Original Article

Developing models to predict stunting among 6-59 months children in a slum of Kolkata

Chowdhury R[1], Sinha B[2], Adhikary M[3], Mukherjee A[4], Lahiri SK[5]

[1,4]PG III, [5]Professor & Head, Department of Community Medicine, RG Kar Medical College, Kolkata, [2]PG II, Department of Community, Lady Hardinge Medical College, New Delhi, [3]PG II, Department of Community Medicine, Vardhaman Mahavir Medical College and Safdarjung Hospital, New Delhi.

Abstract

Background: India is one among the many countries where child malnutrition is severe and is a major underlying cause of child mortality. 48 per cent of under five children in India are stunted and India accounts for more than 3 out of every 10 stunted children in the world. Even after implementation of the national nutritional programmes the magnitude of the problem remains at large, this necessitates a detailed analysis regarding the factors leading to stunting and to identify which group of factors to target first to make a significant effect.

Methods: This Community based cross-sectional study was done in the service area of Urban Training Centre in Baghbazar, Kolkata with 84 children aged 6-59 months. Anthropometric measurements of the study population were done using standard methods and information regarding risk factors were collected from their parents using a pre-designed questionnaire. WHO Anthro for personal computers version3.2.2 (Z score) and SPSS version16.0 was used to analyse the data (multivariate logistic regression and ROC curve).

Results: The study indicates a 26.2% prevalence of stunting among the study population. To observe the risk factors for stunting two models were compared by creating ROC curves, a socio demographic factor model which explained 70% of the stunting in the population in comparison to the second model regarding the factors related to birth and feeding practices which explained 65%.

Conclusion: The current study further emphasizes the need to implement relevant interventions to combat malnutrition in this region and other similar settings.

Key Words: Stunting, Models, ROC curve, Multivariate logistic regression.

Introduction:

Under nutrition in children below five years of age is conventionally measured by three indices: underweight (weight for age below 2 standard deviations [SD] of World Health Organization [WHO] growth reference), stunting (length or height for age below 2 SD of WHO growth reference), and wasting (weight for length or height below 2 SD of WHO growth reference). Weight for age represents a composite measure of height for age and weight for height. A low weight for height (wasting) is used to define acute under nutrition and a low height for age or linear growth retardation (stunting) is believed to represent a relatively longer lasting deprivation. India is one among the many countries where child malnutrition is severe and also malnutrition is a major underlying cause of child mortality in India. The problem has caught the attention of policy makers and researchers for several decades. Stakeholders invariably relate childhood under nutrition to underweight. Consequently all policy discussions revolve around underweight only, thereby eroding the public health importance of stunting and wasting. Though, wasting has recently gained recognition for identification of SAM while stunting still remains neglected. The golden interval for intervention is believed to be from pregnancy to 2 years of age, after which under nutrition may cause irreversible damage including shorter adult height, lower attained schooling, reduced adult income, and decreased offspring birth weight.[1] Inadequate cognitive or social stimulation in first two to three years has lifelong negative impact on educational performance and psycho-social functioning. In view of the increasing importance of human resource development, it is imperative that stunting be now viewed as a primary indicator of childhood under nutrition by policy and program stakeholders. According to NFHS 3 data 48% of children under age five years are stunted which indicates that, half of the country's children are chronically malnourished.[2] Various studies and surveys have been conducted to find out the main causes of child malnutrition, all these studies including the three National Family Health Surveys (NFHS) reveal that factors related to malnutrition can be divided into two main groups i.e. socio demographic factors including socio economic status specially poverty, literacy status, mother's working status and factors related to birth and feeding practices including birth weight, birth order, feeding practices including breast feeding, pre lacteal feeds, formula feeding, adequacy of supplementary feeding. The problem is multifaceted, the factors acting

Address for Correspondence:
Ranadip Chowdhury, 3rd year post graduate student, Department of Community Medicine (3rd floor Academic Block), R.G Kar Medical College, 1, Khudiram Bose Sarani Kolkata-700004, West Bengal.
Email: ranadip84@gmail.com

singly or in combination leads to malnutrition[1,2,3,4]. With this back ground the present study was designed

1. To find out the prevalence of stunting in the 6-59 months old children in a slum of Kolkata.
2. To develop models to predict factors responsible for stunting in the study population.

