1	0.2	0.1
Homeopathies	0.2	0.3	0.3	0.2

Frequency of visit to CNU OPD with diarrhoea, fever and pneumonia.

OPD records of children referred by the health workers and those of children brought by parents for consultation were analysed to see the frequency of visits and the clinical diagnosis as determined by the OPD physicians (see figure 3.2.9). The groups are combined because, although the DCD group tended to make fewer visits with the illnesses mentioned, the difference was not significant. Sixty seven percent of the children attended CNU with diarrhoea (24% three times or more); 73% attended with fever (±) upper respiratory infection (26% three times or more) and 58% visited with pneumonia (10% three times or more). This high prevalence of infection may have contributed to the modest weight gain and no catch-up in linear growth. On the other hand, the number of visits to CNU for treatment possibly explains the low relapse and mortality rates (presented in the next section).

Figure 3.2.9 . Frequency of visits to CNU OPD with diarrhoea, fever and pneumonia (diagnosed by physician) during the long-term study



3.2.7. **Readmissions and death during the long-term study**

The other main outcome variables of interest in the long-term study were readmissions and deaths. Considering the frequency of visits to CNU with major infections, the number of readmissions and deaths were low. The overall mortality was 2.3% and readmissions 1.8% (table 3.2.1).

Readmissions - 3 out of 8 were readmitted for relapsed PEM and 5 for other medical causes of concern, for example, pneumonia. Of the 3 PEM cases, 1 was from the day-care group and 2 had been in-patients. All 5 non-nutritional readmissions were referred to general hospitals after initial observation in CNU for 48 hours.

Deaths - There were 10 deaths. Except for 1 child, the cause of death was non-nutritional. Table 3.2.12 describes anthropometric status on readmission and the last measurements prior to death. Children who died were comparatively young and had lower anthropometric status by all parameters than the readmitted ones. Out of 10 deaths, 3 died of pneumonia (one in CNU), 3 had high fever, 1 had convulsion, 1 dehydration (died at the International Centre for Diarrhoeal Diseases and Research) 1 died of renal failure (in the post graduate hospital) and 1 drowned. The majority died at home (7 out of 10).

Table 3.2.12 Age and nutritional status on readmission or prior to death in the long-term study

Nutrition status	Readmitted N = 8	Died N = 10
When last seen		
	mean ± sd	mean ± sd
Age in months	31 ± 12	26 ± 12
Days after reaching 80% wt/ht	183 ± 94	107 ± 84
Weight (kg)	8.7 ± 2.1	7.5 ± 2.0
Height (cm)	76 ± 7	70 ± 8
MUAC (mm)	128 ± 13	115 ± 15
Wt/ht %NCHS	86 ± 6	82 ± 2
Ht/age %NCHS	80 ± 5	80 ± 5
Wt/age % NCHS	60 ± 11	52 ± 3
No.of infection present	2 ± 1	3 ± 1

The relapsed PEM child who died, was female, 14 months old on initial admission, weight 2 kg, height 60cm, MUAC 66mm, wt/ht 50% NCHS, wt/age 29%, ht/age 77% and took 40 days to achieve 80% wt/ht. Wt/ht on the last follow-up visit was 65%. Her mother was a day-labourer with 3 children and was working full-time. The child visited CNU with a sibling twice for pneumonia, but mostly was not found at follow-up visits. When found, readmission was refused by the mother and the child died at home.

Socioeconomic and nutritional data of the readmitted children and those who died were further analyzed to compare their initial admission data with those who survived. Of the children who died, 80% were female. They were younger on admission and had lower nutritional status than the ones who completed the study or who were readmitted (table 3.2.13).

Table 3.2.13 Comparison of age, anthropometry and socioeconomic characteristics of children who completed follow-up with those readmitted or died (mean ± sd and %)

	Survived N = 335	Readmitted N = 8	Died N = 10
On initial admission :	mean ± sd	mean ± sd	mean ± sd
Age (month)	26 ± 13	23 ± 11	22 ± 11
Weight (kg)	6.4 ± 2.0	6.0 ± 0.9	5.2 ± 1.8
length/ height (cm)	72 ± 8	71 ± 7	67 ± 6
MUAC (mm)	102 ± 13	99 ± 5	89 ± 14
Wt/ht %NCHS	70 ± 6	69 ± 5	64 ± 10
Ht/age %NCHS	83 ± 5	83 ± 5	80 ± 6
Wt/age %NCHS	51 ± 3	51 ± 6	43 ± 12
No. of infection present	2 ± 2	2 ± 1	3 ± 0
Other characteristics (%)			
male	47.8	50.0	20.0
female	52.2	50.0	80.0
birth order (mean ± sd)	2.7 ± 1	3.2 ± 2	3 ± 1
Breast fed on initial admission	47.5	25.0	35.5
Percent living in 1 room	90.0	100.0	100.0
Father lives with family	78.7	90.0	75.0
Mother lives with family	97.6	100.0	100.0
Mother employed	27.7	25.0	20.0
Income (tk/week) (mean ± sd)	343 ± 52	290 ± 80	340 ± 47
Followed advice on feeding	67.4	87.3	80.0
No.of instruction sessions during short-term (mean ± sd)	21 ± 8	16 ± 5	18 ± 10

3.2.8 **Catch-up growth and factors affecting it**

This section presents some explanatory analysis to examine whether catch-up in weight gain and height gain of those who completed the study was affected by the presence of infection, and parents'job status.

Diarrhoea morbidity and weight and height gain - As diarrhoeal disease is considered to be one of the major causes of growth faltering in developing countries, the average weight gain per month (kg) and height gain (cm) were analyzed according to the number of days with diarrhoea, categorised as low,

medium, or high. Average weight gain per month was significantly lower in children having diarrhoea more than 42 days during the year ($p < 0.03$) (table 3.2.14).

Table 3.2.14 Average weight (kg) and height (cm) gain with and without diarrhoea in the long term period, all groups combined

	average monthly weight gain ± sd	average monthly height gain ± sd
No diarrhoea (n=20)	0.173 ± 0.12	0.586 ± 0.21
Low (n=129)	0.203 ± 0.08	0.606 ± 0.19
Medium (n=85)	0.183 ± 0.08	0.573 ± 0.53
High (n=86)	0.153 ± 0.01	0.536 ± 0.20

Wt gain $p < 0.03$ Ht gain not significant
Wt and ht gains adjusted for age.

Days with diarrhoea in a year:

low (1-20 days)
medium (21-42 days),
high (42 and above)

Days of illness and rate of weight gain

A second analysis were performed to explore further the effect of diarrhoea and also to determine whether fever, and fever and cough had any effect on weight gain. For this purpose the average monthly weight gain was categorized into lower and higher gain groups (table 3.2.15). Diarrhoea prevalence and episode duration were both associated with significantly lower weight gain. Fever and cough did not affect weight gain significantly

Table 3.2.15 Average weight gain/month and days with diarrhoea, fever and cough (mean ± sd)

	weight gain kg/month	
Infections	<0.250 (n= 244)	≥ 0.250 (n = 76)
Diarrhoea:		
number of days	37 ± 40	24 ± 22*
% of time	10.5 ± 9.0	6.6 ± 5.7*
number of episodes	7.3 ± 6.3	5.2 ± 4.6*
average duration (days)	5.8 ± 2.0	4.2 ± 1.5**
Fever:		
number of days	34 ± 31	31 ± 33
% of time	9.6 ± 8.6	8.3 ± 6.0
Cough:		
number of days	39 ± 47	37 ± 45
% of time	10.1 ± 13.0	10.5 ± 12.5
Fever and Cough:		
number of days	46 ± 47	42 ± 56
% of time	10.0 ± 8.5	9.9 ± 7.3

* $p < 0.03$; ** $p < 0.02$ (Anova)
weight gains were adjusted for child age

Parent's job status and income and rate of weight gain

The data were examined in a similar manner to determine whether parents'job status and income were associated with weight gain. There were no associations between rate of weight gain and parents' job status or income (table 3.2.16). Weight gain was also analyzed according to sex as gender discrimination in food intake is widely reported, but no association was observed.

Table 3.2.16 Average weight gain and parents' income and job status

Parents' job status	average weight gain < 0.250 (n=244)	≥ 0.250 (n=76)
Percent of time employed fathers worked	89 ± 47	94 ± 55
Percent of time employed mothers worked	37 ± 28	34 ± 22
Mean income taka/month	1052 ± 560	1125 ± 760

3.2.9 **Choice of rehabilitation approach by parents.**

The costs of rehabilitation of the three alternative approaches were described in section 3.1.8. Parental costs were substantial in the DCD group representing a quarter of the weekly income. Parental preferences were ascertained by asking at the final visit in month 12 of the follow-up which approach they would have preferred had they been given a choice. The results are shown in table 3.2.17. Overall, 67% would have preferred domiciliary treatment. DC was the least popular option, preferred by only 4.2%. Of the IP group, none opted for DC and in the DCD group only 0.9% opted for DC. Of the DC group, 82.9% would have preferred DCD type of rehabilitation.

Table 3.2.17 Preferred type of short-term rehabilitation if parents'could choose (%)

Preferred type	IP n = 118	DC n = 111	DCD n = 106	Total N = 335
In-patient	72.0 (85)	5.4 (6)	5.7 (6)	29.0 (97)
Day-care	0.0 (0)	11.7 (13)	0.9 (1)	4.2 (14)
Domiciliary	28.0 (33)	82.9 (92)	93.4 (99)	66.8 (224)

P <0.0001 by chi-square between groups

Figures in the parentheses are number of parents/care taker

In conclusion the results show that, after attaining 80% wt/ht, there was no difference in growth, morbidity, mortality or readmission in the three study groups during one year of follow-up. Morbidity was high during the year, and visits to CNU OPD for consultation and timely medical care may have prevented mortality and relapse. The children improved in wt/ht but did not reach 100% wt/ht even after a year. There was no change in their mean ht/age. Diarrhoeal episodes significantly diminished weight gain. Not only was DCD the most cost-effective approach to treatment but it was also the most popular option, being preferred by 67% of the parents/carers.

CHAPTER 4. DISCUSSION

This study is the first to compare the cost effectiveness of three alternative approaches to the treatment of severe PEM in a single location. Furthermore children were randomly allocated to the three treatment groups, a methodology not followed in previous studies which have attempted to compare cost-effectiveness of different approaches to the treatment of severe PEM. Consequently in previous studies, treatment groups are likely to have differed in severity and the results should be viewed cautiously.

4.1 Short-term outcomes

4.1.1 Defaulting during treatment

None of the studies reviewed in section 1.2 reported a method for assessing the acceptance of different approaches to treatment by the communities they serve, but most report defaulting as a serious problem during treatment, particularly in NRCs.

In this study the three treatment groups were comparable as regards age, sex, nutritional status, prevalence of infections and socioeconomic status at recruitment. The children were similar to those previously studied at CNU [Khanum,1985] and their living conditions were typical of the urban slum population in Dhaka [West, 1986, Das et al., 1989;]. Although the three groups were comparable in all aspects, discontinuation of treatment was highest in the day-care group. Seventeen percent of these children discontinued in their allotted group compared to only 4% and 1% in the domiciliary and in-patient groups respectively. Inconvenience of daily attendance, family problems, and the improved appearance of the child were the main reasons for discontinuation in day-care. Earlier studies elsewhere in NRCs have reported drop-out rates of 17-30% [Lamptey et al., 1980; Ramprasad et al., 1980; Roy et al., 1980; Stanton et al., 1987; Asokan et al., 1992; Pecoul et al.,

1992]. In a recent study in Bangladesh, Nielsen et al [1992] reported a drop out of 50% among patients who were advised to attend for rehabilitation on a daily basis after treatment in hospital for diarrhoea and dehydration. The main reasons for drop-out were transport cost (21%), wage loss (16%), could not leave other children alone (31%), and could not come alone (30%). The high drop-out during day-care treatment in previous studies and in the present study suggests that this approach does not fit in with the needs of the mothers.

