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Evaluation of Nutritional Status and Heavy Metals Toxicity for Asthmatic Children

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Abstract: The present study aimed to investigate blood heavy metals toxicity for asthmatic children and their nutritional status. One hundred children suffering asthma attending the Al-Galaa Teaching Hospital during winter were enrolled in the study. Data was collected by personal interview with their mothers to fill a special questionnaire sheet (socioeconomic and clinical characteristics, anthropometric measurements and 24h dietary recall). Results showed most parents had (10–12 years) of education levels. The majority of fathers were smoking at the same room with their children. All children had high blood levels of lead (B-Pb) and cadmium (B-Cd). Most children were intake less than 50% of DRI from fiber, vitamins (A, D, B_1 and B_2) and minerals (K and Mg). There were a negative significant correlation between B-Pb and both Hb and animal protein (r = 0.312 and r = 278, P <0.05, respectively). There were a significant correlation between B-Cd and bilirubin (r = -0.381, P <0.05). Also, there were adverse significant correlation between plasma K and both urea and creatinine (P <0.01). It is concluded preventing heavy metals poisoning in early childhood is an essential component of strategy to improve the health success.

Keywords: Children, Nutritional Status, Heavy Metals, Asthma, Dietary Intake, Liver and Kidney Function

1. Introduction

Prolonged exposure to pollutants, especially those emitted by motor vehicles, is associated with high levels of hospitalizations for cardiorespiratory morbidities and can negatively affect children's cognitive development [1]. This situation is aggravated in winter due to the increase in thermal inversions which make it more difficult for primary air pollutants to disperse, provoking episodes of acute pollution.

Greater attention is paid to air pollution in cities and industrial regions; however, various epidemiological studies have revealed health consequences even when pollution levels are below the limits permitted by Brazilian legislation [2]. The environment is considered in terms of the most tangible aspects like air, water and food, and the less tangible, though no less important, the communities we live in [3]. A pollutant is any substance in the environment, which causes objectionable effects, impairing the welfare of the environment, reducing the quality of life and may eventually cause death. Such a substance has to be present in the environment beyond a set or tolerance limit, which could be either a desirable or acceptable limit [4]. El-Desoky *et al*, [5] also stated that street dust comprises various heavy metals including Pb, Cd and Cu. Infant exposure to Pb may have highly toxic influences on nervous system and thus reduce children's intelligence. Moreover, [6] found that, there was a positive correlation between monthly frequency of rhinitis and concentration of pollutants, and negative with relative air humidity. Even with levels of air pollutants below that allowed by law, the prevalence of asthma, rhinitis and associated symptoms tended to be higher in the central region school, where there is heavy vehicular traffic.

The prevalence of allergic airway diseases has increased dramatically during the past few decades in both industrialized and industrializing countries alike. Although

genetic factors are important in the development of allergic airways diseases, this rapid increase over recent years can only be explained by the changes that have been observed in the environment [7]. Although asthma is a multifactorial disease, an immune/inflammatory response ultimately is followed by the development of allergic inflammatory diseases when the genetically predisposed individual encounters key environmental factors [8]. According, [9] reported that, air pollutants also may cause severe respiratory problems in the children during their developmental stages.

These environmental factors include infections, allergens, tobacco smoke, and environmental toxicants [10]. There is strong evidence that indoor air pollution, such as secondhand smoke and the use of biomass, is a risk factor for respiratory infections in children [11].

Numerous studies suggest that significant decreases in the intake of dietary antioxidants have led to an increased vulnerability of the pulmonary airways to reactive oxygen species and thus this may be an important contributing factor to the increasing incidence of asthma over the last three decades [12]. Also, [13] found that, the LEP (low esterified pectin) and HEP (high esterified pectin) have beneficial effects which could be able to antagonize lead toxicity. Moreover, LEP was contributed to fast elimination of the lead acetate to blood, organs and bones, whereas HEP removed lesser amount of lead. It could be recommended that LEP has a good effect to bind material of lead and should be incorporated into human food to reduce the hazards toxicity of lead pollution of food and water.

