

Research Article

Dermatological Manifestation in Malnourished Children under 5 Years of Age in a Tertiary Care Hospital

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Abstract: Background: The replenishment of macronutrients and micronutrients is essential for normal function of cutaneous tissues, making cutaneous manifestations a good indicator of nutritional status.

Objective: To evaluate dermatological manifestation in malnourished children under 5 years of age presenting in pediatric outpatient clinic in a tertiary care hospital.

Materials and Methods: This cross-sectional study was performed in Pediatric outpatient clinics at Liaquat National Hospital during 1st August 2024 to 1st August 2025 bearing IRB no App#1067-2024-LNH-ERC, dated: 24th July 2024. Children under five-years of age having malnutrition were included. Assessment of malnutrition was done using anthropometric measurements (weight and length/height) to calculate Z-scores using the WHO reference standards. A dermatological examination was carried out by a consultant dermatologist to evaluate skin manifestations. Recorded data included patients' age, gender, WHO-z scores, term status, feeding type, immunization status, monthly income, maternal education and dermatological complaints.

Result: A total of 196 patients were studied with an average age of 27.3 ± 11.6 months. The acute malnutrition based on WHZ-Score demonstrated that 54.1% children having moderate acute malnutrition and 45.9% children having severe acute malnutrition. The most frequent manifestation was angular cheilitis (89.8%) followed by lusterless hair (84.7%) and xeroderma (82.1%), pigmentary change (66.8%) of patients, lost subcutaneous fat 63.8%, and excessive lanugo lashes (25.5%), ichthyosis skin changes and lichenoid skin changes (9.2%).

Conclusion: This study shows that malnourished children exhibit cutaneous and adnexal related disorders. Regardless of clinical spectrum, these dermatological manifestations frequently seen in malnourished children with angular cheilitis, lusterless hairs and xeroderma being the most common features.

Keyword: Severe Acute Malnutrition, Child Nutrition Disorders, Skin Diseases, Cheilitis, Child, Preschool, Xerodermia, Ichthyotic, Ichenoid.

INTRODUCTION

Nutritional deficiency is an important public health problem that is a major contributory factor in the morbidity and mortality of children under the age of five-years in developing countries [1-3]. Globally around 45% to 50% of all deaths in children under the age of five-years are accounted by malnutrition, mainly affecting children living in lower- and middle-income countries (LMICs) [4]. The skin is the largest organ of the human body, has the fastest turnover rate of all tissues and has the greatest metabolic rate. Thus, the skin is usually the first to show signs of systemic imbalances that are due to malnutrition [5, 6]. The replenishment of macronutrients and micronutrients is essential for normal function of cutaneous

tissues, making cutaneous manifestations a good indicator of nutritional status. In children who suffer from severe and moderate acute malnutrition, characteristic cutaneous changes can occur because of impaired epidermal homeostasis, protein synthesis and wound healing, allowing for an early assessment of a child's nutritional status and severity of malnutrition [5, 7, 8].

The burden of child undernutrition is the highest in South Asia in the world, positioning the region a global hotspot for both pediatric wasting and stunting [4, 9]. Within this population of malnourished children, the combination of protein-energy malnutrition (PEM) and the co-occurrence of vitamin and mineral deficiencies have resulted in a wide range of mucocutaneous disorders [10, 11]. Insufficient protein intake can lead to kwashiorkor, often characterized by observable cutaneous manifestations, such as changes in pigmentation, large bullae, erosion

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and desquamation of skin, and the “flaky” paint dermatosis while the marasmic equivalent typically produces extreme dry skin and atrophy of the skin [5, 12, 13]. In addition, micronutrient deficiencies such as vitamin A, B-complex, and zinc can occur simultaneously with one another, and thereby may contribute to the development of follicular hyperkeratosis, angular stomatitis, and periorificial dermatitis in susceptible populations in South Asia [5, 14].

