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北京市方庄地区儿童全血微量营养素含量检测结果分析

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摘要 目的:通过分析北京市方庄地区儿童全血微量营养素的含量及影响因素,研究探讨微量营养素缺乏的防治措施。**方法:**2011年1月至12月北京中医药大学东方医院儿科门诊1887例健康体检儿童,收集末梢血,采用原子吸收光谱仪检测全血5种微量营养素铜、锌、钙、镁、铁的含量,并从性别、年龄、季节(月份)方面进行比较分析。**结果:**全血5种微量营养素含量无性别差异($P>0.05$),但存在季节差异,4-6月铜、锌含量降低;7-9月钙、镁含量降低;10-12月铁含量降低($P<0.05$)。全血锌、铁含量存在年龄差异,婴幼儿最低($P<0.05$)。1887例儿童中,缺乏较多的元素依次为铁(38.8%)、钙(22.3%)、锌(12.8%),其中,4-7岁(17.0%)、7-12岁(21.5%)年龄段组以锌缺乏居多。1岁以内(51.2%)、1-3岁(44.6%)年龄段组以铁缺乏居多。全血铜、锌、钙、铁缺乏无性别差异($P>0.05$)。全血5种微量营养素缺乏存在季节差异,1-3月镁缺乏明显,4-6月铜、锌缺乏明显,10-12月钙、铁缺乏明显($P<0.05$)。**结论:**北京市方庄地区儿童主要存在锌、钙、铁的缺乏,以秋冬季及初春明显。其中婴幼儿以铁缺乏为主,学龄前期及学龄期儿童以锌缺乏为主。应加强对该地区儿童的营养宣教和饮食指导。

关键词:微量营养素;儿童;北京方庄;影响因素

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Analysis of Micronutrient Content of Whole Blood in Beijing Fangzhuang Children

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ABSTRACT Objective: Analysing micronutrients content in Beijing Fangzhuang Children's whole blood, identifying the influencing factors, and researching the prevention measures of Micronutrient deficiencies. **Methods:** 1887 cases of peripheral blood of healthy outpatient children from the Dongfang Hospital of Beijing University of Traditional Chinese Medicine from January 2011 to December 2011 were collected. Whole blood contents of copper, zinc, calcium, magnesium and iron were examined using atomic absorption spectroscopy. The comparative analysis of gender, age and season was also conducted. **Results:** there were no differences in micronutrient content of whole blood among different genders ($P>0.05$), but among different seasons; Copper and zinc content decreased from April to June, calcium and magnesium content decreased from July to September, iron content decreased from October to December ($P<0.05$). Whole blood content of zinc and iron showed difference among different age groups, the lowest being infant ($P<0.05$). From the 1887 cases of children, the most lacking elements were iron (38.8%), calcium (22.3%) and zinc (12.8%). Among different age groups, the most zinc deficient age groups were 4-7 years old (17.0%) and 7-12 years old (21.5%). Among different age groups, the most iron deficient age groups were less than a 1 year old (51.2%) and 1-3 years old (44.6%). Whole blood content of copper, zinc, calcium and iron deficiency showed no difference among different genders ($P>0.05$). There were different whole blood micronutrient deficiencies among different seasons; from January to March, significant magnesium deficiency was shown; from April to June, significant copper and zinc deficiency was shown; from October to December, significant calcium and iron deficiency was shown ($P<0.05$). **Conclusion:** Beijing Fangzhuang children had showed zinc, calcium and iron deficiency, and these deficiency of elements was evident in autumn, winter and early spring. Infant mainly showed iron deficiency, and preschool and school-age children mainly showed zinc deficiency. The children of this region should strengthen nutrition education and dietary guidance.

Key words: Micronutrients; Children; Beijing Fangzhuang; Influencing factors

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前言

儿童健康与微量营养素紧密相关,微量营养素包括钙、镁等常量元素和铜、锌、铁等微量元素,虽然在人体含量不多^[1],但因其参与机体物质代谢,促进酶活性,调节细胞膜通透性,因此成为维持机体结构和功能的重要物质^[2]。微量元素缺乏会直接影响儿童的免疫机能、智力水平和生长发育,严重者可引发相关疾病^[3],因此日益受到广大医务工作者、营养学家及家长的重视。据世界卫生组织统计,发展中国家儿童锌缺乏很普遍,而39%的5岁以下儿童及48%的青少年患有贫血^[4]。因此,积极监测儿童铜、锌、钙、镁、铁含量,及时发现并纠正微量营养素缺乏,制定针对性强的防治措施对于儿童健康成长尤为重要。我院儿科已经连续数年开展了儿童微量营养素的监测工作,为了解我院所在地儿童微量营养素缺乏的现状 & 影响因素,探讨针对性的防治措施,故对2011年北京市方庄地区1887例健康体检儿童全血微量营养素含量进行回顾性研究,结果报告如下。