Fagerstedta et al., [14] who stated that, from previously studies shown that the anthroposophic lifestyle is associated with reduced risk of allergic disease in children, but details on the influencing environmental factors are largely unknown. While, they concluded that, an association between anthroposophic lifestyle and higher concentrations of Cd, Co and Pb. As smokers were excluded from their study, the higher concentrations of Cd are likely a result of a diet rich in plant-derived foods and/or iron status of the mothers. However, it remains to be elucidated which specific aspects in the anthroposophic lifestyle contribute to the increased exposure to Cd, Co and Pb.

Krajčovičová-Kudláčková et al. [15] concluded that, the significantly higher mean blood cadmium concentration was measured in vegetarian group when comparison to non-vegetarian group. The highest cadmium content was found in vegan subgroup and that value decreased with increasing animal food consumption (which added dairy products and egg or fish and poultry). Healthy risk values were found in 8% of vegetarians vs. no non-vegetarian. Cadmium risk vegetarians vs. cadmium non-risk vegetarians consume the significantly higher amounts of whole grain products, grain sprouts and oil seeds. Cadmium blood concentration is directly influenced by age, whole grain product intake and duration of vegetarianism.

The aim of this study was to determine levels of some blood heavy metals (lead, cadmium and copper) and some minerals (Fe, Ca, P, Na and K) in children's who admitted to

Pediatric Department, at Al Galaa Teaching Hospital and repeated bronchial asthma. Assess the nutritional status and anthropometric measurements to correlate between it and children health status.

2. Subjects, Materials and Methods

2.1. Subjects

One hundred children (60 boys and 40 girls) aged (1-9 years) were randomly chosen from Pediatric patients admitted to pediatric department through the period from (December 2010) to (February 2011). Data was collected by personal interview with each mother to fill a special questionnaire sheet, which included their clinical characteristics, socioeconomic characteristics of the children's parents and families. Questionnaire sheet also included the quantity and sufficiency of food and beverages consumed by each child during the last 24hrs was collected and their anthropometric measurements. Blood sample from each child was taken to determine levels of some heavy metals, some minerals and complete blood count. Also, kidney and liver functions were determined for only 60% of children because blood samples of the rest (40%) were not sufficient. Table 1 summarized the children characteristics.

Before starting this study a written approval was taken from the hospital director, head of pediatric department and a written consent from children's mothers who will accept to interview with her and their child included in this study.

2.2. Materials

Nitric acid and percholoric acid were purchased from Sigma–Aldrich (St. Louis, MO, USA). Kits used to determine plasma urea, creatinine, ALT, AST, ALP and minerals were punched from Gamma-Tread Company, Cairo Egypt.

Table 1. Characteristics of examined children.

Items	Children groups		
	1-3 years (n=50)	4-6 years (n=30)	7-9 years (n=20)
Height (cm)	85.54±7.99	104.67±6.83	122.05±7.35
Weight (kg)	12.88±2.75	18.03±3.32	25.05±5.26
BMI (kg/m^2)	17.58±2.87	16.48±2.78	16.74±2.69
Mid arm circumference; MAC (mm)	14.98±1.31	15.95±1.09	17.74±1.15
Triceps skin fold; TSF (mm)	11.64±1.40	11.20±1.93	12.00±2.49
Head circumference; HC (mm)	47.60±1.71	49.23±1.87	50.80±2.04

3. Methods

3.1. Anthropometric Measurements

Height, weight, mid arm circumference (MAC), triceps skin fold (TSF) and head circumference (HC) for each child were recorded following the method of [16]. The anthropometric measurements evaluations were compared to

reference values computerized by World Health Organization/ United Nations Children's Fund (WHO/UNIEF) reference population [17]. The evaluation represents Height-for-age Z score (HAZ), Weight-for-age Z score (WAZ), Weight-for height Z score (WHZ), (MAC), TSF and body mass index (BMI). Using the WHO AnthroPlus Software (Version 10.4, 2010) [18]. The children were classified using three indices:

1. Under weight (low weight for age).
2. Stunting (low height for age).
3. Wasting (low weight for height)

The extent of malnutrition is expressed as the percentage following below two standard deviations from the reference population median.

3.2. Dietary Intakes

The intakes of energy, protein, carbohydrates, fat, fiber, minerals and vitamins were calculated using computer software of [19]. The nutrients intakes were compared to [20, 21, 22, 23 and 24].

