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The Prevalence and Association of Micronutrient Deficiencies with Hair Loss in Children and Adolescents: A Cross-Sectional Study

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A B S T R A C T

Background: Hair loss is one of the most frequent dermatological complaints that causes significant stress not only for adult patients but also for children and adolescents and their families. Since the latter are more prone to metabolic deficiencies, the association between this complaint and micronutrient deficiencies is worth evaluating. This study did not explore the prevalence of the disease among the specified age group but only found the association between micronutrient deficiency (vitamin D and iron) among the selected study sample.

Methods: a cross-sectional observational study, the study sample was taken from a dermatology clinic in the city of Sirte – Libya, over a time period of 6 months, patients were selected according to their clinical presentation (two main complaints: hair loss and alopecia areata) and according to age (from birth to 15 years old), after careful history, clinical examination and investigations, a total of 35 cases were included and their serum levels of Vit D, Ferritin and calcium were registered and analyzed by SPSS program.

Results: A total of 35 cases were evaluated, comprising 27 female and 8 male patients. The mean age of the participants was 11.03 years, with a median age of 12 years and a standard deviation of 3.50198. Of the cases examined, 29 patients (82.86%) reported experiencing hair loss, while 8 patients (17.14%) were diagnosed with alopecia areata. Within the hair loss group, 96.55% were found to have low levels of vitamin D, 34.48% presented with low serum calcium, and 68.97% exhibited low serum iron levels. Among the patients with alopecia areata, 83.3% had a deficiency in vitamin D, 50% had hypocalcemia, and 100% exhibited iron deficiency.

Conclusion: The findings indicate a significant prevalence of micronutrient deficiencies associated with hair loss and alopecia areata in children and adolescents. This observation may suggest a potential etiological relationship between these deficiencies and hair-related symptoms. Nevertheless, further large-scale studies are necessary to validate this association.

1 Introduction

Hair is regarded as a significant aspect of an individual's overall appearance, and scalp hair, in particular, has been linked with positive attributes such as beauty and power. Conversely, baldness or hair loss has been perceived negatively 1. Hair loss (either alopecia aerates or diffuse hair loss) is among the most frequent complaints that any dermatologist faces and it usually causes significant distress 2-3 not only for adults but also for children and young teenagers.

Hair loss can be related to several etiological factors, which vary according to gender, age, ethnic group, and other nutritional and developmental factors. Micronutrients are essential components in hair follicle growth and development, contributing to cellular turnover, which commonly occurs in the rapidly dividing matrix cells within the follicular bulb. Deficiency or insufficiency of such nutrients contributes to hair loss 4.

For alopecia aerate the lifetime incidence is about 2% worldwide 5 main age of presentation is recorded above 20 years old 5-6, while hair loss showed a prevalence ranging from 16% for 18-29 years of age to 40-60% for those older than 40 years (males more than females) 7-8, yet such figures for teenagers and children are not available.

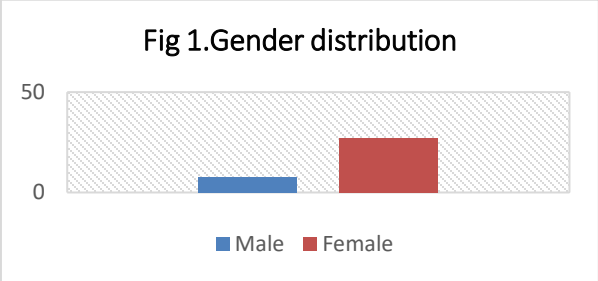
The prevalence and the relationship between hair symptoms and micronutrient deficiencies among children and young teenagers has not been comprehensively studied in the context of this research area. Consequently, this study aims to investigate the association between non-scaring hair loss and micronutrient deficiencies in children from birth to 15 years of age.

2. Materials and Methods

This study is an observational study dictated to examine the prevalence of particular micronutrient deficiency and hair-related symptoms (namely hair loss and alopecia areata) among the age group from birth to 15 years old, data collected from polyclinic visits to the dermatology clinic, in the city of Sirte – Libya, cases included to this study according to the presenting symptom and the age, during a time period from 1.3.2024 to 31.8.2024 , a full history was taken and full clinical examination was done to exclude all other causes of hair loss (such as infectious, scaring and psychological causes). A total of 35 cases were registered and included in this study, data was collected and analyzed by using SPSS software.

