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Research Article

Risk factors for severe malnutrition in under five children admitted to nutritional rehabilitation centre: a case-control study from Central India

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ABSTRACT

Background: Protein energy malnutrition is a major public health problem in India with maximum prevalence in central part of country known as Madhya Pradesh (60.3%). It is one of the leading causes of morbidity and mortality in under five children. The objective of the study if the study was to identify the risk factors for severe malnutrition in under five children admitted to Nutritional Rehabilitation Centre as compared to normal nourished children in the community.
Methods: 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, student t test and binary logistic regression were used for data analysis using spss-17.0 software.
Results: In logistic regression age 0-2 years, female sex, low birth weight, rural locality, S.T caste, illiterate paternal education, early marriage of mother, partially or unimmunized children, kaccha house, lack of hygiene, open field defecation, inadequate calorie, infectious diseases ARI, diarrhoea, and fever were significantly associated with severe malnutrition. The overall Prediction of model was R^2 = 92.9%. The mean time gap between first identification of children as malnourished and their admission to N.R.C. is 4.38 months.
Conclusions: There is evidence of strong association between severe malnutrition and some of the risk factors. Long delay in referral and admission of severe malnourished children is a major challenge.

Keywords: ARI, N.R.C., SAM

INTRODUCTION

Protein energy malnutrition is a major public health problem in India and it affects 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. It is associated in 60% of under five deaths in developing world.[1] According to UNICEF India tops South East Asia in child malnutrition. It is estimated that 40% of all under weight babies in the world are Indian. The prevalence of underweight among children in India is amongst the highest in the world, and nearly doubles that of Sub-Saharan Africa. Fifty million Indian under five are affected by malnutrition. The national average is 42 out of 100 children.[2] On an average a child dies every 5 Seconds as a direct or indirect result of malnutrition. The global community has designated halving the prevalence of malnutrition by 2015 as a key indicator of progress towards MDG goals.[3]

According to the 2010 report of the National Rural Health Mission, malnutrition among children is the most prevalent in Madhya Pradesh. The percent of underweight children in M.P has increased from 54 in 1998-99 to 60.3 at present. The percentage of wasted (extremely malnourished) children has according to

NFHS-3given up from 20 to33 despite UNICEF involvement. According to data 29,274 children died in the state during 2008-09.[4]

The integrated child development Services (ICDS) is a major programme to tackle malnutrition and the ill health of mothers and children which followed the adoption of a National Policy for Children.[5] Yet more than thirty years later, its performance remains unsatisfactory. The most important cause of death of malnourished children is delay in referral and admission to Nutritional rehabilitation centre (N.R.C.). The present study was conducted to know the risk factors for severe malnutrition, time gap between identification of malnourished children and their admissions to N.R.C.

METHODS

Study setting

This was a case control study conducted at Nutritional Rehabilitation Centre of N.S.C.B. Medical College Jabalpur India and affected community at rural and urban area from where maximum numbers of cases are reported. Jabalpur is an important city of central India situated 396 meters above the sea level. The total population of Jabalpur district is 2,460,714 according to 2011 census.[6]

Sample size calculation

Sample size was calculated for two proportion-Hypothesis testing large proportion equal allocation using the proportion of severe malnutrion 33% as per NFHS in MP.

Formula:

H_0: $P_1 = P_2$; H_a : $P_1 \neq P_2$

$$n = \frac{\left\{ Z_{1-\frac{\alpha}{2}} \sqrt{2\bar{P}(1-\bar{P})} + Z_{1-\beta} \sqrt{P_1(1-P_1) + P_2(1-P_2)} \right\}^2}{(P_1 - P_2)^2}$$

Where,

$$\bar{p} = \frac{P1+P2}{2}$$

P_1: Proportion in the first group
P_2: Proportion in the second group
α: Significance level
1- β: Power

Two Proportion - Hypothesis Testing - Large Proportion - 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 for 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 was 339 (rounded to 350).

