

1 **Table S1 Comparison of developmental quotients of neurobehavioral**
2 **functional domains at 6 months of age in offspring with different maternal and**
3 **child demographic characteristics**

Characteristics	Gross motor	Fine motor	Adaptability	Language	Social behavior
Gender					
Boy	91.26±10.10	92.81±10.94	92.32±9.80	95.80±9.07	95.22±9.34
Girl	90.27±11.78	95.06±10.88	94.62±9.23	93.46±9.11	95.97±9.53
<i>t</i>	0.562	-1.295	-1.522	1.612	-0.501
<i>P</i>	0.575	0.197	0.130	0.109	0.617
Gestational age (weeks)					
37	93.29±15.75	87.35±9.77	87.12±6.83	87.39±16.31	96.05±9.98
≥37	90.68±10.95	94.13±10.94	93.67±9.56	94.70±8.98	95.61±9.44
<i>t</i>	0.406	-1.066	-1.179	-1.375	0.080
<i>P</i>	0.685	0.288	0.240	0.171	0.937
Birth weight (kg)					
≥2.50	90.76±10.96	94.09±11.01	93.83±9.49	94.82±9.02	95.60±9.46
<2.50	90.06±12.72	92.21±9.67	87.38±9.28	88.83±10.51	96.04±9.17
<i>t</i>	0.165	0.442	1.760	1.705	-0.121
<i>P</i>	0.869	0.659	0.080	0.090	0.904
Feeding pattern					
Exclusive breastfeeding	91.23±10.51	93.88±10.21	93.70±9.69	93.64±8.94	96.03±8.32
Mixed and artificial feeding	90.31±11.44	94.11±11.55	93.41±9.48	95.32±9.28	95.27±10.28
<i>t</i>	0.521	-0.135	0.189	-1.155	0.502
<i>P</i>	0.603	0.893	0.850	0.250	0.616
Only child or not					
Yes	90.47±10.95	94.40±10.41	93.71±8.74	94.61±9.41	95.64±9.47
No	90.59±10.95	93.12±11.91	93.11±9.96	94.34±8.82	95.25±9.50
<i>t</i>	-0.064	0.683	0.381	0.173	0.241
<i>P</i>	0.949	0.496	0.704	0.863	0.810
Delivery mode					
Vaginal births	90.49±11.38	93.54±10.83	93.45±9.44	94.79±9.23	94.81±9.07
Cesarean section	91.62±9.57	95.72±11.27	93.87±10.04	93.72±8.90	98.58±10.18
<i>t</i>	-0.533	-1.033	-0.223	0.600	-2.090
<i>P</i>	0.595	0.303	0.824	0.549	0.038
Pregnancy mode					
Spontaneous conception	90.80±11.22	93.79±11.12	93.70±9.85	94.49±9.22	95.90±9.54
Assisted reproductive conception	90.15±9.05	95.91±9.12	92.16±6.22	95.16±8.61	93.13±8.14
<i>t</i>	0.223	-0.734	0.612	-0.276	1.115
<i>P</i>	0.824	0.464	0.541	0.783	0.267
Per capita annual household income (CNY 10,000)					
<10	91.12±11.31	94.05±10.42	90.36±9.10	93.98±9.43	97.36±8.72
≥10	90.63±10.96	93.99±11.11	94.42±9.51	94.72±9.09	95.14±9.58

