ORIGINAL ARTICLE

Nutritional Assessment by Anthropometric Methods under five-year-old Children Attending the Pediatric Outpatient Clinic at Al-Zahraa University Hospital

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Abstract

Introduction: ***Nutrition in early childhood is crucial for physical, cognitive, and emotional growth, where its deficits lead to irreversible consequences like stunting, wasting, and heightened infection risk.***

Aim: ***To identify the nutritional status of children under five years through anthropometric measurements and their possible associated factors.***

Patients and Methods: ***An analytical cross-sectional study was conducted among 350 children of both genders, aged 6 months to 5 years, from the pediatric outpatient clinic of Al-Zahraa University Hospital using a systematic random sample. Anthropometric measurements, including weight, height, mid-upper arm circumference (MUAC), and skinfold thickness, were taken according to WHO guidelines. A structured questionnaire was designed to collect data about socio-demographics, Complaints of children, diagnosis, mode of delivery, and birth weight by interviewing caregivers or mothers. Nutritional status was classified using the WHO growth standards.***

Results: ***Revealed that 56.3% of the children were male, and 98% resided in urban areas with a mean age of 23.4 ± 17.02 months. The common diagnoses were respiratory diseases (64.3%) and gastroenteritis (27.7%). Anthropometric measurements showed that 42.9%, 25.1%, 32.3%, and 12% had malnutrition according to weight for age z score, height for age z score, weight for height z score, and UMAC, respectively. The logistic regression displayed the predictors of malnutrition, encompassing female gender, chronic illnesses, working mothers, and normal deliveries, with a statistically significant p-value ≤ 0.05 and families with high income levels without a significant p-value > 0.05.***

Conclusion: ***The study highlights a significant proportion of children under five with malnutrition, particularly those with chronic illnesses. Targeted nutritional interventions, community education, early detection and treatment, and socio-economic support are essential to address these disparities and mitigate the long-term impacts of malnutrition on child health.***

Keywords: Malnutrition; Anthropometry; Children under five; Nutritional assessment; Chronic illness; Growth deficits

1. Introduction

Nutrition during the first five years of life is a cornerstone for physical, cognitive, and emotional development. This critical period is marked by rapid growth and vulnerability, where nutritional deficits can have irreversible consequences, such as stunting, wasting, and increased susceptibility to infections .[1]

Undernutrition is particularly detrimental during the first 1,000 days of life, from conception to two years of age, as it can result in irreversible physical and intellectual deficits.[2]

Malnutrition encompasses undernutrition, micronutrient deficiencies, and overnutrition (childhood obesity), each of which poses unique challenges to child health, recent global estimates revealed that 22.3% of children under five are stunted, 6.7% are wasted, 5.7% are overweight, these burdens are predominantly observed in low- and middle-income countries, where socio-economic disparities exacerbate nutritional inequalities .[3]

Malnutrition often exists within a vicious cycle of poverty, disease, and inadequate dietary intake. This cycle can be disrupted through targeted interventions that improve health, nutrition, and socio-economic conditions .[4]

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Screening for malnutrition involves comprehensive nutritional assessments, which collect data on anthropometric measurements, dietary intake, clinical history, feeding practices, and biochemical markers.[5]

Anthropometric indicators such as weight-for-age, height-for-age, weight-for-height, and mid-upper arm circumference (MUAC) are widely used to assess the nutritional status of children under five years. These tools are crucial for identifying malnutrition in community settings and guiding intervention strategies.[6]

Child malnutrition is multifactorial, tied to socio-economic status, food quality, rural challenges like poverty and environmental issues, and the widespread impact of infectious diseases and micronutrient deficiencies influenced by social, economic, and geographic factors.[7] It was reported that the site of delivery, parents' education, mothers' age in the first pregnancy, number of all children per household, a child's weight at birth, age of the child at weaning, and history of diseases were associated with the nutritional status of children under 5 years of age .[8-10]

Assessment the nutritional status of young children is crucial to define those who are susceptible to malnutrition and provide timely interventions to be controlled and reduce the lifelong consequences, therefore this study was planned to determine the nutritional status by anthropometric measures and identify the possible associated factors among children under five years who attend the outpatient pediatric clinic at AL-Zahraa University Hospital (University Hospital of Faculty of Medicine for girls, Al-Azhar University, Cairo Egypt).

