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Environmental factors for severe acute malnutrition in under five children admitted at nutritional rehabilitation centre in central India

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Abstract---Malnutrition is a major public health problem in India and it effects the growth and development of young children. It is one of the leading causes of morbidity and mortality in under five children in developing countries. Globally, more than three million children under five years of age die each year from environment related causes and conditions. To study the environmental factors affecting severe acute malnutrition under five children admitted at nutritional rehabilitation centre. This was a case control study design. 350 cases were selected from N.R.C. of N.S.C.B. Medical College Jabalpur and 350 neighbourhood controls were selected from same community. The chi square test is applied for categorical variables and student t test is used to compare the continuous variables and odds ratio was calculated in statistical analysis. There was significant association between severe acute malnutrition in under five children with absence of separate kitchen (OR -3.2), kaccha house (OR-14.2), overcrowding present (OR-3.3), cross ventilation absent (OR-5.7), natural light absent in the house (OR-7.2) and open field defecation present (OR-6.5) in study subjects. Severe acute malnutrition in children admitted in Nutritional Rehabilitation centre is significantly associated with the specific environmental factors as compared to normal nourished children in the community.

Keywords---environmental factors, severe acute malnutrition, N.R.C.

Introduction

Malnutrition is a global public health problem considered to be principal causes of ill health and morbidities. Normal growth and development take place only if there is optimum nutrition, complete immunization, adequate birth weight, freedom from recurrent episodes of infections and also if there is freedom from genetic and environmental influences.¹In the year 2020, globally, 149.2 million children under the age of 5 years of age were stunted, 45.4 million wasted, and 38.9 million overweight. The number of children with stunting is declining in all regions except Africa. More than half of all children affected by wasting live in Southern Asia and Asia as a whole is home to more than three-quarters of all children suffering from severe wasting.²In India, as per the National Family Health Survey (NFHS- 5) report the number of children under 5 years who are stunted (less height-for-age) is 35.5% and the number of children who are underweight (less weight-for-age) 32.1%.³

The immediate factors of children's status are dietary intake and health status. These are in turn influenced by underlying determinants such as food security, adequate care for mothers and children and a proper healthy environment, which includes the availability of safe water, sanitation, healthcare and environmental safety.⁴ According to the UNICEF, unhealthy household environment is one of the three most common underlying factors which cause childhood malnutrition.⁵ Acute respiratory infections annually kill an estimated 1.6 million children under the age of five. As much as 60 percentages of acute respiratory infections worldwide are related to environmental conditions. Diarrhoeal diseases claim the lives of nearly 1.5 million children every year. Eighty to ninety percentage of these diarrhoea cases are related to environmental conditions particularly contaminated water and inadequate sanitation.⁶ Children who are living in families who have accessed drinking water from safe source were less likely to die as compared to those who accessed drinking water from an unsafe water source. Children living in families with access to an improved toilet were less likely to die as compared to those who do not have such an access.⁷ This study was conducted to identify the environmental factors responsible for severe acute malnutrition in children as compared to normal nourished children in the community.

Methods

Study design and study area

This was a case control study design conducted at Nutritional Rehabilitation of N.S.C.B. Medical College Jabalpur India. The cases were selected from Nutritional Rehabilitation centre of N.S.C.B. Medical College Jabalpur M.P. Controls were selected from the same locality from where maximum number of cases was reported to N.R.C. (Neighbourhood reference population control). The controls were selected from 35 different sites from community to prevent the selection bias. The study was conducted in 2012.

Sample size calculation

Sample size was calculated for two proportion hypothesis testing large population equal allocation using the proportion of severe malnutrition 33% as per NFHS in MP at the time of study.

Two proportion – Hypothesis Testing – Large population- Equal Allocation

Proportion in group I	0.33
Proportion in group II	0.44
Estimated risk difference	-0.11
Power (1- beta) %	80
Alpha Error (%)	5
1 or 2 sided	2
Required Sample size in each arm	306

Sample size to show a difference of 11% in one of the risk factors across cases and control was found to be 306 in each group with 80% power and 5% Alpha level. Assuming 10 % drop out the calculated sample size was 339 (rounded to 350). The total number of 350 cases and 350 controls were selected for the study. The total numbers of 700 subjects were in the study.

Matching

In this study we have matched age group under 5 children and same locality in both the groups.

Ethical Approval & consent

Research was initiated after acceptance of the study by the Ethical Review committee of the N.S.C.B. Medical College Jabalpur India for research. Informed written consent was taken from parents of both the group.

Statistical analysis

Information was obtained about risk factors and associated factors in the same manner for both cases and controls. Information is collected by anthropometry measurements & examination of child and by interviewing the groups with the help of predesigned pretested questionnaire. Association of each variable is measured in cases and controls. The Chi- square test is applied for the categorical variables and student t test is used to compare the continuous variables. The level of significance was considered at p value of <0.05. The SPSS -16 (SPSS Inc.,) was used for the study.