Nutrients adequacy were classified into five categories:

1. < 50% of RDA/ DRI was considered unsafe level of consumption.
2. 50- < 75% of RDA/ DRI was considered unacceptable level of consumption and need improvement.
3. 75-<100% of RDA/ DRI was considered acceptable level of consumption.
4. ≥ 100% of RDA/ DRI was considered adequate level of consumption.

3.3. Biochemical Analysis

The blood samples were transferred into glass tubes containing heparin. After determination of complete blood count (CBC). Then, taken 1 ml of whole blood to determine lead, cadmium, copper and iron. After that, plasma was separated by centrifugation and stored frozen (-20˚C) until analyzed.

a) Blood hemoglobin; Hb (g/dl), red blood cells; RBC ($x10^6/\mu l$), white blood cells; WBC ($x10^3/\mu l$) and platelets ($x10^3/\mu l$) were determined by Coulter counter M_4 (30) system according to the method of [25]. Alanine amino transferase (ALT) and Aspartate-amino transferase (AST) were determined according to [26]. While, plasma alkaline phosphatase (ALP) was determined according to [27]. Plasma creatinine, urea and BUN were determined according to [28 and 29]. Plasma total bilirubin was measured using the method of [30].

b) Determination of lead, cadmium, iron and copper: A 1-ml aliquot of each blood sample was then wet-digested in duplicate with electronic grade niric acid and perchloric acid. Digested samples were made up to 10 ml using dionswater. An important factor in estimating the trace metal concentrations in blood samples is the blank value of the reagents and materials used. Extreme care was taken to avoid all contamination. Only reagents with low background impurities were used. Together with each batch of seven

samples, reagent blanks were taken through the whole procedure to assess the blank values for each metal, and also positive or negative contamination during the decomposition procedure [31]. Using Perkin- Elmer model 4100 Z. L spectrophotometer with atomic absorption and a graphite oven [32].

c) Plasma calcium ionized and phosphorus levels were estimated calorimetrically by the method given by [33]. Plasma sodium and potassium contents determined calorimetrically by using methods of [34 and 35].

3.4. Statistical Analysis

Data was statistically analyzed using SPSS software program, Version 17.0 [36]. Descriptive statistical analysis including mean± standard deviations, percentages and Correlation coefficients were performed. The level of significance was fixed at 0.01 and 0.05.

4. Results and Discussion

Lead has been known and used in hundreds of products and processes over millennia. Research conducted over the past century in particular, has produced unequivocal evidence of the harm caused by lead, especially in fetal stage and young children. For example, even at low levels in blood, lead has been associated with hearing loss, learning difficulties and poor school performance, lower levels of tertiary educational attainment and a decline in lifetime earnings. Studies have also shown that widespread lead exposure has a depressive effect on community prospects and on economies. Recently, it has associated lead exposure with elevated levels of aggression or violence. At highly elevated levels, a range of clinical effects have been demonstrated, including anemia, damage to a range of organs, permanent muscular paralysis, coma or death [37]. Nicolussi, *et al.* [6] reported that, a higher prevalence of medical diagnoses of asthma, rhinitis and associated symptoms were found among pupils in region, where there is heavy vehicle traffic and, therefore, a higher concentration of pollutants. Compromised air quality, as an exogenous component, together with other biological, economic and/or social factors, are significant aggravators of allergic diseases [38].

Table 2 illustrates socioeconomic characteristics of the children's family. From this table it could be noticed that, more than half (56% and 58%) of the mothers and fathers aged (21-30) and (31-40) years old, respectively. Regarding educational status of parents, the majority of mothers and fathers (44% and 36%) were finished (10-12) years. Also, the high percentage of mothers (78%) were housewives. Meanwhile, 38% of fathers are working as laborers followed by the fathers had a private work (30%).

The results revealed that, 66% of fathers were smokers and almost half (48.49%) were smoked at the same room with their children. The majority (88%) of children belonged to simple families and their income (62%) did not exceed 500 L. E. Most 70% of these families had (1-3) children.

Concerning clinical characteristics of children Table 3

revealed that, most children come from urban (86%). And, 40% of children were second or third child in their families. The majority (84%) of children had repeated admission 2-3 times on the hospital. While, more than half (52%) of them were inpatient and half of them (53.8%) were admitted (5-7 days). Sixty four percent of children had positive family history to asthma. High percentages (48% and 46%) of children had good and accepted appearance, respectively. The most diagnosis was mentioned that, the majority of children were suffering by anemia.

