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Pattern and Risk Factors of Malnutrition among Under-Five Children Attending Nutrition Clinic, Egypt

Alyaa A. Mohamed[1], Doaa M. El Shehaby[2], Eman M. Mohamed[1], Medhat A Saleh[1], Osama M El-Asheer[3]

[1] Public Health and Community Medicine Department, Faculty of Medicine, Assiut University, Assiut, Egypt
[2] Forensic Medicine and Toxicology Department, Faculty of Medicine, Assiut University, Assiut, Egypt
[3] Pediatrics Department, Assiut University Children Hospital Assiut, Egypt

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ABSTRACT

Background: Malnutrition in young children is a major public health issue that is linked to early and later life health problems; it is one of the leading causes of illness in children under 5 years of age. **Objectives:** This study aims to identify the patterns of malnutrition and risk factors for stunting among young children aged 24– 59 months who attended the Nutritional Clinic of Assiut University Children Hospital. **Method:** In a cross-sectional study of 134 children, anthropomorphic measurements were taken, and children's mothers completed several nutrition-related scales and a face-to-face structured questionnaire. **Results:** The percentage of stunting among the children was 56.7%, and the total percentage of underweight was 67.2%. Birth order was inversely related to height for age Z-score (HAZ), and that association was statistically significant, as there was a positive association between HAZ and spacing between children. Children from households that consumed two or more various types of fat had twice the risk of stunting of the risk in households that consumed no more than one type of fat. Household consumption of no more than one type of animal protein increased stunting risk by seven times the risk in households that consumed at least two types of animal protein. **Conclusion:** Stunting was the most common pattern of malnutrition among children attending the clinic. Reduced household consumption of animal protein and increased fat consumption are significant predictors of stunting; therefore, health education programs for mothers should be conducted on a regular basis to increase their awareness about dietary diversity.

INTRODUCTION

Undernutrition (wasting, stunting, and underweight), insufficient vitamins and minerals, overweight, obesity, and the resulting diet-related noncommunicable illnesses are all examples of malnutrition. Child malnutrition can be determined by anthropometric indicators referred to international growth standards.[1,2] Stunting is a metric for chronic malnutrition that represents insufficient nutrition over time or the impact of repeated or chronic illnesses. The percentage of children under the age of five whose height-for-age is less than minus two standard deviations (moderate and severe stunting) from the median height-for-age is known as the stunting rate. Wasting is a metric for current acute malnutrition, which can be caused by a lack of food or recent sickness. The wasting rate is defined as the percentage of children under the age of five whose weight-for-height is less than minus two standard deviations (moderate) or minus three standard deviations (severe) from the median. Acute and chronic malnutrition are both reflected in being

Corresponding Author: Alyaa Abdelaal Mohamed, Department of Demonstrator of Public Health and Community Medicine, Faculty of Medicine, Assiut University, Egypt. Email: Alyaa_abdelal@med.aun.edu.eg.
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underweight. The percentage of children under the age of five whose weight-for-age is below minus two standard deviations (moderate) or minus three standard deviations (underweight) from the median weight-for-age is known as the underweight rate.[3]

In 2020, it was anticipated that 149 million children under the age of five were stunted (too short for their age), 45 million were wasted (too thin for their height), and 38.9 million were overweight or obese. Under-nutrition is responsible for almost 45 percent of mortality among children under the age of five. Low- and middle-income countries are the most affected. At the same time, childhood overweight and obesity rates are rising in these same countries. The global burden of malnutrition has substantial and long-term developmental, economic, social, and medical consequences for individuals and their families, communities, and countries.[1,2]

Despite investments in the health sector and a significant reduction in child mortality, Egypt's malnutrition rates remain high. Stunting remains a significant public health concern in Egypt for young children under the age of five, affecting one out of every five children. Since 2000, there has been a large increase in wasting, with the tendency being significantly higher among females. Wasting and being underweight account for 8% and 6% of the population, respectively.[4]

Short stature is rarely a problem in and of itself. Instead, it is considered a 'Stunting Syndrome,' in which linear growth retardation is viewed as a symptom of numerous pathogenic alterations that raise morbidity and mortality while reducing physical, neurodevelopmental, and economic potential.[5]