2. Patients and methods

Study Design and Setting

The current study was an analytical cross-sectional study conducted among children (6 months to under 5 years) who attended the pediatric outpatient clinic at AL-Zahraa University Hospital (University Hospital of Faculty of Medicine for Girls, Al-Azhar University, Cairo, Egypt) for 6 months from November 2023 to May 2024.

Study Population

This study recruited children who fulfilled the eligibility criteria including those aged from 6 months to 5 years, male and female sexes, and those whose parents or caregivers accepted to participate in the study, while children aged more than 5 years old or less than 6 months and their parents or caregivers refused to participate were excluded.

Sample Size and Sampling Methods

The sample size was calculated using the World Health Organization tool of Sample size determination in health studies, Lwanga & Lemeshow[7] in the single population proportion formula by considering 24.7% of the under-five children suffer from malnutrition based on previous Egyptian study, Hagag et al.,[8] by using 95% confidence interval, a marginal of error (d) of 5%. The calculated sample size was 286. To compensate for a possible non-response, 20% of the calculated sample was added; the total sample size was 350 participants. A systematic random sample was used based on the attendance serial number assigned to them. The interval size was determined according to the daily flow of the pediatric outpatient clinic, with a randomly selected starting point. We used a sampling frame of the clinic during the previous month to estimate the average daily flow. The total number of children under study attending the outpatient department per week was taken from the paediatric registration books in the outpatient departments last month.

Data collection tools

An interviewer-administered questionnaire was developed to collect data from children's mothers or caregivers after obtaining oral consent about:

Socio-demographic data, including the child's age, sex, residence, number of siblings, parents' ages, occupations, family income levels, and number of children in the family.

Complaints of children, diagnosis.

Mode of delivery (normal or Cesarian section), and birth weight

Anthropometric measurements [weight, height or length, head circumference (HC), and mid-upper arm circumference (MUAC)] were conducted using reliable and standardized equipment, including a weight scale, skinfold callipers, and a non-stretchable tape measure, following World Health Organization (WHO) and American Academy of Paediatrics (AAP) guidelines. The HC was measured using a tape around the largest part of the head, ensuring accuracy by taking two readings within 0.2 cm and recording the average. The recumbent length was measured for infants and toddlers who could not stand using an infantometer, while standing height was measured with a stadiometer for older children, ensuring proper posture. Weight was measured to the nearest 0.01 kg using a calibrated beam or digital scale for infants and a balanced floor scale for children over two years, with minimal clothing to ensure accuracy. The MUAC is measured at the midpoint between the shoulder and elbow, with the arm bent and hanging straight down. Body Mass Index (BMI) was calculated using weight (kg) / [height (m)]2, which is recommended for children

over two years, following WHO guidelines. Then, Height-for-age, weight-for-age, and weight-for-height z-scores were plotted using WHO growth charts from 2006 to classify nutritional status.

Finally, the nutritional status of studied participants was categorized according to the WHO Height for-Age Z-Score (HAZ), Weight-for-Age Z-Score (WAZ), and Mid-upper arm circumference (MUAC) .[11]

Pilot study

Before the data collection started, a pilot study was conducted to evaluate the questionnaire's clarity, response rate, and completion time. Accordingly, minor editing was needed to improve the flow and comprehensibility of the questions. The questionnaire took 10 to 15 minutes to be completed through interviews. Moreover, all participants involved in the pilot study were excluded from the final analysis.

Ethical Considerations

Before starting the data collection process, ethical approval was obtained from the Institutional Review Board (IRB) of the Faculty of Medicine for Girls, Al Azhar University, Cairo, Egypt (IRB no: 2023092086). Approval was also obtained from authorized personnel of the pediatric outpatient at Al Zahraa University Hospital. Informed consent was obtained from the mothers or caregivers of each child before participation. They were informed about the purpose of the study, their voluntary participation, and the fact that the collected data would be used for research purposes only. Participants were guaranteed anonymity, confidentiality, and free withdrawal from the study at any time without giving a reason.