1 对象和方法

1.1 实验对象

2011年1月至12月北京中医药大学东方医院儿科门诊健康体检儿童,共1887例。其中男1117例,占59.2%;女770例,占40.8%。年龄最小3个月,最大17岁。

1.2 方法

1.2.1 取样及检测方法 消毒手指,采集20 μL 末梢血,加入BH5100专用反应液,混匀后送检某技术公司,原子吸收光谱仪检测全血铜、锌、钙、镁、铁的含量^[5]。

1.2.2 全血微量营养素含量标准 参照李毅等标准^[5]结合送检公司检测标准,制定全血微量营养素含量标准:铜11.8~39.3 $\mu\text{mol/L}$, 钙1.55~2.10 mmol/L , 镁1.12~2.06 mmol/L , 铁7.52~11.82 mmol/L 。不同年龄儿童锌含量标准:1岁以内58~100 $\mu\text{mol/L}$, 1-2岁62~100 $\mu\text{mol/L}$, 2-3岁66~120 $\mu\text{mol/L}$, 3-4岁72~130 $\mu\text{mol/L}$, 4-17岁76.5~170 $\mu\text{mol/L}$ 。

1.2.3 统计学方法 将样本按性别、年龄、月份(季节)分组,其中铜、钙、镁、铁样本分为5个年龄段组(婴儿期、幼儿期、学龄前期、学龄期、青春期),锌样本分为7个年龄段组(1岁以内,1-2岁,2-3岁,3-4岁,4-7岁,7-12岁,12-18岁)。各样本按时间段又分为4组:1-3月、4-6月、7-9月、10-12月。运用GraphPad Prism 5.0, SPSS 16.0软件进行分析,偏态分布数据,中位值(四分位间距)即M(25%, 75%)描述,性别间比较采用Mann-Whitney检验;两组以上样本比较,采用Kruskal-Wallis检验, Dunn's Multiple Comparison Test ($P < 0.05$)。组间率比较,采用列联表分析,进行Pearson卡方检验($P < 0.05$)。

2 结果

2.1 不同性别、季节、年龄儿童全血微量营养素含量(见表1)

不同性别比较,全血铜、锌、钙、镁、铁含量差异均无统计学意义($P > 0.05$)。不同季节比较,全血铜、锌、钙、镁、铁含量均存在差异,其中4-6月铜、锌含量降低($P < 0.05$);7-9月钙、镁含量降低($P < 0.05$);10-12月铁含量降低($P < 0.05$)。不同年龄比较,全血锌、铁含量均存在差异,其中3岁以内儿童全血锌、铁含量降低($P < 0.05$)。

表1 不同性别、季节、年龄儿童全血微量营养素含量

Table 1 Contents of whole blood micro nutrition of children in different gender, season, age

	Cu [$\mu\text{mol/L}$]	Zn [$\mu\text{mol/L}$]	Ca [mmol/L]	Mg [mmol/L]	Fe [mmol/L]
Male	21.70(16.60, 27.20)	78.20(76.30, 86.15)	1.63(1.55, 1.90)	1.25(1.17, 1.48)	7.64(7.43, 8.20)
Female	21.95(17.10, 27.00)	78.05(76.10, 87.03)	1.64(1.55, 1.90)	1.25(1.17, 1.49)	7.64(7.42, 8.30)
P	0.770	0.680	0.630	0.980	0.820
1-3month	24.60(18.15, 29.70)	90.60(78.90, 100.10)	1.78(1.61, 2.01)	1.31(1.17, 1.51)	8.00(7.62, 8.56)
4-6month	21.20(15.20, 27.15)*	76.40(74.50, 80.00)*	1.70(1.55, 1.89)*	1.27(1.19, 1.55)	7.57(7.39, 8.27)*
7-9month	19.40(16.40, 24.30)*	77.90(76.50, 79.60)*▲	1.57(1.55, 1.64)*▲	1.20(1.16, 1.26)*▲	7.59(7.42, 7.84)*
10-12month	23.90(19.20, 27.90)*▲	78.30(76.70, 91.03)*▲	1.68(1.54, 1.92)*	1.37(1.20, 1.63)*▲	7.51(7.41, 8.72)*
K-W statistics	80.25	276.81	146.56	178.15	91.37
P	0.000	0.000	0.000	0.000	0.000
Infancy	21.40(18.25, 26.08)	76.55(75.90, 77.70)	1.62(1.54, 1.95)	1.25(1.16, 1.47)	7.51(7.37, 7.87)
Early childhood	21.55(16.53, 26.80)	77.30(75.80, 80.25)	1.61(1.55, 1.88)	1.24(1.17, 1.45)	7.56(7.41, 8.06)
Pre-school age	22.40(17.50, 27.60)	78.80(76.53, 89.38) ^{ab}	1.66(1.55, 1.92)	1.27(1.18, 1.51)	7.66(7.43, 8.32) ^{ab}
School age	21.70(16.28, 27.30)	79.30(76.50, 93.63) ^{ab}	1.64(1.55, 1.88)	1.26(1.18, 1.50)	7.73(7.46, 8.42) ^{ab}
Adolescence	20.40(14.80, 24.90) ^c	79.60(76.80, 92.10) ^{ab}	1.61(1.56, 1.85)	1.23(1.17, 1.44)	7.76(7.48, 8.35) ^{ab}
K-W statistics	12.75	100.74	7.17	9.91	32.90
P	0.013	0.000	0.127	0.042	0.000