Early-life malnutrition, such as undernutrition of the mother during pregnancy, nonexclusive breastfeeding, inadequate supplemental feeding, and a high prevalence of enteric illnesses, as well as poor hygiene practices, result in growth restriction in children.[6–8]

Stunting is increasingly recognized as a major global health concern, with various high-profile projects such as Scaling Up Nutrition, the Zero Hunger Challenge, and the Nutrition for Growth Summit focusing on it. Stunting is also at the heart of the World Health Assembly's six global nutrition targets for 2025, and it

Table 1: Malnutrition indicators among children aged 24–59 months attending the nutrition clinic at Assiut University Children Hospital, 2020

Anthropometric measurements	Total (n = 134) No.	%
(Weight for height Z-score) WHZ		
Obese	0	0
Normal	110	82.1
Mild wasting	22	16.4
Moderate wasting	1	0.7
Severe wasting	1	0.7
(Weight for age Z-score) WAZ		
Normal	44	32.8
Mild underweight	54	40.3
Moderate underweight	19	14.2
Severe underweight	17	12.7
(Height for age Z-score) HAZ		
Normal	58	43.3
Moderate stunting	39	29.1
Severe stunting	37	27.6
Combined malnutrition		
Stunted and wasted	2	1.5

has been proposed as a leading indicator for the post-2015 development agenda. Stunting has received more international attention as a result of a growing understanding of its importance as a serious public health issue.[9]

This study aims to identify pattern of malnutrition in children aged 24–59 months who were attending the Nutritional Clinic of Assiut University Children Hospital in Asyut, Egypt, and to identify risk factors for stunting in those children. Toward that objective, a cross-sectional comparison of stunted and normal children was conducted among the population at the clinic.

METHOD

To calculate sample size from the participating children at the clinic, we used Open Epi version 3 and set 95% confidence intervals (CIs); we excluded children from the study if they were critically ill, had a congenital anomaly, or had any systemic disease. A total of 134 children were included in the study based on the 9.5% prevalence of wasting among children

Table 2: Correlations between family sociodemographic characteristics and height of children aged 24–59 attending the nutrition clinic at Assiut University Children Hospital, 2020

Socio demographic data	normal n= 58		Stunted n= 76		COR (95% CI)	P-value*
	No.	%	No.	%		
Order of the child						
First child‡	30	60.0	20	40.0		
2nd-3rd	23	35.9	41	64.1	**2.67 (1.248-5.73)**	**0.007**
≥4 th	5	25.0	15	75.0	**4.5 (1.41-14.35)**	
Spacing period						
First child‡	30	60.0	20	40.0		
<24 months	5	23.8	16	76.2	**4.8 (1.516-15.2)**	**0.006**
≥24 months	23	36.5	40	63.5	**2.6 (1.22-5.6)**	
Age of the mother						
<20 & ≥36 years	6	33.3	12	66.7	1.625 (0.57-4.625)	0.360
21-35 years‡	52	44.8	64	55.2		
Mother work						
Housewife‡	48	42.9	64	57.1	0.9 (0.359-2.256)	0.822
Working mother	10	45.5	12	54.5		
Father occupation						
Professional work or Employee ‡	17	47.2	19	52.8		0.274
Worker	29	39.2	45	60.8	1.388 (0.622-3.1)	
Commerce or Farmer	4	33.3	8	66.7	1.79 (0.456-7.02)	
Retired, not working or others	8	66.7	4	33.3	0.447 (0.114-1.755)	
Mother education						
Illiterate/ Read & write	4	23.5	13	76.5	2.79 (0.715-10.86)	0.214
basic education	15	55.6	12	44.4	0.686 (0.23-2.02)	
Secondary education	27	42.2	37	57.8	1.175 (0.47-2.94)	
Higher education ‡	12	46.2	14	53.8		
Family history of stunting#						
Yes	4	57.1	3	42.9	0.555 (0.119-2.582)	0.477
No ‡	54	42.5	73	57.5		
Disease during the last 3 months						
Yes	30	40.5	44	59.5	1.283 (0.645-2.552)	0.477
No ‡	28	46.7	32	53.3		

