

ORIGINAL ARTICLE

Analysis of the Levels of Vitamin A, D and E in Peripheral Blood of Children in Zhejiang Province

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SUMMARY

Background: This study aims to investigate the serum fat-soluble vitamins A, D, and E levels of children in Zhejiang Province, and to provide a reference range of fat-soluble vitamins for children in Zhejiang Province.

Methods: Between May 2019 and December 2019, 871 children who sent peripheral blood samples to Hangzhou Biozon Medical Institute Co., Ltd. for fat-soluble vitamin A, D, and E analysis were selected, including 432 boys and 439 girls. After the peripheral blood was collected, the serum A, D, and E levels were measured, and the differences in age, gender, season, and region were compared.

Results: With age, the level of vitamin A gradually increased ($p < 0.01$), and vitamin D2, D3, and total vitamin D all increased first and then decreased. Vitamin A (131.79 ± 47.05 ng/mL vs. 121.96 ± 41.01 ng/mL) and E (5.87 ± 2.23 μ g/mL vs. 5.56 ± 2.13 μ g/mL) levels of girls were higher than boys ($p < 0.01$), and vitamin D3 (15.25 ± 6.16 ng/mL vs. 15.17 ± 7.26 ng/mL) and total vitamin D (18.09 ± 7.01 ng/mL vs. 17.03 ± 8.79 ng/mL) levels of boys were higher than girls ($p < 0.01$). From the perspective of regional distribution, the levels of vitamin A, D2, and E in Ningbo were higher than those in Hangzhou and other regions. The seasonal distribution of vitamin A and E levels were highest in summer, while vitamin D3 and D levels were highest in fall. The average vitamin concentrations were as follows: vitamin A was (126.81 ± 44.42) ng/mL; vitamin D2 was (1.84 ± 3.16) ng/mL, vitamin D3 was (15.71 ± 6.75) ng/mL, total vitamin D was (17.55 ± 7.91) ng/mL, and vitamin E was (5.72 ± 2.19) μ g/mL. The reference value ranges of vitamin A, D2, D3, D, and E were (52.44 - 222.27) ng/mL, (0.01 - 11.66) ng/mL, (4.92 - 30.96) ng/mL, (4.92 - 30.96) ng/mL, and (2.66 - 10.92) μ g/mL, respectively.

Conclusions: The children's fat soluble vitamin levels in Zhejiang province show significant differences in age, gender, season, and regional distribution. Corresponding reference standards should be formulated as soon as possible, and vitamin supplements should be targeted and reasonable to ensure the healthy development of children.

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Supplementary Data

Table S1. Analysis of the percentile reference values of serum vitamin A, D2, D3, D, and E in 871 children (ng/mL).

Vitamins	Groups	n	Mean	SD	Min	Max	<i>P</i> _{2.5}	<i>P</i> ₂₅	<i>P</i> ₅₀	<i>P</i> ₇₅	<i>P</i> _{97.5}	
Vitamin A	Total	871	126.81	44.42	36.88	481.98	52.44	96.06	124.90	150.87	222.27	
	Gender											
	Boy	432	121.77	41.01	43.19	281.93	51.04	92.50	118.93	145.86	219.05	
	Girl	439	131.79	47.05	36.88	491.98	54.41	100.96	128.57	154.70	224.62	
	Age											
	Less than 3 months	125	84.82	28.63	42.54	186.69	44.07	64.15	80.63	96.51	159.68	
	3 - 6 months	124	115.57	39.99	46.43	228.20	54.60	83.63	108.64	139.99	215.01	
	6 months - 1 year	125	118.25	33.65	36.88	279.32	61.44	100.61	112.88	134.13	216.97	
	1 - 3 years	125	133.45	29.96	48.77	213.30	73.56	115.28	136.04	151.07	194.24	
	3 - 6 years	125	139.24	47.10	51.87	481.98	66.99	111.91	137.60	159.78	230.22	
	6 - 10 years	121	136.40	32.86	62.02	224.53	73.21	113.18	133.85	158.02	209.53	
	Over 10 years	126	159.95	52.33	44.04	416.76	73.22	119.43	156.22	188.52	277.52	
	Region											
	Hangzhou	407	115.60	42.41	36.88	481.98	48.23	84.08	112.60	142.23	195.34	
Ningbo	340	140.79	46.53	44.04	416.76	67.24	108.41	134.90	167.86	242.58		
Others	124	125.31	33.08	61.34	225.08	62.46	102.40	127.39	144.77	198.90		
Vitamin D2	Total	871	1.84	3.16	0.01	33.29	0.11	0.44	0.81	1.55	11.66	
	Gender											
	Boy	432	1.84	2.67	0.01	17.21	0.88	0.46	0.91	1.76	10.75	
	Girl	439	1.84	3.59	0.02	33.29	0.12	.044	0.74	1.42	12.91	
	Age											
	Less than 3 months	125	1.28	3.02	0.04	31.47	0.08	0.41	0.75	1.14	5.47	
	3 - 6 months	124	3.04	4.69	0.01	33.29	0.04	0.44	0.93	4.15	13.70	
	6 months - 1 year	125	3.36	4.33	0.21	18.02	0.24	0.68	1.17	4.06	17.07	
	1 - 3 years	125	1.84	2.34	0.07	12.94	0.08	0.44	1.06	2.2	9.56	
	3 - 6 years	125	1.72	2.80	0.08	24.44	0.12	0.51	1.03	1.65	10.07	
	6 - 10 years	121	0.83	0.62	0.11	5.27	0.12	0.46	0.69	1.05	2.33	
	Over 10 years	126	0.81	0.83	0.02	7.01	0.10	0.30	0.55	1.06	2.60	
	Region											
	Hangzhou	407	1.45	3.09	0.01	33.29	0.11	0.46	0.77	1.29	9.55	
Ningbo	340	2.58	3.55	0.02	18.02	0.11	0.44	1.04	2.70	13.14		
Others	124	1.10	1.46	0.06	13.43	0.12	0.43	0.74	1.32	5.73		
Vitamin D3	Total	871	15.71	6.75	3.29	48.01	4.92	10.58	14.95	19.83	30.96	
	Gender											
	Boy	432	16.25	6.16	3.43	40.14	6.44	11.74	15.60	19.84	29.32	
	Girl	439	15.18	7.25	3.29	48.01	4.46	9.32	13.81	19.81	31.17	
	Age											
	Less than 3 months	125	17.01	6.17	3.50	32.65	4.49	13.53	16.61	21.69	29.18	
	3 - 6 months	124	19.10	6.05	6.28	40.46	9.04	14.72	18.41	22.52	34.56	
	6 months - 1 year	125	20.24	7.10	6.74	48.01	7.57	15.73	19.23	24.52	39.26	
	1 - 3 years	125	18.05	5.86	7.21	37.63	8.76	14.26	17.16	21.28	31.26	
	3 - 6 years	125	13.53	4.86	4.96	31.73	5.96	10.30	13.38	16.30	27.42	