Methods:

It was a community based observational type of cross-sectional study carried out in the service area of Urban Training Centre in Baghbazar under Department of Community Medicine R.G.Kar Medical College, Kolkata, catering total 1853 population from 1st July 2011 to 31st July 2011. This study included all the children aged between 6-59 months of that area. Out of total 87 children were in this age group, 3 children could not contacted even after 3 visits. Rest 84 children present during the study period were included in the study after getting verbal consent from their parents or care givers. All the children thus included in the study were subjected to anthropometric measurement following standard methods. The data included recumbent length (for children less than24 months of age) and height (for children more than 24 months of age). Height was measured against a non stretchable tape fixed to a vertical wall, with the participant standing on a firm/ level surface and it was measured to the nearest 0.5cm. Recumbent length (for children less than 24 months of age) was measured by using an infantometer. Each measurement was done twice, and the mean of the two readings was recorded. If any pair of readings exceeded the maximum allowable difference for a given variable (e.g. length/height, 7 mm), the measurements were repeated. The same measuring instruments were used throughout the study. Age of the child was determined by reviewing the records (Birth certificate, discharge certificate, Immunisation card) and local events calendar method was used if any record was not available. Information regarding risk factors was collected using a pre-designed questionnaire.

Data of the anthropometric measurement were analysed using WHO Anthro[5] for personal computers, version3.2.2, January 2011 to compute the Z scores of W/A, W/H and MUAC/A. SPSS version16.0 was used to analyse the data. Multivariate logistic regression was done to formulate model regarding factors associated with stunting in SPSS 16.0 version by step wise method. Two ROC curve models were created to explain the stunting in this population, a socio demographic factor model and another model to relate the factors regarding birth and feeding practices.

Results:

Out of total 84 study subjects, females were 48 (57.14%) and males were 36 (43.86%). Maximum number of the study subjects was in the age group 30 – 35 months (19.0%) [table.1]. Among the 84 children in the age group of 6-59 months, 22 were found to be stunted i.e. length or height for age below 2 SD of WHO growth reference with a prevalence of 26.2%. According to the 1st ROC Curve [Fig.1] 70% of the stunting in this population could be explained by this socio demographic factor model and which was statistically significant. The factors included in this model were age in months, sex, religion, socioeconomic status (Modified Kuppuswamy Scale), mother's education, working status of mother. Multivariate analysis was done to find out the association between the socio demographic factors and stunting. The factors Age in months (p= 0.045), Sex (Male) (p= 0.03), Mother's occupation (working) (p= 0.017) were found to be statistically significant [table 2]. According to the 2nd ROC Curve [Fig.2] 65.7% of the stunting in this population could be explained by this model of birth and feeding practices and which was statistically significant. The factors included in this model were mode of delivery, birth weight, birth order, exclusive breast feeding (EBF) in months, pre lacteal feeds, formula feeding. Multivariate analysis was done to find out the association between the factors related to birth and feeding practices and stunting. The factors found to be statistically significant were Pre lacteal feeding (p= 0.036), EBF months (p= 0.019), Formula fed (p= 0.017) [table 3].

Table 1. Distribution of the Study Subjects according to Age and Sex (N = 84)

Age(in Months)	Sex (%)		
	Male	Female	Total
6-11	1(2.8)	8(16.7)	9(10.7)
12-17	2(5.6)	5(10.4)	7(8.3)
18-23	5(13.9)	5(10.4)	10(11.9)
24-29	3(8.3)	5(10.4)	8(9.5)
30-35	9(25.0)	7(14.6)	16(19.0)
36-41	4(11.1)	4(8.3)	8(9.5)
42-47	5(13.9)	4(8.3)	9(10.7)
48-53	5(13.9)	4(8.3)	9(10.7)
54-59	2(5.6)	6(12.5)	8(9.5)
Total	36(100)	48(100)	84(100)

Table 2. Association between Stunting and Socio Demographic Factors:

S no	Factors	P value	Odds Ratio(95% C.I)
1	Age (in months)	0.045*	1.543(1.098 – 1.756)
2	Sex (Male)	0.03*	0.780(0.306 – 0.910)
3	Religion (Muslim)	0.592	2.309(0.108 – 49.275)
4	Socio Economic Status(Lower Middle)	Reference	
	Socio Economic Status(Upper Lower)	0.519	1.591(0.387 - 6.534)
	Socio Economic Status(Upper Middle)	0.673	0.745(0.190 – 2.920)
5	Mother Education(Graduate)	Reference	
	Mother Education (Higher secondary)	0.680	0.570(0.039 – 8.261)
	Mother Education (Secondary)	0.585	2.073(0.151 – 28.458)
	Mother Education (Primary)	0.661	1.745(0.145 – 20.987)
	Mother Education (illiterate)	0.601	2.118(0.128 – 35.170)
6	Mother Occupation(Working)	0.017*	2.399(1.029 – 15.504)