**Chi square test, ‡ Reference category for each variable, # Mother and/or father height was below 150 cm*

under 5 years of age according to the WHO Joint Child Malnutrition Egypt survey 2014.[8] The Assiut University Faculty of Medicine Ethical Review Committee approved this project (IRB 17100702), and permission was obtained from the director of Children University Hospital to collect data from the nutrition clinic. Data were collected from face-to-face interviews with the children's mothers using a questionnaire designed for this study as well as previously validated instruments.[10]

Following a literature review of medical journals, we devised a questionnaire to administer to the mothers of the children attending the nutrition clinic. Before we administered the questionnaire to the full population, we conducted a pilot study with 10% of the population to ensure clarity of the questions and to address any challenges; we modified questionnaire items based on feedback from the pilot. The final questionnaire took 20–25 min to complete.

Data collection took 6 months. We began in January 2020 but stopped in mid-March when COVID-19 was declared a pandemic and the country had to lock down, and data collection continued from October to December 2020. Before we began to collect the data

Table 3: Associations between HDDS subscores by food source and height among children aged 24–59 months attending the nutrition clinic at Assiut University Children Hospital, 2020

HDDS	Normal n=58		Stunted n=76		COR (95% CI)	P -value*
	No.	%	No.	%		
Sources of carbohydrates						
Consumed one food group‡	1	50.0	1	50.0	1.316 (0.081-21.489)	0.847
Consumed ≥ 2 food groups	57	43.2	75	56.8		
Sources of fat						
Consumed one various of food or not consuming at all‡	32	58.2	23	41.8	**2.836(1.391-5.782)**	**0.004**
Consumed ≥ 2 various of food	26	32.9	53	67.1		
Sources of animal proteins						
Consumed one food group	1	10.0	9	90.0	**7.657 (0.941-62.273)**	**0.027**
Consumed ≥ 2 food groups‡	57	46.0	67	54.0		
Sources of plant sources of proteins						
Consumed one various of food	41	41.4	58	58.6	1.34 (0.616-2.898)	0.463
Consumed ≥ 2 various of food	17	48.6	18	51.4		
Sources of vitamins and minerals						
Consumed one food group	0	0	6	7.9	------	**0.029**
Consumed ≥ 2 food groups	58	45.3	70	54.7		
Others**						
Consumed one various of food	2	100	0	0	------	0.103
Consumed ≥ 2 various of food	56	42.4	76	57.6		
Total score						
High‡	57	43.2	75	56.8	0.76 (0.047-12.412)	0.847
Moderate	1	50.0	1	50.0		

***Others: spices, condiments, and beverages, *Chi square test, ‡ Reference category for each variable*

from each mother, we presented the study purpose and goal and ensured each that her child's participation was entirely voluntary. Because of the particularly high prevalence of low education levels in rural areas of Egypt, the prevailing culture of fear of signing any document, and the fact that the research was noninterventional, the ethical review board accepted oral informed consent. All information was kept private and confidential.

The first tool we used to conduct this study was an author-designed questionnaire to collect demographic and basic health data. The questionnaire was designed to collect sociodemographic data related to malnutrition in children under 5 years of age, birth data for each child, and data on postnatal breastfeeding and complementary feeding. This questionnaire was administered face-to-face and took 20–25 min to complete. All other tools for this study were translated from their original language into Arabic at the Center for Translation and Linguistic Research at Assiut University.

Household Dietary Diversity Score: We used the validated HDDS to determine the diversity in the diets of the families at the clinic.[11–13] To calculate the HDDS, a dietary diversity questionnaire presents 16 food groups (cereals, white roots and tubers,vit a rich vegetables and tubers, dark green leafy vegetables, other vegetables,vit a rich fruits, other fruits, organ meat, flesh meat, eggs, fish and sea food, legumes ,nuts and seeds, milk and milk products, oil and fats, sweets, spices, condiments and beverages). Data on consumption of these food groups over the last week. Based on HDDS score modifications, dietary diversity is divided into three categories: HDDS modification

Table 4: Multivariate logistic regression analysis of predictors of stunting among children aged 24–59 months attending the nutrition clinic at Assiut University Children Hospital, 2020