High drop out rates (18-36%) have also been reported in urban home based management due to moving house [Verkley et al., 1983; Jansen and Verkley, 1986; Farnandez-Concha et al., 1992]. Thus in highly mobile populations, there may be disadvantages to domiciliary management.

A high rate of absconding (17%) was reported from hospital treatment in Tanzania [Van Roosmalen-Wibenga et al., 1986] and in Zambia (24%) [Hone et al., 1987]. In contrast, only 1% dropped-out from in-patient treatment in the present study. Inability to leave their families, dissatisfaction with the treatment, belief that their children have sufficiently recovered, or availability of other health care facilities nearby, may have been some of the reasons for absconding in other studies. The likely reasons for non-defaulting from in-patient treatment in the present study are a) although mothers were expected to be resident, in practice a flexible system operated, with other family members substituting b) most mothers came to CNU as a last resort after trying various other treatment facilities, and had no options for treatment elsewhere c) confidence in the treatment was established, as mothers quickly witnessed an improvement in the child's condition which was maintained d) staff were kind, caring and supportive.

4.1.2 Prevalence of infection on admission

The presence of infection can profoundly influence nutrition [Chandra et al., 1977; Scrimshaw, 1989; Tomkins and Watson, 1989]. A history of measles 1-3 months prior to admission was particularly striking in this study as in earlier reports from CNU [Khanum, 1985]. Early studies of measles in West Africa showed

considerable weight loss [Morley, 1969] and measles was often reported as preceding marasmus and kwashiorkor in Nigeria [Laditan and Reeds 1976]. Post-measles growth faltering is frequently protracted in Bangladeshi children [Koster et al., 1981; Bhuiya et al., 1987] especially among those who develop post-measles dysentery. There are several reasons why measles can have a marked impact on nutritional status. i) Immune suppression may persist for 3 or 4 months, allowing other infections to become established with a further deterioration in the nutritional status. ii) Reduction of food intake due to anorexia and sore mouth, or food is withdrawn from children as a treatment for measles. iii) The measles virus may damage the intestinal mucosa sufficiently to cause malabsorption and protein loss [Dosseter and Whittle 1975]. iv) Metabolic changes can also lead to excessive breakdown and net loss of body protein [Tomkins et al., 1983]. For example mobilisation of skeletal muscle may be needed to provide substrate for the synthesis of acute phase proteins. A high fatality risk in severely malnourished children with measles has been documented [Vis, 1985; Koster et al., 1988].

In addition to measles, the high prevalence of other infections in this study is comparable with previous reports from the CNU [Brown et al., 1981; Khanum, 1985,] and in hospitalised PEM patients elsewhere [Morehead et al., 1974; Phillips et al., 1968; Cooper et al., 1980; Laditan et al., 1983; Tolboom et al., 1986; Mitra et al., 1991; Christie et al., 1992; Friedland et al., 1992; Khin-Maung-U et al., 1992; Fagbule, 1993]. Day-care and domiciliary patients in this study however, had more infections than is usually the case for patients treated in these two ways elsewhere [Stanton et al., 1987; Glatthaar et al., 1986; Gillam, 1989; Heikens et al., 1989; Gueri et al., 1985].

Xerophthalmia was prevalent in the children, which is similar to previous reports from the CNU [Brown et al., 1979; Cohen et al., 1983;] and elsewhere in Bangladesh, particularly in urban children [Helen Keller International and Institute of Public Health and Nutrition, 1985; Stanton et al., 1985;]. Measles and gastroenteritis are probable precipitating factors for xerophthalmia [Reddy et al., 1986; Shahid et al., 1988].

4.1.3. **Mortality during treatment**

The children studied were all severely malnourished yet the death rate was very low in all the groups. All deaths occurred during the first week of treatment and most (70%) died within 3 days of admission. The two most frequent causes of death were acute respiratory infection and diarrhoea with severe dehydration. In the non-study children, 80% of deaths occurred within 7 days [Mostafa, 1993] which is identical to that reported by Cooper et al [1980]. Others have also reported that most deaths occur within 7 days of admission [Gomez et al 1956; Garrow et al 1962; Tolboom et al 1985; Pecoul et al 1992]. This clearly suggests that at least 1 week of intensive medical care, either as in-patients or as day-care, should precede domiciliary rehabilitation.

Brown et al [1981] reported a case-fatality of 21% at CNU in 1976. The overall case fatality at CNU was 7% for all admissions (n=1332) in 1992. This reduction is probably because during this period there were changes in case-management, notably the routine prescribing of broad-spectrum antibiotics on admission, blood transfusion (packed cells) for severe anaemia, withholding of iron in the first week, avoidance of an intravenous route for rehydration whenever possible, cautious refeeding with low sodium diets, and daily monitoring for signs of over treatment with fluids (sudden weight gain even when losing oedema, tachypnoea, soft tender and enlarging liver, basal crepitations, which when present are treated with diuretics and readjustment of volume of feeds). This study contradicts the high hospital mortality reported by Cook [1971], Coulter et al [1988] and others reviewed by Waterlow [1992].

Although death rates in NRCs are claimed to be low [Cook, 1971; Ojofeitimi et al., 1980;] mortality as high as 16.6 and 14.4% has been reported by Huseini et al. [1982] and Pecoul et al.[1992] respectively despite their children being less severe and less complicated compared to the DC and DCD children in the present study.

In a recent review of mortality in severe PEM from 57 hospitals and 9 NRCs, the median case-fatality in the 1990s was 22% and unchanged from that in the 1950s,

although the range has somewhat narrowed [Schofield and Ashworth, personal communication]. Reported causes of death in severe PEM are dehydration and electrolyte disturbances [Laditan et al.,1983], cardiac failure from over treatment with fluids [Wharton et al., 1967], severe anaemia, hypoglycaemia and hypothermia [Jackson et al., 1987;]. Management of these complications needs a cautious approach. For example oral rehydration therapy has a well-established role in the management of diarrhoeal dehydration, but its use in malnourished children requires special care since it is difficult to judge the extent of dehydration among these children [Scrimshaw, 1989; Nagpal et al, 1992].

It is likely that poor case-management has been the cause of death in previous studies with a high case-fatality rate, which was probably associated with i) iron supplementation given on admission (case fatality 31%) [Smith et al., 1989], ii) inadequate documentation of hypoglycaemia, hypothermia and sepsis (case fatality 28%) [Laditan and Tindimebwa, 1983], iii) Inability to detect complications and treat dehydration (case fatality 34%) [Khin-Maung U et al., 1992], iv) septicaemia and respiratory infection or causes other than dehydration (case fatality 28%) [Mitra et al., [1991], v) poor hospital management of electrolyte imbalance and septicaemia (case fatality 49%) [Erinoso et al., 1993].

4.1.4. **Weight gain during treatment**

The rate of weight gain was significantly slower in the domiciliary group compared with IP and DC. This could have been due to a) lower meal frequency as 16% of families were unable to achieve the recommended frequency b) lower food quantity than was recommended (12% of families) c) fed with milk of lower energy concentration as the addition of oil was not considered feasible at home d) unidentified infection, because they were not under continuous medical supervision. In a previous study in CNU, reinfection during rehabilitation limited growth despite high energy intake [Khanum et al., 1989b], e) lower levels of micronutrient supplementation and f) withholding of food in respiratory distress. Mothers were reportedly afraid to feed children with breathing difficulty. Nevertheless, 80% wt/ht was achieved by 6 weeks on average with a maximum of

13 weeks, which is in marked contrast to the prolonged periods sometimes reported [Bengoa, 1976].

The rate of weight gain in the day-care group was significantly slower than for in-patients. The reason probably is that although DC children were supposed to receive at least 3 meals at home between 5pm and 8am and all meals on Fridays, some mothers may not have fed them enough at home.

A number of studies have described a clear relationship between energy intake and weight gain [Waterlow, 1961; Ashworth et al., 1968; Ashworth, 1969; Ashworth and Millward, 1986]. The mean weight gain of 11g/kg/day for in-patients with a mean energy intake of 174 kcal/kg/day (10% of which was from protein) is in keeping with expectations, on the basis of an energy cost of 5kcal/g weight gain and taking into account oedema loss. Weight gain in the DC and DCD groups was lower than expected for energy intake. However energy intake in the DC and DCD groups could only be approximated and might have been an over estimation.

Zinc was deliberately withheld from all the children during this study, because of the logistical difficulties in administering zinc in the domiciliary group. This may have led to less than optimal rates of catch-up growth [Simmer et al., 1988; Khanum et al., 1988; Golden, 1981]. If administration of zinc is advocated in domiciliary treatment, further research will be necessary to determine compliance, especially as this would have to be in addition to the administration of iron and multivitamins. Iron is known to interfere with absorption of zinc. In CNU, in non-study conditions, administration of zinc is given at a different time of the day from that for iron. This separation to minimise nutrient interaction, cannot be guaranteed at home.

Low rates of weight gain observed in domiciliary studies have been cause for concern, particularly as children are provided with supplementary food in most programs [Khare et al., 1976; Rao, 1984; Tandon et al., 1984; Gueri et al., 1985; Jansen and Verkley, 1986;]. In this study, even without food supplementation,

supplementation, weight gain was better than has been reported elsewhere. This may be attributable to the following measures: 1) The initial week of medical care in the day-care facility brought infections quickly under control and restored appetite. The visible improvement led parents to have confidence in the health team. A trusting relationship with the designated health worker was also established during this period which created an unbroken chain of support and interaction. 2) Parents were not blamed for the child's condition, but were supported sympathetically through the immediate medical crisis. 3) The initial week in the day-care facility also provided an opportunity for careful instruction and practical experience regarding meal preparation. Mothers and carers gained confidence during this period. Care was taken to ensure that advice was feasible, based on detailed knowledge of typical home conditions and dietary patterns. 4) The weekly home visits provided continuity of support and an opportunity to evaluate progress and health status. Health workers were trained to distinguish major medical problems from minor ones and to refer if necessary. Parents also knew they should take the child to the Unit if problems arose between visits. 5) Confidence of the health workers was built through continuous support and supervision from senior staff. 6) Health workers were encouraged to assist families if appropriate, eg writing a letter to an employer requesting paid leave. No monetary help was provided except for three destitute families, where a small loan was made to purchase stock for income generation. The loans were repaid in full.

4.1.5. **Oedema loss and time taken to achieve 80% wt/ht**

Oedema persisted longer in the DCD group (mean 21 days) compared to the other treatment groups, although their mean plasma protein concentration was above 6g% by week 2. The slower rate of oedema loss with domiciliary care may be due to i) only 7 days of potassium and magnesium supplementation, ii) difficulty in preparing a salt-free meal at home as foods for the child are largely derived from family foods, iii) receiving salt-containing snacks or excessive fluid (fizzy drinks) from siblings or neighbours unnoticed by carers. Shah et al [1971] and Khare et al. [1973] reported that children took on average 5 weeks and 8 weeks respectively

to become oedema-free when treated at home. It is not clear why children in these studies took longer to lose oedema, but i) vegetarians took longer than non-vegetarians to become oedema free (5.9 weeks), ii) plasma albumin remained consistently low for a longer time, indicating low food intake even with supplementation [Khare et al., 1973]. It is also possible that avoidance of salty food and excess fluid, were not emphasised.

The time taken to achieve 80% wt/ht is clearly related to the rates of weight gain and oedema loss. DCD took twice as long as the other groups to reach 80% wt/ht. Not only were energy intakes lowest in the domiciliary group, but children in this group were reported to be ill quite frequently, particularly with diarrhoea and fever. It is difficult to compare duration to achieve 80% wt/ht in this study with that in other studies, because of inconsistent admission and discharge criteria.

