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Original Research Article

A STUDY TO ASSESS THE RISK FACTORS AND BIOCHEMICAL PROFILE OF UNDERNOURISHED CHILDREN AGED 6- 59 MONTHS IN A TERTIARY CARE CENTRE

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Abstract

Background: Risk factors for undernourishment are vary with time and place. Similarly, the biochemical profile was altered with respect to nourishment status. Hence, this study was conducted to evaluate the risk factors and biochemical profile of undernourishment in children under the age of five. **Materials and Methods:** We conducted a case control study between June 2023 and September 2023 among undernourished and normal (healthy) children in the Department of Paediatrics at Kanyakumari Government Medical College and Hospital, Kanyakumari. Children aged 6-59 months, who attended the Department of paediatrics, either as outpatients or inpatients were included in the study. In total 300 children which includes 150 cases (malnourished children) and 150 controls (healthy children) were included. Both cases and controls were matched for age and gender. Using a systematic proforma, demographic, clinical, and data of biochemical parameters were collected. Statistical Package for Social Sciences was used to conduct the statistical analysis. **Result:** Of the malnourished cases in this study, severe and moderate acute malnutrition, as well as chronic malnutrition, accounted for 28%, 40.7%, and 31.3% of cases, respectively. Low birth weight, premature delivery, and improper weaning schedule were identified as risk factors associated with undernourishment. The biochemical indicators that undernourished children had considerably lower levels of haemoglobin, packed cell volume, total protein and serum albumin. **Conclusion:** For all cases of undernourishment, the risk factor profile should be evaluated critically.

INTRODUCTION

In many nations around the world, malnutrition, particularly undernutrition, affects children under the age of five at a significantly high rate and poses a serious threat to their development.[1] The World Health Organization (WHO) estimates that 45 million children worldwide were wasted (too thin for height), 38.9 million were overweight, and 149 million children under five years old were stunted in 2020. The study also showed that undernutrition, which is prevalent in low- and middle-income nations, accounts for almost 45% of fatalities among children under the age of five.[2] In poorer nations, undernutrition remains the main factor contributing to poor health, early mortality, and morbidity in children.[3]

In India, childhood malnutrition is a serious public health issue as well.[4] According to an analysis of data from the fifth National Family Health Survey (NFHS-5), the prevalence of stunting, wasted, severely wasted, underweight, and overweight among children under five is 35.5%, 19.3%, 7.7%, and 32.1%, respectively.[5] The nutritional status of children is impacted by a number of factors, either directly or indirectly. Maternal low body mass index (BMI) (<18.5 kg/m2), maternal anemia (hemoglobin

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<12 g/dL), maternal birth size, maternal education,[6] maternal nutrition were the primary determinants of anthropometric failures (stunting, wasting, and underweight) among the children are the child's birth order and birth weight,[6,7] mother age, residence,[8] antenatal care (ANC), child's sex and size at birth, toilet facility,[9] stool disposal system,[10] short period of breastfeeding and household income level.[10,11] Notwithstanding significant advancements, obstacles still exist in tackling the issue of undernourishment,[12] especially for children of school age.[13] Children of school age have extremely important nutritional needs since these set the stage for their long-term physical and mental well-being. This is a critical time to assess their long-term financial, mental, and physical health,[14] as well as any potential major health issues.[15] These factors may function independently or in concert.

Given the complexity of childhood malnutrition, the mother's nutritional condition is the primary contributing factor. Maternal education increases contribute to a decrease in childhood malnutrition cases. Compared to other mothers, children of illiterate mothers had a higher chance of malnutrition.[16] It's been said that girls are more prone than boys to malnutrition. Boys were observed to be fed earlier and to continue drinking their mothers' milk than females, which therefore resulted in health problems.[17] Malnutrition is more common in children born in higher birth orders than in those born in lower birth orders. Severe incidences of malnutrition were shown to harm children of higher rank. Mothers who have a large number of children have been reported to find it difficult to care for and feed them. Reduced time between pregnancies prevents the mother from fully recovering her health, which worsens the condition of both the mother and her offspring.[18] Therefore, in order to guarantee that policies are created to address nutrition issues among the most vulnerable segments of society, it is vital to comprehend these differences.