Selection of Cases

The cases were selected according to admission criteria of severe malnourished children in Nutritional Rehabilitation Centre.[7]

Infant less than 6 months or less than 3 kg being breast-fed-

The infant is too weak or feeble to suckle effectively independently of his/her weight for-length (if this is due to acute illness, the acute illness should be treated first) or

The infant is not gaining weight at home (by serial measurement of weight during growth monitoring) or Presence of bilateral oedema.

Children between 6 months & 60 months of age

W/H or W/L < -3Z score (W.H.O standards) And/ or MUAC < 11.5 And/or Presence of bilateral oedema.

Each time 20 malnourished children are admitted for 14 days. The total numbers of 40 children less than 5 years of age are admitted in a month. The total number of admission in ten months will be 400. I have taken 350 severely malnourished children admitted in 10 months duration from 01 Oct 2010 to 30 September 2011.

Selection of controls

The control has normal weight for age (>3 Z score as per the standard W.H.O Growth chart) and not showing signs and symptoms of malnutrition.[8] The controls were selected from the same locality from where the maximum numbers of cases were reported to N.R.C. (Neighbourhood reference population control).[9] The controls are selected from 35 different sites from community to prevent the selection bias.[10] The total numbers of 350 controls are selected for the study. The total numbers of 700 subjects were in the study.

Matching

In this study I have matched age group (under 5 children) and locality. (Same locality) in both of the groups.

Ethics approval & consent

Research was initiated after acceptance of the study by the Ethical Review board of the N.S.C.B. Medical College Jabalpur India for research (68924). Informed written consent was taken from parents of participants. During processing of the data, strict confidentiality was maintained.

Measurement of risk factors

Information about risk factors or associated factors is obtained in precisely the same manner both for cases and controls. Information is collected by interviewing the both the groups with the help of predesigned pretested questionnaire P-51(instrument developed for this study).

Information regarding time gap is obtained from parents of the child only in cases of malnutrition. It is also crosschecked by seeing the growth chart of the child if malnourished child is referred and come with local health worker.

Statistical analysis

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 variables which were significant in univariate analysis were taken in binary logistic regression analysis to calculate the adjusted odds ratio. The level of significance was considered at p value of < 0.05. The SPSS-16 (SPSS Inc.,) software is used for the analysis.

RESULTS

The total no. of 700 subjects was taken for the study, of which 350 were severely malnourished children and 350 were well nourished controls. Mean age of the cases are 21.46± 1.28 months and that of controls are 25.93± 1.73 months. There is significant difference in mean weight, height/length and mid left upper arm circumference of cases and control.

In univariate analysis age ,female sex, lower birth weight, locality, S.T caste, unskilled & unemployed worker, per capita income level below 570rupees/month, illiterate mother & father , marriage age of mother below 18 years, partially or unimmunized children, exclusive breast feeding absent up to six months, age of weaning, inadequate calorie & protein consumption, <3 antenatal visits, <= 50 Iron folic acid tablets taken during pregnancy, kaccha (mud) house, overcrowding present, cross ventilation absent, open field defecation present, poor hygiene, separate kitchen not present, dung & firewood used for cooking, health & dietary education not given and infectious diseases in last three months were found statistically significant but religion(p=0.35), type of family(p=0.39) and waste disposal found insignificant (Table 1).

Table 1: Baseline characteristics and results of univariate analysis of cases and controls.

Characteristics		Cases	Controls	Significance
Age (months)		21.46± 1.28	25.93± 1.73	< 0.0001
Sex	Male	152 (43.4%)	194(55.4%)	P=0.002
	Female	198 (56.6%)	156(44.6%)	
Weight (k.g.)		6.69± 1.83	10.14± 3.04	< 0.0001
Height/length (c.m.)		72.89± 1.07	80.14± 1.4	< 0.0001
MUAC (c.m.)	< 11.5	280(80%)	0 (0%)	< 0.0001
	11.5-12.5	64(18.3%)	14(4%)	
	12.5- 13.5	05(1.4%)	87(24.9%)	
	> 13.5	01(0.3%)	249(71.1%)	
Birth weight (k.g.)	< 2.5	137(39.1%)	27(7.7%)	<0.0001
	≥ 2.5	213(60.9%)	323(92.3%)	
Locality	Urban	71(20.3%)	205(58.6%)	< 0.0001
	Rural	279(79.7%)	145(41.4%)	
Religion	Hindu	343(98%)	342(97.7%)	0.354
	Muslim	07(2%)	06(1.7%)	
	Others	0(0%)	02(0.6%)	
Caste	ST	115(32.9%)	20(5.7%)	< 0.0001
	Others	235(67.1%)	330(94.3%)	
Unemployed/labour		219(62.6%)	113(32.3%)	0.024
Others		131(37.4%)	237(67.7%)	
Per capita Income (Rupees)	≥ 570	82(23.4%)	186(53.1%)	0.005
	<570	268(76.6%)	164(46.9%)	