Statistical Analysis

Data coding, entry, and analysis were conducted using the IBM Statistical Package for Social Science (SPSS program) (version 27). The quantitative data, such as age, weight, and height, were described as Mean ± SD, while the qualitative data, such as residence, sex, and occupation, were summarised into frequency (N.) and percentage (%). Furthermore, we used the Pearson Chi-square test (X2) to compare the qualitative data. Binary logistic regression was conducted to define the predictors of malnutrition among the studied children. Probabilities (p-values) of ≤ 0.05 are considered significant at a 95% confidence level.

3. Results

This study was conducted among 350 children. The results revealed that the mean age of children (mean ± SD) was 23.4 ± 17.02 months, 56.3% were male, and 98% resided in urban areas; 92% of mothers were housewives, and 82.6% of fathers had private work. Additionally, 80.9% had enough family income to meet only their necessary needs. (Table 1)

Concerning complaints and provisional diagnoses, it was reported that 64.3% were diagnosed with respiratory diseases, 27.7% suffered from gastroenteritis, and only 32% needed to be hospitalized. Moreover, chronic cases attended for follow-up accounted for 7.4%. (Table 2)

Regarding the nutritional status of the studied children according to different anthropometric measures, Table 3 describes that 42.9%, 25.1%, 32.3%, and 12% had malnutrition according to weight for age z score, height for age z score, weight for height z score, and UMAC, respectively. Table 4 reveals the nutritional status among those with gastroenteritis diseases, where 35.1%, 26.8%, 33%, and 8.2% had malnutrition according to weight for age z score, height for age z score, weight for height z score, and UMAC, respectively. Table 5 demonstrates the nutritional status among those with acute respiratory diseases, where 45.8%, 22.2%,30.7%, and 12.9% had malnutrition according to weight for age z score, height for age z score, weight for height z score, and UMAC, respectively. Table 6 shows the nutritional status among children with chronic diseases where 61.5%, 38.5%, 42.3%, and 7.7% had malnutrition according to weight for age z score, height for age z score, weight for height z score, and UMAC, respectively. Finally, Table 7 presents the nutritional status among all studied children based on age groups; where among children aged less than two years, 34.7% had malnutrition according to the weight-for-height z score, while among children aged two years and older, 29.2% and 31.8% had malnutrition according to weight-for-height z score and BMI z score respectively.

Table 1: Sociodemographic characteristics of studied children

ITEMS	(N = 350)	%
AGE (IN MONTHS)		
MEAN ± SD	23.4 ± 17.02	
(MINIMUM-MAXIMUM)	(6 - 60)	
AGE GROUP OF CHILDREN (MONTHS): -		
○ 6 - <24	196	56.0
○ ≥24 - <42	88	25.1
○ ≥42 – 60	66	18.9
GENDER		
○ MALE	197	56.3
○ FEMALE	153	43.7
RESIDENCE		
○ URBAN	343	98.0
○ RURAL	7	2.0
NO. OF CHILDREN IN THE FAMILY		
○ 1-2	310	88.5
○ 3-4	38	10.9

o 5-6	2	0.6
OCCUPATION OF FATHER: -		
o NOT WORKING	19	5.4
o GOVERNMENT EMPLOYEE	42	12.0
o PRIVATE EMPLOYEE	289	82.6
OCCUPATION OF MOTHER: -		
o HOUSEWIFE	322	92.0
o EMPLOYEE	28	8.0
FAMILY INCOME:		
o NOT ENOUGH	55	15.7
o ENOUGH NECESSARY NEEDS ONLY	283	80.9
o ENOUGH NECESSARY AND EMERGENCY	12	3.4
o ENOUGH AND EXTRA	0	0.0

Table 2. Causes of attendance of children to outpatient clinic

ITEMS	(N=350)	%
COMPLAINT: -		
o SHORTNESS OF BREATH	30	8.5
o COUGH	100	28.5
o FEVER	120	34.3
o DIARRHEA AND VOMITING	97	27.7
o ABDOMINAL PAIN	50	14.3
o DYSURIA AND HEMATURIA	12	3.4
o SORE THROAT AND RHINORRHEA	20	5.7
o EAR ACHE	5	1.4
PROVISIONAL DIAGNOSIS: -		
o RESPIRATORY DISEASES*	225	64.3
o GASTROENTERITIS	97	27.7
o URINARY TRACT INFECTION	17	4.8
o OTHERS**	11	3.2
HOSPITAL ADMISSION: -		
o YES	112	32.0
o NO	238	68.0
CHRONIC CASES FOR FOLLOW-UP	26	7.4

*Respiratory diseases included all children diagnosed with pharyngitis, pneumonia, asthma, common cold, otitis media, tonsillitis, and pneumothorax.