4.1.6. **Cost to achieve 80% wt/ht**

A unique aspect of this study was to compare costs in the 3 groups and to separate institutional and parental costs. The staff services were the highest component in all 3 groups. Although DCD took longer to achieve 80% wt/ht than the other groups, this was the most cost-effective approach. The higher cost incurred for in-patient treatment is understandable. In-patient care demands a 24- hour service and it is notable that staff services account for 70% of IP costs. IP costs for medicine were higher than for the other two groups because injectable antibiotics were used for the first 72 hours, which is the usual CNU practice. Intramuscular or intravenous medication including the syringes etc is more expensive than oral medication. Higher laboratory costs for IP could have been due to over investigation in some cases.

The DCD parents' cost was substantial. The major cost was for the child's food. This is in contrast to the findings of Shah et al [1971] who found parental costs for in-patient treatment (transport and wage loss) exceeded the food costs for domiciliary management. It should be emphasized that not all food was bought in the present study. Some was home grown, brought or sent from the village of

origin, donated by relatives and neighbours, or bartered for work. All food consumed by the child, however was costed regardless of the source. The parents' cost therefore may overestimate the actual monetary expenditure. Health workers observed that despite the government's food pricing policy, there is an uncontrolled fluctuation of food prices, with a rise particularly in the rainy season. Daily food prices may vary by 50% during political upheaval.

Most parents were poor but could afford the expenses for food during rehabilitation. Some writers ascribe to the hypothesis that malnutrition is, above all, a consequence of poverty, and therefore cannot be prevented or corrected without an economic transfer [Musgrove, 1990]. But it has been also shown that poverty is not always the constraint of child nutrition [Bairagi, 1980]. In acknowledgement of the hypothesis that parents lack the resources to carry out rehabilitation, domiciliary programmes often provide supplementation [Tandon et al., 1984; Verkley et al., 1983, Jansen and Verkley, 1986; Gueri et al., 1985; Heikens et al., 1993a]. It has been shown however,that when supplementation has been withdrawn, mothers can become disinterested and children regress. Economic support in the way of targeted income generation and education to the mothers/carers will possibly give a more sustainable anthropometric status and at the same time will retain the dignity of the parents.

Day-care treatment was less than half the cost of in-patient care, which is in keeping with previous studies [Cook, 1971; Beaudry-Darisme and Latham, 1973; Beghin and Viteri, 1973; Cutting and Cutting, 1975]. However, the parental costs were not included in any of these studies.

4.1.7. **Option preferred by most parents**

Domiciliary care was the majority's preference, especially among those who had experienced it. Seven days of daily attendance initially for the DCD group did not seem to interfere very much with the family demands, and once the child was at home from day 8 onwards the caring time could be shared between parents if both were working. Day-care although half the cost of in-patient care, proved to be a

most unpopular option and only 4% gave it as their preference. This is because day-care required full-time commitment by a family member for one month on average, to which was added the burden of transporting a sick child to and fro through busy traffic, even though the child was improving.
In-patient care proved much more acceptable to families than day-care, despite the seemingly heavy time-demands. Absences were tolerated.

It seems from parents/carers' preference that it will be quite possible to replicate the domiciliary management anywhere, provided basic health care facilities are available. The ideal set up for the treatment of severe malnutrition will depend on local conditions. However, it appears from this study that in-patient care for 1 week in a health care facility is advisable, and when infection and complications are under control, then the children should recover at home under the care of parents/carers supervised by a team of caring and committed health workers. The team should consist of a physician, a nurse, a dietitian (optional) and several health workers/home visitors, depending on the size of the area and number of children to be monitored at home.

4.1.8. **Conclusions and implications**

This study demonstrates that although the domiciliary group took longest to achieve 80% wt/ht, it did so at the lowest cost and suggests that domiciliary care, preceded by one week of careful medical treatment for complications and infection is compatible with low mortality and is the most cost-effective approach.

Less than half the children were considered eligible for the study either because they were <12 months of age, critically ill, severely anaemic or diagnosed TB or anomalies. Eligibility for the study was purposely restricted because the research design required random allocation to the treatment groups, and there was concern that critically ill or severely anaemic children could not safely be sent home after 1 week of day-care. In non-study conditions, however, there is no reason why such children could not continue treatment at home once their medical condition has improved. Whether patients with TB or <12 months of age can safely be

considered for domiciliary care is uncertain. Cooper at al [1980], in a randomised study in which malnourished children were treated as in-patients or at home, reported that all deaths in the domiciliary group were aged below 12 months. This would suggest that great caution should be exercised when considering patients aged <12 months for domiciliary management in future.

Day-care treatment approached in-patient care as regards speed of recovery, but at less than half the cost. Its major drawback is parents' inability to maintain regular attendance for 3-4 weeks.

In-patient care was very successful, but had high institutional costs. Most developing countries have few in-patient facilities for malnourished children. These limited facilities can be used primarily for critically ill children or new admissions. It is believed from the experience of this study that domiciliary management is a feasible option in both urban and rural areas provided the basic principles of treatment can be implemented, and there is a committed, well-trained health team available.

4.2 Long-term outcomes.

4.2.1. Losses to follow-up

In the present study after one year of monthly follow-up, 7.5% of children were not found. This contrasts with 55% of patients who could not be traced 2 years after discharge in an earlier study at CNU. These figures are low compared to other studies [Stanton et al., 1985; Macintyre, 1993; Fronazak et al., 1993]. The possible reasons why most could be traced in this study are a) through fortnightly follow-up visits it was possible to keep track of the children; health workers were aware of the movement of the families, especially when they went to the villages b) although some families moved more often than others, information regarding their new address was available to the health worker, except in situations like un-warranted eviction of slums when the families themselves did not know where they

were moving to. This situation occurred during the study when 5 fairly permanent slums (residing for > 5 years) were targets for demolition by the local government [Dhaka Courier, 1991]. The residents were unaware and no alternative arrangements were made, thus contact was lost with 40 children who had been followed for 6 months.

Although, parents' income and socioeconomic status remained similar in all 3 groups throughout the year, more children in IP (11.5%) could not be traced than in the other two groups. The reason for this difference is unclear. It is possible that after being confined for 3 weeks in hospital, they took the opportunity to visit relatives, perform unfinished work, change accommodation and take care of other social obligations .

4.2.2. **Mortality and relapse**

Despite the high prevalence of infection, the study shows very low mortality (2.3%) and relapse (0.6%) rates during follow-up. Of the 10 children who died, 80% were female, and only 1 died with PEM. No gender difference was observed in mortality during the treatment period. In Bangladeshi children aged 0-60 months, female mortality begins to exceed male mortality during the second half of the first year of life and thereafter this differential becomes increasingly pronounced [Koenig, 1986]. Chen et al [1980] and Black et al [1982] found that while field morbidity rates among children aged 0-4 years were similar, male children were hospitalised for treatment almost twice as frequently as females.

The low mortality after discharge is in marked contrast to most previous reports. In Tanzania 9% of children under 3 years of age treated in hospital for PEM died within 1 year and the death rate was even higher (41%) in those who absconded [Van Roosmalen-Wibenga et al., 1987]. In Zaire 19% died during the first year post- discharge, after an average stay of 79 days [Hennart et al., 1987]. High post-discharge mortality following treatment in hospital has been reported in some earlier reports [Cook, 1971]. Clearly for these children treatment has failed. Although post-discharge mortality in NRCs is claimed to be low, a high mortality

(30%) has been reported from NRCs in Southern Africa [Frankish, 1979], from the Philippines (12.4) [Lamptey et al., 1982], and Nigeria (15%) [Ogbeide et al., 1984].

Eight children in the present study were readmitted; of these, 3 were for relapsed PEM. This again is very low in contrast to other post-discharge relapses (13-30%) after treatment in hospitals, [Van Roosmalen-Wibenga et al., 1987; Cooper et al., 1980; Cook, 1971]. High relapse rates for NRCs from urban Dhaka (13%) and Philippines (23%) have been reported [Fronazak et al 1993; Lamptey et al., 1982].

The reasons for low mortality and relapse rates in this study are likely to be i) access to medical care during fortnightly follow-up when health workers could identify minor and major illnesses and refer illnesses of concern to the CNU physician, ii) Mothers were aware of the consequences of illness and used the available health services when needed. Ninety percent of the study children visited CNU at least once with an illness, and 30% more than 3 times either with diarrhoea or fever or pneumonia and received treatment. Of those who attended CNU, 53% received antibiotics at least once. Moreover, mothers/carers continued to feed their children during illness as much as they could afford. This is attributable to the instruction they received from CNU. Effective follow-up, and accessible and timely medical care possibly prevented both relapse and mortality in this study.

4.2.3. **Growth performance during the long-term**

During the follow-up, there was no difference in the anthropometric measurements in the 3 groups, except that the mean weight gain of the IP group was low in the first quarter after discharge. This is probably because, not used to being at home during treatment, they had to make a sudden transition. This may have affected food intake and hence weight gain. At the end of the follow-up, wt/ht averaged 91% percent of the NCHS median , which is a substantial gain from a mean of 70% on admission with oedema. The rate of weight gain averaged 1g/kg/d which

is much slower than during the treatment period. The question arises as to why 100% wt/ht was not reached even after one year. The likely reasons for not reaching 100% are a) the children are similar to their peers in the community [Bangladesh Bureau of Statistics, 1993] b) financially parents may be unable to sustain the extra expenditure for the child's food and c) repeated illness may have limited growth.

Height gain was even slower. There are several possible reasons why no catch-up in ht/age was observed. a) it is possible that the wt/ht deficit prevented the triggering of catch-up in height. It has been documented that weight gain precedes height gain [Waterlow, 1994]. Walker and Golden [1988] observed that 85% wt/ht had to be attained by severely malnourished children before they began to increase in length. Height spurts have been reported in PEM following discharge at 100% wt/ht [Ashworth, 1975]. b) the high prevalence of infection may have contributed in limiting catch-up in linear growth [Henry et al., 1987; Lutter et al., 1989; Smith et al., 1991; Cooper et al., 1990]; c) dietary deficiencies of energy [Gopalan et al., 1973; Fjeldet al., 1989] protein [Kabir et al., 1993], calcium [Piyadasa, 1993]] zinc [Ronaghy et al., 1974; Castillo-Duran et al., 1989; Schlesinger et al., 1992], vitamin A [Mele et al., 1991] and iron [Angeles et al., 1993] singly or in combination may have affected linear growth.

Some studies suggest that severe malnutrition results in permanent height deficits even in comparison with children of the same socioeconomic background who are themselves short [Alvear et al., 1986]. The findings of Graham et al. [1982] are not consistent with this view. Eight malnourished children were able to make a rapid increase in linear growth after adoption even though they were transferred to better homes at an age when catch-up growth in height is believed by some to have ceased. Kulin et al. [1982] shares the view that catch-up beyond 3 years is possible. This is in marked contrast with researchers in Guatemala who suggest reduced growth potential after 36 months of age [Martorell et al., 1990; Martorell, 1994].

Whether complete catch-up is possible for stunted malnourished children in their usual environment seems to be inconclusive from these studies. However, given the general view that there is gross retardation in bone maturity and in height [Ghosh et al., 1967; Briers et al 1975; Keet et al., 1971] it appears that most malnourished children retain their capacity for full catch up. It has been suggested that with a change of environment of the child and appropriate diet over a sufficient period of time it is possible to enhance linear growth in severely malnourished children [Golden, 1994].

4.2.4. Morbidity

Twice a month follow-up of morbidity for one year shows that the prevalence of infectious diseases is high among these urban children living in slum conditions. Mothers reporting of diarrhoea and the study's definition were in agreement in 90% of cases as was also observed by Black et al [1982]. There was no difference in reported diarrhoea in the 3 groups studied, but fever and cough were significantly less prevalent in the domiciliary group (DCD). There is no plausible explanation for this finding, but the interpretation could be a) DCD mothers having been required to report morbidity during the preceding treatment period may be more cautious and more experienced in identifying fever b) DCD mothers may have become disinterested or tired after reporting morbidity in the treatment phase and may have failed to record morbidity on the calendar or report febrile illnesses. The latter interpretation is unlikely, because the reporting of diarrhoeal illness was similar in all groups. The physician's diagnosis at the CNU also suggests a lower presence of febrile illness and pneumonia in DCD.