3. Results

A total of 35 cases were registered, 8 (22.9%) male patients and 27 (77.1%) female patients as shown in Figure 1. The mean age of the study sample is 11.0286, the median: is 12.0000 and the standard deviation: is 3.50198. the study sample was allocated into different age groups < 5, 6-10 and 11-15 years old as shown in Table 3.



The survey findings indicate that the overall prevalence of symptoms varied among different genders. Specifically, 29 cases, representing 82.86%, reported experiencing hair loss. Conversely, 8 cases, or 17.14%, indicated that they were affected by alopecia areata. This data is presented in the accompanying table (Table 1).

	gender		Total
	male	female	
hair loss	5	24	29
alopecia areata	3	3	6
Total	8	27	35

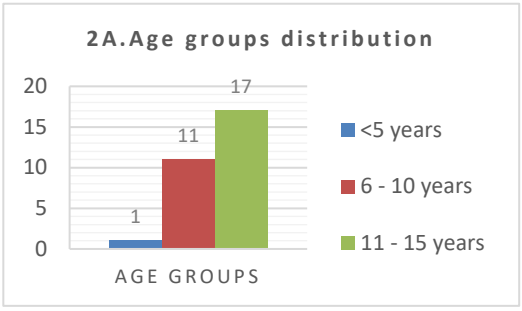
Tab 1.distribution of patients according to symptoms and gender.

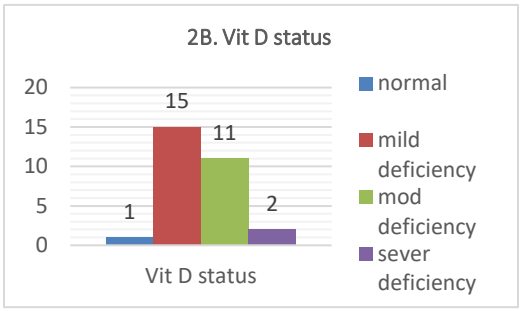
The micronutrients under survey were serum Vit D level, serum ferritin, and serum calcium, their descriptive statistics are shown in (Table 2).

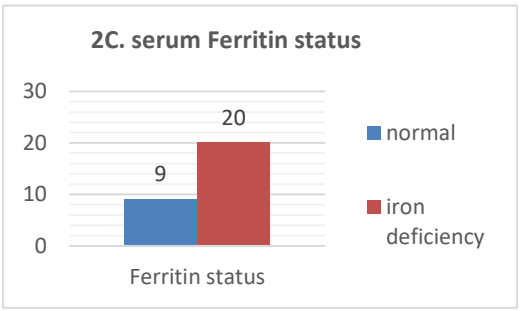
	S- ferritin	S- Vit D	S- Calcium
Reference range	>12 µg/L[9]	> 20 ng/ml[10]	>8.8 mg/dl[11]
Mean ± SD	10.57 ± 6.188	12.90 ± 7.191	8.79 ± 0.509
Median	9.0	12.0	8.9
% below range	74.3%	100%	48.57%
% normal range	25.7%	0.0%	51.43%

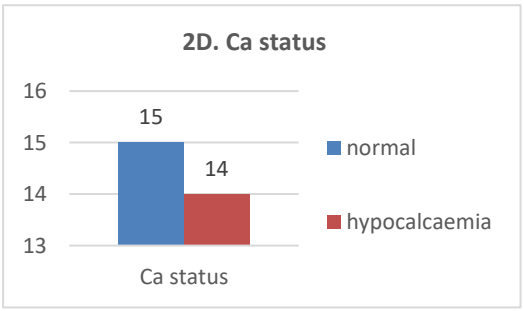
Tab 2.Biomedical results obtained from 35 cases complaining of hair loss symptoms

The hair-related symptoms under study were hair loss and alopecia areata, data analyses based on those symptoms are blotted in (table 3) and in Figures **2A-2D** and **3A-3D**.