Table 3. Nutritional status among all studied children using anthropometric measurements

ITEMS	(N = 350)	%
WEIGHT FOR AGE Z SCORE: -		
o NORMAL	200	57.1
o MALNUTRITION	150	42.9
HEIGHT FOR AGE Z SCORE: -		
o NORMAL	262	74.9
o MALNUTRITION	88	25.1
WEIGHT FOR HEIGHT Z SCORE: -		
o NORMAL	237	67.7
o MALNUTRITION	113	32.3
UPPER MID-ARM CIRCUMFERENCE IN CM (UMAC)	308	88.0
o NORMAL	42	12.0
o MALNUTRITION		

Table 4. Nutritional status among studied children suffering from acute gastroenteritis:

ITEMS	N = (97)	%
WEIGHT FOR AGE Z SCORE: -		
o NORMAL	63	64.9
o MALNUTRITION	34	35.1
HEIGHT FOR AGE Z SCORE: -		
o NORMAL	71	73.2
o MALNUTRITION	26	26.8
WEIGHT FOR HEIGHT Z SCORE: -		
o NORMAL	65	67
o MALNUTRITION	32	33.0
UPPER MID-ARM CIRCUMFERENCE IN CM (UMAC)		
o NORMAL	89	91.8
o MALNUTRITION	8	8.2

Table 5. Description of anthropometric measurements among studied children suffering from acute respiratory diseases

ITEMS	N = 225	%
WEIGHT FOR AGE Z SCORE: -		
o NORMAL	122	54.2
o MALNUTRITION	103	45.8
HEIGHT FOR AGE Z SCORE: -		
o NORMAL	175	77.8
o MALNUTRITION	50	22.2
WEIGHT FOR HEIGHT Z SCORE: -		
o NORMAL	156	69.3
o MALNUTRITION	69	30.7
UPPER MID-ARM CIRCUMFERENCE IN CM (UMAC)		
o NORMAL	196	87.1
o MALNUTRITION	29	12.9

Table 6. Nutritional status among studied children with chronic diseases

ITEMS	N = (26)	%
WEIGHT FOR AGE Z SCORE: -		
o NORMAL	10	38.5
o MALNUTRITION	16	61.5
HEIGHT FOR AGE Z SCORE: -		
o NORMAL	16	61.5
o MALNUTRITION	10	38.5
WEIGHT FOR HEIGHT Z SCORE: -		
o NORMAL	15	57.7
o MALNUTRITION	11	42.3
UPPER MID-ARM CIRCUMFERENCE IN CM (UMAC)	24	92.3
o NORMAL	2	7.7
o MALNUTRITION		

Table 7. The nutritional status of studied children in different age groups

ITEMS		N	%
WEIGHT FOR HEIGHT Z SCORE: -			
o NORMAL	Children < 2 years	128	65.3
o MALNUTRITION	N = 196	68	34.7
WEIGHT FOR HEIGHT Z SCORE: -			
o NORMAL	Children ≥ 2 years	109	70.8
o MALNUTRITION	N = 154	45	29.2
BMI Z SCORE: -			
o NORMAL		105	68.2
o MALNUTRITION		49	31.8

As regards factors affecting the nutritional status among studied children, Table 8 demonstrates that malnutrition was more common among children aged less than two years, females, urban residence, working mothers, high income, normal delivery, low birth weight, families having children less than 4 children, and those who suffered from chronic diseases with significant P-value < 0.05 regarding gender, mother occupation, mode of delivery, and disease chronicity. Additionally, Table 9 explains the predictors of malnutrition among studied children, which included female children, those suffering from chronic diseases, working mothers, and those who had normal delivery, with a statistically significant p-value ≤ 0.05, and families with high income levels without a significant p-value > 0.05