The level of pediatric malnutrition in Pakistan has reached critical levels, impacting the broader healthcare system [15]. A national survey from Pakistan in 2013 found that around 12% of all children under 5 years of age living in Pakistan are classified as severely malnourished [16]. In industrial and peri-urban hospital centers, there is a strong association between skin conditions and malnutrition among children [17]. Review of international institutional audits shows that dermatologic changes in children with severe acute malnutrition are not just coincidental, but show a clear association to the underlying systemic disease, for instance, prospective, multi-center study data shows that skin conditions may be found as high as 73.5% of acutely malnourished children and provide critical information regarding outcomes of hospital care and potential for mortality [7, 12]. Examples of common dermatological findings in children in hospitals throughout Pakistan include both infectious-dermatoses, such as scabies and impetigo, and noninfectious nutritional changes, such as widespread hyperpigmentation, changes in hair pigment, and severe ichthyosis-like xerosis [5, 7].

There is a well-defined relationship between severe systemic wasting and skin degradation but skin lesions mapping in pediatric specialized units is very fragmented. Available literature reports dermatological conditions in malnourished children but scarcity of such studies in Pakistan. Tertiary care hospitals in Pakistan's malnutrition population manage malnutrition through metabolic stabilization but do not have systematically audited dermatological landscapes for evaluating the concurrent skin lesion data on malnourished patients, therefore leaving a major gap in structured clinical guidelines. It is important to assess the specific characteristics of skin lesions at this age because identifying dermatological manifestations early allows for the initiation of nutrition-based interventions. Ultimately, this study aims to determine the frequency and diverse clinical spectrum of dermatological manifestations among malnourished children under 5 years of age presenting to our tertiary care hospital.

MATERIALS AND METHODS

This cross-sectional study was performed in Pediatric outpatient clinics at Liaquat National Hospital during 1st August 2024 to 1st August 2025. The study was formally approved from Hospital ethics committee on institutional letter head bearing number Ref: App#1067-2024-LNH-ERC, dated: 24th July 2024. This study was reported in accordance with the STROBE cross-sectional reporting guidelines.

Children under five-years of age having malnutrition as per World Health Organization (WHO) growth charts were included. Patients with genetic skin disorders, congenital diseases, immunodeficiency, human immunodeficiency virus (HIV), Stevens - Johnson syndrome, toxic epidermal necrolysis, drug-induced urticaria, taking corticosteroids cytostatic agents or other immunosuppressants from past 4 weeks were excluded. Patients were enrolled into the study with written consent of their primary caregiver. Malnourished children who met qualifications were evaluated for eligibility by the pediatric team in the Pediatric OPD. Then within the pediatric OPD a qualified dermatologist examined them to assess them for dermatological symptoms.

A sample size of 196 was calculated taking frequency of 53.5% lusterless and sparse hair among malnourished children [18] at 95% confidence interval and margin of error 7%. Sample size calculation was performed using WHO sample size calculator. A non-probability consecutive sampling technique was used to enroll patients. The investigator approached children and their guardians, once they had completed their medical appointment with the physician. The timing for recruiting was designed to allow for a careful and thorough clinical exam and accurate anthropometric measurements to be completed, without any constraints on time. All physical and dermatological assessments were conducted in a contained and well-lit room; therefore, these settings facilitated accurate measurements and preserved confidentiality.

Recorded data included patients' age, gender, WHO-z scores, term status, feeding type, immunization status, monthly income, maternal education and dermatological complaints. Malnutrition was assessed based on World Health Organization (WHO) using anthropometric measurements (weight and length/height) to calculate Z-scores. Any of the following children were considered to be malnourished: weight-for-age Z-score (WAZ) < -2 standard deviations (SD) which indicated underweight, height-for-age Z-score (HAZ) < -2SD indicating stunt-

ing, or weight-for-height Z-score (WHZ) < -2 SD indicating wasting. Moderate malnutrition was identified as Z-scores between -2 and -3 SD; severe malnutrition was defined as Z-scores < -3 SD [19]. Children who had bilateral pitting edema of nutritional cause were also classified as having severe acute malnutrition regardless of the anthropometric measures.