	<i>t</i>	0.230	0.024	-2.225	-0.415	1.220
	<i>P</i>	0.819	0.981	0.028	0.679	0.224
Maternal age (years)						
	<30	91.48±6.77	97.07±10.47	94.50±8.30	95.45±11.12	99.01±9.40
	30~35	89.69±11.11	94.18±10.79	94.24±9.90	94.08±9.03	95.39±8.74
	>35	92.91±12.23	92.03±11.35	91.37±9.09	95.28±8.48	94.47±10.79
	<i>F</i>	1.270	1.460	1.407	0.350	1.636
	<i>P</i>	0.284	0.235	0.248	0.705	0.198
Maternal education						
	college and below	93.27±13.86	96.44±9.36	96.05±9.06	92.84±10.50	98.14±7.22
	undergraduate or above	90.32±10.47	93.61±11.14	93.14±9.59	94.83±8.91	95.21±9.69
	<i>t</i>	1.168	1.129	1.332	-0.950	1.357
	<i>P</i>	0.244	0.261	0.185	0.344	0.177
Materna BMI (kg/m ²)						
	<18.5	88.86±12.93	91.97±11.78	92.10±9.01	94.02±8.22	95.81±8.35
	18.5~23.9	90.95±10.35	94.00±10.57	93.27±9.63	94.67±8.73	95.25±9.63
	≥24.0	92.58±10.99	97.21±11.05	97.16±9.50	94.84±12.41	97.17±10.21
	<i>F</i>	0.791	1.482	1.950	0.075	0.369
	<i>P</i>	0.455	0.230	0.146	0.928	0.692

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28 **Table S2 Comparison of baseline characteristics between infants who completed and those**
 29 **with incomplete neurobehavioral assessments**

Characteristics	Include (N=158)	Exclude(N=110)	$t/F/\chi^2$	P
Birth weight (kg)	3.18±0.38	3.23±0.43	-0.915	0.361
≥2.50	151 (95.6)	104 (94.5)	0.147	0.701
<2.50	7 (4.4)	6 (5.5)		
Gestational age at birth (weeks)	39.25±1.11	39.07±1.40	1.207	0.228
≥37	155 (98.1)	104 (94.5)	2.527	0.112
<37	3 (1.9)	6 (5.5)		
Gender			0.901	0.343
Boy	74 (46.8)	58 (52.7)		
Girl	84 (53.2)	52 (47.3)		
Only child or not			0.156	0.693
Yes	107 (67.7)	71 (64.5)		
No	51 (32.3)	39 (35.5)		
Pregnancy mode			0.192	0.661
Spontaneous conception	142 (89.9)	97 (88.2)		
Assisted reproductive conception	16 (10.1)	13 (11.8)		
Delivery mode			0.565	0.452
Vaginal births	124 (78.5)	82 (74.5)		
Cesarean section	34 (21.5)	28 (25.5)		
Feeding pattern			0.891	0.365
Exclusive breastfeeding	72 (45.6)	44 (40.0)		
Mixed and artificial feeding	86 (54.4)	66 (60.0)		
Maternal age (years)	33.78±7.95	34.08±3.91	-0.364	0.716
<30	20 (12.7)	14 (12.7)	0.707	0.702
30~35	98 (62.0)	56 (50.9)		
>35	40 (25.3)	40 (36.4)		
Pre-pregnancy BMI (kg/m2)	20.74±2.67	21.19±3.12	-1.265	0.207
<18.5	33 (20.9)	17 (15.5)	1.278	0.528
18.5~23.9	104 (65.8)	78 (70.9)		
≥24.0	21 (13.3)	15 (13.6)		
Maternal education			0.532	0.466
college and below	22 (13.9)	12 (10.9)		
undergraduate or above	136 (86.1)	98 (89.1)		
Paternal age (years)	32.92±4.28	33.21±5.50	-0.477	0.634
<30	33 (20.9)	22 (20.0)	0.055	0.973
30~35	88 (55.7)	54 (49.1)		

	>35	37 (23.4)	34 (30.9)		
Paternal BMI (kg/m ²)		23.55±3.22	23.03±2.85	1.338	0.182
	<18.5	7 (4.4)	4 (3.7)	0.900	0.638
	18.5~23.9	85 (53.8)	65 (59.6)		
	≥24.0	66 (41.8)	40 (36.7)		
Paternal education				0.500	0.480
	college and below	33 (20.9)	27 (24.5)		
	undergraduate or above	125 (79.1)	83 (75.5)		
Quality of sleep during pregnancy				0.831	0.362
	Good	122 (77.2)	90 (81.8)		
	Not good	36 (22.8)	20 (18.2)		
Per capita annual household income (10,000 Yuan)				0.055	0.814
	<10	34 (21.5)	25 (22.7)		
	≥10	124 (78.5)	85 (77.3)		

