Can Hair Loss Assessments Predict the Severity of Zinc Deficiency in the Pediatric Population?

A Prospective Observational Study

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Abstract

Background and aims: Zinc deficiency causes many problems in adult and pediatric populations. However, the association between serum zinc levels and hair loss has not been well studied in pediatric populations. The aim of this study was to assess serum zinc levels in children with hair loss and to find other characteristics predictive of low zinc levels.

Materials and Methods: Data were collected from pediatric patients seen at pediatric and dermatology clinics affiliated with Mutah University, Jordan from January 2015 to January 2017. Detailed histories were taken and physical examinations were performed on all patients. Serum zinc levels and other relevant lab tests were performed in patients who had some form of hair abnormality.

Results: Of the 5200 cases examined, 7.7% (n=401/5200) had some form of hair abnormality. In the study population, 3.1% (n=162/5200) had both hair loss and zinc deficiency, with a mean zinc level of 51.3 μg/dL. Of those with zinc deficiency, 14.2% had patchy hair loss (mean zinc level: 32.8 μg/dL, P<0.001), 31.5% had diffuse hair loss (mean zinc level: 39.2 μg/dL, P<0.001), 58% had a scaly scalp (mean zinc level: 45.7 μg/dL, P<0.001), and 95.1% had hair texture or color changes (mean zinc level: 50.7 μg/dL, P=0.001).

Conclusion: Many factors predicted the severity of zinc deficiency in pediatric patients with hair abnormalities. Physical examination of the hair and scalp to assess for hair textures and color changes, diffuse hair loss, patchy hair loss, and scaly scalp, is a useful method for predicting the severity of serum zinc deficiency.

Keywords: Alopecia, Children, Hair loss, Predictive factors, Zinc deficiency.

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Introduction

Zinc is a trace element that is essential in countless metabolic pathways and cellular functions. It is involved in DNA and protein synthesis, and plays a role in wound healing, cell division, and immunity [1, 2]. Zinc deficiencies pose major health problems worldwide [3] and may result from decreased dietary intake, decreased intestinal absorption, or increased zinc losses via urine, stool, and sweat [4]. Patients with chronic diseases such as inflammatory bowel disease, malabsorption

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syndromes, chronic renal disease, liver cirrhosis, and alcoholism have increased risks of developing zinc deficiency [5].

The skin is the third largest zinc repository in the body. The epidermis has a higher concentration of zinc than the dermis, likely due to epidermal keratinocytes high zinc requirements for proliferation and differentiation [6]. Zinc inhibits hair follicle regression and aids in accelerating hair follicle recovery [7]. Hair and cutaneous manifestations such as alopecia and perioral, acral, or perineal dermatitis occur with moderate to severe zinc deficiencies [8].

Arguments that zinc deficiency negatively affects adult hair growth have emerged since the 1990s. A few studies have reported that zinc deficiency is associated with telogen effluvium and alopecia areata [9]. Little is known about zinc deficiency and hair loss in children. Collipp et al. investigated associations between the zinc levels found in infants' hair and their volume of scalp hair as well as the presence of diaper rash. The study showed that diaper rash and hair loss in otherwise normal infants correlated well with low zinc hair concentrations [10]. Another case reported hair dryness, brittleness, and diffuse progressive hair loss from dietary zinc deficiency [11]. However, reports of associations between serum zinc levels and hair loss are limited in pediatric populations. The aim of this study was to assess serum zinc levels in children with hair loss, and to find characteristics that predict low zinc levels.

Materials and Methods

Patient population and study design

This was an outpatient, clinic-based, prospective observational study conducted in pediatric and dermatology clinics in Jordan's Al-Karak teaching hospital. We developed and implemented a data collection protocol for all pediatric patients seen in those clinics from January 2015 to January 2017. We included patients with low serum zinc levels and one or more of the following: hair loss complaints (partial or diffuse), hair texture changes, regressing hair growth, and hair loss or scalp disorders on examination. We excluded patients with normal hair, normal serum zinc levels, and those taking multivitamins. We screened 5200 total patients (2800 in dermatology clinics and 2400 in pediatrics clinics). The local ethics committee approved the study protocol. Informed consent was obtained from the patients' parents prior to enrollment.