A dermatological examination was carried out by a consultant dermatologist to evaluate skin manifestations. Xeroderma was classified to be dry rough skin that is flaky. Sparse and lusterless hair was classified to be dull, dry, fall out easily and a positive test of hair pull (grabbing approximately 10-20 hair about 1 cm from the scalp, applying a steady pull, and if greater than 10% of the hair fell out, it is a positive test). A hair pull test can be performed by gently pulling on several (about 10-20) hairs close to your scalp (1 cm) with a steady pull. If more than 10% of the hair fell out, it was positive. Evidence of hypo/hyper-pigmentation was recorded if pigmentation change was seen on clinical examination. Subcutaneous fat loss was determined if fat loss is seen over the cheeks, upper arms, buttocks and thigh area. Angular cheilitis was found to be present when there was redness, fissuring, eroded or crusted angular area of the mouth. Excessive lanugo hair is body hair on the trunk, face, or on the arms and legs that is fine, soft, light in colour. Ichthyotic skin was characterized as dry, thickened skin with scale and Lichenoid skin was thickened, papular, flat-topped, hyper-pigmented lesions which are rough in texture and seen on clinical examination.

STATISTICAL ANALYSIS

Data was entered into SPSS version 27 for statistical analysis. Frequency and percentages were computed to summarize categorical variables. numerical variables were expressed as mean $\pm$ standard deviation. Dermatological features were compared among patients with severely acute malnutrition and moderately acute malnutrition using Chi-square test. Statistical significance was set at $p < 0.05$ level.

RESULTS

A total of 196 patients were studied with an average age of 27.3 ± 11.6 months. The age range was 1-60 months. Around half of patients were males (45.4%). Most of the patients were delivered at full term (83.2%), on bottle feed (66.8%) and completed their vaccination (83.7%). Few of mothers were graduates (6.6%). Table 1 displays summary of patients' features.

Table 1. Summary of Patients' Sociodemographic Profile.

Variables	Categories	Frequency	Percentage
Age groups	< 12 months	51	26%
	12 to 24 months	42	21.4%
	25 to 60 months	103	52.6%
Gender	Male	89	45.4%
	Female	107	54.6%
Birth Weight	Low	67	34.2%
	Normal	129	65.8%
Term Status	Term (≥ 37 completed weeks of gestation)	163	83.2%
	Preterm (< 37 completed weeks of gestation.)	33	16.8%
Feeding Status	Bottle Feed	131	66.8%
	Mother Feed	65	33.2%
Immunization Status	Vaccinated (received at least one age-appropriate vaccine dose according to the national immunization schedule)	164	83.7%
	Not Vaccinated (received no vaccine doses)	32	16.3%
Monthly income	Rs. <25,000	19	9.7%
	Rs. 25,000-45,000	143	73%
	Rs. >45,000	34	17.3%
Maternal education	Primary	66	33.7%
	Secondary	50	25.5%
	Intermediate	67	34.2%
	Graduate	13	6.6%

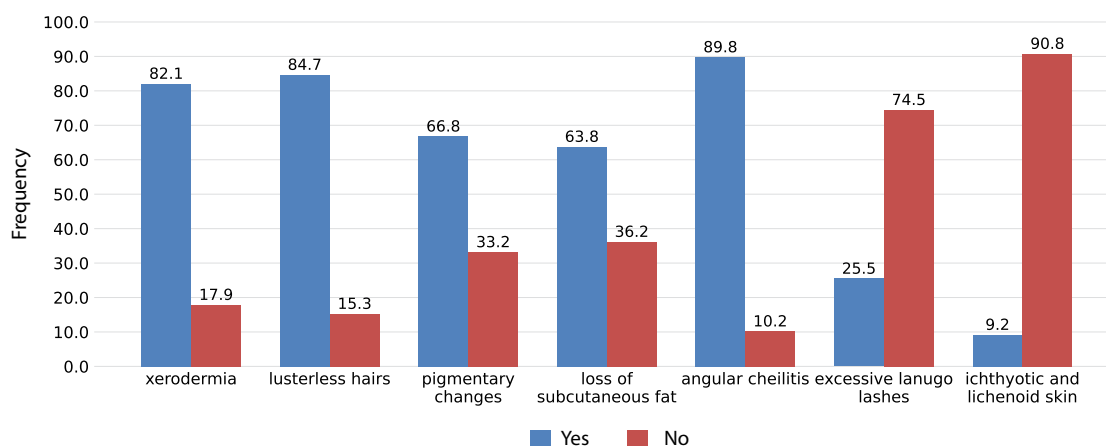
Table 2 displays summary patients' malnutrition profile based on WHO growth charts. According to the WAZ-score, 61.7% children were classified as moderately underweight and 38.3% children were classified as severely underweight. According to the HAZ-score, 58.1% children were classified as moderately stunted and 41.9% children were classified as severely stunted. The acute malnutrition based on WHZ-Score demonstrated that 54.1% children having moderate acute malnutrition and 45.9% children having severe acute malnutrition. We found that 11.7% children having bilateral pitting edema.