Type of Family	Nuclear	214(61.1%)	203(58%)	0.39
	Joint	136(38.9%)	147(42%)	
Maternal Education	Illiterate	163(46.6%)	59(16.9%)	<0.0001
	Others	187(53.4%)	291(83.1)	
Paternal Education	Illiterate	106(30.2%)	24(6.9%)	<0.0001
	Others	244(69.8%)	326(93.1%)	
Age of mother At marriage	< 18 yrs	286(81.7%)	150(42.9%)	<0.0001
	≥ 18 yrs	64(18.3%)	200(57.1%)	
Fully immunized (as per age)		239(68.3%)	318(90.9%)	<0.0001
Partially/unimmunized (as per age)		111(31.7%)	32(9.1%)	
Exclusive breast Feeding *	Present	64(19.2%)	105(34.7%)	<0.0001
	Absent	269(80.8%)	198(65.3%)	
Mean age of weaning (months)		7.9± 3.5	6.5± 2.7	< 0.0001
Calorie consumption**	Adequate	75(21.4%)	181(51.7%)	<0.0001
	Inadequate	275(78.6%)	169(48.3%)	
Protein Consumption**	Adequate	170(48.6%)	280(80%)	< 0.0001
	Inadequate	180(51.4%)	70(20%)	
Antenatal Visits	<3	187(53.4%)	72(20.6%)	<0.0001
	≥ 3	163(46.6%)	278(79.4%)	
Total no. of Fe/folic Acid taken by mother	≤50	220(62.9%)	128(36.6%)	<0.0001
	> 50	130(37.1%)	222(63.4%)	
Type of House	Kaccha	331(94.6%)	207(59.1%)	<0.0001
	Semipacca/Pacca	19(5.4%)	143(40.9%)	
Overcrowding	Present	255(72.9%)	157(44.9%)	<0.0001
	Absent	95(27.1%)	193(55.1%)	
Cross ventilation	Present	42(12%)	154(44%)	<0.0001
	Absent	308(88%)	196(56%)	
Defecation Facility	Open field	277(79.1%)	129(36.9%)	<0.0001
	Sanitary toilet	73(20.9%)	221(63.1%)	
Kitchen	Separate	76(21.7%)	165(47.1%)	<0.0001
	Not seperate	274(78.3%)	185(52.9%)	
Waste Disposal	Indiscriminate	231(66.1%)	223(63.7)	0.24
	Others	119(33.9%)	127(36.3%)	
Fuel used For cooking	dung & firewood	321(91.7%)	187(53.4%)	< 0.0001
	others	29(8.3%)	163(46.6%)	
Hygiene of Child	Poor	151(43.1%)	15(4.2%)	<0.0001
	Fair/good	199(56.9%)	335(95.8%)	
Health Education	Given	248(70.9%)	332(94.9%)	<0.0001
	Not Given	102(29.1%)	18(5.1%)	
Dietary Education	Given	250(71.4%)	330(94.3%)	<0.0001
	Not Given	100(28.6%)	20(5.7%)	

*Exclusive breast feeding up to six of age (study subjects below 6 months are excluded).
** Inadequate calorie/Protein means less than 80% of dietary requirement for that age.