Clinical assessments

Detailed histories of the hair symptoms were taken including: type of hair loss (partial or diffuse), scalp symptoms, and changes in hair texture and growth. Patients were classified into three groups based on initial presentation. Group 1 comprised patients complaining of hair loss as their primary concern, group 2 comprised patients complaining of hair loss as a secondary concern alongside another more significant concern, and group 3 comprised patients without hair loss complaints. Detailed histories were taken regarding hair grooming/habits, tics, nail changes, cutaneous changes, systemic diseases (e.g. cystic fibrosis, celiac disease, cow's milk allergy, or enteritis), family history of similar conditions or autoimmune diseases, and medication history. Economic status was assessed based on the per capita family income. Economic status classifications comprised high, upper-middle, lower-middle, or low income, according to World Bank data as of July 1, 2017. Dietary histories were taken, focusing mainly on picky eating behaviors that excluded animal products (meat, poultry, fish), and decreased diversity of foods. Patients that showed signs of picky eating from 2 to 3 years of age were considered to have early-onset picky eating, whereas patients with picky eating around 4.5 to 5.5 years of age were considered to have late-onset picky eating. Patients starting as early-onset picky eaters and continuing with picky eating behaviors were considered persistent picky eaters [12].

Scalp examinations included scalp skin assessments for erythema, scales, and follicular plugging. Hair examinations included assessments of hair texture, fragility, color, and root examinations. Other hairy sites including the eyebrows and eyelashes were examined for hair loss.

Anthropometric measures assessed included weight for height, height for age, and weight for age. Nutritional indices values were converted into Z scores (standard deviations) using data from the 2000 Centers for Disease Control (CDC) growth charts, and the interpretations followed World Health Organization (WHO) recommendations.

Biochemical assessments

Total zinc concentrations in patients' sera were measured using an automated chemistry analyzer (Biosystem BT-350 module, Spain). Low zinc levels were defined by a serum zinc < 70 µg/dL. Hemoglobin, ferritin, and vitamin D levels were also obtained to assess nutritional status. Anemia was defined as hemoglobin < 11 g/dL. Ferritin was considered deficient if the level was <12 ng/mL for children younger than 5 years and <15 ng/mL for children older than 5 years. Vitamin D was considered deficient when it was <25 nmol/L.

Other investigations included sweat chloride tests for cystic fibrosis and tissue transglutaminase antibody IgA screens for celiac disease. These tests were occasionally performed to confirm the presence of systemic diseases. Thyroid function, antinuclear antibody, and other auto antibodies blood tests were also performed if the tests were deemed necessary.

Statistical methodology

In this study, 5 main statistical tests were used, namely, the independent Student's T-test, analysis of variance (ANOVA), Pearson's Chi-Square test, Fisher's exact test, and multiple linear regression analysis. The Student's T-test and ANOVA were used to analyze the mean zinc levels. The Chi-Square test was used to find associations between two categorical variables (such as sex and presentation). Multiple linear regression analysis was used to create a model that could predict a patient's serum zinc level based on clinical characteristics.

The tolerable maximum probability of a type 1 error in this study was 0.05 (i.e. $\alpha = 0.05$). Any P-value below 0.05 was considered statistically significant. SPSS Statistics V.21 software (IBM Corp., Armonk, NY) was used for the statistical analysis.

Results and Discussion

Of the 5200 cases examined, 7.7% (n=401/5200) had some form of hair abnormality. In the study population, 3.1% (n=162/5200) had both hair loss and zinc deficiency, with a mean zinc level of 51.3 µg/dL. The patients' ages ranged from 1 month to 14 years, and the mean was 4.8 years.

Table 1 summarizes the factors associated with mean zinc level differences. There was no statistically significant difference between the mean zinc levels in boys and girls, or between the age groups. The patient's sex had no significant association with zinc levels overall. However, in patients who complained primarily of hair loss (i.e. Group 1), boys had a significantly lower mean zinc level than girls (43.2 and 50.1 respectively, P=0.043). Furthermore, girls were almost 5 times more likely to complain primarily of hair loss than boys (P<0.001).

Ferritin deficiency was not associated with lower mean zinc levels. However, patients with anemia or vitamin D deficiency had lower mean zinc levels than patients without such deficiencies. Anemia or vitamin D deficiency was not correlated with the patients' initial presentation (P=0.140 for anemia, and P=0.584 for vitamin D).

Patients who were aware of their hair loss (Groups 1 and 2) had significantly lower mean zinc levels than patients who were not (group 3). Diffuse hair loss, patchy hair loss, scaly scalp, hair texture or color changes, or skin manifestations were all associated with lower mean zinc levels. Table 2 summarizes the mean zinc values based on the history and physical examination findings.