Variables	P-value	AOR (95% CI)
Order of the child (Ref. = 1st child**):**		
2nd-3d	.238	5.653 (.319-100.133)
≥4 th	.203	7.477 (.337-166.040)
Spacing period (Ref. =1st child**)**		
<24 months	.756	.631 (.034-11.590)
≥24months	.626	.483 (.026-9.016)
Place of delivery (Ref.= hospital**)**		
Rural and private centers	.802	.823 (.179-3.777)
home	.110	.289 (.063-1.323)
Household consumption of fat (Ref.= consuming< one type**)**		
consuming≥ 2various types	**.018**	2.671 (1.188-6.008)
Household consumption of animal protein (Ref.= consuming≥ 2various types**)**		
Consuming< one various type	**.033**	13.585 (1.237-149.203)

Nagelkerke R Square=0.286

scores range from 0 to 12. Scoring the sources of carbohydrates, animal protein, and vitamin and mineral categories is done by giving a 0 if the household did not consume any food groups in each category, a 1 if the household consumed one food group in each category, and a 2 if the household consumed two or more food groups in each category. The sources of fat, plant sources of protein, and other groups are scored by assigning a 0 if the household did not consume any food groups in each category, and a 1 if the household consumed one variety of each. The respondent's household dietary diversity is then categorized as:, low (≤5), moderate (6–8), or high (>9). All summary and scale scores indicated acceptable reliability, as evidenced by Cronbach's alpha coefficients better than 0.7.[14]

Food Frequency Questionnaire: We also checked food frequency as well as diversity using a brief food frequency questionnaire translated into Arabic. Mothers reported how often (times per day, week, month, or year) their children consumed 34 foods categorized into groups: fruit, vegetables, dairy products, fish, cereals, pulses, eggs, meat, fats, sweets, beverages, and nuts. The questionnaire was updated to include beans and artificial snacks.[15]

Food Insecurity Experience Scale: To measure food insecurity among the population at the clinic over a typical 12-month period, we used the Arabic version of the UN Food and Agriculture Organization's Food Insecurity Experience Scale. This statistical scale was designed to cover a range of food insecurity severity and should be analyzed together as a scale, not as separate items.[16–18] The total FIES showed excellent internal consistency and reliability, with Cronbach's alpha above 0.93.

Anthropometric Measurements: We finally took anthropomorphic measurements of all the participating children, specifically their weight and height. Height was taken using a height measuring board while the child was standing barefoot and rounded to the nearest 0.1 cm. We calculated nutritional status using the WHO Anthro software. (12,19,20)

Statistical analysis: All study data were entered, revised, cleaned, and analyzed using SPSS Statistics 20 (IBM Corp., Armonk, NY, USA), and we set statistical significance at p = 0.05. We calculated descriptive statistics as frequencies, means, and SDs and conducted quantitative chi-squared or Mann–Whitney U test analyses depending on the variable's distribution (normal or not). We applied binary logistic regression to identify the different predictors of stunting, and we included in the models the variables that were significant at the bivariate level. We calculated odds ratios (ORs) as a measure of the association at 95% CI.

RESULTS

Of the 134 children who participated in the study, 47% were boys and 53% were girls. By age, 47% of the

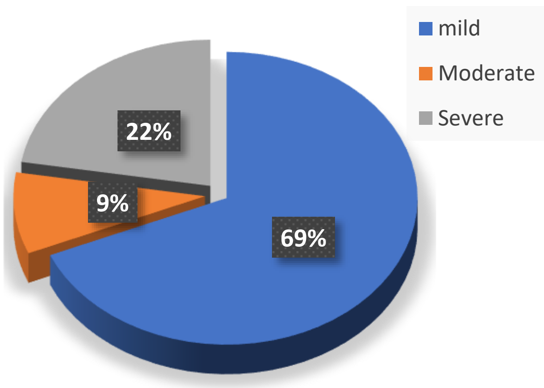

Figure 1: Grades of children household food insecurity 2020.

children were under 35 months old, 17.9% were 35 to 47 months, and 35.1% were 48 months or older; mean age was 39.5 ± 12.5 months. By residential area, 28.4% of the children resided in urban areas and the remaining 71.6% resided in rural Egypt. Only approximately 50% of mothers reported having sufficient family income. Most families (92.5%) were using a house tap as their water source.