Various methodologies have been used in the literature to define malnutrition in India. While some research focused on the clustering of sibling malnutrition, others used mother-child dyads.[19] The intra-household burden of malnutrition based on two or more individuals suffering from under or over nutrition has been the subject of other investigations.[20] Few studies, nevertheless, have fully captured the disparate aspects of childhood malnutrition in India at the population level14,17. In light of these, the purpose of this study was to evaluate the biochemical profile and risk factors of undernourishment in children under the age of five.

MATERIALS AND METHODS

We conducted a case control study between June 2023 and September 2023 among the undernourished and normal (healthy) children in the department of Pediatrics at Kanyakumari Government Medical College and Hospital, Kanyakumari. Children aged 6-59 months, who attended the department of Pediatrics, either as outpatient or inpatient were included in the study. Undernourished children (cases) were included who were below -3 SD (severe acute malnutrition) and -2 SD to -3SD (moderate acute malnutrition). However, children who were healthy and having appropriate weight for height were included as controls. In total 300 children which includes 150 cases (malnourished children) and 150 controls (healthy children) were included. This study protocol was reviewed and approved by Institutional Ethical Committee (Approval No. S-029/IEC/2022). Written informed consent was obtained from either of the parent of children, who participated in this study. Both cases and controls were matched for age and gender. Using a systematic proforma, demographic, clinical, and data of biochemical parameters were collected. Biochemical parameters including CBC, RFT, LFT, Serum electrolytes, TFT, serum calcium, Total protein, sr. albumin and globulin were studied. The Statistical Package for Social Sciences was used to conduct the statistical analysis. Data were shown using the applicable mean or percentage. As necessary, odds ratio, chi-square test and Independent sample t test were utilized.

RESULTS

In this study undernourished children in the age range of ≤ 20 months, 21 to 30 months, 31 to 40 months, 41 to 50 months and 51-60 months were noted to be 18%, 22.7%, 16.7%, 22% and 20.7% respectively. Based on sex distribution 52.7% of the undernourished children were males and 47.3% of the undernourished children were females [Table 1].

On assessing the weight 9.3% of the children were normal, 20.7% of the children were found to be underweight while 70% of the children in the study was severely underweight. Height was recorded to be normal among 34.7% of the cases, 21.3% of the children were stunted whereas 44% of the children had severe stunting. In accordance with weight /height chronic malnutrition was noted among 28% of the study participants, 40.7% of the children had SAM while 31.3% of the children had MAM [Table 2].

In this current study among preterm babies 15.3% were undernourished while 4% of the babies were normal, whereas among term babies 84.7% were undernourished and 96% of the babies are normal. The risk of undernourished babies was 4.3 times higher among preterm birth. The association between pregnancy outcome and the babies nutritional status was highly significant (p value =0.0019). Among LBW babies 26% were undernourished and 10% of the children were

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normal however among normal weight babies 74% of the kids were undernourished and 90% of the kids were normal. The odds ratio was recorded as 3.2, which shows 3.2 times higher risk of undernourishment among LBW babies, with significant association (p value = 0.0005).

Among Exclusive Breast-fed babies 60% were undernourished while 82.7% were normal while among non-Exclusively Breast-fed babies, 40% babies were undernourished and 17.3% of the children were normal. This shows Exclusive breast feeding is a protective factor and it reduced the risk of undernourishment to 0.3 times. There was statistically significant association noted for EBF and Undernourishment (p value < 0.0001). Similarly appropriate weaning was found to be protective against undernutrition in our study with p value of <0.0001 and 0.0153 respectively. There was no significant statistical association noted for immunization status vitamin A supplement, mother's knowledge, mother's education, income pattern, separated parents and alcoholics in the family with undernourished children respectively [Table 3].

On assessing the difference in various biochemical parameters for undernourishment among the study children, Hemoglobin, packed cell volume, total protein and serum albumin were found to be significantly high among healthy children compared to undernourished children. However various other biochemical parameters were found to be insignificant when compared with undernourished and normal children (p value >0.05) [Table 4].