Table 2. Socioeconomic characteristics of the children's family.

Items	No.	%
Mother's age (19–45 years):		
≤20	2	2
21-30	56	56
31-40	34	34
≥41	8	8
Mother's education: (by years)		
Illiterate	30	30
1-6	14	14
7-9	12	12
10-12	44	44
Mother's occupation		
Housewife	78	78
Laborer	6	6
Employee	8	8
Private	8	8
Father's age (20-70 years)		
Dead	2	2
20–30	16	16
31–40	58	58
41–>50	24	24
Father's education: (by years)		
Illiterate	24	24
1-6	24	24
7-9	16	16
10-12	36	36
Father's occupation:		
Dead	2	2
Laborer	38	38
Employee	20	20
Private	30	30
Retried or without work	10	10
The place of father's smoking (n=66):		
At the same room	32	48.49
Other room	16	24.24
Outside the house	18	27.27
No. of children in the family:		
1–3	70	70
4–5	26	26
6–7	4	4
Type of family:		
Simple	88	88
Complex	4	4
Extended	8	8
Income (LE):		
≤ 250	20	20
251–500	42	42
501–750	20	20
751–1000	18	18

Table 3. Children distribution according to their clinical characteristics.

Items	No.	%
Child region		
Urban	86	86
Rural	14	14
Rank:		
First	36	36
2-3	40	40
≥4	24	24
No of repeated admission		
2-3	84	84
4-9	16	16
Situation of the child during interview:		
Inpatient	52	52
Outpatient	48	48
Period of admission (inpatient n=52)		
3-4 days	24	46.16
5-7 days	28	53.8
Family history to asthma		
Positive	64	64
Negative	36	36
Child appearance:		
Good (7-10)	48	48
Accept (5->7)	46	46
Not accepted (less than 5)	6	6
Diagnosis:		
Normal	16	16
Microcytic hypochromic anemia	50	50
Leucocytosis, relative lymphocytosis	4	4
Microcytic hypochromic anemia, eosinophilia	4	4
Normocytic normochromic anemia	4	4
Microcytic hypochromic anemia, Relative neutropenia	4	4
Relative lymphocytosis	2	2
Normocytic normochromic anemia, leukocytosis	8	8
Microcytic hypochromic anemia, Leucocytosis, relative lymphocytosis	2	2
Normocytic normochromic anemia, eosinophilia	2	2
Normocytic normochromic anemia, Relative lymphocytosis	4	4

In this respect, [39] reported that, asthma is the most common chronic illness among US children and is most prevalent in low income and minority groups. Meanwhile, the prevalence of asthma was 10.6% among poor children, compared with 5.6% among children in the highest income category. According, [40] found support for a childhood Socio- Economic Status (SES) effect, whereby each decrease in SES was associated with an increased health risk. Childhood injury showed stronger relationships with SES at younger ages.

The results in table 4 showed that the hemoglobin (Hb) was a similar in three groups (10g/dl). The findings are a line with [31 and 41] who found decrease in Hb with increase of B-Pb concentration. The mechanism for the observed association between lead and anemia remains confounded because both lead poisoning and iron deficiency are associated with a variety of circumstances related to lower socioeconomic status [41]. Children aged (4-6 years) were the highest levels of RBC and WBC compared to children aged (1-3 years and 7-9 years). While, they were the lowest level of platelet. The Pb, Cd, Cu and Fe were estimation in whole blood. The blood lead in children was a high level (252.36, 183.83 and 198.52μg/dl) for 1-3, 4-6 and 7-9 years,

respectively. Children aged (1-3 years) were a high levels in B-Pb and B-Cd in compared to other children. These results may be due to the child in this age put everything in his/her mouth however, increased the pollution. The present findings of study are the highest levels of B-Pb compared to earlier studies [42, 31, 43, 41 and 44]. Also, all children were high levels of B-Cd (10 – 50 µg/dl). This result is represent the health risks as reported by [45]. These results were higher than the results reported by [31, 46 and 15]. The high levels of B-Cd in the present study may be due to the most common sources of environmental Cd exposure are diet and smoking as reported by [46] and heavy metal can contaminate food local industrial pollution, Phosphate fertilizer and some plastic products [47]. While, the B-Fe in all children ranged between 34.82 to 36.96 mg/dl. These findings were almost similar with [31] who found B-Fe (34.5 mg/dl) in Hyderabad, India. Evens *et al.* [48] found higher lead exposures among children belonged to lower income, very low birth weight and /or born to mothers with less education. These factors are likely due to higher lead exposures resulting from residence in poorer quality housing and higher lead communities.