Patients with lower weight for age z scores, height for age z scores, and weight for height z scores had lower mean zinc levels. A family history of hair loss was associated with a decreased mean zinc level. There was no major difference between mean zinc levels in the four different income categories.

The majority of patients in this study population (92.6%) had no systemic diseases. In most cases, zinc deficiency and hair loss were most likely associated with dietary issues. Of the 162 patients in this study, 137 were grouped based on their diet, but the other 25 were too young to be classified. Of those that were classified, 24.1% were early picky eaters, 32.1% were late picky eaters, 16.8% were persistent picky eaters, and 27% were never picky eaters. Persistent picky eaters had the lowest mean zinc level (38.7 µg/dL), followed by early picky eaters (46.0 µg/dL), late picky eaters (55.4 µg/dL), and finally, the never picky eaters (61.8 µg/dL) (P<0.001, F=65.4). Patients with underlying systemic illnesses had significantly lower mean zinc levels than those without systemic illnesses (36.6 and 52.5 µg/dL respectively, P<0.001, T=5.1). Of the 12 patients with underlying systemic diseases, 7 had disorders that are known causes of zinc deficiency and presented with hair loss and some other major complaint. Of the 7 patients with additional complaints, 3 had celiac disease (Mean zinc: 31.6 µg/dL), 3 had cystic fibrosis (27 µg/dL) and 1 had hereditary acrodermatitis enteropathica (25 µg/dL). The other 5 comprised 4 patients with cow's milk allergy (43.3 µg/dL) and 1 patient with hypothyroidism (30 µg/dL).

In a stepwise multiple linear regression analysis, a significant regression equation was produced that predicted approximately 83% of the variability in serum zinc levels ($F(10,151) = 71.23$, $P < 0.001$, $R^2 = 0.8251$) as shown in Fig. 1. Table 3 shows the coefficients (B) for each variable with their respective P values. The factors were used in the analysis if the patient met any of the following parameters: noticed hair abnormality (Groups 1 and 2); had stunted growth; were picky eaters at any point; had a family history of hair loss; had an underlying illness; had vitamin D deficiency; had positive physical examination findings of hair texture and color changes, diffuse hair loss, patchy hair loss, scaly scalp, and/or skin manifestations. The strongest predictors were the physical examination findings. The strongest predictive physical examination finding was hair texture and color changes, which reduced the predicted serum zinc level by -9.85 µg/dL.

Zinc is a cofactor for most of the known human enzyme subtypes. The wide range of presentations of zinc deficiency can delay diagnosis and allow progression to severe and dangerous deficiency levels [1, 5] which, if untreated, can potentially be fatal [5, 13]. The manifestations of severe zinc deficiency include diarrhea, weight loss, alopecia, bullous pustular dermatitis, recurrent infections, poor ulcer healing, emotional disorders, neurosensory disorders, and hypogonadism in boys and men [13]. Recognizing cases of zinc deficiency and estimating its severity using mainly clinical information is invaluable for avoiding complications.

We showed that 3.1% of the pediatric population in this study had hair abnormalities associated with low serum zinc levels, indicating that zinc deficiency is an important cause of hair loss in adults and children, and should be part of the differential diagnosis.

We found that if patients were aware of their hair loss and complained about it (as a primary or secondary complaint), they were more likely to have lower zinc levels than those found to have hair loss on physical examination only. Patchy hair loss seemed to be associated with the lowest zinc levels. Diffuse hair loss, hair texture and color changes, scaly scalp, and skin manifestations were also predictive of low zinc levels.

Anemia and vitamin D deficiency were associated with lower mean zinc levels. This could mean that anemia and vitamin D deficiency are clues to nutritional defects that might also cause zinc deficiency. Although nutritional sources of iron and zinc overlap significantly [14, 15], low ferritin levels was not significantly correlated with lower zinc levels. This was probably due to the small number of patients in this study without ferritin deficiencies. A larger sample size would be useful to reach a conclusion regarding ferritin. Notably, neither anemic nor vitamin D-deficient patients had increased likelihoods of presenting with hair loss as the primary complaint.

Both sex and age were poor predictors of zinc levels in our whole patient sample. However, when boys complained of hair loss primarily, their severe zinc deficiencies were much more severe than their female counterparts with the same complaint. Girls were almost 5 times more likely to have hair loss as their primary complaint than boys, which might be due to greater parental concerns for cosmesis in girls. Therefore, boys may tend to present later with more severe deficiencies and other non-hair related symptoms.