Table 2. Summary Patients' Malnutrition Profile Based on WHO Growth Charts.

Variables	Frequency	Percentage
Underweight (Weight-for-Age Z-score)		
Moderate underweight (−2 to −3 SD)	121	61.7%
Severe underweight (< −3 SD)	75	38.3%
Stunting (Height-for-Age Z-score, HAZ)		
Moderate stunting (−2 to −3 SD)	114	58.1%
Severe stunting (< −3 SD)	82	41.9%
Acute Malnutrition (Weight-for-Height Z-score, WHZ)		
Moderate Acute Malnutrition (−2 to −3 SD)	106	54.1%

Severe Acute Malnutrition (< −3 SD)	90	45.9%
Bilateral Pitting Edema		
Present	23	11.7%
Absent	173	88.3%

Fig. (1) depicts the frequency of dermatological manifestation among patients. Angular cheilitis seen in 89.8% of patients while lusterless hair found in 84.7% and Xeroderma frequency was 82.1%. Pigmentary change noted in 66.8% of patients, 63.8% of patients had lost subcutaneous fat, and excessive lanugo lashes were noted in 25.5% of patients. Ichthyotic skin changes and lichenoid skin changes were present 9.2% of occurrences.

**Fig. (1).** Frequency Distribution of Dermatological Manifestation among Patients.

The frequency of Xeroderma was found to be higher in the SAM category compared to the MAM category ($p<0.001$). SAM individuals were also noted to have more lusterless hair compared to the MAM individual ($p=0.009$). The presence of loss of subcutaneous fat was noted to be significantly higher in the SAM cohort as opposed to the MAM cohort ($p<0.001$). The prevalence of angular cheilitis was significantly higher in MAM indi-

viduals compared to those with SAM ($p<0.001$). Likewise, frequency of excessive lanugo in the SAM cohort was higher compared to the MAM cohort ($p<0.001$). Ichthyosis and lichenoid changes of the skin were only seen in patients with SAM ($p<0.001$). There were no significant differences in pigmentary changes between the SAM and MAM groups ($p=0.880$) (Table 3).

Table 3. Comparison of Dermatological Manifestation with Malnutrition Status.

Variables	Total	Malnutrition		p-value
		SAM n(%)	MAM n(%)	
Xeroderma	161(82.1)	88(54.7)	73(45.3)	* <0.001
Lusterless hairs	166(84.7)	86(51.8)	80(93)	*0.009
Pigmentary changes	131(66.8)	65(49.6)	66(50.4)	0.880
Loss of subcutaneous fat	125(63.8)	85(68)	40(32)	* <0.001
Angular cheilitis	176(89.8)	80(45.5)	96(54.5)	* <0.001
Excessive lanugo lashes	50(25.5)	38(76)	12(24)	* <0.001
Ichthyotic and lichenoid skin	18(9.2)	18(100)	0(0)	* <0.001

SAM: Severely acute malnutrition, MAM: Moderately acute malnutrition, *Significant at $p<0.05$.