***Table 4.** Mean ± SD of some hematological indices for studied children.*

Items	Children groups		
	1-3 years (n=50)	4-6 years (n=30)	7-9 years (n=20)
CBC			
Hb (g/dl)	10.01±1.44	10.41±1.46	10.00±1.23
RBC (X10^6/µl)	3.99±0.57	4.01±0.50	3.70±0.49
WBC (X10^3/µl)	7.82±2.80	8.68±3.97	7.64±1.91
Platelet (X10^3/µl)	211.64±147.00	180.53±180.43	191.90±167.56
Whole blood minerals			
Pb (µg/dl)	252.36±156.76	183.83±109.64	198.52±65.10
Cd (µg/dl)	10.00±0.19	40.00±0.03	50.00±0.02
Fe (mg/dl)	36.96±13.98	34.82±17.63	36.73±12.79
Cu (mg/dl)	0.92±1.19	1.30±1.41	1.12±1.75
Plasma minerals			
Ca ionized (mg/dl)	4.50±0.35	4.50±0.29	4.670.26
P (mg/dl)	4.09±2.62	3.75±2.28	3.67±2.07
Na (mg/dl)	312.78±9.26	311.65±9.86	308.04±11.84
K (mg/dl)	15.41±0.86	14.72±1.82	15.11±1.57
Liver and kidney functions*			
Urea (mg/dl)	19.50±2.68	20.13±3.76	23.13±4.76
BUN (mg/dl)	9.11±1.25	9.40±1.76	10.80±2.22
Creatinine (mg/dl)	0.68±0.14	0.73±0.15	0.80±0.17
AST (U/l)	17.93±2.56	17.75±2.71	18.25±2.76
ALT (U/L)	16.57±3.25	17.25±3.85	17.63±3.46
ALK (IU/L)	124.00±14.38	126.75±10.01	113.25±9.02
Bilirubin	0.41±0.03	0.34±0.02	0.40±0.03

* Children numbers; 1-3 years (n=28), 4-6 years (n=16) and 7-9 years (n=16).

***Table 5.** Means ± SD for some nutrients intake during 24h recall.*

Items	Mean ± SD	% of RDA, (1998)*							
		< 50		50 - < 75		75 - < 100		≥ 100	
		No.	%	No.	%	No.	%	No.	%
Energy (Kcal)	875.29±373.01	54	54	20	20	18	18	8	8
Protein (g)	38.47±27.79	18	18	12	12	10	10	60	60
Fat (g)	19.32±13.57	--	--	--	--	--	--	--	--
T. CHO (g)	136.87±62.19	10	10	--	--	24	24	66	66
T. fiber (g)	2.29±2.16	98	98	2	2	--	--	--	--
Vitamin A (IU)	100.24±160.54	82	82	4	4	8	8	6	6
Vitamin D (µg)	1.36±2.55	89	89	--	--	3	3	8	8
Vitamin C (mg)	21.03±9.67	18	18	30	30	42	42	10	10
Vitamin B$_1$ (mg)	0.26±0.22	64	64	16	16	12	12	8	8
Vitamin B$_2$ (mg)	0.32±0.43	64	64	16	16	12	12	8	8
Ca (mg)	293.93±126.00	42	42	48	48	4	4	6	6
Fe (mg)	4.82±0.3.67	40	40	24	24	10	10	26	26
P (mg)	555.42±108.20	8	8	--	--	--	--	92	92
Na (mg)	1314.29±1355.84	28	28	14	14	18	18	40	40
K (mg)	942.85±532.06	90	90	10	10	--	--	--	--
Mg (mg)	45.89±31.32	68	68	20	20	8	8	4	4
Zn (mg)	3.54±2.76	28	28	8	8	24	24	40	40
Cu (mg)	0.44±0.69	42	42	16	16	18	18	24	24

Table 6. *Correlation coefficient between some studied variables (n= 100 child).*