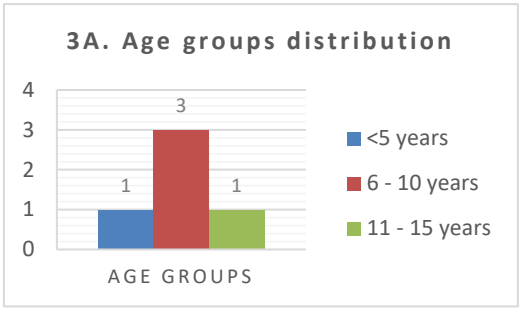


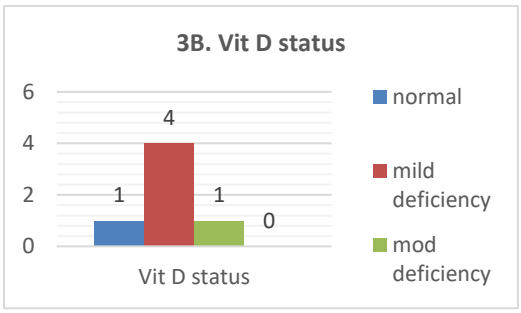


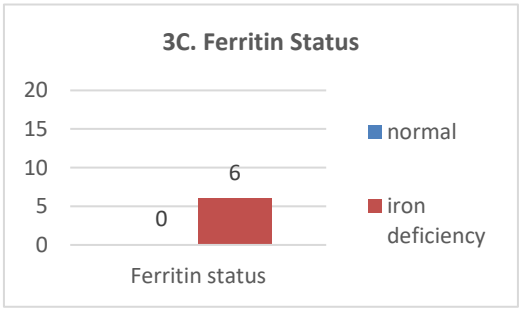


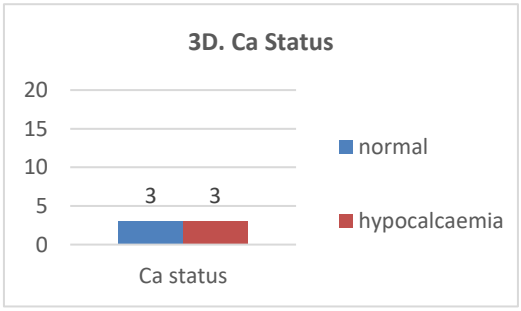


Figures 2A-2D. Hair loss group related figures : 2A: frequency of hair loss among different age groups. 2B: Vit D status among the group. 2C: serum ferritin status. 2D: serum calcium among this group.









Figures 3A-3D. Alopecia areata group related figures : 3A: frequency of hair loss among different age groups. 3B: Vit D status among the group. 3C: serum ferritin status. 3D: serum calcium among this group.

	FREQUENCY		AGE CATEGORIES*						VIT D STATUS*								Ca STATUS				IRON STATUS			
			<5		6-10		11-15		normal		mild deficiency		mod deficiency		sever deficiency		low		normal		low		normal	
hair loss	29	♂:5	1	♂:0	11	♂:2	17	♂:3	1	♂:0	15	♂:1	11	♂:2	2	♂:0	14	♂:3	15	♂:2	20	♂:5	9	♂:0
		♀:24		♀:1		♀:9		♀:14		♀:1		♀:14		♀:9		♀:2		♀:11		♀:13		♀:15		♀:9
alopecia areata	6	♂:3	1	♂:1	3	♂:1	1	♂:1	1	♂:0	4	♂:4	1	♂:1	0	♂:0	3	♂:2	3	♂:1	6	♂:3	0	♂:0
		♀:3		♀:0		♀:2		♀:0		♀:1		♀:0		♀:0		♀:0		♀:1		♀:2		♀:3		♀:0

Table 3. shows the frequencies of age groups, vitamin D status, serum calcium status and serum ferritin (iron) status in relation to the two clinical groups (alopecia areata and hair loss), frequencies shown in total and according to each gender separately.

* VitD status categorized as: normal at > 20 ng/ml, mild deficiency: <20 ng/ml, moderate deficiency at <10 ng/ml, and severe deficiency at <5 ng/m

Among the study sample, hair loss was more frequent than alopecia areata at 82.86% and 17.14% respectively.

In the hair loss group, the majority of cases were found in the oldest age category (11-15 years), with a predominance of females. Regarding vitamin D status in this group, 96.55% of cases exhibited low serum vitamin D levels, with 51.7% having mild deficiency, 37.9% moderate deficiency, and 6.9% suffering from severe deficiency. However, only 48.3% of the group showed low serum calcium levels. Additionally, 68.97% of the patients were experiencing iron deficiency (20 cases), while the remaining 31.03% (9 cases) had normal serum ferritin levels. In the alopecia areata group, they represented only 17.14% of the study sample, with the highest prevalence in the 6-10 year age group, where it was noted in 3 out of 6 alopecia areata cases. Among these patients, vitamin D deficiency was observed in 5 out of 6 individuals (83.3%), and half of the cases (3 out of 6 patients) were also suffering from hypocalcemia. Furthermore, all alopecia areata cases (100%) had serum ferritin levels below normal. In summary, across the entire hair loss group, 96.55% had low vitamin D levels, 34.48% had low serum calcium, and 68.97% had low serum iron levels. In contrast, within the alopecia areata cases, 83.3% had vitamin D deficiency, 50% had hypocalcemia, and 100% exhibited iron deficiency.