Results

The total number of 700 subjects was taken for the study of which 350 were severely malnourished children and 350 were well nourished controls. Table -1 Show that mean age of the cases are 21.46 ± 1.28 months and mean age of controls are 25.93 ± 1.73 months.

Table 1
Age wise distribution of cases and controls

Age Group	Cases		Controls		Crude odds ratio 95% CI	P value
	No.	Percentage	No.	Percentage		
0-1 years	74	21.1 %	100	28.6%	1.9 (1.2-3.0)	0.003
1-2 years	148	42.3%	64	18.3%	6.1 (3.9-9.6)	< 0.0001
2-3 years	81	23.1%	61	17.4%	3.5 (2.2-5.6)	< 0.0001
3-5 years	47	13.5%	125	35.7%	1	
TOTAL	350	100%	350	100%		
Overall mean Age	21.46 ± 1.28 months			25.93± 1.73 months		
Sex wise Distribution						
Male	152	43.4%	194	55.4%	1	0.002
Female	198	56.6%	156	44.6%	1.6 (1.2-2.2)	

It also shows that severe acute malnutrition was significantly higher in 1-2 years of age group. The children who are in the age of one to two years are six times more at risk as compared to 3-5 years of age group. The children who are below one year of age are two times at risk as compared to three to five years of age group. Female child is 1.6 times more risk as compared to the male child in the study subjects.

Table 2
Weight wise distribution of cases and controls (Weight in Kg)

Age Group	Cases		Control	
	Mean weight	SD	Mean weight	SD
0-1 years	4.45	1.13	6.71	1.62
1-2 years	6.36	0.98	8.89	0.84
2-3 years	7.59	0.81	10.60	1.15
3-5 years	9.54	9.30	13.15	1.77
Overall Mean weight	6.69	1.83	10.14	3.04

The table -2 shows that mean weight of the severe malnourished child is 6.69±1.83 kg while it is 10.14 ± 3.04 kg in normal nourished child. The difference in weight increase as the age of the child increases.

Table 3
Height/Length wise distribution of cases and controls (in Centimetre)

Age Group	Cases		Control	
	Mean height/length	SD	Mean height/length	SD
0-1 years	61.67	5.56	63.32	6.98
1-2 years	70.88	4.69	74.73	4.12
2-3 years	77.10	1.009	84.44	4.86
3-5 years	88.28	8.017	94.28	6.19
Overall Mean height/length	72.89	1.076	80.14	1.40

The table- 3 shows that mean height/length of the cases 72.89 ± 1.07 cm while mean height /length of the control is 80.17 ± 1.4 cm. This table shows that height/length of severe malnourished child is much lower as compared to normal nourished child.

Table 4
Distribution of Children according to Environmental & Sanitation practices by family

Environmental & Sanitation Variable		Cases		Controls		Crude Odds ratio 95% CI	P value
		No.	Percent age (%)	No.	Percentage (%)		
Separate kitchen	Present	76	21.7%	165	47.1%	1	<0.0001
	Absent	274	78.3%	185	52.9%	3.2 (2.3-4.4)	
Type of House	Kaccha	331	94.6%	207	59.1%	14.2 (7.4-27.2)	< 0.0001
	Semi pacca	8	2.3%	45	12.9%	1.5	0.35
	Pacca	11	3.1%	98	28.0%	1	
Fuel used for cooking	Dung & Firewood	321	91.7%	187	53.4%	Not Significant	
	Kerosene stove	11	3.2%	4	1.1%		
	L.P.G gas	18	5.1%	159	45.5%		
Source of drinking water	Tape	247	70.6%	255	72.9%	1	
	Well	49	14%	29	8.3%	1.7 (1.0-2.8)	0.02
	River	5	1.4%	0	0%		0.9
	Hand pump	49	14%	66	18.8%		0.2
Waste disposal	Indiscriminate	204	58.2%	223	63.7%	Not Significant	
	Burning	8	2.3%	10	2.9%		
	Dumping	100	28.6%	34	9.7%		
	Composting	21	6%	14	4%		
	Municipality	17	4.9%	69	19.7%		
Overcrowding	Present	255	72.9%	157	44.9%	3.3	< 0.0001

						(2.4-4.5)	
	Absent	95	27.1%	193	55.1%	1	
Cross Ventilation	Present	42	12%	154	44%	1	< 0.0001
	Absent	308	88%	196	56%	5.7 (3.9-8.4)	
Proper lighting at home	Present	71	20.3%	277	64.9%	1	< 0.0001
	Absent	279	79.7%	123	35.1%	7.2 (5.1-10.1)	
Defecation facility	Open field	277	79.1%	129	36.9%	6.5 (4.6-9.1)	< 0.0001
	Sanitary toilet	73	20.9%	221	63.1%	1	