Height-for-age is an important functional indicator identified in previous studies that helps to establish a diagnosis of zinc deficiency [16]. This study also showed significant associations with serum zinc levels, not only in height for age, but also in weight for age and weight for height anthropometric parameters. Patients who were severely underweight had the lowest mean zinc levels compared to any other anthropometric characteristics. However, in the linear regression model, height for age was the only significant factor that predicted serum zinc levels. This finding corresponds well with previous studies. A positive family history or an underlying illness also predicted lower serum zinc levels.

Low dietary zinc intake or poor absorption of zinc can cause dietary inadequacies [17]. In low-income developing countries, the diets of large portions of the population are primarily plant-based, including foodstuffs such as cereals, which are known to have high phytate contents. Foods with high phytate levels inhibit zinc absorption. Young children with these diets are at a high risk of zinc deficiency, which is likely due to the increased dietary zinc requirements needed to sustain their growth [18]. There are no reserves or body stores of zinc, except possibly in infants [19], hence, a relatively continuous dietary supply of zinc is required. Most patients in this study (92.6%) had hair loss due to zinc deficiencies that were associated with dietary problems rather than underlying diseases (such as the patient in Fig. 2). Serum zinc deficiencies and hair loss in patients with dietary problems were less severe and progressed more slowly compared to patients with underlying diseases. From this we can conclude that low-resource settings predispose patients to mild or moderate zinc deficiencies. In contrast, this study showed that family income was a poor predictor of serum zinc levels. This may be explained by the picky eating behaviors associated with all income categories.

Picky eaters tended to have reduced meat, seafood, whole-grain products, and unsweetened cereal intake, and tended to have increased intake of confectionary cereals, savory snacks, and French fries, compared to non-picky eaters [20, 21]. Based on this fact, we can argue that the reduced diversity of food intake in picky eaters likely increased the risk of zinc deficiency, which ultimately caused their hair loss. In this study, the persistent picky eaters had the lowest zinc levels among all the types of picky eaters. Moreover, picky eating behavior seemed to be associated with how the patient presented ($\chi 2$ = 21.71, P=0.001). Patients who were never picky eaters were less likely to complain of hair loss than patients who had some sort of picky eating behavior, especially persistent picky eating.

Acrodermatitis enteropathica results from one of the most severe forms of zinc deficiency and serum zinc concentrations are usually extremely low (<30 µg/dL) [22]. It represents a genetic hair disorder caused by a nutritional zinc deficiency [23]. Other examples of disorders with symptoms caused by poor absorption of dietary zinc are celiac disease and cystic fibrosis. Children with celiac disease have many clinical features similar to those with zinc deficiency, such as diarrhea, anorexia, and short stature [23, 24]. Zinc deficiency in cystic fibrosis typically presents later in infancy and manifests as faltering growth, diarrhea, and dermatitis, similar to acrodermatitis enteropathica [25, 26]. In cystic fibrosis and celiac disease, hair loss may be attributed to zinc deficiency. Hypothyroidism is a well-known cause of hair loss. Zinc deficiency can sometimes result in hypothyroidism, which can be masked in children. Furthermore, hypothyroidism can result in further zinc deficiency as thyroid hormones are essential for the absorption of zinc [27]. The novel finding in this study, with regard to systemic diseases, was hair loss observed in patients with cow's milk allergy. It could be argued that zinc deficiency due to chronic enteritis may increase hair loss and other skin manifestations. We also found that systemic diseases associated with zinc deficiency were not a very common cause of hair loss. However, the symptoms in these patients were more obvious. Particularly in the patients with alopecia, the serum zinc deficiency was more severe. Interestingly, the most severely affected patient was a 2-month-old underweight infant with acrodermatitis enteropathica, complicated by severe failure to thrive and hair loss that included almost the whole scalp. This infant had a serum zinc level of 25 µg/dL (normal zinc levels range from 70 to 120 µg/dL). Overall, the presence of any of the above diseases was predictive of lower serum zinc levels.

One of the main strengths of this study was the relatively large number of patients screened (5200), which allowed our sample to be fairly representative of the local pediatric population. Furthermore, many variables were considered before finding the most predictive factors for serum zinc levels. The main weakness of this study is that patients with normal serum zinc levels were not considered. This precludes the ability to make any strong conclusions with regard to those patients. Therefore, the predictive factors found in this study can only be applied to pediatric patients with zinc deficiency-related hair loss.