注:与1-3月比较,★ $P < 0.05$;与4-6月比较,▲ $P < 0.05$;与7-9月比较,● $P < 0.05$;与婴儿期比较,a $P < 0.05$;与幼儿期比较,b $P < 0.05$;与学龄前期比较,c $P < 0.05$ 。

Note: Compared with 1-3month, ★ $P < 0.05$; Compared with 4-6month, ▲ $P < 0.05$; Compared with 7-9month, ● $P < 0.05$; Compared with the infancy, a $P < 0.05$; Compared with the early childhood, b $P < 0.05$; Compared with the preschool, c $P < 0.05$.

2.2 不同性别、季节、年龄儿童全血微量营养素缺乏结果(见表2)

1887 例儿童中,铜缺乏率 2.7%(51/1887),锌缺乏率 12.8%(241/1887), 钙缺乏率 22.3%(420/1887), 镁缺乏率 1.5%(28/1887),铁缺乏率 38.8%(732/1887)。其中,全血铜、锌、钙、

铁缺乏的儿童中,不同性别间差异均无统计学意义($P>0.05$)。全血铜、锌、钙、镁、铁缺乏均存在季节差异,其中 4-6 月铜、锌缺乏明显,10-12 月钙、铁缺乏明显,1-3 月镁缺乏明显 ($P<0.05$)。铜、钙、镁缺乏无年龄差异($P>0.05$)。婴幼儿铁缺乏明显 ($P<0.05$)。学龄前期及学龄期儿童锌缺乏明显($P<0.05$)。

表 2 不同性别、季节、年龄儿童全血微量营养素缺乏率比较

Table 2 Comparison of whole blood micronutrient deficiency rate in different gender, season, age children

	Cu deficiency rate(%)	Zn deficiency rate(%)	Ca deficiency rate(%)	Mg deficiency rate(%)	Fe deficiency rate(%)
Male	2.86(32/1117)	13.43(150/1117)	21.04(235/1117)	0.98(11/1117)	38.05(425/1117)
Female	2.47(19/770)	11.82(91/770)	24.03(185/770)	2.21(17/770)	39.87(307/770)
Xe	0.274	1.061	2.351	4.664	0.637
P	0.601	0.303	0.125	0.031	0.425
1-3 month	2.24(8/357)	8.68(31/357)	8.40(30/357)	2.52(9/357)	15.97(57/357)
4-6 month	8.08(37/485)	23.30(113/485)	24.33(118/485)	1.86(9/485)	44.12(217/485)
7-9 month	0.90(5/553)	12.12(67/553)	23.51(130/553)	1.63(9/553)	37.97(210/553)
10-12 month	0.20(1/492)	6.10(30/492)	28.86(142/492)	0.20(1/492)	50.41(248/492)
χ^2	63.537	73.489	53.705	8.683	113.676
P	0.000	0.000	0.000	0.034	0.000
Infancy	0(0/86)	0(0/86)	26.74(23/86)	2.33(2/86)	51.16(44/86)
Early childhood	2.04(12/588)	0.17(1/588)	23.81(140/588)	1.70(10/588)	44.56(262/588)
Pre-school age	2.37(16/676)	17.01(115/676)	20.86(141/676)	0.89(6/676)	37.28(252/676)
School age	4.19(18/430)	21.50(102/430)	22.33(96/430)	2.09(9/430)	32.79(141/430)
Adolescence	4.67(5/107)	9.54(23/107)	18.69(20/107)	0.93(1/107)	30.84(33/107)
X^2	8.836	160.900	3.372	3.563	23.800
P	0.065	0.000	0.498	0.468	0.000