The high prevalence of infection is in agreement with Black et al [1982]. During one year of morbidity surveillance of under 5's in rural Bangladesh, they found that at least one or often several concurrent illnesses were noted in 75% of children. Fever was reported at least once in 81% of children, pneumonia in 64% at least once, diarrhoea in 52% and diarrhoea with fever in 12%. They observed that diarrhoeal diseases accounted for 52% of all hospitalisations. In their study, 19.5% of children were hospitalised for diarrhoea 33 times during the year and

6.5% were hospitalised 11 times with pneumonia. The high frequency of diarrhoeal hospitalisations may be because the Matlab hospital is biased for diarrhoeal admissions. Considering the extent of infection, mortality was reported to be low (1.8%) compared to the usual rate in that area (5.6%). This was attributed to the medical services provided during the study.

A high prevalence of infections has been reported in urban slums by many other workers [Fariduddin, 1989; Das et al., 1989; Kirchhoff et al., 1983; Lehmann et al., 1988; Lopez et al., 1989; Schorling et al., 1990a; Macintyre et al., 1992; Heikens et al., 1993b]. Baqui et al. [1993] suggested that children with a wt/ht less than -2 Z-score had a 3.5 times increased risk of persistent diarrhoea. Compared with immunocompetent children, immunodeficient children had twice the risk of developing persistent diarrhoea. Children with < -2 Z-score were likely to be immunodeficient and therefore more vulnerable to infections.

4.2.5. Morbidity and catch-up growth.

Children with repeated episodes of diarrhoea, or episodes with longer duration, experienced lower average weight gain in this study. It has been observed that a reciprocal relationship exists in which diarrhoea leads to malnutrition and malnutrition predisposes to diarrhoea [Scrimshaw et al., 1968]. It is clear that diarrhoea has adverse effects on growth [Rowland et al., 1977; Rowland et al., 1988; Rahaman et al. 1983; Molla et al., 1983; Schorling and Guerrant, 1990b; Mata, 1971; Mata, 1992; Guerrant et al., 1992]. Enterotoxigenic E. coli had the most pronounced effect on short-term weight gain, and shigella diarrhoea had the largest effect on linear growth in Bangladeshi children studied by Black et al [1984a]. In the present study it was not possible to separate diarrhoea by causative organisms, but it was possible to get information on consistency and presence of blood and mucus in the stool. In 85% of diarrhoeal cases, the stool was non-watery and non-bloody (unformed soft/loose stools without blood). This suggests that the majority of cases were not shigella. This agrees with the findings of Henry et al. [1987]; Briend et al [1989]; Black et al. [1984b]; and Bhandari et al. [1989].

Recurrent diarrhoea is likely to have prevented catch-up growth in affected children in this study since 7 episodes on average during the year, each lasting for more than 5 days could block the catch-up that normally follows diarrhoeal illness. High prevalence and persistent episodes of diarrhoea and their negative effects on catch-up growth have also been reported by others in developing countries [Black et al., 1982; McAuliffe et al., 1986; Schorling et al., 1990b].

4.3. Conclusions and recommendations for further research.

4.3.1. Conclusions

This study shows that domiciliary care, preceded by 1 week of careful medical treatment for dehydration, electrolyte imbalance, infection etc is compatible with low mortality and is the most cost-effective approach for treatment of PEM.

Families studied were exceedingly poor, with an average income of less than £25/month and family size of 5. Most houses comprised 1 small room (90%) with mud floor (78%). Latrines and water supply were communal. The majority of parents were illiterate. Yet despite their humble resources, parents in the domiciliary group rehabilitated very malnourished children in 6 weeks on average, and only 7% would have preferred an alternative treatment.

Although NRCs have continued to play a significant role over the past decade in the rehabilitation of malnourished children, their benefits have been limited. Day-care management proved unpopular in this study, although more cost-effective than in-patient care. Considering the fact that many mothers cannot leave their families for long periods of time (every day), consideration should be given to providing supervision and nutrition education at home.

In-patient care was successful, but costly. Although this approach demanded time and absence from the rest of the family it was more popular than day-care. Despite the reputation of hospitals as being inappropriate places for rehabilitation,

they still have an important role in the management of severely malnourished children and infants, particularly during the first few days after admission. With cautious management, mortality in hospitals elsewhere can be drastically reduced.

All 3 groups increased in wt/ht during the follow-up year from 80% to 91% on average but not in ht/age, which may indicate a requirement for supplementation with micronutrients. There was a high prevalence of infections, indicating the need for continuation of medical support and accessible health care facilities with well-trained medical personnel, and provision for home visiting if required. With enhanced awareness by the carers, support from the health team, nutrient/micronutrient supplementation for a substantial period of time and provision of some targeted income generation, further improvement of anthropometric status would seem possible.

4.3.2 **Recommendations for further research:**

The results of the study have raised other issues to be explored:

1) Stunting is reported to be associated with impaired mental development [Wagstaff et al., 1987; Grantham-McGregor, 1992; Grantham-McGregor, 1993]. It is therefore important to determine whether improvement in height for age can be achieved, and whether this will be accompanied by improvement in their mental development?

2) Stunting in preschool children is known to be associated with increased morbidity [Pelletier, 1991; Tomkins, 1993]. It is therefore also important to determine whether improvement can be made in immunocompetence, thereby reducing morbidity in the post-treatment period, and whether this will be accompanied by improvement in linear growth ? Nutritional intervention with zinc, calcium and iron, which have improved the linear growth of stunted children in other studies and also immune function, could be considered [Schlesinger et al., 1992; Piyadasa, 1993; Angeles et al., 1993; Castillo-Duran et al., 1989].

3) A third question is whether domiciliary management benefits not only the target

child but also neighbouring children through a "ripple effect"? Home visiting in crowded slums inevitably attracts curious on-lookers. Home visiting involves teaching sessions and these could encompass surrounding families who will also witness the rehabilitation of a malnourished child in their midst. It is therefore anticipated that the community impact will be greater in terms of awareness of improved infant feeding practices when children are rehabilitated in the community rather than at a distant treatment centre.

4) The present study suggests that families with severely malnourished children have characteristics which might make them identifiable for intervention, thereby facilitating prevention of malnutrition. Further analysis of the existing data of the present study would thus be of value.

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ANNEX 1

Recipes

Composition of in-patient solid diets (before cooking) quantity for 60 children.

Foods	Weight (g)	Calorie	Protein (g)
Rice Pudding:			
Rice	1200	4152	77
Sugar	267	1065	0
Milk	267	1001	100
Water 8400 ml (all to be absorbed)			
Rice, meat and vegetables:			
Rice	1200	4152	77
Pumpkin	2000	520	20
Meat	1200	781	154
Onion	10	6	0
Oil	385	3465	0
Water	5000 ml (all to be absorbed)		
Rice and Dhal:			
Rice	1200	4152	77
Dhal (Legume)	840	2906	211
Onion	12	6	0
Oil	300	2700	0
Spice	5	0.9	0
Roll/Chappati (60X15gm):			
Flour (Atta)	400	2076	63
Sugar	60	240	0
Oils	15	135	0
Yeast	3	7	0

Full strength dried skimmed milk (FSDSM)

Contents/100 ml

DSM	8 g	calories
Protein	3 g	12
Carbohydrates	4.5 g	18
		30
2. Oil	5 g	45
3. Glucose	6.25 g	25
		100 calories/100 ml

Order for kitchen

DSM	80 g	300 calories
Oil	50 g	450 calories
Sugar	62.5 g	250 calories

Add water to make 1000 ml

Total calories/1000 ml = 1000

Half strength dried skimmed milk (HDSM)

Contents/100 ml

1. DSM	4g	calories
protein	1.5g	6.0
carbohydrate	2.0	8.0
2. Oil	3.0 ml	27.0
3. Glucose/sugar	8.3g	34.0
		75 calories/100 ml

Order for kitchen

DSM	80g	300 calories
Oil	60 ml	540 calories
Glucose/sugar	166 g	660 calories

Add water to make 2000 ml
Total calories/2000 ml=1500.

ANNEX 2

Feeding schedule

Diet during intensive phase (week 1)

a) Half strength dried skimmed milk (2 hourly)

Marasmus - 100-120 ml/kg/day
MK & K - 90-100 ml/kg/day

b) Solid meals (ad libitum)

(For MK and K diet is cooked salt free initially when oedema is present)

8.30 am (morning)	Rice pudding or Suji+milk or chappati+milk
10.00 am (morning)	Banana/chappati
12.30 pm (noon)	Rice+vegetable+meat (Khichuri)
3.30 pm (afternoon)	Rice or suji or rice pudding or chappati
6.30 pm (evening)	Rice+dhal

Energy aimed at 100-120 kcal/kg/day
Protein aimed at 2-3 g/kg/day

Diet during recovery phase (week 2, 3, 4)

For younger infants : 4 times whole milk/ FDSM+solids as above+ breast milk

For older children : 5-6 times solid (Family diet)

Energy aimed at : 150-200 kcal/kg/day

Protein aimed at : 3-4 g/kg/day

Other foods : Egg, banana, peanuts, etc given as and when required/if affordable.

ANNEX 3

Calorie and protein values

Values of diet after cooking per 100g/ml

Sl No	Ingredients	Calories(kcals)	Protein(g)
01.	Rice pudding	68	1.94
02.	Suji	60	0.00
03.	Rice+dhal	77	2.92
04.	Rice+meat+pumpkin	80	4.33
05.	Cooked dhal	100	6.00
06.	Chappati per piece	66	2.10
07.	Roll per piece	40	1.00
08.	Banana one piece	88	0.90
09	Egg one piece	65	5.20
10.	HSDSM (100 ml)	75	1.52
11.	FSDSM (100 ml)	100	3.04

NOTE

HSDSM = Half Strength Dried Skimmed Milk
FSDSM = Full Strength Dried Skimmed Milk
Fed from cups and spoons

ANNEX 4

CHILDREN'S NUTRITION UNIT

DIET CHART (Amount in ml and g)

NAME _____ ADM. NO. _____ DATE _____

PEM TYPE I—M/MK/K

RESTRICTIONS OF a) SALT and FLUID Yes/No Restriction withdrawn Yes/No

b) SOLIDS Yes/No

SIX TIMES SOLID FOOD ONLY Yes/No

AMOUNT GIVEN/FEED TOTAL	DRIED SKIMMED MILK					SOLID FOODS										
TIME	HALF STRENGTH DSM	FULL STRENGTH DSM	OTHER FLUIDS/OIL	VOMITED OR REFUSED	TIME	RICE PUDDING	SUJI	CHAPATI OR ROLLS	RICE+VEG+ MEAT	RICE+DAL	BANANA	EGG	PEANUT	GUR	OTHER FOODS	VOMITED OR REFUSED
12 A.M.																
2 A.M.																
4 A.M.																
6 A.M.					6-00											
8 A.M.					8-30											
10 A.M.																
12 NOON.					12-30											
2 P.M.																
4 P.M.					3-30											
6 P.M.																
8 P.M.					6-30											
10 P.M.					8-00											
TOTAL																
CALORIE																
PROTEIN																

TOTAL CALORIE/DAY— Kcal/kg/day Protein(gm)/kg/day

DATE																
12 A.M.																
2 A.M.																
4 A.M.																
6 A.M.					6-00											
8 A.M.					8-30											
10 A.M.																
12 NOON.					12-30											
2 P.M.																
4 P.M.					8-30											
6 P.M.																
8 P.M.					6-30											
10 P.M.					8-00											
TOTAL																
CALORIE																

TOTAL CALORIE/DAY—

ANNEX 5

Antibiotics, vitamins and minerals used in the management of PEM at CNU

1. Ampicillin: 50-100 mg/kg/day i.m/i.v for 3 days followed by 50-125 mg/kg/day orally for 7-10 days 6 hourly.

(dose increased to 200mg/kg/day + gentamicin 5mg/kg/day if septicaemia is suspected)

2. Cloxacillin: 50-100 mg/kg/day i.m/i.v for 4 days followed by 50-100 mg/kg/day orally for 3-6 days 6 hourly.

(given in post-measles bronchopeumonia, in combination with gentamicin or ampicillin with septicaemia and when indicated)

3. Gentamicin : 3-5 mg/kg/day i.m/i.v 8 hourly for 7 days.
(if with septicaemia)

4. Pronapen (Procaine Penicillin) : 25,000-50,000 i.u/kg/day i.m for 7 days.
(if with respiratory infection, infected scabies, impetigo, when indicated).