Conclusion

Many factors are predictive of the severity of zinc deficiency in pediatric patients with hair-related symptoms or signs. A physical examination of the hair and scalp to assess for hair texture and color changes, diffuse hair loss, patchy hair loss, and scaly scalp was valuable for predicting serum zinc levels. The presence of underlying diseases and picky eating also predicted lower serum zinc levels. Zinc deficiency-related hair loss is prevalent in Jordan, so routine hair and scalp examinations should be part of any pediatrician's physical examination. Further studies to assess the usefulness of clinical assessments for hair loss and skin manifestations to directly predict zinc deficiency-related complications would be clinically useful.

Data Availability

No data were used to support this study.

Conflict of Interests

The authors declare there are no conflicts of interest.

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None.

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Table 1. Factors associated with differences in mean zinc levels

Characteristic		Percentage (n=162)	Mean zinc level ± 1 SD (µg/dL)	P value *
Sex	Girls	61%	50.2 ± 12.2	0.302
	Boys	39%	52.1 ± 10.5	
Age	Less than 2 years	15.4%	47.4 ± 13.1	0.097
	Between 2-6 years	56.8%	51.4 ± 10.5	
	Above 6 years	27.8%	53.4 ± 11.2	
Anemia	Present	27.2%	47.5 ± 13.1	0.006
	Not present	72.8%	52.8 ± 10.0	
Vitamin D	Deficient	18.5%	41.9 ± 13.7	<0.001
	Sufficient	81.5%	53.5 ± 9.3	
Ferritin	Deficient	3.1%	44.8 ± 12.8	0.180
	Normal	96.9%	51.6 ± 11.1	

Characteristic		Percentage (n=162)	Mean zinc level ± 1 SD (µg/dL)	P value *
Weight for age (Z score)	Normal	86.4%	53.4 ± 9.4	<0.001
	Underweight	9.3%	44.2 ± 12.0	
	Severely underweight	4.3%	26.4 ± 4.0	
Height/length for age (Z score)	Normal	87.7%	52.7 ± 10.2	<0.001
	Stunted	9.3%	41.8 ± 12.8	
	Severely Stunted	3.1%	41.6 ± 16.8	
Weight for height/length (Z score)	Normal	74.7%	52.9 ± 9.7	<0.001
	Wasted	17.3%	50.1 ± 11.5	
	Severely Wasted	8%	39.8 ± 16.1	
Family history	Present	51.5%	47.7 ± 10.8	<0.001
	Absent	48.5%	54.8 ± 10.5	
Income	Low	4.9%	46.0 ± 13.8	0.290
	Low-middle	59.9%	50.9 ± 11.6	
	High-middle	33.3%	53.2 ± 9.8	
	High	1.9%	47.7 ± 11.0	

* T-test was performed when two independent variables were present, analysis of variance (ANOVA) test when three or more independent variables were present

Table 2. Estimation of differences in mean zinc levels in patients with hair loss

Characteristic		Percentage (n=162)	Mean zinc level ± 1 SD (µg/dL)	P value *
Presentation of patients[†]	Group 1	21.6%	49.3 ± 6.5	<0.001
	Group 2	32.1%	45.8 ± 13.0	
	Group 3	46.3%	56.1 ± 9.4	
Diffuse hair loss	Present	31.5%	39.2 ± 9.6	<0.001
	Absent	68.5%	56.9 ± 6.4	
Patchy hair loss	Present	14.2%	32.8 ± 8.8	<0.001
	Absent	85.8%	54.5 ± 8.2	
Hair texture and color changes	Present	95.1%	50.7 ± 11.0	0.001
	Absent	4.9%	64.4 ± 2.4	
Scaly scalp	Present	58%	45.7 ± 11.1	<0.001
	Absent	42%	59.1 ± 4.8	
Skin manifestations	Present	30.2%	44.5 ± 12.2	<0.001
	Absent	69.8%	54.3 ± 9.3	

*T-test was performed when two independent variables were present, analysis of variance (ANOVA) test when three or more independent variables were present

[†] Group 1 had hair loss as their primary concern, Group 2 had hair loss as a secondary concern, Group 3 did not complain of hair loss

Table 3. Factors used in the multiple linear regression model

Characteristic	Coefficient (B–Value)*	P value *
Hair texture and color changes	-9.85	<0.001
Diffuse hair loss	-5.57	<0.001
Patchy hair loss	-6.06	<0.001
Scaly scalp	-6.97	<0.001
Skin manifestations	-4.56	<0.001
Stunted growth (Z score less than -2)	-4.26	0.001
Presentation of patients†	-1.58	0.083
Picky eating history	-3.41	<0.001
Underlying disease	-4.12	0.013
Vitamin D deficiency	-4.27	<0.001

