BMC Nutrition | 地理位置、社会经济和饮食因素对处于不同泌乳期的城市母亲母乳中维生素 B 浓度的影响

本文关键字：母乳、维生素 B、横断面研究、高效液相色谱-串联质谱法；微生物含量

影响因子：无

建议阅读时间：3 分钟

背景

母乳中充足的维生素 B 被认为是婴儿生命早期健康发育的先决条件。本研究旨在确定中国城市母亲母乳中维生素 B 浓度及其与不同地理位置、哺乳阶段、社会经济特征以及饮食摄入因素之间的关系。

方法

从北京（n=150）、苏州（n=146）和广州（n=147）这三个城市的 443 名健康哺乳期母亲中获得母乳。同时采用高效液相色谱-串联质谱法对母乳中的硫胺素、核黄素、维生素 B3（烟酰胺和烟碱酸）以及维生素 B6（吡哆醛、吡哆醇和吡哆胺）进行分析。并采用微生物分析法对母乳中的泛酸、生物素和叶酸进行分析。同时通过访谈和结构化问卷调研的方法，分别收集 24 小时膳食回顾及社会经济特征的信息。

结果

母乳中维生素 B 浓度的差异很大。产后 5-11 天、12-30 天、31-60 天、61-120 天以及 121-240 天的维生素 B 浓度中位数依次如下：硫胺酸为 3.13、5.07、4.28、5.65、6.28（μg/100 g）；核黄素为 20.8、20.2、11.9、13.6、15.6（μg/100 g）；维生素 B3 为 194.0、300.0、 261.0、212.5、218.0 （μg/100 g）； 泛酸为 236.5、 291.0、254.0、179.0、 189.0 （μg/100 g）；维生素 B6 为 6.34、7.58、8.60、 9.34、10.20（μg/100 g）；生物素为 0.462、0.834、 0.606、0.523、 0.464 （μg/100 g）； 叶酸为 0.730、 2.390、 2.440、 2.420、2.330 （μg/100 g）。维生素 B 浓度呈现出地理位置差异，且在不同的哺乳阶段也存在显著差异。在多变量分析中，我们发现硫胺素、维生素 B6 和叶酸与母亲 BMI 之间呈负相关（$p<0.05$），与没有额外补充的妇女相比，额外补充维生素的哺乳期妇女，其母乳中的泛酸、叶酸和生物素的含量显著更高（$p<0.05$）。同时在多变量分析中，我们还发现核黄素含量与定期运动显著相关（$p<0.05$）。

结论

本研究表明，地理位置、社会经济因素、哺乳阶段以及是否额外补充都可能会对健康中国母亲母乳中的维生素 B 浓度产生影响。对母乳中维生素含量进行准确而完整分析的进一步研究，对帮助我们更加全面地了解母乳中的维生素状况至关重要。

参考文献：

Xue et al. BMC Nutrition (2017) 3:22

文献链接：https://bmcnutr.biomedcentral.com/articles/10.1186/s40795-017-0139-1

Table 1 Socioeconomic characteristics of lactating mothers with different stages of lactating period

	5–11 d ($n=89$)	12–30 d ($n=87$)	31–60 days ($n=89$)	61–120 d ($n=90$)	121–240 d ($n=88$)	*P*-value
Age, years [1]						0.120
< 25	26 (29.2)	27 (31.0)	18 (20.2)	26 (28.9)	34 (38.6)	
25–30	42 (47.2)	38 (43.7)	44 (49.4)	50 (55.6)	39 (44.3)	
> 30	21 (23.6)	22 (25.3)	27 (30.3)	14 (15.6)	15 (17.0)	
Offspring gender [1]						0.729
Male	50 (56.2)	46 (52.9)	47 (52.8)	54 (60.0)	42 (47.7)	
Female	39 (43.8)	37 (42.5)	39 (43.8)	36 (40.0)	43 (48.9)	
Education [1]						<0.001 *
Middle school or blow	11 (12.4) [a]	15 (17.2) [a, b]	26 (29.2) [b]	22 (24.4) [a, b]	38 (43.2) [c]	
High school	31 (39.1)	34 (39.1)	21 (23.6)	25 (27.8)	23 (26.1)	
College or above	45 (42.5)	37 (42.5)	42 (47.2)	41 (45.6)	26 (29.5)	
Family's per capita income, Yuan/month [1]						0.165
< 2000	20 (22.5)	17 (19.5)	23 (25.8)	26 (28.9)	31 (35.2)	
2000–4000	36 (40.4)	43 (49.4)	41 (46.1)	40 (44.4)	39 (44.3)	
> 4000	30 (33.7)	21 (24.1)	23 (25.8)	22 (24.4)	18 (20.5)	
Unclear	3 (3.4)	6 (6.9)	2 (2.2)	2 (2.2)	0 (0.0)	
Delivery mode [1]						0.038 *
Vaginal	50 (56.2) [a, b]	45 (51.7) [a]	37 (41.6) [b]	55 (61.1) [a]	54 (61.4) [a]	
Cesarean	37 (41.6)	42 (48.3)	52 (58.4)	35 (38.9)	33 (37.5)	
Present BMI [1]						0.109
Underweight	5 (5.6)	2 (2.3)	2 (2.2)	4 (4.4)	7 (8.0)	
Normal	54 (60.7)	58 (66.7)	56 (62.9)	69 (76.7)	64 (72.7)	
Overweight	26 (29.2)	26 (29.9)	26 (29.2)	16 (17.8)	16 (18.2)	
Obesity	3 (3.4)	1 (1.1)	5 (5.6)	1 (1.1)	1 (1.1)	
Dietary supplements intake [1]						0.810
Yes	10 (11.2)	12 (13.8)	11 (12.4)	8 (8.9)	8 (9.1)	
No	79 (88.8)	75 (86.2)	78 (87.6)	82 (91.1)	80 (90.9)	
Pregnancy duration, weeks [2]	39 (39, 40)	39 (39, 40)	39 (38, 40)	39.5 (39, 40)	40 (39, 40)	0.268