5. Penicillin (Benzyl Penicillin) : 50,000 i.u/kg/day i.m 6 hourly for 7-10 days.
(when indicated)

6. Co-trimoxazol (Trimethoprim): 10 mg/kg/day 12 hourly orally for 7-10 days.
(with respiratory infection or if indicated)

7. Nitrofurantoin: 10 mg/kg/day 6 hourly orally for 10-14 days (to treat urinary tract infection)

9. Chloramphenicol: 50 mg/kg/day 6 hourly i.m/i.v or orally for 7-10 days.
(in combination with penicillin in, meningitis or singly when indicated).

10. Nalidixic acid: 50mg/kg/d oral 6 hourly for 7-10 days
(if with shigella dysentery resistent to cotrimoxazole or ampicillin).

11. Chloramphenicol: Eye drop 1-2 drops locally 6 hourly for 7-10 days. (for conjunctivitis, keratomalacia)

12. Chloramphenicol: Eye ointment applied BD for 7-10 days.
(alternative to eye drop)

13 Atropine eye drop/ointment 1 drop in each eye once for 3-5 days (with keratomalacia).

14.**TB drugs :**

a) Streptomycin: 30-40 mg/kg/day IM daily for 1-2 months.

b) Isoniazid : 10-15 mg/kg/day PO daily for 9-12 months.

c) Rifampicin : 10-15 mg/kg/day PO daily for 9-12 months.

d) Thiacetazone: 3-5 mg/kg/day PO daily for 9-12 months.

(combinations used: usual a+b+d, incase of hypersentivity to d, combination is a+b+c. Maintenance b+d or b+c)

e) Pyridoxine : 1-4 mg/kg/day PO daily for 9-12 months.
(for TB cases)

15. Magnesium sulphate : 1-2 meq/kg/day 8 hourly PO for 14 days.

16. Potassium chloride : 5 meq/kg/day 12 hourly PO for 14 days.

17. Lugols Iodine : 5-10 drops daily PO for 14 days.

18. Oral saline, ingredients:
1. sodium chloride = 1.75g
2. potassium chloride = 0.75g
3. sodium citrate,dihydrate = 1.45g
4. Anhydrous dextrose = 10g
Sachet for 500ml solution

Ingredients mmol/litre: sodium chloride= 60; sodium citrate=30; potassium chloride=20; glucose anhydrous=110

19. Cholera saline for i.v administration, ingredients:
Each 1000ml contains:
1. Sodium acetate B.P = 6.53g
2. sodium chloride B.P = 5.0g
3. potassium chloride B.P = 1.0g

Ingredients meq/L: sodium = 133; potassium = 13; chloride = 98 and acetate = 48.

20. Dextrose solution (50%): 1 ml/kg/dose i.v or 25% dextrose by nasogastric tube or orally).
in hypoglycaemia (blood sugar<40mg/100ml)

21. Frusemide (diuretic): 1 mg/kg of body wt i.v/i.m
(in congestive heart failure and with blood transfusion)

22. Vitamin A (high potency capsule) for :

a.Normal eye : 200,000 i.u single dose >12 months.
: 100,000 i.u single dose <12 months.
b.Xerophthalmia: WHO guide line is followed which is:

Night blindness (XN) & X1A) : 200,000 i.u on day 1 and repeated on day 2, on discharge and repeated every 6 months.

Corneal lesion (X1B and X2) : 200,000 i.u on day 1 & 2 & repeated on day 8 and on discharge, repeated every 6 months.

Keratomalacia (X3): vitamin A as in X2, plus chloramphenicol eye drop, atropine eye ointment or drop and eye pad.

23. Vitamin C: 50-250 mg once daily orally
(if with signs of deficiency)

24. Folic acid: 2.5-5 mg once daily

25. Riboflavin: 2 mg/kg/day once daily

26. Multivitamin : 5-15 drops daily orally (the drops contain vitamin A, C, D, B_1, B_2, Nicotinic acid, calcium pentothenete).

27. Iron (Feso4): 4mg/kg/day once daily oral dose from week 2 of treatment.

28. Metronidazole: 50 mg/kg/day orally 8 hourly for 7 days.

(if with Giardia, Entamoeba histolytica, suspected upper gut colonization).

29. Mebendazole: 100 mg orally 12 hourly for 3 days.

(Ascaris lumbricoides, Anchylostoma, Trichuris trichuria).

30. Avlochlor (chloroquine):

i) for children <1 year: day 1, first dose 50mg, 6 hours later 25mg, days 2 and 3 a single dose of 25mg

ii) for children 1-5 years : a first dose of 100mg and 6 hours later 50mg days 2 and 3 a single dose of 50mg.
(if with malaria/suspected malaria)

31. Benzyle Benzoate lotion: 25% strength, applied for 3 consecutive days.
(if with scabies).

32. Zinc: 10mg/kg/day for those weighing < 6 kg and 50 mg daily for ≥ 6 kg for 2-3 weeks given orally.

(zinc was not used during study period because of inconvenience of administration to the domiciliary group).

33. Nystatin oral suspension: 100,000 i.u 4 hourly 5-7 days.
(if with oral thrush).
OR
34. Gentian violet (1%), aqueous, 4 hourly for local application.

35. Ointments: salicylic acid, zinc-boric, furacin etc when indicated.

Note

Medicines are prescribed on the basis of clinical response, sensitivity and availability.

Footnote: i.m=intramuscular;
i.v=intravenous
i.u=international unit;
meq=milliequivalent

ANNEX 6

Data management forms for in-patients and day-care patients (short-term study)

FORM - 1

ADMISSION RECORD

Health Worker : _____

ame of the Child : _____

other's Name : _____

esponder's Name : _____

ddress : _____

L.NO.	VARIABLES	CODE
01.	Patient ID NO	
02.	Hospital Number	
03.	Which group 1 = In Patient 2 = Day Care 3 = Domiciliary	
04.	Date of admission	
05.	Age in months	
06.	Sex 1 = Male 2 = Female	
07.	Birth order (1 - 8) 0 = not known 9 = 9 or more	

008. Mother lives with family or not
1= with family
2= dead
3= deserted
4= absent/separated
5= absent/remarried
6= oters (specify):

009. Mother's age (in year)
00= not known
99= not applicable

010. Mother's occupation
1= house wife
2= maid servant
3= labourer
4= petty trader
5= service
6= any other (specify):_____
9= not applicable

011. How many days in last week, mother had job put approximate day.
00= Nil (house wife)
99= not applicable

012. How much money(TK) Mother has earned in last month put amount in taka
999 = not applicable

013. Mother's education
(can read & write)
0 = no
1 = yes
2 = other (specify):_____

014. Father lives with family or not
1= with family
2= dead
3= deserted
4= absent/separated
5= absent/remarried
6= oters (specify):_____

015. Father's education
(can read & write)
0 = no
1 = yes
2 = other (specify):_____

016. father's occupation
0= Unemployed
1= riksaw puller
2= farmer
3= day labourer
4= petty trader
5= service
6= any other (specify):_____
9= not applicable

017. How many days in last week, father had job
put approximate no of days.
0= Nil
9= not applicable

018. How much money(TK) father has earned in last month
put amount in Taka
999 = not applicable

019. Total income/month
(father + mother + others)
(put exact or approximate income in Taka.)

020. Number of rooms in the house.

021. No. of adults living in the house.
(adult = ≥ 16 yrs)

022. No. of children living in the house.
(Children = < 16 yrs)

023. Grandmother/aunt living in the same house
0 = none
1 = grandmother
2 = aunt
3 = both (1 + 2)
4 = Others (soecify):_____

024. Type of living place/ Residence
1 = slum
2 = squatter settlement
3 = town (outside metropolitan area)
6 = others (specify):_____

025. Type of roof
1 = straw roof/bamboo
2 = tin roof
3 = concrete roof
4 = other (specify):_____

026. Type of floor
1 = mud floor
2 = concrete floor
3 = Bamboo/wood
4 = other (specify):_____

027. House rent/month
(put exact amount in tk.)
0000 = own house.

028. Source of water supply
(use same code for 029,030,031)
1 = pond/ditch
2 = tube well
3 = stand pipe/tap
4 = lake
5 = river
6 = other (specify):_____

029. For drinking (use code no. 028)

030. For Washing (use code no. 028)

031. For bathing (use code no. 028)

032. Type of latrine
0 = open space
1 = pit/katcha
2 = hanging latrine
3 = pacca (concrete pan)
5 = other (specify):_____

ADMISSION MORBIDITY
(Mother's history)

033. Diarrhoea
00 = no
if yes put exact days for how long

034. Fever
00 = nil
if yes put exact days

035. Vomiting
00 = nil
01 = yes

036. Respiratory illness (cough fever,breathing difficulty
0 = no
1 = yes

037. Skin disease
0 = nil
1 = yes
2 = others (specify):_____

038. Measles
0 = never
1 = yes <14 days ago
2 = yes 15-30 dats
3 = yes 1-2 months ago
4 = >2 months ago

039. Xerophthalmia (mothers response)
0 = no
1 = yes

040. Sore mouth
0 = no
1 = yes

041. Breast fed
00 = never breast fed
88 = still breast fed
if stoped put exact months
99 = not applicable

042. Reasons for never breast feeding/stopped

01 = baby did not like
02 = not sufficient milk
03 = ill health of the child
04 = ill health of the mother
05 = mother is working
06 = lack of motivation to bf
07 = breast milk is not good
08 = tin milk better
10 = mother is pregnant
11 = child is old enough
12 = others (specify):_____
99 = not applicable

043. Food withheld (during present illness)

0 = no
1 = yes

044. Age (in months) of introduction of other foods

00 = not yet given
98 = not known

ANTHROPOMETRY

045. Weight in Kg. on day 01 [ ][ ].[ ][ ]

046. Height/length in cm. [ ][ ][ ].[ ]

047. Mid upper arm circumference (MUAC) in mm. [ ][ ][ ]

048. Oedema [ ]
0 = nil
1 = yes

049. Weight on day 02 [ ][ ].[ ][ ]

050. Weight on day 03 [ ][ ].[ ][ ]

051. Weight on day 04 [ ][ ].[ ][ ]

052. Weight on day 05 [ ][ ].[ ][ ]

053. Weight on day 06 [ ][ ].[ ][ ]

054. Weight on day 07 [ ][ ].[ ][ ]

055. Weight on day 08 [ ][ ].[ ][ ]

056. Weight on day 09 [ ][ ].[ ][ ]

057. Weight on day 10 [ ][ ].[ ][ ]

058. Weight on day 11 [ ][ ].[ ][ ]

059. Weight on day 12 [ ][ ].[ ][ ]

060. Weight on day 13 [ ][ ].[ ][ ]

061. Weight on day 14 [ ][ ].[ ][ ]

062. Weight on day 15 [ ][ ].[ ][ ]

063. Weight on day 16 [ ][ ].[ ][ ]

064. Weight on day 17 [ ][ ].[ ][ ]

065. Weight on day 18 [ ][ ].[ ][ ]

066. Weight on day 19 [ ][ ].[ ][ ]

067. Weight on day 20 [ ][ ].[ ][ ]

068. Weight on day 21 [ ][ ].[ ][ ]

069. Weight on day 22 [ ][ ].[ ][ ]

070. Weight on day 23 [ ][ ].[ ][ ]

071. Weight on day 24 [ ][ ].[ ][ ]

072. Weight on day 25 [ ][ ].[ ][ ]

073. Weight on day 26 [ ][ ].[ ][ ]

074. Weight on day 27 [ ][ ].[ ][ ]

075. Weight on day 28 [ ][ ].[ ][ ]

076. Weight on day 35 (mean, 5th week) [ ][ ].[ ][ ]

077. Weight on day 42 & above (mean 6th week) [ ][ ].[ ][ ]

078. Weight on day discharge [ ][ ].[ ][ ]

079. Height on day 08(cm) [ ][ ][ ].[ ]

080. Height on day 15 (cm) [ ][ ][ ].[ ]

081. Height on day 21 (cm) 3rd week [ ][ ][ ].[ ]

082. Height on day 28 (cm) 4th week [ ][ ][ ].[ ]

083. Height on day 35 (mean, 5th week) [ ][ ][ ].[ ]

084. Height on day discharge (cm) [ ][ ][ ].[ ]

085. MUAC on discharge (mm) [ ][ ][ ]

086. Oedema free on hospital day [ ][ ]
(put exact day)
00 = if marasmus
88 = discharge with oedema

ENERGY INTAKE(EI) Kcal/kg/day (NEAREST ONE)