*The constant in this model was 73.32

†Group 1 and Group 2 patients were aware of their hair loss, group 3 were unaware

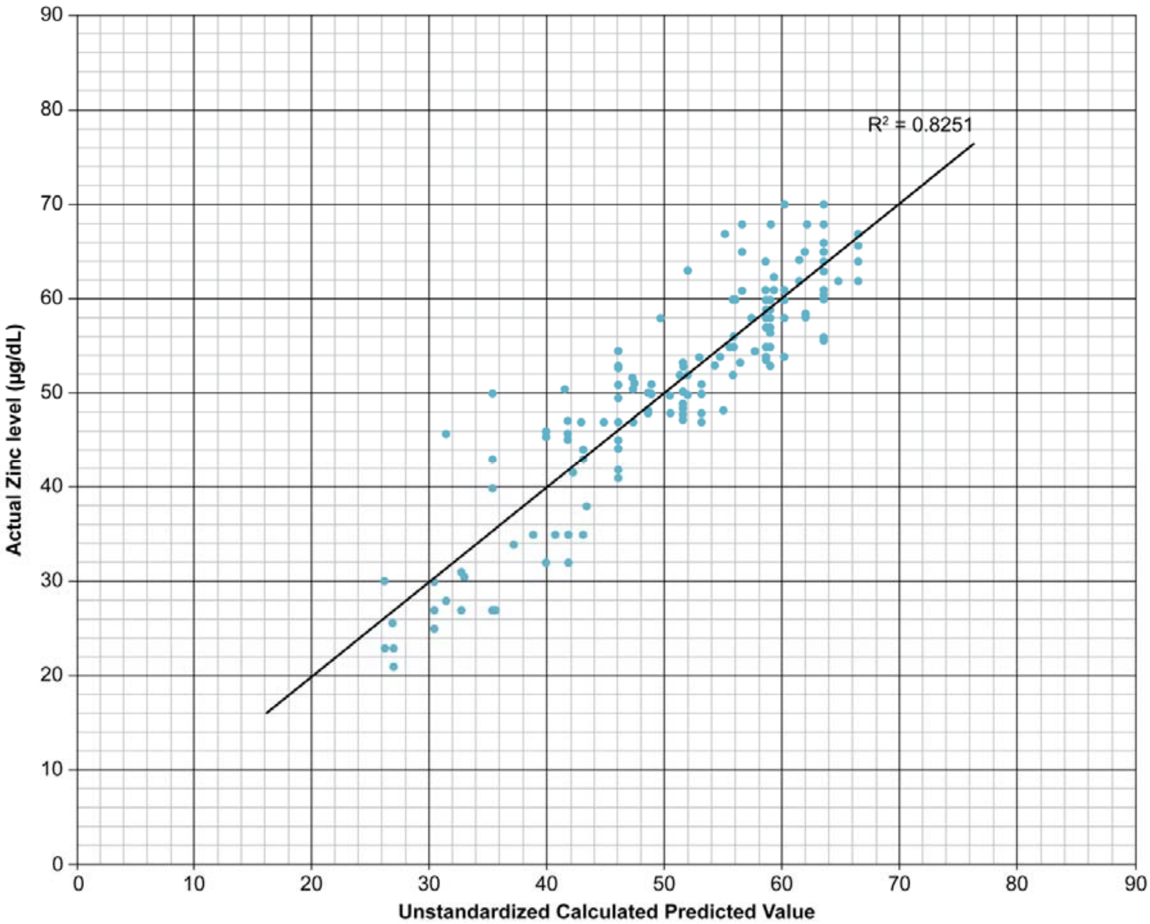

Fig. 1. The linear relationship between the calculated predicted value of serum zinc levels and the actual serum zinc levels

Fig. 2. A 13-year-old female patient with diffuse hair loss and dietary zinc deficiency, which persisted for several months

References

[1] Sandstead, H. H "Understanding Zinc: Recent Observations and Interpretations," *J Lab Clin Med* , 1994,vol. 124, pp. 322–327.

[2] Hussain, A. M., Saldanha, P. R. M., Sharma D. et al., "Estimation of Zinc Levels in Children with Lower Respiratory Tract Infections: A Prospective Observational Study from India,". *Pediatr Neonatal Nurs Open J.* , 2016. 2(3): 91–98.