Table 1: Age and sex distribution of the study participants

Age group	**Undernourished**	**Normal**
≤ 20 months	27 (18)	27 (18)
21 to 30 months	34 (22.7)	34 (22.7)
31 to 40 months	25 (16.7)	25 (16.7)
41 to 50 months	33 (22)	33 (22)
51-60 months	31 (20.7)	31 (20.7)
Sex	**Undernourished**	**Normal**
Male	79 (52.7)	79 (52.7)
Female	71 (47.3)	71 (47.3)

Table 2: Proportion of children based on Anthropometric parameters

Interpretation of weight	**Frequency**	**Percentage**
Normal	14	9.3
Underweight	31	20.7
Severe underweight	105	70.0
Interpretation of height	**Frequency**	**Percentage**
Normal	52	34.7
Stunting	32	21.3
Severe stunting	66	44.0
Interpretation of weight/ height (W/H)	**Frequency**	**Percentage**
Chronic malnutrition	42	28.0
SAM	61	40.7
MAM	47	31.3

Table 3: Association between undernourished children with various factors

Variables	**Undernourished**	**Normal**	**Odds ratio**	**95% CI**	**p value**
Term/Preterm					
Preterm	23 (15.3)	6 (4.0)	4.3	1.7-11.0	0.0019*
Term	127 (84.7)	144 (96.0)			
Birth weight					
LBW	39 (26)	15 (10.0)	3.2	1.6-6.0	0.0005*
Normal	111 (74)	135 (90.0)			
Birth order					
One	60 (40)	74 (49.3)	0.7	0.4-1.1	0.1045
More than one	90 (60)	76 (50.7)			
Exclusive Breast feeding					
Yes	90 (60)	124 (82.7)	0.3	0.1-0.5	<0.0001*
No	60 (40)	26 (17.3)			
Weaning					
Started inappropriately	105 (70)	67 (44.7)	2.8	1.7-4.6	<0.0001*
Started appropriately	45 (30)	83 (55.3)			
Immunization					
Fully immunized	125 (83.3)	130 (86.7)	0.6	0.2-1.4	0.6153
Partially immunized	25 (16.7)	20 (11.3)			
Vitamin A supplement					
Given	98 (65.3)	112 (74.7)	0.6	0.3-1.1	0.0787
Not given	52 (34.7)	38 (25.3)			
Mother's education					
School	88 (58.7)	93 (62)	0.9	0.5-1.4	0.5552
Graduates	62 (41.3)	57 (38)			

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Mother's knowledge					
Adequate	96 (64)	95 (63.3)	1	0.6-1.6	0.9045
Inadequate	54 (36)	55 (36.7)			
Income pattern					
Daily	108 (72)	110 (73.3)	0.9	0.6-1.6	0.7956
Monthly	42 (28)	40 (26.7)			
Separated parents					
Yes	44 (29.3)	35 (23.3)	1.4	0.8-2.3	0.2389
No	106 (70.7)	115 (76.7)			
Alcoholics in the family					
Yes	77 (51.3)	83 (55.3)	0.9	0.5-1.3	0.4876
No	73 (48.7)	67 (44.7)			

*Significant

Table 4: Biochemical parameters vs undernourishment among study participants

Parameters	Undernourished	Normal	p value
Hemoglobin (Hb)	10.3±1.5	11.5±0.8	<0.0001*
Total counts (TC)	9307±3969	8752±2955	0.1706
Packed cell volume (PCV)	33.1±4.0	38.1±2.4	<0.0001*
Platelets (PLT)	3.5±1.2	3.4±1.5	0.5242
Total Bilirubin	0.5±0.3	0.5±0.2	0.9432
Direct bilirubin	02.±0.1	02.±0.1	0.9746
Indirect bilirubin	0.3±0.2	0.3±0.1	0.8942
SGOT	37.8±16.6	32.5±20.6	0.4341
SGPT	35.6±29.2	32.3±21.4	0.3426
Total protein	6.0±0.7	6.9±0.4	<0.0001*
Sr. Albumin	2.8±0.7	3.0±0.6	0.0083*
Sr. Globulin	3.2±0.6	3.1±0.7	0.1851
Alkaline phosphatase	227.8±104.5	202.5±87.5	0.634
Urea	17.6±4.3	15.3±2.6	0.7303
C- reactive protein	0.6±0.1	0.5±0.07	0.7015