Items	Height	Weight	Family history	Repeated admission	Period of admission	Child region	Diagnosis	WBC	RBC	Hb	AC	HC	K	Na	Ca	B-Fe	B-Cu	P	B-Pb	B-Cd
Height	1																			
Weight	0.872**	1																		
Family history	-0.03	-0.112	1																	
Repeated admission	-0.006	-0.028	-0.068	1																
Period of admission	-0.295*	-0.241*	0.036	0.097	1															
Child region	0.156	0.095	0.062	-0.021	-0.008	1														
Diagnosis	-0.076	-0.135	0.285*	-0.218	0.176	-0.246*	1													
WBC	-0.029	-0.16	0.234	0.076	0.173	0.064	0.579**	1												
RBC	-0.208	-0.322*	0.144	0.278*	-0.019	0.068	-0.043	0.300*	1											
Hb	0.008	-0.033	0.228	0.143	-0.181	0.106	-0.231	0.053	0.728**	1										
AC	0.749**	0.785**	-0.098	0.14	-0.159	0.009	0.191	-0.086	0.015	-0.214	1									
HC	0.636	0.684	0.084	0.053	-0.263*	-0.143	0.108	0.005	-0.175	-0.001	0.511**	1								
K	-0.006	0.122	-0.014	0.083	-0.022	0.003	-0.13	0.004	-0.036	0.107	-0.108	0.115	1							
Na	-0.003	0.112	-0.229	0.021	0.086	-0.07	0.005	-0.175	-0.15	-0.227	0.264*	0.063	-0.148	1						
Ca	0.2	0.11	0.238*	0.138	-0.214	0.193	-0.032	0.247*	0.348**	0.282*	0.243*	0.073	0.087	-0.277*	1					
B-Fe	0.033	0.012	0.055	0.208	-0.132	0.083	-0.056	0.197	0.107	0.002	0.237*	0.023	0.021	-0.089	0.179	1				
B-Cu	0.028	-0.098	-0.07	-0.026	-0.138	0.188	-0.065	0.116	-0.002	-0.052	-0.037	-0.211	0.015	-0.243*	0.07	0.323*	1			
P	-0.177	-0.104	0.056	0.484**	0.052	-0.014	-0.196	0.116	0.196	0.153	0.073	-0.033	0.122	-0.270*	0.149	0.577**	0.192	1		
B-Pb	-0.159	-0.112	0.039	-0.095	0.142	-0.057	0.00	0.069	-0.086	-0.312*	0.019	-0.211	-0.012	-0.034	0.12	0.265*	-0.073	-0.087	1	
B-Cd	-0.108	-0.159	0.04	-0.067	0.231	0.048	0.148	-0.021	0.104	0.149	-0.18	-0.02	-0.021	0.031	-0.075	-0.17	-0.091	-0.117	-81	1

* Correlation is significant at the 0.05 level. ** Correlation is significant at the 0.01 level.

The results in same table 4 showed that the serum Na and K were in normal levels in children. Also, all liver and kidney functions were a normal range except AST was a high of normal level for children.