Table S1. Analysis of the percentile reference values of serum vitamin A, D2, D3, D, and E in 871 children (ng/mL) (continued).

Vitamins	Groups	n	Mean	SD	Min	Max	$P_{2.5}$	P_{25}	P_{50}	P_{75}	$P_{97.5}$
Vitamin D3	6 - 10 years	121	11.84	4.63	3.43	30.98	4.45	8.93	11.37	13.61	25.25
	Over 10 years	126	10.15	5.09	3.29	29.68	3.89	6.46	8.98	12.07	24.74
	Region										
	Hangzhou	407	15.48	6.02	6.43	40.14	6.36	10.95	14.81	19.22	28.94
	Ningbo	340	15.67	7.43	3.29	40.46	4.40	9.74	14.71	20.29	31.57
	Others	124	16.58	7.05	4.44	48.01	5.93	12.09	15.65	20.40	33.10
Vitamin D	Total	871	17.55	7.91	3.82	58.90	5.80	11.55	16.32	21.95	36.28
	Gender										
	Boy	432	18.09	7.01	3.94	44.31	7.42	13.14	17.38	21.82	34.15
	Girl	439	17.02	8.79	3.82	58.90	5.29	10.26	15.04	22.12	37.65
	Age										
	Less than 3 months	125	18.28	7.20	4.64	53.18	5.69	14.37	17.28	22.69	33.83
	3 - 6 months	124	22.14	8.64	6.72	58.90	9.61	16.30	20.79	26.36	47.13
	6 months - 1 year	125	23.60	8.34	7.64	48.40	8.67	17.70	22.60	28.82	42.20
	1 - 3 years	125	19.89	6.13	7.97	38.79	9.11	16.00	19.26	22.73	33.48
	3 - 6 years	125	15.26	5.47	5.82	36.49	6.70	11.31	14.75	18.06	31.68
	6 - 10 years	121	12.67	4.65	3.94	31.10	5.30	9.70	11.90	14.85	26.37
	Over 10 years	126	10.97	5.01	3.82	30.32	4.46	7.29	9.94	13.15	25.16
	Region										
	Hangzhou	407	16.94	7.03	3.94	58.90	7.11	11.79	16.11	20.71	34.10
	Ningbo	340	18.25	9.12	3.82	48.09	5.19	10.72	16.92	24.53	39.00
Others	124	17.68	7.39	5.29	48.40	6.59	12.61	16.32	21.97	34.03	
Vitamin E	Total	871	5.72	2.19	0.48	23.19	2.66	4.29	5.39	6.75	10.92
	Gender										
	Boy	432	5.56	2.13	0.48	23.19	2.66	4.15	5.30	6.50	9.91
	Girl	439	5.87	2.23	0.93	20.46	2.71	4.40	5.49	6.93	11.27
	Age										
	Less than 3 months	125	6.20	2.37	0.93	16.11	1.93	4.60	5.82	7.22	13.22
	3 - 6 months	124	6.79	2.78	2.49	23.19	3.46	5.14	6.28	7.64	13.39
	6 months - 1 year	125	6.06	1.94	2.09	15.15	3.15	4.79	5.68	7.31	10.64
	1 - 3 years	125	5.21	1.76	0.48	14.77	2.79	4.09	4.81	6.13	8.96
	3 - 6 years	125	4.79	1.58	1.51	12.45	2.54	3.71	4.50	5.80	8.26
	6 - 10 years	121	5.26	2.00	1.98	12.29	2.24	3.91	5.02	6.15	9.93
	Over 10 years	126	5.72	2.04	1.26	12.41	2.03	4.24	5.51	6.69	11.33
	Region										
	Hangzhou	407	5.61	2.02	0.93	13.75	2.67	4.24	5.24	6.75	10.07
	Ningbo	340	6.04	2.33	0.48	20.46	2.92	4.50	5.62	7.09	11.87
Others	124	5.20	2.22	1.51	23.19	2.07	3.82	5.14	6.27	8.58	