For the parental demographics, the percentages of mothers in each age group were 3%, 86.6%, and 10.4% in <20 years, 21–36 years, and >36 years, respectively. By education level, 23.9% of the children's fathers and 19.4% of the mothers were university graduates. Nearly half of the mothers, 47.8%, had completed secondary education or higher, and 43.3% of fathers had done so. Meanwhile, 20.9% of the fathers and 12.7% of the mothers were illiterate and could not read or write. Nearly one-quarter (22.4%) of the participating children's fathers were employees, and 35.8% were skilled workers; for the mothers, these rates were only 6% and 9%, respectively, and 83.6% of the mothers were housewives. In the analyses of the nutrition factors, we divided participants into two groups, normal and stunted, to examine the associations between malnutrition and other characteristics. We defined stunting as a Z-score below −2 SDs and standard or well-nourished as Z-score greater than −2 SDs.[3] Under the FIES standards, 69% of the children aged 24–59 months who attended the nutrition clinic showed mild malnutrition, only 9% showed moderate malnutrition, and 22% were severely malnourished. Specifically, we found rates of stunting, wasting, and underweight of 56.7%, 17.8%, and 67.2%, respectively. Table 1 presents the anthropomorphic indicators of malnutrition levels among the participating children; approximately one-fourth of the children were low birth weight. Table 2 presents correlations between the children's height and family sociodemographic characteristics. One notable observation was that 76.5% of the children with stunted growth had mothers who could not read and write, although the association was not significant. Birth order and spacing were also highly significant, with 75% stunting among children who were the fourth child or later in their families and stunting in more than three-quarters (76.5%) of children who were separated from their next oldest sibling by 24 months or shorter.

In data not shown, we also analyzed factors related to mothers' pregnancy such as place of birth, number of antenatal visits, child's birth weight, and breastfeeding. Interestingly, we found stunting in 66% and 75%, respectively, of children born in a rural health or other private center or born at home. We also found stunting in nearly two-thirds (65.3%) of children of either low or unknown birth weight. Nearly all mothers, 90.3%, breastfed, and more than two-thirds were still breastfeeding at the child's first year.

Table 3 presents associations between the children's heights and their household food diversity scores, and Table 4 presents logistic regression adjusted ORs for predictors of stunting including among these scores; we found a significantly higher frequency of bread consumption in children who were stunted (median = 14, IQR = 7, range: 0–28) than the frequency in normal children (median = 14, IQR = 14, range: 0–21). Notably, we also found that children in households where two or more various types of fat were consumed regularly had twice the risk of stunting as that of children from homes that consumed no more than one type of fat (OR = 2.836, p = 0.004). Regular household consumption of only one or no animal protein increased the stunting risk by seven times more than the risk in households that consumed two or more various types of animal protein (OR = 7.657, p = 0.027). Children from households that consumed two or more various types of fat had twice the risk for being stunted as that of children whose families consumed no more than one type of fat (OR = 2.671, P = 0.018).

DISCUSSION

We conducted the present study with a population of 134 preschool children aged 24 to 59 months who attended a nutrition clinic at a university children's hospital in Asyut, Egypt; we aimed to identify factors related to malnutrition and stunting in these children. Our findings of 56.7% stunting and 67% underweight were higher than the findings reported from an Egyptian demographic health survey that was conducted among children under 5 years of age sampled from the community.(4) Our finding was also considerably higher than the stunting percentage of 20.3% found in a study from Minia, Egypt.[21] These discrepancies, however, could be a function of the fact that the children in our study were patients at a nutrition clinic, a tertiary referral level, with a high number of stunted and malnourished children.