The table-4 shows that if a separate kitchen is not present at house the child is 3.2 times at risk of malnutrition as compared to the house where separate kitchen is present. If child is living in kaccha house he or she has 14.2 times at risk of severe malnutrition as compared to pacca house. There is no significant difference in semipacca house and malnutrition status as compared to pacca house. There is no significant association between fuel used for cooking and malnutrition status. The child who drink well water is 1.7 at risk as compared to normal nourished child (but 95% confidence interval contains one). There is no significant association with other source of drinking water and malnutrition status. Indiscriminate waste disposal is present above fifty percent both in cases and control. The waste disposal practice is unhygienic present in both of the study population. There is no significant association between waste disposal & severe malnutrition status. Overcrowding is a significant risk factor for severe malnutrition. The child who lives in overcrowded house is 3.3 times at more risk of severe malnutrition as compared to normal nourished children. It was found that a child who lives in a house where cross ventilation is not present is 5.7 times at risk of severe malnutrition as compared to the child who lives in a well-ventilated room. It was found in the study that type of toilet facility that members of a household use are strongly related to severe malnutrition. If there is open field defecation is present the child is 6.5 times more risk of severe malnutrition as compared to use of sanitary toilet at home..

Discussion

This case control study was done at Nutritional Rehabilitation centre of N.S.C.B. Medical College for cases and community settings for controls. The total subjects 700 (350 cases & 350 controls) were taken for the study. A detailed evaluation of environmental factors affecting severe acute malnutrition in under five children in comparison to normal nourished children in the community was done. The children who are below one year of age are two times at risk as compared to three to five years of age group in this study. It means that the first two years of life is a critical period in the growth and development of children, but it is clear that nutritional deficiencies generally worsen during this period. A study done by Ray SK at Department of Community Medicine Medical College Kolkata- Severe degree of malnutrition had highest prevalence under two years of age.⁸ A study done by A Mittal et al also found that maximum children who were underweight in the age group of 12-23 months.⁹ Female sex is 1.6 times more at risk as compared to the male sex in our study. The study conducted by S.Malik et al in tertiary hospital

Kolkatta reported that more male child (44.9%) with malnutrition as compared to female child.¹⁰ On the contrary B Banerjee et; al found that female child was observed to be not only suffering more from severe degree of malnutrition and the difference in the prevalence and severity of PEM based on sex had been observed to be statistically higher significant.¹¹ The finding is similar to the finding observed in my study. If we see the sex ratio of our state it is 925 per 1000. It means difference in risk of malnutrition may be due to discrimination of female child regarding food and more nutritious diet is given to male child as compared to female child.

Lack of separate kitchen in the house is 3.2 times more associated with severe malnutrition as compared to the house where separate kitchen is present. The children who are living in kaccha house are 14.2 times at risk of severe malnutrition as compared to the pacca house. Jeyaseelan L et al has done a study at Vellore India found that the risk of malnutrition was 1.2 times higher for children living in thatched roof house as compared to those living in pukka house ($p < 0.05$).¹² This may be due to fact that kaccha house promotes chances of infection and infection may lead to malnutrition. The findings of above mentioned studies are similar with my study. There is no significant association between fuel used for cooking and malnutrition status. The study A sharghi et, al states that there is no significant association between type of fuel (oil) used and malnutrition status. ($p = 0.54$).¹³ children who drink well water are 1.7 at risk as compared to children who drink tape water. There is no significant association with other source of drinking water and malnutrition status. Indiscriminate waste disposal is present above fifty percent both in cases and control. The waste disposal practice is unhygienic present in both of the study population. There is no significant association between waste disposal & severe malnutrition status. The children who live in overcrowded house are 3.3 times at more risk of severe malnutrition as compared to children who live in house where overcrowding is absent. It may be due to infection at the overcrowded place that leads to severe malnutrition. Children living in house where cross ventilation is not present are 5.7 times associated with severe malnutrition as compared to the well ventilated house.

Children who live in a house where natural light is absent are 7.2 times more at risk of severe malnutrition as compared to the house where natural light is present. In the present study type of toilet facility that members of a household use are strongly related to severe malnutrition. If there is open field defecation is present the children are 6.5 times more at risk of severe malnutrition as compared to use of sanitary toilet at home. The relationship between unsanitary latrines in the home and childhood malnutrition has been shown in studies done by El-Sayed et; al in Egypt.¹⁴ This may reflect the effect of poor environmental health, exposing the child to multiple infections. This has the long term effect of growth problems and childhood malnutrition. According to NFHS-3 in India more than half of households (55%) do not have any toilet facility and households use non-improved toilet facilities. Young children in the households without improved toilet facilities are underweight, compared with only 28 percent of children in households without improved toilet facilities are stunted, compared with 34 percent on household with improved toilet facilities.¹⁵ The findings in my study is similar with the finding observed in above mentioned studies.

Conclusion

There was significant association between severe acute malnutrition in under five children with absence of separate kitchen in the family, kaccha house, overcrowding present, cross ventilation absent, natural light absent in the house and open field defecation present in study subjects. Efforts towards correction of these environmental factors will lead to decrease in morbidity and mortality due to severe acute malnutrition in affected population.

Conflict of interest

None

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