Data were expressed as median (interquartile range) for continuous variables without normal distribution and count (percentage) for categorical variables
BMI body mass index, was calculated as body weight by height squared (kg/m^2)
[1] Compared by chi-square test
[2] Compared by Kruskal-Wallis test
* Indicates a significant difference among six stages of lactating period ($p < 0.05$)
[a, b, c] Data with the different superscript letters in the same row differ significantly ($p < 0.05$); Difference between two subgroups using Chi-squared tests (categorical variables) and Mann-Whitney U test (continuous variables without normal distribution)

Table 2 B-vitamins concentrations of milk samples during different lactation stages [1, 2]

B-group vitamin	5–11 d ($n = 89$)	12–30 d ($n = 87$)	31–60 d ($n = 89$)	61–120 d ($n = 90$)	121–240 d ($n = 88$)
Thiamine, μg/100 g					
n	44	73	82	89	86
Median (IQR)	3.13 (2.58, 4.89) [a]	5.07 (3.11, 6.47) [b]	4.28 (3.06, 6.61) [b]	5.65 (3.78, 7.69) [c]	6.28 (5.11, 8.03) [d]
Mean ± SD	3.60 ± 1.29	5.01 ± 2.10	4.69 ± 1.85	5.75 ± 2.18	6.69 ± 2.17
Riboflavin, μg/100 g					
n	88	86	83	89	88
Median (IQR)	20.8 (13.2, 31.5) [a]	20.2 (10.1, 27.4) [b]	11.9 (7.1, 21.1) [c]	13.6 (9.7, 20.1) [c, d]	15.6 (12.3, 19.4) [b, d]
Mean ± SD	25.4 ± 18.8	19.4 ± 9.9	15.3 ± 12.0	15.1 ± 7.6	16.4 ± 7.1
Vitamin B_3 [3], μg/100 g					
n	89	87	89	90	88
Median (IQR)	194.0 (110.0, 320.5) [a]	300.0 (248.0, 378.0) [b]	261.0 (183.0, 323.5) [c]	212.5 (168.8, 277.3) [a, d]	218.0 (168.8, 328.8) [c, d]
Mean ± SD	239.1 ± 156.3	337.1 ± 151.4	272.1 ± 118.4	227.8 ± 82.6	253.6 ± 118.9
Pantothenic acid, μg/100 g					
n	86	84	89	90	
Median (IQR)	236.5 (166.3, 324.3) [a]	291.0 (229.5, 374.3) [b]	254.0 (187.0, 346.5) [a]	179.0 (154.5, 220.0) [c]	189.0 (153.0, 251.5) [c]
Mean ± SD	255.1 ± 117.9	304.0 ± 109.6	264.2 ± 94.6	204.2 ± 79.5	205.8 ± 63.2
Vitamin B_6 [4], μg/100 g					
n	60	75	89	89	87
Median (IQR)	6.34 (3.83, 9.85) [a]	7.58 (5.92, 9.86) [a, b]	8.60 (6.32, 10.55) [b]	9.34 (7.40, 12.00) [c]	10.20 (8.15, 13.80) [c]
Mean ± SD	8.63 ± 7.57	8.22 ± 4.10	8.94 ± 3.86	10.30 ± 4.91	10.90 ± 4.37
Biotin, μg/100 g					
n	78	84	88	90	87
Median (IQR)	0.462 (0.187, 0.856) [a]	0.834 (0.550, 1.190) [b]	0.606 (0.435, 0.876) [c]	0.523 (0.366, 0.749) [a, c]	0.464 (0.316, 0.648) [a]
Mean ± SD	0.691 ± 0.795	0.967 ± 0.703	0.701 ± 0.424	0.617 ± 0.429	0.577 ± 0.627
Folates, μg/100 g					
n	88	87	89	90	88
Median (IQR)	0.730 (0.387, 1.245) [a]	2.390 (1.340, 3.120) [b]	2.440 (1.615, 3.440) [b, c]	2.420 (1.653, 3.265) [c]	2.330 (1.515, 3.875) [c]
Mean ± SD	1.072 ± 0.945	2.421 ± 1.379	2.665 ± 1.366	2.759 ± 1.583	2.860 ± 1.694