*statistically significant

No family in the Upper and Lower classification of Modified Kuppuswamy scale

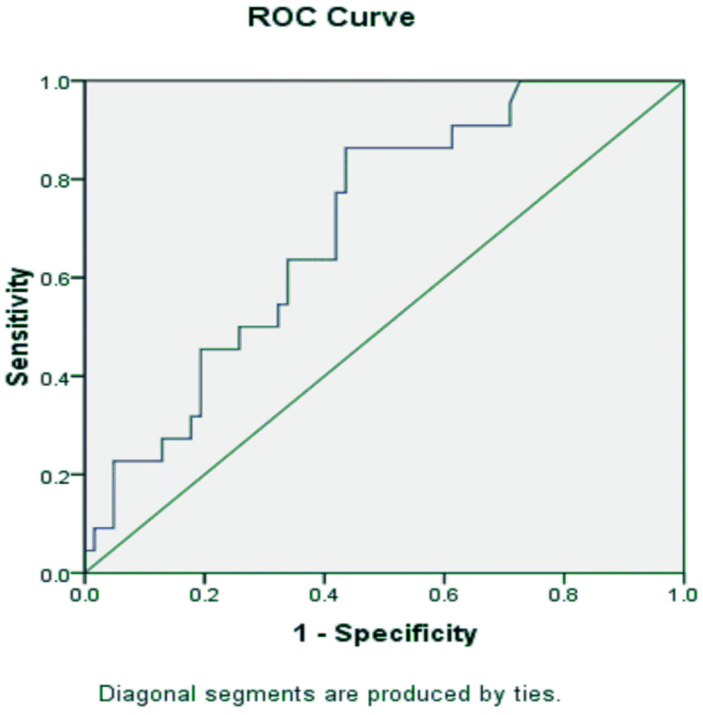

Figure 1: ROC Curve relating socio demographic factors to stunting

ROC area: .706; 95% CI: .590-.822(p value= .004); Hosmer-Lemeshow goodness-of-fit statistic p value= .725

Table 3. Association between Stunting and factors related to birth and feeding practices:

S no	Factors	P value	Odds Ratio(95% C.I)
1	Birth Weight in Kg	0.282	0.540(0.176 – 1.654)
2	Type of Delivery(C/S)	0.883	0.913(0.270 – 3.082)
3	Birth Order N>3	0.973	1.003(0.159 – 6.697)
4	Pre lacteal feeding(No)	0.036*	2.187(1.034 – 6.009)
5	EBF(Months)	0.019*	0.634(0.337 – 0.894)
6	Formula Fed(Yes)	0.017*	1.419(1.119 – 1.474)