*Significant

DISCUSSION

In south India, the incidence and risk factors for malnutrition in school-age children were evaluated by Jayaseelan V et al.[21] The incidence of severe underweight and stunting varied significantly between male and female children (6.4% and 4.2%, respectively). Compared to households with a kitchen, children living without a separate kitchen were 1.3 times more likely to be seriously underweight. Compared to their counterparts who had access to toilets, children without such facilities were much more likely to be severely underweight. Compared to children of literate parents, children of illiterate parents were more likely to suffer from severe stunting. In summary, the rate of severe malnutrition was high in children who were in their pubertal years, and the rate of malnutrition among these children from South India has remained constant throughout time. The majority of the risk factors for stunting and underweight were connected to poverty and poor cleanliness, respectively. Teenagers in southern India should have regular malnutrition screenings at school and, if required, get nutritional support. In West Bengal, Sarkar S et al,[22] looked at the prevalence and risk factors of child malnutrition in children under five. The most common type of malnutrition among children under five, according to their survey, is stunting (51%) followed by underweight status (41%), and wasting (22%). Gender discrimination in children rises with age, with females experiencing greater deprivation than boys in later childhood compared to earlier years. Additionally, they showed that the child's birth order, age, caste, and religion were all highly significant indicators of their nutritional status.

In order to determine the risk factors for childhood malnutrition, Wong HJ et al,[23] identified the traits of malnourished children under the age of five. They stated that a total of 274 kids were enlisted, comprising 137 cases and 137 controls. Every respondent was Malay. A greater number of the cases were female and were from low-income households. Childhood malnutrition was substantially correlated with low birth weight, frequent illness, history of worm infection, number of children, hunger in children, dietary energy consumption, protein intake, and vitamin A intake after controlling for all other variables. They came to the conclusion that inadequate child care practises, food insecurity in the home, and a lower socioeconomic position were all linked to childhood malnutrition. According to Katoch OR et al,[24] the most reliable indicators of child malnutrition were mother education, household income, nutritional status, age of the child, availability of a sanitary facility at home, family size, child's birth weight, and birth order in the family. Child malnutrition is also caused by breastfeeding and other caring behaviours, the type of cooking area and fuel used, sex, and the children's social standing.

In another study, the prevalence of malnutrition was evaluated, and related risk variables were investigated, by Sharma A et al,[25] 54%, 84%, and 63% of youngsters were found to be stunted, underweight, and wasted, according to the study.

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Three main characteristics were found to have a substantial impact on underweight, wasting, and stunting: birth weight, exclusive breastfeeding (EBF), and family poverty. A noteworthy link was discovered between stunting, underweight, and wasting. In addition, Nair ABS et al,[26] identified some of the risk factors for undernutrition in an area where mother and child health outcomes are excellent. Undernutrition was linked to feeding diluted milk, having more than two children with a birth gap of less than two years, and being sick during the previous month. There was no correlation found between the absence of exclusive breastfeeding, the caregiver's educational attainment, and environmental factors such as water availability. Among this population, some notable contributing factors were consumption of diluted milk, short birth intervals, and childhood illnesses. According to Chopra H et al,[27] the most common and urgent causes of triple burden of malnutrition (TBM) are diseases and insufficient nutritional intake (undernutrition, overnutrition, and micronutrient insufficiency). A healthy lifestyle, nutritional habits, contaminated water, food insecurity, a lack of basic sanitation and hygiene, unhygienic feeding and caring practises, inadequate health infrastructure, and a lacklustre execution of government nutrition programmes are some of the other important variables linked to the TBM. There is scientific proof that TBM is expensive for any society and has long-term effects on children's physical and mental development.