IQR interquartile range; *SD* standard deviation

[1] Data were presented as the median (IQR) and mean ± SD

[2] Compared by One-Way analysis of variance (ANOVA) after the ln transformation followed by Fisher's least significant difference (LSD) post hoc comparisons

[3] Vitamin B_3 = nicotinamide + nicotinic acid

[4] Vitamin B_6 = pyridoxine + 0.702pyridoxamine + 0.831pyridoxal

[a, b, c, d] Data with the different superscript letters in the same row differ significantly ($p < 0.05$)

Table 3 B-vitamins concentrations of milk samples from lactating mothers in the three cities[1,2]

B-group vitamin	City1: Beijing ($n = 150$)	City2: Suzhou ($n = 146$)	City3: Guangzhou ($n = 147$)	Total ($n = 443$)
Thiamine, μg/100 g				
n	134	108	132	374
Median (IQR)	6.61 (5.21, 7.89) [a]	4.25 (2.74, 6.38) [b]	4.40 (3.49, 5.60) [b]	5.17 (3.54, 6.81)
Mean ± SD	6.41 ± 1.98	4.90 ± 2.67	4.60 ± 1.52	5.34 ± 2.22
Riboflavin, μg/100 g				
n	150	139	145	434
Median (IQR)	20.1 (14.5, 25.1) [a]	12.5 (6.6, 19.3) [b]	14.8 (9.5, 23.1) [c]	16.2 (10.0, 23.5)
Mean ± SD	20.7 ± 8.06	16.7 ± 17.1	17.4 ± 10.4	18.3 ± 12.4
Vitamin B_3[3], μg/100 g				
n	150	146	147	443
Median (IQR)	264.0 (185.8, 349.0) [a]	212.0 (151.5, 291.8) [b]	244.0 (179.0, 343.0) [a]	240.0 (171.0, 322.0)
Mean ± SD	274.0 ± 124.4	226.4 ± 94.3	295.9 ± 162.9	265.6 ± 133.2
Pantothenic acid, μg/100 g				
n	148	146	143	437
Median (IQR)	230.0 (184.5, 299.5) [a,b]	225.0 (174.5, 339.8) [a]	199.0 (155.0, 282.0) [b]	223.0 (166.5, 302.0)
Mean ± SD	245.7 ± 78.7	261.9 ± 121.9	230.1 ± 97.8	245.9 ± 101.6
Vitamin B_6[4], μg/100 g				
n	139	132	129	400
Median (IQR)	8.37 (6.52, 10.90) [a]	7.27 (4.64, 10.2) [b]	9.46 (8.22, 13.30) [c]	8.63 (6.43, 11.00)
Mean ± SD	9.06 ± 3.37	8.57 ± 6.35	10.89 ± 4.74	9.49 ± 5.04
Biotin, μg/100 g				
n	144	142	141	427
Median (IQR)	0.585 (0.385, 0.878) [a]	0.554 (0.325, 0.875) [a]	0.554 (0.314, 0.846) [a]	0.568 (0.336, 0.858)
Mean ± SD	0.749 ± 0.674	0.691 ± 0.585	0.685 ± 0.596	0.709 ± 0.619
Folates, μg/100 g				
n	149	146	147	442
Median (IQR)	1.790 (1.125, 2.710) [a]	2.400 (1.190, 3.428) [b]	2.220 (1.230, 3.420) [a,b]	2.140 (1.190, 3.143)
Mean ± SD	1.998 ± 1.226	2.635 ± 1.766	2.446 ± 1.576	2.358 ± 1.557

IQR interquartile range; *SD* standard deviation

[1] Data were presented as the median (IQR) and mean ± SD

[2] Compared by One-Way analysis of variance (ANOVA) after the ln transformation followed by Fisher's least significant difference (LSD) post hoc comparisons

[3] Vitamin B_3 = nicotinamide + nicotinic acid

[4] Vitamin B_6 = pyridoxine + 0.702pyridoxamine + 0.831pyridoxal

[a,b,c] Data with the different superscript letters in the same row differ significantly ($p < 0.05$)