[3] Muhamed, P. K and. Vadstrup, S "Zinc is the Most Important Trace Element," *Ugeskr Laeger*, 2014, 176 (5):. 431–433.

[4] Arlette, J. P. "Zinc and the Skin," *Pediatr Clin North Am* , 1983,30(3):. 583–596.

[5] Evans, G. W. "Zinc and its Deficiency Diseases," *Clin Physiol Biochem* , 1986,4(1):. 94–98.

[6] Ogawa, Y. Kawamura T. and Shimada, S. "Zinc and Skin Biology," *Arch Biochem Biophys* , 2016, vol. 611, pp. 113–119.

[7] Plonka, P. M. Handjiski, B. Popik M. et al., "Zinc as an Ambivalent but Potent Modulator of Murine Hair Growth In Vivo- Preliminary Observations," *Exp Dermatol* , 2005, 14(11): 844–853.

[8] Corbo, M. D. and Lam, J. "Zinc deficiency and its management in the pediatric population: A literature review and proposed etiologic," *J Am Acad Dermatol* , 2013s 69(4):. 616–624.

[9] Kil, M. S., Kim ,C. W. and Kim, S. S. "Analysis of Serum Zinc and Copper Concentrations in

Hair Loss," *Ann Dermatol* , 2013, 25(4):. 405–409.

[10] Collipp, P. J., Kuo, B. ,Castro-Magana, M. et al., "Hair Zinc, Scalp Hair Quantity, and Diaper Rash in Normal Infants," *Cutis* , 1985, 35(1):. 66–70

[11] Alhaj, E., Alhaj N. and Alhaj, N. E. "Diffuse Alopecia in a Child Due to Dietary Zinc Deficiency," *Skinmed* , 2007. 6. (4):. 199–200.

[12] Taylor, C., Northstone, K., Wernimont S. and Emmett, P. "Macro- and Micronutrient Intakes in Picky Eaters: A Cause for Concern?" *Am J Clin Nutr* , 2016. vol. 104, pp. 1647–1656.

[13] Prasad, A. S. "Clinical and Biochemical Manifestations of Zinc Deficiency in Human Subjects," *J Am Coll Nutr* , 1985. 4(1):. 65–72.

[14] Hunt, J. R. "Bioavailability of Iron, Zinc, and Other Trace Minerals from Vegetarian Diets," *Am J Clin Nutr* , 2003, 78(3):. 633S–639S.

[15] Gibson, R. S; Heath. A. L. and Szymlek-Gay, E. A. "Is Iron and Zinc Nutrition a Concern for Vegetarian Infants and Young Children in Industrialized Countries?" *Am J Clin Nutr* , 2014, 100(1), :459S–468S.

[16] Fischer Walker, C. L. and Black, R. E. "Functional Indicators for Assessing Zinc Deficiency," *Food Nutr Bull* , 2007, vol. 28, pp. 454–479.

[17] Lowe, N. M. Dykes, F. C., Skinner A. L. et al., "EURRECA _ Estimating Zinc Requirements for Deriving Dietary Reference Values," *Crit Rev Food Sci Nutr* , 2013, vol. 53, pp. 1110–1123.

[18] Alves, C. X. Neves de Brito, N. J. Vermeulen, K. M. et al. "Serum Zinc Reference Intervals and its Relationship with Dietary, Functional, and Biochemical Indicators in 6- to 9-year-old Healthy Children," *Food Nutr Res* , 2016, vol. 60, p. 30157.

[19] Coni, P. Ravarino, A. Farci, A. M. et al. "Zinc Content and Distribution in the Newborn Liver," *J Pediatr Gastroenterol Nutr* , 1996, 23(2):125–129.

[20] Tharner, A. Jansen, P. W. Kiefte-de Jong, J. C. et al., "Toward an Operative Diagnosis of Fussy/Picky Eating: A Latent Profile Approach in a Population-based Cohort," *Int J Behav Nutr Phys Act* , 2014,vol. 11, p. 14.

[21] B. R. Carruth, P. J. Ziegler, A. Gordon and S. I. Barr, "Prevalence of Picky Eaters among Infants and Toddlers and their Caregivers' Decisions about Offering a New Food," *J Am Diet Assoc* , 2004, vol. 104, pp.57–64.