087. EI Day 01 [ ][ ][ ]

088. EI Day 02 [ ][ ][ ]

089. EI Day 03 [ ][ ][ ]

090. EI Day 04 [ ][ ][ ]

091. EI Day 05 [ ][ ][ ]

092. EI Day 06 [ ][ ][ ]

093. EI Day 07 [ ][ ][ ]

094. EI Day 08 [ ][ ][ ]

095. EI Day 09 [ ][ ][ ]

096. EI Day 10 [ ][ ][ ]

097. EI Day 11 [ ][ ][ ]

098. EI Day 12 [ ][ ][ ]

099. EI Day 13 [ ][ ][ ]

100. EI Day 14 [ ][ ][ ]

101. EI Day 15 [ ][ ][ ]

102. EI Day 16 [ ][ ][ ]

103. EI Day 17

104. EI Day 18

105. EI Day 19

106. EI Day 20

107. EI Day 21

108. EI Day 22

109. EI Day 23

110. EI Day 24

111. EI Day 25

112. EI Day 26

113. EI Day 27

114. EI Day 28

115. EI Day 35 (mean 5th week)

116. EI Day 42 (mean 6th week)

117. EI Day on discharge

118. Packed cell volume [(PCV%) on admission] [ ][ ]

119. Packed cell volume [(PCV%) on 8th day] [ ][ ]

120. Packed cell volume [(PCV%) on discharge] [ ][ ]

121. Total Protein (g%) on admission [ ].[ ]

122. Total Protein (g%) on 8th day [ ].[ ]

123. Total Protein (g%) on discharge [ ].[ ]

DIAGNOSIS AFTER EXAMINATION

124. Dehydration
0 = nil
1 = yes

125. Septicaemia
0 = nil
1 = yes

126. Respiratory Infection
0 = nil
1 = URTI
2 = LRTI (Pneumonia on X ray)
3 = URTI & LRTI

127. Xerophthalmia
0 = nil
1 = yes

128. Angular stomatitis
0 = nil
1 = yes

129. Conjunctivitis
0 = nil
1 = yes

130. Urinary tract infection
0 = nil
1 = yes

131. Ascariasis (Round worm)
0 = nil
1 = yes

132. Anchylostomiasis (Hook worm)
0 = nil
1 = yes

133. Giardiasis
0 = nil
1 = yes

134. Amoebiasis (E. histolytica)
0 = nil
1 = yes

135. Trichuriasis
0 = nil
1 = yes

136. Ear Infection
0 = nil
1 = yes

137. Others
0 = nil
1 = yes (Specify):_____

138. Mother stayed with child
00 = no
if yes put exact no.of days

139. No.of education sessions attended
00 = nil
Yes = number of days

CNU COST IN TAKA

140. Cost for child's food during stay

141. Cost for medicine total during stay

142. Cost for laboratory tests (total)

143. Cost for X-ray

144. Cost for staff services

145. Cost/day for mother and sib. food (DCC)

146. Cost/day for mother attender food (IPD)

147. Child bed cost during stay (IPD)
999= Not applicable

148. Child bed cost during stay (DCC)
999= Not applicable

149. Mother hotel cost during stay (IPD)

150. Service charge for IPD
(Water, Gas, Electricity,transport etc)
999= Not applicable

151. Service charge for DCC
(Water, Gas, Electricity,transport etc)
999= Not applicable

152. Capital cost

PARENTS COST DURING HOSPITALIZATION

153. Total transport cost in TK. [ ][ ][ ]
(put exact amount)
999= Not applicable
(i,e walked or came in own transport)

154. Total cost of wage loss [ ][ ][ ][ ]
999= Not applicable

155. Total cost for attender at home (extra food) [ ][ ][ ]
999= Not applicable

156. Date of discharge [ ][ ][ ][ ][ ][ ]

157. Taken home by [ ]
1= mother
2= father
3= foster parent
4= grandparent
5= aunt
6= stepmother
7= uncle
8= sibling

158. If choice was given which type parents would prefer [ ]
[N.B. This question was asked at the end of the study]
1= In-Patient
2= Day Care
3= Domiciliary

Signature of HW: _____ _____

Date: _____ _____

Comments: _____ _____

SAVE THE CHILDREN FUND (U.K)

Children's Nutrition Unit

CONSENT FORM

(Translated from Bengali)

Your child named.....age(m).....sex M/F needs admission to the hospital. While under treatment all necessary investigations will be done, such as blood, urine, stool, aspirates, wound swabs, X rays etc and also other procedures required to assist improvement of your child. He/she may be alloted to any of the available options for management of his/her condition. It is important that the mother or carer stays with the child in the centre as long as necessary.

If you agree to admit your child accepting these conditions please sign or put your thumb impression below.

Mother/father/carer: signature.....

name.....

Mother/father/carer: thumb impression.....

name.....

Date.....

SAVE THE CHILDREN FUND (UK)
CHILDREN'S NUTRITION UNIT
2, Bara Moghbazar, Dhaka
DAILY EXAMINATION SHEET (IPD+DAY-CARE)

.....	Date.....
e rate/Min.....	Pulse rate/Min.....
iratory rate/Min.....	Respiratory rate/Min.....
findings.....	Lung findings.....
; findings.....	Heart findings.....
(cm)..... Spleen(cm).....	Liver(cm)..... Spleen(cm).....
lration.....	Dehydration.....
ia.....	Oedema.....
s.....	Others.....

.....	Date.....
rate/Min.....	Pulse rate/Min.....
ratory rate/Min.....	Respiratory rate/Min.....
findings.....	Lung findings.....
findings.....	Heart findings.....
(cm)..... Spleen(cm).....	Liver(cm)..... Spleen(cm).....
ration.....	Dehydration.....
a.....	Oedema.....
s.....	Others.....

.....	Date.....
rate/Min.....	Pulse rate/Min.....
ratory rate/Min.....	Respiratory rate/Min.....
findings.....	Lung findings.....
findings.....	Heart findings.....
(cm)..... Spleen(cm).....	Liver(cm)..... Spleen(cm).....
ration.....	Dehydration.....
a.....	Oedema.....
s.....	Others.....

Calorie, protein and cost of cooked food items/100g and per piece

Food items		Weight/piece	Kcal	protein (g)	cost (tk)
Boiled rice	Rice	100	93	1.7	.450
pudding		100	78	1.9	.508
Suji (samolina)		100	65	0.5	.384
Rice+dhal		100	100	2.9	.392
Rice+meat+pumpkin		100	117	4.3	.818
Cooked dhal		100	93	6.0	.849
Chapapti or roll		1 piece (40g)	90	2.1	.333
Banana		1 Piece	88	0.7	.600
Peanut		100	400	20.3	4.00
Oil		100 ml	900	0.0	3.30
HSWM		100 ml	75	1.0	1.41
FSWM		100 ml	100	2.0	2.17
HDSM		100 ml	75	1.5	.823
FDSM		100 ml	100	3.0	1.30
Egg		1 Piece	65	5.2	2.80

HSWM = half strength whole milk

FSWM = full strength whole milk

HDSM = half strength dried skimmed milk

FDSM = full strength dried skimmed milk

COST FOR CHILD'S FOOD

NAME :_____ ID NO:_____ GROUP NO:_____

Food items (cooked)	Total amount consumed	Unit	Unit cost (in taka)	Total (kcal)	Total cost (in taka)
Half strength WM		ml	.0141		
Full Strength WM		ml	.02166		
Half strength DSM		ml	.00823		
Full strength DSM		ml	.01297		
Rice pudding		gm	.00459		
Suji		gm	.00384		
Chapati or rolls		n	.33333		
Dhal		gm	.00849		
Rice+meat+pumkin		gm	.00818		
Rice+dhal		gm	.00392		
Banana		n	.6		
Egg		n	2.8		
Peanut		gm	.04		
Oil*		ml	.033		

NOTE: WM - Whole milk

DSM - Dried skimmed Milk

* - Extra oil excluding amount used in cooked food items.

Ingredients, food mixes and costs

Half strength dried skimmed milk

Sl NO.	Ingredients	Weight(g)	Price (tk)
1.	Milk powder	80.0	9.44
2.	Oil (ml)	60.0	1.98
3.	Sugar	167.5	5.03
4.	Water		
	After cooking	2000 ml	16.45
	Cost of	100 ml	0.8225

Full strength dried skimmed milk

1.	Milk powder	80.0	9.44
2.	Oil	50.0	1.65
3.	Sugar	62.5	1.88
4.	Water		
	After cooking	1000 mls	12.97
	Cost of	100 mls	1.297

Half strength whole milk

1.	Milk powder	100	12.60
2.	Sugar	50	1.50
3.	Water	850	
	After cooking	1000 mls	14.10
	Cost of	100 mls	1.411

Full strength whole milk

1.	Milk powder	160	20.16
2.	Sugar	50	1.50
3.	Water	800	
	After cooking	1000 mls	21.66
	Cost of	100 mls	2.166

Dhal

Sl No	Ingredients	Weight (g)	Price (Tk)
1.	Dhal	250	7.50
2.	Oil	50	1.65
3.	Onion	12	.17
4.	Spices	10	.70
5.	Water		
	After cooking	1180 mls	10.02
	Cost of	100 mls	0.84915

Rice pudding

1.	Rice	400	4.80
2.	Milk	100	11.80
3.	Sugar	40	1.20
4.	Water		
	After cooking	3500	17.08
	Cost of	100	0.488

Suji

1.	Suji	300	6.00
2.	Sugar	300	9.00
3.	Water		
	After cooking	3905	15.00
	Cost of	100	0.38412

Rice+meat+pumpkin

1.	Rice	800	9.60
2.	Meat	800	40.00
3.	Pumpkin	1334	6.67
4.	Onion	6	.08
5.	Spices	4	.28
6.	Oil	257	8.48
7.	Water		
	After cooking	7965	65.11
	Cost of	100	0.81745

Rice + dhal

Sl No	Ingredients	Weight(g/ml)	Price (tk)
1.	Rice	600	7.20
2.	Dhal	420	12.60
3.	Oil	171	5.60
4.	Onion	6	.08
5.	Spices	3	.21
6.	Water		
	After cooking	6560g	25.73
	Cost of	100g	0.392