DISCUSSION

This cross-sectional study evaluated all dermatologic manifestations in malnourished children and found a great deal of cutaneous/adnexal involvement. The most frequent manifestation was angular cheilitis (89.8%) followed by lusterless hair (84.7%) and Xerodermia (82.1%), pigmentary change (66.8%), lost subcutaneous fat 63.8%, and excessive lanugo lashes (25.5%), Ichthyotic skin changes and lichenoid skin changes (9.2%). As a whole, this pattern represents predominately xerotic, deficiencies of nutrition associated dermatoses, which contribute to impaired barrier function of the skin, adnexal structures and at the mucocutaneous junctions.

This study showed an extremely high level of Xerodermia in this population (82.1%). That is consistent with the fact that protein and energy malnutrition, as well as low levels of vitamins and minerals, negatively affect the skin's ability to maintain its barrier and keratinize. Prior studies in children have reported very high levels of Xerodermia as well, including Pandit *et al.* [18], who reported 58% of their patients had Xerodermia [2]; Shekar VS reported 52% in another pediatric series [20]; and Babu and Kottapalli found 45.8% of their group had xerosis in conjunction with hyperpigmentation (35%), angular stomatitis (31.6%), dermatitis (30%), and hair changes (28.3%) [5]. As a result, the higher percentage (82.1%) of xerodermia in this cohort compared to previous studies indicates that the children have more severe malnutrition or there were many more advanced cases than normal. It is also likely that there is a much larger proportion of children with vitamin A and EFA deficiencies, which are known to contribute to xerosis and scale [5].

According to our study, angular cheilitis was the most common finding (89.8%), much greater than other reported literature (the rates are typically reported between 9.25-47% [5, 20, 21]. In a study by Pandit *et al.*, the authors state they found angular cheilitis in 20% of their cases [18]; however, Shekar VS *et al.* found a greater rate of occurrence (i.e., 47%) [20]. The significantly higher rate of angular cheilitis could indicate that the subjects of our study are experiencing a very significant amount of vitamin B-complex and/or iron deficiency (both of which are significantly associated with inflammatory processes around the mouth) [22]. The results of this study strongly indicate that angular cheilitis is an important indicator of moderate-to-severe nutritional deficiency among the study population.

In this research, we found that hair changes were very common seen in 84.7%. This is significantly higher than the previously reported prevalence of hair changes such as 53% [18] and 45.5% [23] and lower than 37.93% of dry hair [3]. Wali *et al.* reported that 94.1% of malnourished patients had hair abnormalities [24], which is closest to our results and correlates strongly with the associations of malnutrition with hair shaft abnormalities. These findings are likely due to protein deficiencies affecting the synthesis of keratin and deficiencies in micronutrients such as zinc or biotin, which alter both pigmentation and the structure of the hair shaft, making it fragile.

Out of 196 cases, 66.8% showed pigmentary changes, which is similar to the 72.7% found by van den Brink *et al.* in children who were malnourished and hospitalized [23]. In contrast, Gonzalez *et al.* published data indicating the rate to be 31.48% [21]. According to Wali *et al.* [24], pigmentation changes in 90.2% of their 1 cases have been recorded and whilst they are slightly higher than those recorded in this study, there is a similar trend. These differences may be attributable to varying nutritional deficiencies, illness duration, and co-existing deficiencies of micronutrients; specifically, Vitamin A, Copper and an imbalance of protein and calories will all have an effect on the process of melanin formation.

In this study, 63.8% of children in this study showed subcutaneous fat loss, demonstrating significant wasting and chronic lack of energy. This is more than the 31% by Pandit *et al.* [18] and 16-20% by previous authors [20, 21]. It is feasible that most children have a higher prevalence of advanced malnutrition, and that fat stores deplete to a clinically measurable extent. This observation is congruent with pathophysiology of severe acute malnutrition whereby energy reserves are mobilized, resulting in significant tissue wasting.

Less frequently seen manifestations of malnutrition were ichthyosis and lichenified skin, which were reported to be present in 9.2% of our cohort. These were somewhat less than the previously reported prevalence rates of ichthyosis (7.4 - 16%) by other authors [18, 21, 23]. The lower rate in this study may be related to earlier presentation and possible different environmental exposures and/or secondary infections. Eczematous and lichen-planus-like lesions were also noted with a less than expected average of 25.5%, however, inflammatory dermatoses of malnourished children may be worsened by micronutrient deficiencies, such as zinc and vitamin D [25].