The results in table 5 showed that the nutrients during 24h recall and compared to the Dietary Reference Intakes (DRI). The majority of children were intake less than 50% of DRI of fiber, vitamins (A, D, B_1 and B_2) and minerals (K and Mg). More than half of children (54%) were energy intake less than 50% of RDI. Also, the results showed that, 60% of children were total protein intake more than 100% of RDI, followed by 18% of them were total protein intake less than 50% of RDI. Two-third of children (66%) were total carbohydrates intake more than 100% of RDI, then 24% of them were ranged (75 - <100%) of RDI. While, about 40% of children were less than 50% of DRI for Ca and Fe intake. Moreover, most of children (92%) were intake P more than 100% DRI. While, (40%) of children were intake Na and Zn above 100% DRI.
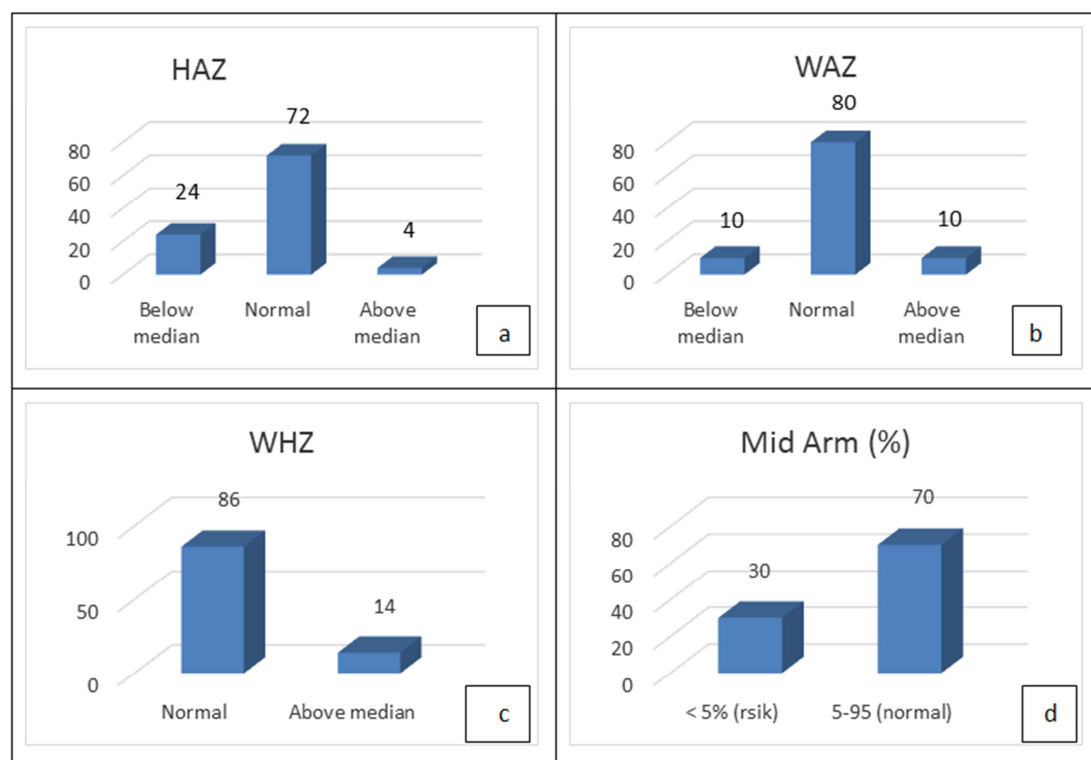
Prevalence of below median, normal and above median were presented in fig. 1, using Z- scores based on the standard growth curves for WHO/UNICEF (2009) as reference population. Height-for-age Z score (HAZ) for children recorded (24%) stunting, then 4% only were above median. Weight-for-age Z score (WAZ) results showed that, 10% of children were both below and above median (<- 2 SD and > + 2 SD) respectively. Concerning, weight-for-height Z score (WHZ), the results showed, 14% of children were above median. All children had a normal TSF. Moreover, BMI for all of children were ranged (16.48 - 17.58%) as

shown in table 1. These results were agreement with [49] who found the same range and [50] for WAZ in children in Beni-Suef Governorate, Egypt. While, the results are not in the line with [51] who found a high level values in South Sinai compared this study in Cairo and [50] who found more than 50% of children had stunting (<- 2 SD) in school children in Beni-Suef Governorate, Egypt. These findings may be due to the differences between samples criteria.

The results in table 6, it could be seen there are a significant positive correlation between B-Pb and B-Fe (r = 0.265, P< 0.05). While, there were advisable correlation between B-Pb and each Hb and head circumference (HC). Meanwhile, there were appositive correlation B-Cu and B-Fe (r = 0.323, P< 0.05). Also, there are a negative correlation between B-Cu and serum Na (r = 0.243, P< 0.05). However, there were negative correlation between B-Cd and each B-Fe, B-Cu, B-Pb, plasma Ca and WBC but without significant differences. Moreover, there were a positive correlation between plasma Ca and each family history of asthma, WBC, RBC and Hb (P< 0.05) while, a negative correlation with plasma Na (P< 0.05). There are a significant correlation between diagnosis and family history of asthma (r = 0.285, P< 0.05). The statistical analysis reported in table 6, there were a positive significant correlation between RBC and times of staying (r = 0.278, P< 0.05), but negative correlation with child weight (r = 0.322, P< 0.05). However, there are a positive significant correlation between plasma P and B-Fe (r = 0.577, P< 0.01). There were a positive correlation between diagnosis and WBC (r = 0.579, P< 0.01).