MEDICINE COST

Name :_____ ID NO._____ Group No._____

Sl. No.	Medicines	Unit	Daily dose	Total days received	Total dose recieved	Unit cost (taka)	Total cost (taka)
01.	Vitamin C	tab				.52288	
02.	Folic Acid	tab				.147	
03.	Riboflavin	tab				.06732	
04.	Multivitamin Drop	drop				.04155	
05.	Folfe-tab	tab				.11457	
06.	Potassium Chloride	ml				.02229	
07.	Magnesium Sulphate	ml				.04778	
08.	Lugols Iodin	drop				.00291	
09.	Ampicillin Injection	mg				.036	
10.	Ampicillin Syrup	mg				.011	
11.	Cloxacillin injection	mg				.260	
12.	Cloxacillin syrup	ml				.011	
13.	Cotrimoxazole syrup	ml				.245	
14.	Gentamicin injection	mg				.299	
15.	Penicillin injection	vial				19.50	
16.	Metronidazole syrup	ml				.221	
17.	Mebendazole syrup	ml				.166	
18.	Nitrofurantoin tablet	tab				.023	

19.	Chloramphenicol eye drop	vial				5.83	
20.	lasix (frusemide) injection	ml				3.60	
21.	Cholera saline	ml				0.044	
22.	Water for injection	vial				3.50	
23.	Atropine eye	drop				0.122	
	drop/ointment	drop				0.001	
24	Gentian violet	ml				1.55	
25	Mycostatin oral	ml				0.143	
	suspension	tube				3.50	
26	Benzyle Benzoate lotion	bottle				5.00	
27	Salicylic acid ointment	g				0.0002	
28	Other medicines as per requirements						

COST FOR LABORATORY TESTS

Name :_____ ID NO. _____ Group No._____

SL. No.	Name of test	No. of tests done	Unit cost (in taka)	Total cost
01.	Packed cell volume (PCV)		20	
02.	Plasma protein		30	
03.	Total white cell count (TWCC)		10	
04.	Differential count (DWCC)		10	
05.	Blood culture		100	
06.	Urine culture		100	
07	Urine examination		20	
08.	Stool examination		20	
09.	Blood sugar (mg %)		108	
10.	Blood for MP		10	
11.	platelet Count		10	
12.	R.B.C morphology		40	
13.	Blood group		60	
	TOTAL			
14	X-ray Chest:		30	

ANNEX 7

Data management forms for home visits (short-term study)

HOME VISIT RECORD

[MONTH-1, 4 VISIT (1 VISIT/WEEK)]
[MONTH-2, AND MORE TWICE A MONTH]

Helth Worker : _____ Home visit H. No. [ ][ ]

Name of child : _____

Mother's name : _____

Responder's name : _____

Address : _____

SL.NO. VARIABLES	CODE
01.patientID NO	[ ][ ][ ]
02. Date of visit	[ ][ ][ ][ ][ ][ ]

H.W.EXAMINATION

03. Weight in kg	[ ][ ].[ ][ ]
04. Height/length in cm.	[ ][ ][ ].[ ]
05. MUAC in mm	[ ][ ][ ]
06. Oedema 0 = no 1 = yes	[ ]
07. Xerophthalmia 0 = no 1 = yes	[ ]

08. Eye infection
0 = no
1 = yes

09. Ear infection
0 = no
1 = yes

10. Fever
0 = no
1 = yes

11. Tonsilitis
0 = no
1 = yes

12. Chest infection
0 = no
1 = yes

MOTHER'S REPORT

13. Diarrhoea
    0 = no
    1 = yes (no blood)
    2 = yes (with blood)

14. Vomiting
    0 = no
    1 = yes

15. Caugh
    0 = no
    1 = yes

16. Worms passed
    0 = no
    1 = yes

17. Child's appetite
    1 = eating well
    2 = eating less than normal
    3 = refusing
    4 = taking liquids only
    5 = other specify:_____

FED WITH (IN LAST 24 HOURS)

18. Breast milk
    0 = no
    1 = yes
    9 = not applicable

19. Other milk
    0 = no
    yes = number of cups

20. Rice (1 full bowl = 340g = 318 kcl)
    0 = no
    yes = number of cups/plates

21. Suji
    0 = no
    yes = number of cups/plates

22. Dhal(1 full cup = 180 ml = 165 kcl)
    0 = no
    yes = number of times

23. Sak (Leafy vagetables)
    0 = no
    yes = number of times

24. Pumpkin
    0 = no
    yes = number of times

25. Food cooked in oil
    0 = no
    1 = yes

26. Banana
    0 = no
    yes = number of bananas

27. Chappati
    0 = no
    yes = number of chappatis

28. Other food
    0 = no
    1 = yes specify:_____

SINCE LAST VISIT

29. Mother followed advice on what foods to give
    0 = no
    1 = mostly
    2 = always

30. Difficulties encountered on following advice what foods to give
    0 = no problem
    1 = cannot afford (specify items):_____
    2 = resistance from family (specify items):_____
    3 = child dislikes (specify items):_____
    4 = other specify :_____

31. Mother follows advice on quantity and no of times to give
    0 = no
    1 = mostly
    2 = always

32. Difficulties encountered on following advice on quantities
    0 = no problem
    1 = cannot afford (specify items):_____
    2 = resistance from family
    3 = child has poor appetite
    4 = has no time
    5 = other specify :_____

33. Approximate EI since last visit (Kcal/kg/day)

34. Cost of childs food since last visit (calculate using ref.cost)

35. Cost of work lost since last visit
    999 = not applicable

36. Father earning (TK) since last visit

37. Total cost for attender at home (extra food)
    999 = not applicable

38. Cost for transport to CNU

ACTION TAKEN IF UNWELL

39. Referred
    0 = no
    1 = yes

CNU COST: IF REFERRED TO CNU

40. OPD medicine
    999 = not applicable

41. OPD X-ray
    99 = not applicable

42. OPD lab tests
    999 = not applicable

43. OPD staff salary

44. H.W salary

45. H.W transport

Signature of HW: _____

Date: _____

Advice given:

ANNEX 8
Referral criteria

Examination by health workers

Dysentery
Caused by intestinal parasites or shigella. These may not always be found in stool examination. Children pass frequent loose/soft stools with or without blood and mucus. Child may strain a lot during passing stool and may have prolapsed rectum. Shigella dysentery is accompanied with fever and invariably stool has blood. Even one such stool a day will leave the child weak. Refer if stool has blood.

Diarrhoea
Passing of liquid or watery stool more than three times a day which may or may not be accompanied with mucus, blood, fever and/or dehydration. Most episodes of diarrhoea last from 3-7 days. Diarrhoea is 'persistent'if it is continuous for 14 days or more. Refer if i) child has persistent diarrhoea, or ii) if diarrhoea for >48 hours with moderate dehydration, or iii) watery diarrhoea with poor appetite.

Dehydration
Loss of fluid from all fluid compartments of the body is called dehydration, characterised by dry tongue, sunken fontanelle, quick thready pulse, dry eyes, fast respiration, scanty urine, skin from the belly can be squeezed with gentle pressure with thumb and index finger, that is the skin looses elasticity. The extent of dehydration is important, if severe or moderate with persistent diarrhoea must refer, because if it is severe child may die if fluid is not replaced quickly. Look for the following conditions to differentiate mild/moderate from severe dehydration. Refer if i) moderate: (a+f with any other sign)+diarrhoea >48h, or+fever. ii) severe (any 2 of the list).

	Severity of dehydration	
	mild/moderate	severe
a) Appearance	alert/sleepy, restless	very sleepy, floppy
b) Thirst	normal/thirsty	unable to drink
c) Eyes	normal/sunken	very dry, sunken
d) Tears	present/absent	absent
e) Mouth	wet/dry	very dry
f) Urine	normal/scanty, dark	none for 4-6 hours
g) Skin when pinched	normal/goes back slowly	goes back very slowly
h) Fontanelle	normal/sunken	very sunken, depressed
i) Breathing	normal/fast (>50/minute)	very fast and deep
j) Pulse	normal/faster than normal	very fast, weak, or can not be felt.
Advice	ORS:mild,100-200ml/stool moderate:400-600ml for 4-6 hours or refer to CNU	refer promptly for i.v or intragastric fluids

Fever

This means a body temperature above the usual range of normal that is, 98.4^0 fahrenheit in the mouth, (99.4^0 under arm (axilla) and 97.4^0 rectal) for 3 minutes, Fever can be assessed by touch. Child feels cold even in hot season, face is flushed, may be irritable. If not getting better with home remedy (cold sponge), and is still persisting during second morbidity visit, should be referred to CNU. Refer if persistent fever, or fever+cough for >7 days, fever+vomiting for >1day.

Upper respiratory tract infection (URTI)

These conditions are those which primarily affect the structures of the respiratory tract above the larynx including nose and throat. Pathophysiologic features include inflammatory infiltrates and oedema of the mucosa, vascular congestion, increased mucus secretion and alteration of ciliary structure and function. The child will get fever, nasal discharge, cough and may vomit. He/she will refuse food. Throat must be examined for tonsillitis. Should be referred to CNU if throat infection present.

Otitis media (middle ear infection)

Ear infection may or may not be accompanied with fever. If the discharge from ear(s) is there for a long time, regular cleaning with dry cotton buds should be advised. If ear discharge with fever, should be referred.

Lower respiratory tract infection (LRTI)

Lower respiratory infection are those affecting the structures of the respiratory tract below the larynx. Pneumonia, bronchial asthma, post-measles bronchopneumonia, bronchiectasis etc are some of the examples of LRTI. Characteristics of LTRI are: a) fever b) cough c) rapid breathing (>50/minute) d) nasal flaring e) in drawing of chest f) respiratory distress. Signs a+b with any other (c or d or e or f) should be referred to CNU doctor.

Urinary tract infection (UTI)

Urinary tract infections are those that affect the structures below the kidney to the lower end of the urethra. Usually the route of infection is ascending one from external genitalia and the organism multiply and invade the organs. There may be mild persisting fever (likely to go unnoticed), and unexplained growth faltering. If a child passes urine more frequently than usual which may be accompanied with distress while passing urine. If symptomatic then drinking plenty of fluids should improve the condition. Ask the mother to bring the child to CNU after 5 days or visit if mother fails to come and refer if no improvement.

Scabies with secondary infection

Scabies is a very common skin condition in slum population. Characteristics sites where present are chiefly the finger webs, wrists, elbow, axilla, areola and areas around the umbilicus, the lower abdomen and buttocks. The condition is very itchy and highly infectious. Scabies when detected, advise home remedy for the whole family (warm bath with neem leaves) or usual treatment. Infected scabies has serious complication and therefore should be refereed to CNU OPD for further treatment.

Xerophthalmia
Dryness of the conjunctiva and cornea due to vitamin A deficiency. The condition begins with night blindness and conjunctival xerosis, and progresses to corneal xerosis, if untreated leads to total blindness. This condition will become worse in any of the stages if high potency vitamin A capsule is not given incases with diarrhoea, high fever, measles and pneumonia. Refer for any of the above signs.

Anaemia
It is a clinical condition due to deficiency of iron , folic acid, vitamin B12 and characterised by a low packed cell volume (PCV < 30%) and haemoglobin less than 10g. There may be history of passing worms. The child will have pale conjunctiva, tongue, lips and finger tips. She/he will lose appetite and feel weak. If in doubt should be referred.

Oedema
Pitting oedema first appear on the feet and lower legs and then may become generalized. Oedema (when mild) may or may not be visible; to test its presence press gently but firmly with the thumb in front of the lower leg against the bone for 10 seconds. When the pressure is released there will be a dent which will take few minutes to disappear. Children who develop oedema in the long-term study should be referred to CNU.

Jaundice
The colour of conjunctiva is usually white, if it becomes yellow, and the face looks yellow which along with a tender and enlarged liver, loss of appetite, nausea, vomiting are signs of hepatitis, the child should be sent to CNU for consultation. Refer if all these signs are present, or only yellow eyes or face, or loss of appetite+nausea and vomiting, or enlarged tender liver+vomiting or enlarge tender liver+loss of appetite.