Table 8: Factors affecting nutritional status among studied children

ITEMS	NUTRITIONAL STATUS: MALNUTRITION (113) N (%)	NORMAL (237) N (%)	TEST OF SIGNIFICANT
AGE GROUP			X^2= 1.18
○ < 2 YEARS (196)	68 (60.2)	128 (54.0)	P.value= 0.27
○ ≥ 2 YEARS (154)	45 (39.8)	109(46.0)	OR = 1.3
GENDER			X^2= 4.89
○ MALES (197)	54 (47.8)	143 (60.3)	P.value= 0.027*
○ FEMALES (153)	59 (52.2)	94 (39.7)	OR = 0.602
RESIDENCE			X^2= 0.045
○ URBAN (343)	111 (98.2)	232 (97.9)	P.value= 0.83
○ RURAL (7)	2 (1.8)	5 (2.1)	OR = 1.2
MOTHER OCCUPATION			X^2= 6.3
○ HOUSEWIFE (322)	98 (86.7)	224 (94.5)	P.value= 0.012*
○ EMPLOYEE (28)	15 (13.3)	13 (5.5)	OR = 0.4
FAMILY INCOME			X^2=0.5
○ LOW INCOME (338)	108 (95.6)	230 (97.0)	P.value= 0.47
○ HIGH INCOME (12)	5 (4.4)	7 (3.0)	OR = 0.7
MODE OF DELIVERY			X^2=4.03
○ NORMAL (26)	13 (11.5)	13 (5.5)	P.value= 0.045*
○ C. SECTION (324)	100 (88.5)	224 (94.5)	OR = 2.24
BIRTH WEIGHT			X^2=0.078
○ < 2.5 KG (14)	5 (4.4)	9 (3.8)	P.value= 0.779
○ ≥ 2.5 KG (336)	108 (95.6)	228 (96.2)	OR = 1.2
CHILDREN IN FAMILY			X^2=0.045
○ < 4 CHILDREN (343)	111 (98.2)	232 (97.9)	P.value= 0.832
○ ≥ 4 CHILDREN (7)	2 (1.8)	5 (2.1)	OR = 1.2
CHRONICITY OF DISEASES			X^2=14.07
○ CHRONIC (26)	17 (15.0)	9 (3.8)	P.value < 0.001*
○ ACUTE (324)	96(85.0)	228 (96.2)	OR = 4.5

*p. value statistically significant (P ≤ 0.05)

Table (9): Predictors of malnutrition status among studied children by a Logistic Regression Model

Characteristics	B	OR (95% CI)	p. value
Sex			
○ Female	0.58	1.78 (1.11 -2.85)	0.017*
○ Male		Ref	
Mother Occupation			
○ Employee	1.05	2.86 (1.25 - 6.49)	0.012*
○ Housewife		Ref	
Mode of delivery			
○ Normal	0.85	2.33 (1.01- 5.38)	0.046*
○ C. section		Ref	
Chronicity of diseases			
○ Chronic	1.65	5.19 (2.19 - 12.33)	< 0.001*
○ Acute		Ref	
Family income			
○ High income	0.35		0.58
○ Low income		1.42 (0.42 – 4.86) Ref	

*p. value statistically significant (P ≤ 0.05)

4. Discussion

Growth is a special characteristic of childhood and the best global indicator of children's well-being, as growth impairment has both short- and long-term consequences .[12] The present study was an analytical cross-sectional study conducted among 350 children with a mean age of 23.4 ± 17.02 months, ranging from 6 to 60 months. More than half of them (56%) belonged to the (6-24 months) age group, indicating a higher representation of younger children in the sample, which differs from a study by Rahman et al.[13] in Bangladesh, where 18.8% of their sample was under 24 months.

In the present study, gender distribution showed a slight male predominance (56.3% males versus 43.7% females), which is in accordance with a study in Ethiopia by Tariku et al.[14] who reported a male-to-female ratio of 1.2:1.

Concerning the nutritional status of the studied children, the current study revealed that 42.9%, 25.1%, 32.3%, and 12% of them had malnutrition according to weight for age z score, height for age z score, weight for height z score, and UMAC, respectively indicating significant frequency of malnutrition among studied children which is consistent with Egyptian study which demonstrated that 16.2%, 9%, and 15.6% of studied children was Stunting, wasting, and underweight respectively, with a total malnutrition of 24.7%[15] and a Sudanese study which reported that 30.8% of children were underweight, 21.1% were wasting, and 24.9% were stunting .[16] Also, an Indian study revealed that the prevalence of underweight, stunting, and wasting was 24.5%, 27.2%, and 17.8%, respectively.[17] Furthermore, an Ethiopian study recorded that the prevalence of stunting, underweight, and wasting was 46.2%, 24.3%, and 11.3% .[18] This difference may be due to disparities in the method, sample size, socio-economic level, living standards, or cultural differences between countries.