Table 7. *Correlation coefficient between some minerals contents and each of some nutrients intake, kidney and liver functions (n= 60 child).*

Items	Minerals contents							
	K	Na	Ca	B-Fe	B-Cu	P	B-Pb	B-Cd
Total protein intake	-0.130	0.199	0.050	0.056	-0.099	0.114	-0.103	0.078
Animal protein intake	0.011	-0.042	-0.218	0.213	0.064	0.166	-0.278*	0.038
Fat intake	-0.130	-0.153	0.308*	0.275	0.072	-0.013	0.122	-0.066
Vitamin C intake	0.100	-0.077	0.267	0.197	-0.011	0.284*	0.163	0.014
Vitamin B$_1$ intake	-0.133	0.321*	0.198	0.106	-0.095	-0.039	0.045	0.007
Vitamin B$_2$ intake	0.091	0.205	0.133	-0.061	-0.140	0.079	-0.063	-0.025
Zn intake	0.005	0.145	0.215	-0.289*	-0.113	0.195	-0.015	-0.-23
Cu intake	0.048	0.294*	-0.038	0.106	-0.085	0.070	0.043	-0.112
Urea (mg/dl)	-0.557**	-0.212	0.172	0.164	0.027	-0.114	0.157	0.031
Creatinine (mg/dl)	-0.568**	-0.113	-0.005	-0.050	-0.030	-0.252	0.226	0.083
Bilirubin (mg/dl)	-0.041	-0.059	-0.043	-0.195	-0.206	0.089	-0.167	0.381*
AST (U/l)	-0.128	-0.100	0.337*	0.040	-0.135	-0.103	0.098	-0.244
ALT (U/L)	0.029	-0.162	0.230	0.097	-0.046	-0.101	0.053	-0.226
ALK (IU/L)	-0.027	0.173	0.114	-0.043	0.072	0.197	-0.161	0.124

Fig. 1. *Anthropometric measurements according to reference values for studied children.*

The statistical analysis for correlation coefficient between some mineral contents and each some nutrients intake, kidney and liver functions are shown in table 7. There were a negative significant correlation between B-Pb and animal protein intake (r = 0.278, P< 0.05). This result are agree with [15] who reported that, the heavy metal levels were decreased by increasing animal food consumption. Also, there were a negative significant correlation between B-Fe and Zn intake (r = 0.289, P< 0.05). Meanwhile, there are a significant correlation between plasma Na and each vitamin B$_1$ and Cu intake. There were a positive correlation between plasma P and vitamin C intake (r = 0.284, P< 0.05). Concerning kidney and liver functions, the results in the table

7 showed that, there were a negative significant correlation between plasma K content and each urea and creatinine (P< 0.01). While, there are a positive correlation between B-Cd content and bilirubin (r = 0.381, P< 0.05). These results may be due to the largest amounts of Cd (75%) are deposited in liver and kidneys, which they cause a hepatotoxicity and nephrotoxicity. The accumulation and toxicity of cadmium in humans depend on various factors, such as the daily intake, the form of cadmium in food and its multiple interaction with dietary components mainly with calcium, zinc, selenium and iron [15].

Children in less developed nations are more likely to be subject to environmental lead exposure, more likely to

absorb lead through the gastrointestinal tract because of iron and other nutritional deficiencies, and may be more susceptible to the effects of blood-borne lead on the central nervous system because of poor nutrition. The inverse association between B-Pb and cognitive function in poor children in a developing country with a high prevalence of anemia and folate deficiency [41].

The results are in the lines with [31 and 41] who found a negative significant correlation between B-Pb levels and Hb content of children. The inverse association may be causal, in theory related to parallel gastrointestinal uptake of iron and lead [41]. The authors motioned too, children who are poorly nourished are more susceptible to the negative cognitive effects of lead once it is present in their blood. Independent of their anthropometric status, many reflect the importance of nutritional predisposition to the effects of lead. While, the results are in the lines too with [31] who found a negative correlation between B-Pb and B-Cu, and [53] who found inverse correlation between B-Fe and B-Cd in human.

5. Conclusion

Heavy metals exposure remains a critical problem for most regions in Egypt. This problem may be causing health at – risk children. Preventing heavy metals poisoning in early childhood is an essential aim of strategy to improve health success. Also, increasing intakes form animal protein to prevent health hazards resulting from exposure to heavy metals. Therefore, prevention of environmental pollution by heavy metals is importance in terms of public health.

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