Taken together, the dermatological findings from this sample support the notion that skin findings are sensitive indicators of nutritional status. The consistency of xerosis, angular cheilitis, pigmentary changes, and changes in hair with previously described patterns across various geographic locations was evident [5, 18, 20, 21, 23, 24]. The frequencies of several of these characteristics suggest that the study population may have a greater degree or prevalence of severe or chronic malnutrition than those in which these characteristics have been documented.

STRENGTHS AND LIMITATIONS

This study's primary strength came from the relatively large sample size (n=196) and the thorough assessment of various dermatological manifestations within a pediatric population experiencing malnutrition, providing a detailed distribution of the frequency of cutaneous manifestations. Moreover, data presented in this study also served as a valuable comparative reference to international literature, indicating both general and specific patterns of nutritional dermatoses based on their context.

However, there are some limitations to note with this research. First, due to its cross-sectional design, this study does not allow for any causal relationship to be determined between specific type of nutritional deficiency and dermatological presentation. Second, due to the lack of biochemical or micronutrient level verification, establishing a precise etiology of the skin changes observed is impossible. Third, as this study took place in a single location; it may not be generalizable to individuals within different populations and from different socio-economic and nutritional backgrounds. Lastly, because no control group of those not suffering from malnutrition was included in this study, there is no comparative information that allows for the differences in prevalence between the two populations to be interpreted. Despite the limitations outlined above, this study provides significant evidence regarding the dermatological effects associated with pediatric malnutrition and highlights the importance of performing a skin examination early in a non-invasive manner in order to support nutritional assessment.

CONCLUSION

This study shows that malnourished children exhibit cutaneous and adnexal related disorders. Regardless of clinical spectrum, these dermatological manifestations frequently seen in malnourished children with angular

cheilitis, lusterless hairs and Xerodermia being the most common features.

AUTHORS' CONTRIBUTIONS

Romana Nisar: Conceptualization, study design, methodology, data analysis and interpretation, drafting the manuscript, and final approval of the version to be published.

Shabbir Ahmed Mallick: Study design, critical review and revision of the manuscript, and final approval of the version to be published.

Faiqa Qureshi and Ameer Shabbir: Methodology, data analysis and interpretation, drafting the manuscript, and final approval of the version to be published.

All authors approved the final version of the manuscript and agree to be accountable for all aspects of the work, ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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Declared none.

ETHICAL DECLARATIONS

Data Availability

The data supporting the findings of this study are included in the article. Further inquiries regarding the data may be directed to the corresponding author, subject to applicable ethical, privacy, and institutional requirements.

Ethical Approval

This cross-sectional study was conducted in the paediatric outpatient clinics of Liaquat National Hospital, Karachi, Pakistan, from 1st August 2024 to 1st August 2025. The study was approved by the Hospital Ethics Committee (Ref. No. App#1067-2024-LNH-ERC; dated: 24th July 2024).

Consent to Participate

Written informed consent was obtained from the parents or legally authorised guardians of all participating children before their participation in the study.

Consent for Publication

Written informed consent for publication was obtained from the parents or legally authorised guardians of par-

ticipants whose individual information, clinical details, images, or other potentially identifiable material are included in this article, where applicable.

Declaration of Competing Interest

The authors declare that they have no known financial or non-financial competing interests that could have influenced the work reported in this study.

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Use of AI-Assisted Technology

The authors used Claude (Anthropic), an artificial intelligence (AI)-assisted language tool, to assist with improving the language, grammar, readability, and formatting of the manuscript. The use of AI was limited to language-related assistance and did not involve data collection, data analysis, interpretation of results, generation of scientific conclusions, or decision-making related to the research. The authors critically reviewed and, where necessary, revised all AI-assisted content and take full responsibility for the accuracy, integrity, originality, and final content of the manuscript. No AI tool or system was listed as an author.

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