3 讨论

因年龄、性别、民族、环境、地区、生活习惯等因素不同,儿童所需微量营养素存在差异。近期研究认为儿童微量营养素与疾病的相关性较为明显,体内微量营养素缺乏会影响儿童的智力水平、生长发育、免疫机能,导致疾病发生。微量营养素测定已成为评价儿童身体状况与疾病发生的重要检查指标^[7]。其中,铜与色素形成、铁代谢、体内酶活化相关^[8,9],铜缺乏易产生毛发异常、贫血。锌是体内 200 多种酶的激活因子,参与构成膜蛋白,与儿童心智、行为发展、免疫力密切相关^[10,11],锌缺乏可致智力低下、厌食、体格生长迟缓;钙是骨骼重要组成物质,参与儿童机体生长发育,钙缺乏导致肥胖症、生长迟缓、佝偻病以及婴儿湿疹、哮喘等过敏性疾病^[12]。铁是人体内含量最高的微量元素,参与 DNA 合成。铁缺乏可造成贫血、厌食、防御功能低下,并影响神经元发育和髓鞘形成^[13,14]。镁缺乏可致厌食、腹泻、呕吐、抽搐等。

本研究结果显示,全血铜、锌、钙、镁、铁含量无性别差异。锌、铁含量存在年龄差异,其中,婴幼儿期锌、铁含量较低,可能与此期儿童生长发育迅速,锌、铁需求量增加,同时添加动物性辅食不及时、不充足或与挑食、偏食等不良饮食习惯有关。全血微量营养素含量存在季节差异,其中,7-9 月全血铜、锌、钙、镁含量降低,全血铁含量升高,究其原因如下:7-9 月是瓜果、蔬菜丰收的季节,这些植物性食物中富含草酸、植酸、纤维素等,可减少锌、钙吸收^[15];富含 VitC,可减少铜吸收,促进铁吸收;同

时,7-9 月是儿童消化系疾病的高发季节,腹泻、呕吐等症状的出现导致铜、锌、钙、镁等吸收减少。10-12 月全血钙、铁含量降低,其中,钙缺乏可能与秋冬季节日照量不足,内源性 VitD 生成不足,钙吸收减少有关;铁缺乏可能与水果、蔬菜相对较少, VitC 摄入不足有关。

北京市方庄地区儿童以锌、钙、铁缺乏为主,与国内其他地区儿童缺乏的微量营养素种类基本一致^[6,16-18]。锌、钙、铁缺乏存在季节差异,其中 10-12 月钙缺乏率最高,与前述同期全血钙含量降低趋势一致,1-3 月钙缺乏率最低,与家长重视冬季补钙有关。10-12 月铁缺乏率最高,与上述同期全血铁含量降低趋势一致,而 7-9 月铁含量缺乏儿童也占有一定比例,但因此期铁含量比较高,故铁缺乏程度低。婴幼儿、青春期为生长发育高峰时期,锌、钙、铁需求量增加,由于此期较重视钙剂补充,故此年龄段与其他年龄段比较,钙缺乏率无明显差异。婴幼儿期铁缺乏明显,与此期铁储备量不足,添加辅食不及时有关。学龄前期、学龄期儿童锌缺乏明显,与儿童挑食、偏食、膳食结构不合理或锌补充减少等因素有关。综上所述,北京市方庄地区儿童主要存在锌、钙、铁缺乏,以秋冬季及初春明显。其中婴幼儿以铁缺乏为主,学龄前期及学龄期儿童以锌缺乏为主。膳食摄入是最安全有效的预防和干预措施^[19]。故建议加强对此地区儿童、家长及保育机构的营养宣教及饮食指导,合理安排膳食,科学喂养,尤其在婴幼儿期、学龄前期及学龄期及时添加肝脏、禽肉、鱼肉等富含锌、铁元素的食物,并积极防治消化系疾病,同时秋冬及初春季节更要加强铜、锌、钙、镁、铁等元素的补充,定

期监测微量营养素^[20],及时防治各种微量营养素缺乏性疾病,保障儿童健康成长。

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