Our analysis revealed several sociodemographic factors that were significantly inversely associated with stunting, including child's birth order and the spacing between the child and previous siblings. These findings were consistent with those from previous investigations of associations between stunting and family planning practices.[10,22] We also found a high association between mothers' illiteracy and children's stunting; although that association was not statistically significant, it was consistent with the results of several previous studies that demonstrated the importance of mothers' education for children's healthy development.[4,23–26] One element of this association is that educated mothers are more aware of their children's health and nutrition and are more careful about hygiene and sanitation facilities.[24] The significantly higher prevalence in the present study of stunting among children delivered at home was supported by the results of a previous study conducted in Ecuadorian highlands in which stunting was more likely in preterm infants and in infants not delivered at a facility.[27] We believe the reason for these findings is that infants delivered in health facilities receive better natal and postnatal care including growth assessments and follow-up and there is less chance of infection than with home birth.

In contrast with home versus hospital births, we found no association between breastfeeding and stunting. Interestingly, the percentage of children given formula with breast milk in the first 6 months was lower in stunted children than in children of normal height. The reason is that breastfed infants in Egyptian culture are more likely to receive prelacteal feeding, which decreases their consumption of breast milk and increases their intake of alternatives with low nutritional value; this case in turn places formula-fed children in better nutritional status.[23]

In terms of the food diversity scores and weekly nutrient intakes, we found no significant differences between stunted and no stunted children, which aligned with previous research on children aged 12–24 months and 2–3 years in which the scientists concluded that meat and dairy consumption was not linked to stunting.[25,28,29] Only frequency of bread consumption was significantly higher in stunted children in this study, and our interpretation of this finding is that high consumption of bread, a food with low micronutrient value, leads to early satiety, which subsequently reduces a child's consumption of foods with high micronutrient content. The percentage of households consuming plant sources of proteins was much lower than those for other food groups (26%).

The relationship between overall HDDS and stunting in this study was statistically nonsignificant, which was supported by a study conducted in Ethiopia in which there were no associations between child's stunting and either mother's, child's, or household's food diversity.[30] In one conflicting study, however, reduced dietary diversity specifically among children, that is, not the household, was a strong predictor of stunting in rural Bangladesh. In another study conducted in Indonesia, higher dietary diversity scores on a maternal-reported checklist of 12 food groups averaged as a total HDDS were associated with a lower chance of child stunting.[31]

Limitations

One potentially significant limitation of the present study is that the dietary information we collected was only a simple count of the number of food groups consumed; we collected no information on portion sizes or intake amounts. Additionally, the dietary diversity score is calculated on a reference period of the previous 7 days, whereas stunting reflects the long-term cumulative nutritional status of individuals. We conducted this analysis on the assumption that recent diversity is a good proxy of long-term dietary diversity, but future longitudinal research could confirm this. We also cannot exclude the possibility that some self-reported questions, such as those regarding food availability or economic status, could have triggered a social prestige bias such that mothers did not answer honestly.

CONCLUSION AND RECOMMENDATIONS

In this study of preschool children attending a nutrition clinic at a university children's hospital in Egypt, we identified fairly high percentages of stunting and underweight. We also identified more stunting in children who were fourth or later in child order and who were separated from siblings by under 24 months. Moreover, although most associations were not significant, the frequency of bread consumption was higher among stunted children. We found high rates of stunting among mothers who could not read or write, who gave birth at home or in a rural facility, and who attended no more than four antenatal visits. We conclude that nutrition programs in Egypt aimed at improving the health status of children under 5 years of age should incorporate maternal sociodemographic factors as well.

The national government can play a role as well, for instance, by scaling up programs to reduce poverty and increase the availability of diverse food supplies by improving food transport to rural areas. Government campaigns and policies could also aim to limit family size by increasing the spacing between births, and food education programs can teach mothers about the positive impacts of household food diversity on children's health status. In acknowledgment of current circumstances, the government could also institute a national plan to fortify bread with nutrients given its already high consumption among children.

Ethical Approval

The study was approved by the Assiut University Faculty of Medicine Ethical Review Committee (IRB 17100702)

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Declaration of Interest

Authors reported no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Author contribution:

Alyaa Mohamed, data acquisition, analysis, and interpretation and manuscript drafting; Doaa El Shehaby, study design, data interpretation, and manuscript drafting and review; Eman Mohamed, study design, data interpretation, and manuscript drafting and review; Medhat Saleh,study design, data interpretation, and manuscript drafting and review; Osama El-Asheer, study design, data interpretation, and manuscript drafting and review;

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