The demonstrated nutritional status of studied children may be attributed to their suffering from gastroenteritis and respiratory diseases as 35.1%, 26.8%, 33%, and 8.2% of studied children with gastroenteritis diseases had malnutrition according to weight for age z score, height for age z score, weight for height z score, and UMAC, respectively and 45.8%, 22.2%,30.7%, and 12.9% of those with respiratory diseases had malnutrition according to weight for age z score, height for age z score, weight for height z score, and UMAC, respectively.

Regarding the possible factors influencing the nutritional status of the under-five children, the current study showed that malnutrition was more common among female children whose mothers were working, with normal delivery, and those who suffered from chronic diseases, with a significant P-value < 0.05. Additionally, the logistic regression revealed that the predictors of malnutrition were female children, those suffering from chronic diseases, working mothers, and those who had a normal delivery, with a statistically significant p-value ≤ 0.05, and families with high income levels without a significant p-value > 0.05. The high prevalence of malnutrition among females was in line with

many studies conducted in different places .[19-21] On the other hand, Meron Tedla et al. 2024 reported that malnutrition was more frequent among males than females .[18] This difference may be attributed to cultural changes, as some communities provide more care to boys than girls.

Moreover, malnutrition was more common among children whose mothers were working, while Eshete et al reported that there was no statistically significant association between maternal employment and nutritional status of their children .[22] This may be due to their going to work, they had to leave the care of their children to another person, besides the deprivation of children from breastfeeding and the early introduction of complementary food .[23]

Furthermore, the current study demonstrated that malnutrition was more prevalent among chronically diseased children, which is consistent with many studies indicating the high prevalence of malnutrition among chronically ill children .[24, 25] Additionally, these findings align with those reported by Behairy et al.[26] who found 40% moderate wasting in children with chronic conditions. This may be attributed to decreased appetite, altered metabolism, malabsorption, increased nutritional needs, and food restriction.

Also, the present study described that vaginal delivery was associated with malnutrition, which contradicts other studies, which show that caesarean deliveries were associated with malnutrition through their impact on breastfeeding .[27] This discrepancy may be due to birth complications, such as prolonged labour or fetal distress, maternal malnutrition or delayed initiation of feeding. Moreover, it was found that malnutrition is associated with high family income which may be attributed to cultural factors as wealthy families may adopt dietary practice based on trends rather than balanced diet, lack of nutritional education as higher income doesn't always mean better knowledge about nutrition or healthy diets, overemphasis on quantity where families focus on high quantity or calorie dense foods rather than nutrient dense food.

The present study revealed that respiratory complaints were the predominant presenting symptoms, with cough (28.5%) and fever (34.3%) being the most common presentations. Acute Respiratory diseases constituted the largest proportion of provisional diagnoses (64.3%), followed by acute gastroenteritis (27.7%). This distribution aligns with global patterns of childhood morbidity in developing countries, where respiratory infections and diarrheal diseases remain leading causes of outpatient visits.[28]

The higher prevalence in our study may be due to Limited access to specialized nutritional support, the cumulative effect of chronic conditions on nutritional status, and possible inadequate follow-up care and nutritional monitoring.

This study was a cross-sectional study, which hinders causal inferences, based on a survey confined to the pediatric outpatient clinics at Al Zahraa University Hospital, which may limit generalizability. It also missed other malnutrition risk factors like dietary intakes, and a lack of follow-up suggests a need for longitudinal research.

4. Conclusion

The current study demonstrated that malnutrition was more prevalent among children less than two years old, with varying rates based on different anthropometric measures, particularly with chronic illnesses, acute gastroenteritis, and acute respiratory diseases. Additionally, it shed light on the multifaceted factors contributing to childhood malnutrition, including female gender, chronic morbidities, maternal employment, and normal deliveries, with statistically significant associations. Notably, high-income families showed no significant correlation with malnutrition. These findings underscore the need for targeted pediatric nutritional support and monitoring targeting the high-risk group. Moreover, Future research is recommended to explore the impact of socio-economic factors on childhood malnutrition to inform more targeted interventions and policies.

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