In binary logistic regression analysis age is important factor associated with severe malnutrition with negative B value. It means the risk of severe malnutrition is more in lower age group (0-2 years) as compared to higher age group (3-5 years) age group. Female sex is 6.6 times more at risk as compared to male sex (95% CI 3.0-14.4, p< 0.0001). Children who have birth weight less than 2.5 kg is 11 (95% C.I 3.8-32.4, p< 0.0001)) times at risk of malnutrition as compared to children who have normal birth weight (>=2.5 k.g.). The children who live in rural area are 5.5 times at risk of severe malnutrition (95% C.I 2.1-14.3, p< 0.0001) as compared to the children who live in urban area. ST (Schedule tribe) caste children are 3.4 times at risk of severe malnutrition as compared to other caste (95% CI 1.1-10.4, p=0.02), Paternal education is important factor associated with severe malnutrition. If father is illiterate the children are four times (95% CI 1.3-12.4, p< 0.01) at risk as compared to the educated father. Children who are partially immunized or unimmunized as

per age are nine times more at risk (95% CI 3-27.2, p <0.0001) as compared to completely immunized children. Mother age at marriage is less than eighteen years a children are 2.7 times (95% CI 1.2-6.0, p<0.01) at risk of severe malnutrition as compared to normal nourished child. Inadequate calorie intake below 80% of requirement for age is 3.6 times (95% CI 1.4-9.3, p< 0.008) more associated with the cases as compared to control. Children whose mother has taken less than fifty iron folic acid tablets are 3.2 times at risk as compared to more than fifty tablets during pregnancy (95% CI 1.5-6.8,p=0.002). Children who live in kaccha house are 7.5 times (95% CI 2.5-22.1, P< 0.0001) at risk of severe malnutrition as compared to children who live in semi pacca and pacca house. Poor hygiene 7.3 times more associated with severe malnutrition as compared to normal nourished children(95%CI 2.7-19.7,p<0.0001). If type of toilet facility utilized is open field defecation by household members the children are 2.4 times at risk as compared to the use of sanitary toilet (95% CI 0.97-6.1, p< 0.05). Infection of ARI predisposes 1.13 times (95% CI 1.05-1.22, p< 0.0001), fever predisposes 1.2 times (95% CI 1.1-1.2, p< 0.0001) and diarrhoea predispose 1.04 times (95% CI 1.0-1.08, p=0.04) the risk of severe malnutrition. There is no significant relationship of severe malnutrition with paternal occupation, per capita income, maternal education, exclusive breast up to six months, age of weaning, inadequate protein, antenatal visits, overcrowding, cross ventilation absent, separate kitchen absent, fuel used for cooking, health & dietary education given (Table-2).

Time gap b/w first identification of child & their admission to N.R.C

Average time gap b/w first identification of child as malnourished and their admission to

N.R.C	=	4.38 months
Std. deviation	=	4.4
Maximum time gap	=	2 years
Minimum time gap	=	1 week

Table 2: Results of the binary logistic regression analysis of risk factors associated with severe malnutrition – (R^2= 92.9%).

Variable	Wald test	P value	Adjusted odds ratio Exp (B)	95%CI
Age	8.0	0.005	0.96 (-B)	0.93-0.98
Sex (female)	22.55	< 0.0001	6.6	3.0-14.4
Birth weight (< 2.5 k.g.)	19.7	< 0.0001	11.18	3.8-32.4
Locality (rural)	12.4	< 0.0001	5.5	2.1-14.3
Caste (S.T)	4.9	0.02	3.4	1.1-10.4
Occupation (unemployed and labour)	0.01	0.91	0.95	0.39-2.2
Per capita income	1.3	0.23	0.99	0.99-1.0
Maternal education (illiterate)	0.6	0.43	0.7	0.2-1.7
Paternal education (illiterate)	5.9	0.01	4.0	1.3-12.4
Age of mother at marriage (< 18 years)	6.1	0.01	2.7	1.2-6.0
Immunization status(Partially or unimmunized)	15.3	< 0.0001	9.0	3.0-27.2
Exclusive breast feeding (Absent)	0.83	0.36	1.5	0.62-3.5
Age at which complementary feeding started	1.4	0.22	1.08	0.95-1.2
Inadequate calorie	7.1	0.008	3.6	1.4-9.3
Inadequate protein	1.8	0.17	1.7	0.77-4.0
Antenatal visit (<3)	0.28	0.59	1.2	0.52-3.0
Iron folic acid (< 50 tablets)	9.5	0.002	3.2	1.5-6.8
House (kacha)	13.7	< 0.0001	7.5	2.5-22.1
Overcrowding	0.013	0.91	0.95	0.41-2.2
Cross ventilation (absent)	1.7	0.18	1.9	0.72-5.3
Open field defecation facility	3.6	0.05	2.4	0.97-6.1
Kitchen (not separate)	0	0.99	0.99	0.43-2.3
Fuel used for cooking (dung & firewood)	0.54	0.46	0.63	0.18-2.1
Hygiene (poor)	15.3	< 0.0001	7.3	2.7-19.7
Health education (Not given)	0.08	0.77	0.64	0.03-12.9
Dietary education (Not given)	0.05	0.80	1.4	0.08-24.5
A.R.I (days)	12.11	< 0.0001	1.13	1.05-1.22
Diarrhoea (days)	3.8	0.04	1.04	1.0-1.08
Fever (days)	25.8	< 0.0001	1.2	1.11-1.28