[22] Krebs, N. F. "Update on Zinc Deficiency and Excess in Clinical Pediatric Practice," *Ann Nutr Metab* , 2013 , 62(S1): 19–29.

[23] Finner, A. M. "Nutrition and Hair," *Dermatol Clin* ,2013 ,31(1):. 167–172.

[24] Hogberg, L., Danielsson, L., Jarleman S. et al., "Serum Zinc in Small Children with Coeliac Disease," *Acta Podiatry*, 2009. vol. 98, pp. 343–345.

[25] Krebs, N. F. Sontag, M., Accurso F. J. and Hambidge, K. M. "Low Plasma Zinc Concentrations in Young Infants with Cystic Fibrosis," *J Pediatr* , 1998.133(6): 761–764.

[26] Wenk, K. S. Higgins K. B. and Greer, K. E. "Cystic Fibrosis Presenting with Dermatitis," *Arch Dermatol* vol. 146, pp. 171–174, 2010.

[27] Betsy, A., Binitha M. and Sarita, S. "Zinc Deficiency Associated with Hypothyroidism: An Overlooked Cause of Severe Alopecia," *Int J Trichology* 5(1):. 40–42, 2013.

هل تتنبأ تقييمات تساقط الشعر بخطورة نقص الزنك في الأطفال؟ دراسة رصدية

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الملخص

خلفية البحث: نقص الزنك يسبب مشاكل كثيرة عند المرضى البالغين والأطفال، ومع ذلك فإن العلاقة بين مستويات الزنك في الدم وفقدان الشعر لم يتم دراستها بشكل جيد في الأطفال. تهدف هذه الدراسة إلى تقييم مستويات الزنك في الدم لدى الأطفال الذين يعانون من تساقط الشعر وإيجاد عوامل أخرى ممكن أن تنبئ بمستويات الزنك المنخفضة.

الطريقة: تستند هذه الدراسة إلى أخذ عينات من الأطفال الذين زاروا عيادات الأطفال وعيادة الأمراض الجلدية في مستشفى الكرك التعليمي في الأردن. وشوهد ما مجموعه 5200 مريض. كان البروتوكول على النحو التالي: إذا اشتكى مريض من تساقط الشعر عند القدوم إلى العيادة أو تبين أنه قد حدث تساقط للشعر أو تغير في فروة الرأس بالمصادفة في الفحص السريري، فإنه يتم أخذ عينات من الدم للتأكد من نقص الزنك. فإذا تبين وجود نقص الزنك، يتم تضمين المريض في الدراسة. إضافه إلى تحليل عدة عوامل أخرى مثل نوع تساقط الشعر، للتحقق من وجود ارتباطات لهذه العوامل بمستويات الزنك في المصل.

النتائج: من الحالات الـ (5200) التي تم فحصها، كان لدى 7.7٪ (ن = 5200/401) من العينة مشاكل في الشعر، وكان لدى 3.1٪ من عينة الدراسة (ن = 5200/162) فقدان للشعر ونقص الزنك معا، وكان متوسط مستوى الزنك لأفراد العينة 51.3 ميكروغرام / ديسيلتر. من هؤلاء الذين يعانون من نقص الزنك، 14.2 ٪ لديهم تساقط شعر غير مكتمل بمتوسط مستوى الزنك: 32.8 ميكروغرام / ديسيلتر ($P < 0.001$)، 31.5 ٪ لديهم تساقط شعر منتشر بمتوسط مستوى الزنك: 39.2 ميكروغرام / ديسيلتر ($P < 0.001$)، 58 ٪ كان لديهم تقشر في فروة الرأس بمتوسط مستوى الزنك: 45.7 ميكروغرام / ديسيلتر

($P < 0.001$)، وكان 95.1 ٪ لديهم تغير في ملمس أو لون الشعر بمتوسط مستوى الزنك: 50.7 ميكروغرام / ديسيلتر، ($P = 0.001$).

الخلاصة: العوامل التي تنبأت بأدنى مستويات الزنك في المصل هي: ملمس الشعر غير الطبيعي ولونه، وفقدان الشعر المنتشر، وفقدان الشعر غير المحدود، وتقشر فروة الرأس، ومظاهر الجلد الأخرى، ونقص فيتامين (د)، ونمو التقزم. نوصي عند العثور على هذه العوامل في أي مريض، إلى زيادة الشكوك حول نقص مستويات الزنك في مصل الدم.

الكلمات الدّالّة: تساقط الشعر،الأطفال، تساقط الشعر، عوامل التنبأ، نقص الزنك.