4. Discussion

The prevalence of alopecia areata and diffuse hair loss among children and adolescents in this country has not yet been examined, resulting in a lack of available epidemiological data. However, international studies conducted in comparable regions, such as the research by Nield LS et al. 2006, suggest that approximately 2% of the population may experience some form of alopecia at any point in their lives.

Diffuse hair loss was more common than patchy hair loss (alopecia areata) in the study group, with frequencies of 82.86% for diffuse hair loss and 17.14% for patchy hair loss. This finding contrasts with results from various studies, including those by Younis and Mahmoud 2020 , Moneib et al. 2017 from Egypt, Nnoruka et al. 2007 from Nigeria, Al-Refu 2013 from Jordan, and Shetty et al. 2021 from India.

The study revealed that a significant majority of cases, regardless of the presenting symptoms, demonstrated abnormally low levels of vitamin D and serum ferritin. Specifically, 33 out of the 35 cases exhibited low vitamin D levels, while 26 cases showed reduced serum ferritin levels

Vitamin D (1,25-$(OH)_2$D) binds to the Vitamin D receptor (VDR), found in organs related to calcium and bone metabolism, immune cells, and hair follicles. In hair follicles, VDR is expressed in mesodermal dermal papilla cells and epidermal keratinocytes, depending on the hair cycle stage. Lack of VDR causes a defective hair cycle, thus it (VDR) regulates the hair cycle independently of Vitamin D binding, furthermore, due to its immunomodulatory effects, vitamin D can help regulate the immune system, thereby potentially offering protection against various diseases and infections .

Numerous studies were found examining the relation between vitamin D and hair loss, *Thompson J.M. et al 2017* in a review study illustrated 5 case-control studies and one prospective cohort proved a strong relation between vitamin D serum levels and hair loss (Alopecia areata) in adults.

In another review, *Saini, K. and Mysore, V., 2021* found that there was an inverse relationship between serum vitamin D levels and different types of hair loss. In a further review *Gerkowicz, A. et al 2017* found that in the majority of the papers that they reviewed the mean serum levels of vitamin D were lower than normal when compared to the healthy adult's control. Other sporadic studies such as *Jasim, K.I. et al 2021*, *Naser, R.T. et al 2021*, *Al-makhzoomy et al 2024*, and *Salechaa, A.J. et al 2024* that included patients at ages 10 years old and older of both genders found that serum vitamin D and ferritin were lower than normal levels among patients with hair loss all of which is completely consistency with the findings of this study.

The relation between iron deficiency and hair loss was proved as early as 1932 by *Cunningham* in the animal study, and it was proven in humans in 1926 by *Hard, S* demonstrated the role of iron as a cause of diffuse hair loss among non-anaemic women.

Numerous studies have since confirmed the association between low iron levels and various types of hair loss. For instance, *Ruiz-Tagle, S.A et al 2018* reviewed 211 articles and papers and found a connection between low serum iron and hair loss in adults. Likewise, *Thompson J.M. et al 2017* . while *Almohanna, H.M. et al 2019* highlighted the impact of iron deficiency and low serum ferritin on hair loss in adult women specifically. Furthermore, *Treister-Goltzman et al 2022* in A meta-analysis showed that raising serum ferritin levels may benefit women experiencing hair loss. Other occasionally conducted research such as *Gowda, D et al 2017*, *Malkud, S., 2015*, *Poonia, K. et al 2019*, *Öner, Ü. and Akdeniz, N., 2022* revealed similar results.

Having said that, studying the prevalence of two dermatological complaints and micronutrient deficiencies revealed a relationship between two micronutrient deficiencies and two clinical presentations of hair loss, supported by several studies, despite differences in the sample age groups.

5. Conclusions

Micronutrients, may be associated with various forms of hair loss in children and adolescents. This is especially relevant given that these age groups are more susceptible to nutritional deficiencies. However, large-scale clinical trials are necessary to definitively establish this association.

6. Acknowledgements

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7. Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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