Not eating well (loss of appetite)
Refer if the child have not eaten 3 meals a day for 3 consecutive days out of 5 days.

Weight loss
Weight loss or static weight for 2 consecutive visits in absence or presence of any illness with or without food refusal should be referred to CNU for investigation, because some infection may not be visible.

Drop-out
If a child was not brought to the centre for treatment for more than 3 consecutive days: and was not found for 3 consecutive home visits during follow-up, he/she should be considered a 'dropout'.

NAME OF THE CHILD :

DATE OF ISSUE :

DATE OF DISCHARGE :

ID NO. :

ANNEX 9

DATE OF VISIT :

Pictorial morbidity calendar (long-term study)

ANNEX 10

Morbidity data management forms for home visits (long-term study)

FORM-2A

FOLLOW-UP AT HOME
(MORBIDITY RECORD - TWICE A MONTH)

Health Worker : _____ Home visit H.No. [ ][ ]

Name of child : _____

Mother's name : _____

Responder's name : _____

Address : _____

SL.NO.	VARIABLES	CODE
01.	Patient ID_NO	[ ][ ][ ]
02.	Which group 1 = Inpatient 2 = Day care 3 = Day care domicilary	[ ]
03.	Date of visit	[ ][ ][ ][ ][ ][ ]

MOTHER'S REPORT

04. Diarrhoaa
    00 = No (If no go to no.05)
    If yes = For how many days (put exact days)

05. No. of episodes
    (if there are 2 or more diarrhoea free days in between 2 diarrhoeas, then it is 2 episodes)
    9 = not applicable (if no diarrhoea)

06. Vomiting
    00 = No
    Yes = duration in days

07. Fever
    00 = No
    Yes = duration in days

08. Cough
    00 = No
    Yes = duration in days

09. Worms passed
    0 = No
    1 = Yes

10. Eye infection
    0 = No
    1 = Yes

11. Ear infection
    0 = No
    1 = Yes

12. Skin infection
    0 = No
    1 = Yes

13. Mother's response to infection
    0 = did not respond
    1 = attended clinic
    2 = faith healer
    3 = homeopath
    4 = home remedy
    5 = else where (specify):_____
    9 = not applicable (i.e. no infection)

FED WITH (IN LAST 24 HOURS)

14. Breast milk
    0 = No
    1 = yes
    9 = Not applicable (i.e. not bf on discharge)

15. Tin milk
    0 = No
    Yes = Put number of times

16. Cows milk
    0 = No
    Yes = Put number of times

17. Tinned cereal Myboy;Cerelac etc
    0 = No
    Yes = Put number of times

18. Rice
    0 = No
    Yes = Put number of times

19. Total amount of rice (bowl measure)
    (put exact number of bowls given)
    9 = not applicable

20. Suji
    0 = No
    Yes = Put number of times

21. Total amount of Suji (cup measure)
    (put exact number of cups given)
    9 = not applicable

22. Chappati
    0 = No
    Yes = how many (put number)

23. Dhal
    0 = No
    Yes = Put number of times

24. Sak (Leafy vegetables)
    0 = No
    Yes = Put number of times

25. Pumpkin
    0 = No
    Yes = Put number of times

26. Food cooked in oil
(D: ,veg,khichuri,etc)
0 = No
1 = yes

27. Fish
0 = No
Yes = Put number of times

28. Banana
0 = No
Yes = Put number of bananas

29. Other food
0 = No
1 = Yes (specify):_____

30. Food witheld during present illness
0 = No
1 = Yes
9 = not applicable (i.e. not ill)

31. Appetite score
1 = Child is eating well
2 = eating less then usual
3 = refusing to eat
4 = taking liquids only
5 = appetite good but family cannot afford
6 = Other (specify):_____

32. Activity score
1 = running around normally
2 = rather quiet
3 = in bed all day
4 = other (specify):_____

33. Followed hospilal advice on feeding
0 = No
1 = Yes (i.e. mixture 4 times or more)

34. Resons for not following
0 = could not afford
1 = resistance from family (could afford)
2 = child would not eat
3 = mother is working
4 = mother is ill
5 = other (specify):_____
9 = Not applicable (i,e. is following advice)

35. MORBIDITY EXAMINATION
0 = no illness
1 = diarrhoea
2 = pneumonia
3 = fever
4 = eye infection
5 = ear infection
6 = skin infection
7 = others (specify):_____

36. Xerophthalmia
0 = No
1 = Yes

37. Oedema
0 = No
1 = Yes

38. Referred
1 = to CNU OPD
2 = to other specify:_____
9 = not applicable (i.e. not sick)

Signature of HW:_____

Date:_____

Comments:

ANNEX 11

Data management form for monthly home visits (long-term study)

FORM-2B

FOLLOW-UP AT HOME

(RECORD ONCE A MONTH)

ım.Health Worker : _____

ıe of Child : _____

Number : [ ][ ][ ] Visit No : [ ][ ]

NO. VARIABLES	CODE
Out -come 1 = well 2 = not well 3 = re - admission 4 = not found 5 = died 6 = other (specify):	[ ]
If well,(mother's reasons) 1 = eats well 2 = no illness 3 = followed hospital advice 4 = others specify: 9 = Not applicable	[ ]
If not well, (mother's reasons) 1 = poor food intake 2 = refusing food 3 = rather quiet 4 = in bed all day 5 = taking liquid only 6 = irritable 7 = does not play 8 = others specify: _____ 9 = Not applicable	[ ]

04. If dead, cause of death
1 = diarrhoea + dehydration
2 = pneumonia
3 = fever
4 = convulsion
5 = 3 + 4
6 = accident (drowned/road accident)
7 = other (specify):
9 = Not applicable

05. Immunization status (first 4 months only)
1 = Immunization Partial
2 = Immunization Completed
9 = Not applicable

06. Birth/death of a sibling (in last month)
0 = nil
1 = birth
2 = death
3 = birth & death
4 = mother pregnant
5 = other (specify) :

07. Parents, together/separate/died/remarried/deserted
0 = none
1 = together
2 = seperated for work
3 = father deserted
4 = mother deserted
5 = father remarried
6 = mother remarried
7 = father died
8 = mother died
= others :_____

08. Father's job status
0 = unemployed
1 = temporarily employed
2 = regular job
9 = not applicable (i,e. father absent)

09. How many days father had job since last visit
put approximate day.
0= Nil
9= not applicable

10. How much money (TK) father has.earned
since last visit (put amount of taka)
999 = not applicable

11. Mother's job status
    0 = House wife
    1 = temporarily employed out of home
    2 = regular job out of home
    3 = works at home
    9 = not applicable

12. How many days mother had job since last visit
    put approximate day.
    0= Nil (house wife)
    9= not applicable

13. How much money (TK) Mother has.earned
    since last visit (put amount of taka)
    999 = not applicable

14. Total family income in TK/month
    (Father + Mother + Other's)

15. Illness in the family
    (excluding study child)
    0 = none
    1 = father
    2 = mother
    3 = sibling
    4 = grand parents
    5 = other (specify):_____

16. If mother is ill or working who feeds the child
    1 = father
    2 = grandmother
    3 = aunty
    4 = sibling
    5 = neighbour/friend
    6 = others (specify):_____
    9 = not applicable (i.e. mother feeds)

17. Weight of the child in Kg (on that day)

18. Height/length in cm

19. MUAC in mm

Signature of HW:_____

Date:_____

Comments:

ANNEX 12

Study area zones[1]

GROUP - IN PATIENT (IP)

NORTH AND NORTH- WEST (1)
HW NAME : SHAJALAL BHUYAN

1. NEW AIRPORT
2. MIRPUR
3. MOHAMMADPUR
4. NAKHALPARA
5. FARMGATE
6. BANGLAMOTOR
7. DHANMONDI
8. JIKATOLA
9. AZIMPUR
10. HAZRIBAG
11. NELKHET
12. LALBAG
13. BONGSHAL
14. ISLAMBAG
15. KAMRANGIR CHOR
16. NOYABAZAR
17. SODOR GHATE

NORTH - EAST (2)
HW NAME : ARIFUN NAHAR

1. MAGHBAZAR
2. MALIBAG
3. SEPAHIBAG
4. KHILGAON
5. BASABO
6. GORAN
7. RAMPURA
8. BADDA
9. MARADDYA
10. SHANTINAGOR
11. RAZARBAG
12. SHAHJAHANPUR
13. MOHAKHALI
14. GULSHAN
15. BANANI

SOUTH-EAST AND SOUTH-WEST (3 & 4).
HW NAME : DELWAR HOSSAIN

1. KOMALAPUR
2. MUGDAPARA
3. GOPIBAG
4. DHOLPUR
5. MIR HAZIRBAG
6. PAR GANDARIA
7. ZATRABARI
8. MURADPUR
9. DEMRA
10. RUPGONJ

[1] ZONES : 1,2,3,4 in figure 2

Area zones

GROUP - DAY CARE (DC)

NORTH AND NORTH - WEST (1)
HW NAME : ABDUR ROUF

1. NEW AIRPORT
2. MIRPUR
3. MOHAMMADPUR
4. NAKHALPARA
5. FARMGATE
6. BANGLAMOTOR
7. DHANMONDI
8. JIKATOLA
9. AZIMPUR
10. HAZRIBAG
11. NELKHET
12. LALBAG
13. BONGSHAL
14. ISLAMBAG
15. KAMRANGIR CHOR
16. NOYABAZAR
17. SODOR GHATE

NORTH - EAST (2)
HW NAME : FERDOUS AHMED

1. MAGHBAZAR
2. MALIBAG
3. SEPAHIBAG
4. KHILGAON
5. BASABO
6. GORAN
7. RAMPURA
8. BADDA
9. MARADDYA
10. SHANTINAGOR
11. RAZARBAG
12. SHAHJAHANPUR
13. MOHAKHALI
14. GULSHAN
15. BANANI

SOUTH EAST AND SOUTH WEST (3 & 4)
CHW NAME :SHAKHAWAT HOSSAIN

1. KOMALAPUR
2. MUGDAPARA
3. GOPIBAG
4. DHOLPUR
5. MIR HAZIRBAG
6. PAR GANDARIA
7. ZATRABARI
8. MURADPUR
9. DEMRA
10. RUPGONJ

Area zones

GROUP- DOMICILARY (DCD)

NORTH AND NORTH-WEST (1)
CHW NAME : MUSTAFIZUR RAHMAN

1. NEW AIRPORT
2. MIRPUR
3. MOHAMMADPUR
4. NAKHALPARA
5. FARMGATE
6. BANGLAMOTOR
7. DHANMONDI
8. JIKATOLA
9. AZIMPUR
10. HAZRIBAG
11. NELKHET
12. LALBAG
13. BONGSHAL
14. ISLAMBAG
15. KAMRANGIR CHOR
16. NOYABAZAR
17. SODOR GHATE

NORTH - EAST (2)
HW NAME : KOHINOOR BEGUM

1. MAGHBAZAR
2. MALIBAG
3. SEPAHIBAG
4. KHILGAON
5. BASABO
6. GORAN
7. RAMPURA
8. BADDA
9. MARADDYA
10. SHANTINAGOR
11. RAZARBAG
12. SHAHJAHANPUR
13. MOHAKHALI
14. GULSHAN
15. BANANI

SOUTH EAST - SIDE (3)
HW NAME :SALEHA CHOWDHORY

1. MANIK NOGOR
2. DHOLAYPER
3. MIR HAZIRBAG
4. PAR GANDARIA
5. ZATRABARI
6. DAMRA
7. RUPGONJ
8. MURADPUR
9. ZURAIN
10. SUTRAPUR

SOUTH - WEST SIDE (4)
HW NAME : ZIAUL KABIR

1. MUGDAPARA
2. MATHERTAKE
3. NONDIPARA
4. KOMLAPUR
5. GOPIBAG
6. DHOLPUR
7. GULISTAN
8. BONGSHAL