In order to compare intestinal parasite infections (IPI) with other socioeconomic determinants and nutritional status, Deka S. et al,[28] evaluated the prevalence and profile of IPI in children under five. Overall, there were 52%, 31.7%, 12.2%, and 4.1% of cases of Grade I, II, III, and IV malnutrition, whereas there were 60.2% and 36.6% of cases of stunting and wasting IPIs, respectively. 47.2% of the samples had IPIs, while 11.4% had polyparasitism. The most prevalent pathogens were discovered to be soil-transmitted helminths, followed by intestinal protozoa. Tiwari M. et al,[29] assessed the total rate of malnutrition in school-age children in Varanasi's urban and rural areas and examined the socioeconomic variables that were linked to it. In both research locations, undernutrition, or stunting, is prevalent (20.8%). According to a body mass index analysis, in rural schools, 15.77% of students were thin, 6.25% were severely thin, and just 2.38% were overweight; in urban schools, the percentages were 14.24% thin, 7.8% severely thin, and 11.9% overweight. Strong correlation between nutritional condition and the type of home, mother's education, father's education, and mother's education were reported. The triple burden of malnutrition—overweight, stunting, and anemia—was studied by Singh SK et al,[30] in children between the ages of 6 and 59 months. According to their research, 66% of children were anaemic, 4% were overweight, and 34% of children were stunted. The frequency of anaemia and stunting was higher in the central and eastern regions, whereas the prevalence of overweight was higher in the northern and northeastern regions. The triple burden of malnutrition in children is supported, at the macro level, by the cohabitation of stunting, overweight, and anaemia with significant regional variation. They found that factors related to children, mothers, and households significantly influence the prevalence of malnutrition in India.

In consistent with this study the biochemical profile of malnourished children in study conducted by Saroj et al,[31] is reported. They intended to measure the amounts of serum albumin and total protein in kids with PEM and healthy controls. When the average serum levels of total protein and albumin were measured in the case and control groups, the case group's levels were lower than the control group's. Statistical analysis revealed that this decrease in difference was statistically significant. Upon calculation of the albumin/globulin ratio in both groups, the case group's value was found to be substantially lower than that of the control group. In comparison with healthy controls, PEM children have lower serum levels of albumin and total protein, which is likely because they consume less proteins and have less biosynthesis going on. PEM children had lower haemoglobin levels than healthy controls; this is most likely because these children frequently have malnutrition-related deficiencies in iron and other micronutrients. Regardless of age, sex, socioeconomic class, or place of residence, S Ashraf et al,[32] found that serum levels of total proteins and globulins were considerably or comparatively lower in malnourished children when compared to the children in the control group. In these groups, the albumin results varied. Male malnourished children had considerably lower serum total proteins and globulins than male children in the control group, but there was no significant difference in these parameters among female children. They came to the conclusion that children experiencing illness malnutrition have lower serum levels of total proteins and globulins.

Children with PEM and the controls had their serum protein and albumin levels measured by Abdullahi SM et al.[33] In this study, 46.9% of the individuals had low blood protein levels (<60g/l), with severe wasting showing the greatest frequency of 33.3%. For the control group, the prevalence of low serum proteins was 1.5%. In this study, it was revealed that the frequency of low serum albumin levels (< 25 g/l) among the cases was 24.2%, with severe stunting accounting for 15.2% of the cases. Meanwhile, the controls had low serum albumin levels of 3.0%. Low serum levels of protein and albumin were found in undernourished children in Zaria, according to this study.

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CONCLUSION

We infer that in this study among the cases with malnutrition, 28%, 40.7% and 31.3% of cases had chronic malnutrition, severe and moderate acute malnutrition. Preterm delivery, low birth weight and inappropriate starting of weaning were the risk factors found to be associated with undernourishment. Haemoglobin and Albumin were the two biochemical parameters which were significantly low among undernourished children. Thus the risk factors profile to be assessed cautiously and complete blood count and serum albumin can be done in routine for all cases with undernourishment.

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