DISCUSSION

This was a case control study done at Jabalpur district of M.P Central India to focus on risk factors for severe malnutrition. 700 study subjects (350 cases & 350 controls) were taken for the study.

In this study age is an important factor showing that the risk of severe malnutrition is more in lower age group because first two years of life is a critical period in growth and development but nutritional deficiency generally worsen during this period, similar results were with Ray Sk et al and NFHS-3 (National Family Health Survey) report.[11,12] Female is more at risk as compared to male. Similar finding observed by Banerjee et al but differs with other studies.[13,14] This difference may be due to discrimination of female child regarding nutritious diet and more attention is given to growth of male child in studied community. Early marriage age, less consumption of iron folic acid tablets taken during pregnancy, low birth weight are risk factors for severe malnutrition. It is due to fact that in early marriage mother is not physically fit for pregnancy and if proper nutrition and iron tablets are not taken properly by mother it affects the birth weight of child and increases chances of severe malnutrition.

The child who live in rural area were more at risk of severe malnutrition, similar findings were observed by Sachdeve et al[15] & NHFS-3 report.[16] Schedule tribe caste is more at risk of severe malnutrition as compared to other caste. This may be due to the fact that children living in rural area and disadvantage group did not assess the health services. If father is illiterate the child is more at risk of severe malnutrition it may be due to fact that all the decisions in the family are taken by father in patriarchal society including admission of child to N.R.C. Although maternal education was important factor in univariate analysis but it was not found significant in multivariate analysis. Children who are partially immunized or unimmunized as per age are more at risk of severe malnutrition similar finding is observed in study M owor et al in Kampala Africa.[17] Children who are consuming calories below 80% of recommended dietary allowances are more at risk of severe malnutrition as compared to normal nourished children. Kaccha house, poor hygiene and open field defecation increases the chance of infection and infection predisposes severe malnutrition. Malnutrion is associated with episodes of ARI, diarrhoea, fever and predisposes the chances of severe malnutrition it means a vicious cycle is started; similar findings were observed by D Nandan et al.[18]

The mean time gap between first identification of children as malnourished and their admission to N.R.C. is 4.38 months. The delay in admission of the child after identification is the most important cause of increase in morbidity and mortality due to severe malnutrition. There is no previous study regarding time gap between identification and admission of severe malnourished child to Nutritional Rehabilitation Centre. A study done by D Nandan et al at Agra-social Audit for Community Action found that in the children of 1-11 months of age 67.8 % and children 1-5 years of age group 55.9 % of the cases delay in the recognition of seriousness of problem is the social cause of death.[18]A world bank report on India's undernourished children a call for reform and action by Michele Granolati et; al states that ICDS Programme got failure to effectively reach under three children of poorer household and lower caste. In addition ICDS faces substantial operational challenges and suffers from a lack of high level of commitment.[19]

There is urgent need to focus our attention to risk factors & causes of delay in admission in N.R.C so that morbidity and mortality due to severe malnutrition can be prevented.

CONCLUSION

There is evidence of strong association between severe malnutrition and some of the risk factors. Long delay in referral and admission of severe malnourished children is a major challenge.

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