*statistically significant

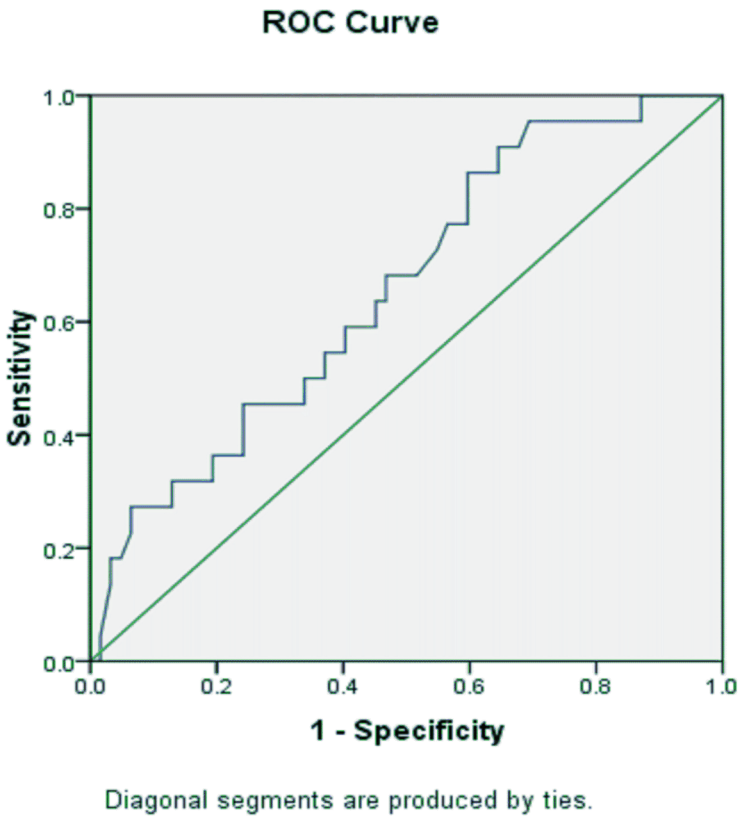

Figure 2: ROC Curve relating factors related to birth and feeding practices to stunting

ROC area: .657; 95% CI: .529-.785 (p value= .029); Hosmer-Lemeshow goodness-of-fit statistic p value= .715

Discussion:

With rapid urbanization 20% of urban population is forced to reside in urban slums. Slums are the physical and social expression of inequalities in the distribution of the beneficiaries of economic growth, as well as the structure performance and special pattern of the urban economy. Non-availability of the basic human necessities in the urban slums adversely affects the growth and nutritional status of the slum dwellers. Being the most vulnerable segment of the population, under-five children in slums are at greater risk of malnutrition because of poor purchasing power, deficient dietary intake and high load of infections hence deserve for special care. According to NFHS3 data, 48% of children under age five years are stunted with highest in Madhya Pradesh (60%) followed by Jharkhand and Bihar, 19.8% of under-five's are wasted and 43% are underweight for their age.[2] Stunting in rural area is much higher around 51% compared to 38% in urban area. It is estimated that one in every three malnourished children in the world live in India. Our present study indicates a 26.2% prevalence of stunting among children in the urban slum of Kolkata. The prevalence of wasting and under nutrition in this urban slum was 23.8 and 31% respectively. In this region of Kolkata the prevalence of chronic malnutrition (stunting) was much lower and that of acute malnutrition (wasting) was higher than that of the national average but still chronic malnutrition was more prevalent. The mean anthropometric status of this population is significantly below the WHO references populations which is generally consistent with findings from other studies conducted[6,7]. According to several previous studies including NFHS data several socio demographic factors including age sex, socioeconomic status, education and factors related to birth and feeding practices including birth weight, birth order, duration of exclusive breast feeding, pre lacteal feeds and top feeding were found to be significantly associated with stunting and malnutrition[1-4, 8-11]. But there is limited information regarding how much the socio demographic factors collectively and the factors related to birth and feeding practices separately contribute to stunting. In the present study to observe the risk factors for stunting two models were compared by creating ROC curves, a socio demographic factor model which explains 70% of the stunting in the population when combined [area under curve- 0.706] and the second model regarding the factors related to birth and feeding practices explains 65% of the stunting in the population when combined [area under curve- 0.657]. The socio- demographic factors were found to be much more contributing to stunting. These results also indicate the need to monitor different indicators of a child's nutritional status as part of the health monitoring programmes, to be able to provide adequate and timely intervention. We also observed that age, Male sex and Working mother were significant risk factors for poor physical growth. These results emphasize the need to implement early intervention to reduce the number of children experiencing growth restriction. Moreover, the results further emphasized the need to investigate factors that contribute to continued growth faltering during toddlerhood. Regarding other factors like Pre lacteal feeding, EBF and formula fed have also significant risk for stunting. Regional based studies of factors contributing to early growth faltering may be salient since growth faltering has been associated with socio-cultural and feeding practices during the weaning period factors that are likely to vary on a regional basis. They should adopt healthier feeding habits.

Conclusions:

In conclusion, we observed the high rates of nutritional deficiency with stunting more prevalent than wasting. Stunting was significantly related to age, sex, maternal occupation, pre lacteal feeding, EBF and formula fed. However, the most consistent risk factor observed to be maternal occupation and formula fed. The current study further emphasizes the need to implement relevant interventions to combat malnutrition in this region and other similar settings. There is only a narrow window of opportunity in early life – the first two years. Maximizing coverage of under twos with the full package of interventions (breast feeding; immunization; appropriate complementary feeding; treatment of infections, especially diarrhoea; safe water supply; and sanitation) may be pivotal for improving linear growth. Policy should primarily concentrate on improving the sub-optimal coverage of pertinent ongoing interventions and ensure equitable access for the poorer and unreached segments of society.

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