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Table S3 Association of breastmilk betaine and related metabolite levels with neurobehavior developmental quotient in offspring (Model I)

Metabolites	Gross motor		Fine motor		Adaptability		Language		Social behavior	
	β (95%CI)	<i>P</i>	β (95%CI)	<i>P</i>	β (95%CI)	<i>P</i>	β (95%CI)	<i>P</i>	β (95%CI)	<i>P</i>
Betaine										
Q3	1.72 (-2.39, 5.82)	0.412	4.70 (0.63, 8.76)	0.024	2.93 (-0.66, 6.52)	0.110	2.97 (-0.49, 6.42)	0.093	3.36 (-0.19, 6.90)	0.063
Q2	-3.70 (-7.80, 0.41)	0.077	-0.76 (-4.82, 3.30)	0.714	-0.56 (-4.15, 3.03)	0.761	1.15 (-2.31, 4.60)	0.514	0.23 (-3.31, 3.78)	0.897
Q1	0		0		0		0		0	
Continuous	3.18 (-0.36, 6.73)	0.078	5.52 (2.07, 8.97)	0.002	3.92 (0.88, 6.97)	0.012	2.49 (-0.45, 5.44)	0.097	3.25 (0.23, 6.27)	0.035
Choline										
Q3	2.38 (-1.80, 6.55)	0.265	4.70 (0.60, 8.80)	0.025	1.58 (-2.05, 5.20)	0.394	1.16 (-2.30, 4.62)	0.511	-1.61 (-5.17, 1.95)	0.375
Q2	0.19 (-3.96, 4.34)	0.928	1.44 (-2.64, 5.52)	0.490	1.87 (-1.74, 5.48)	0.311	2.89 (-0.55, 6.33)	0.100	1.43 (-2.12, 4.97)	0.430
Q1	0		0		0		0		0	
Continuous	2.05 (-1.08, 5.17)	0.199	4.24 (1.19, 7.29)	0.006	2.57 (-0.12, 5.27)	0.061	0.94 (-1.67, 3.54)	0.481	-0.74 (-3.42, 1.95)	0.590
TMAO										
Q3	1.33 (-2.88, 5.53)	0.536	-1.21 (-5.38, 2.95)	0.568	-1.60 (-5.22, 2.03)	0.387	0.18 (-3.32, 3.68)	0.921	1.01 (-2.59, 4.61)	0.582
Q2	1.90 (-2.28, 6.09)	0.373	-2.62 (-6.77, 1.53)	0.216	-3.19 (-6.80, 0.42)	0.083	0.78 (-2.70, 4.27)	0.660	-0.99 (-4.57, 2.59)	0.588
Q1	0		0		0		0		0	
Continuous	0.06 (-1.94, 2.06)	0.950	-0.24 (-2.23, 1.75)	0.813	-0.65 (-2.38, 1.09)	0.464	0.10 (-1.56, 1.77)	0.903	0.07 (-1.64, 1.78)	0.935
L-carnitine										
Q3	-2.10 (-6.22, 2.02)	0.317	-1.10 (-5.24, 3.04)	0.601	0.19 (-3.42, 3.81)	0.917	0.20 (-3.27, 3.66)	0.912	-1.21 (-4.78, 2.36)	0.505
Q2	-4.41 (-8.57, -0.25)	0.038	0.68 (-3.50, 4.86)	0.750	-1.22 (-4.86, 2.43)	0.514	-1.02 (-4.52, 2.48)	0.567	-1.06 (-4.66, 2.54)	0.565
Q1	0		0		0		0		0	
Continuous	-0.81 (-8.47, 6.86)	0.837	1.84 (-5.77, 9.46)	0.635	4.01 (-2.62, 10.63)	0.236	1.29 (-5.08, 7.66)	0.691	-4.40 (-10.93, 2.13)	0.187

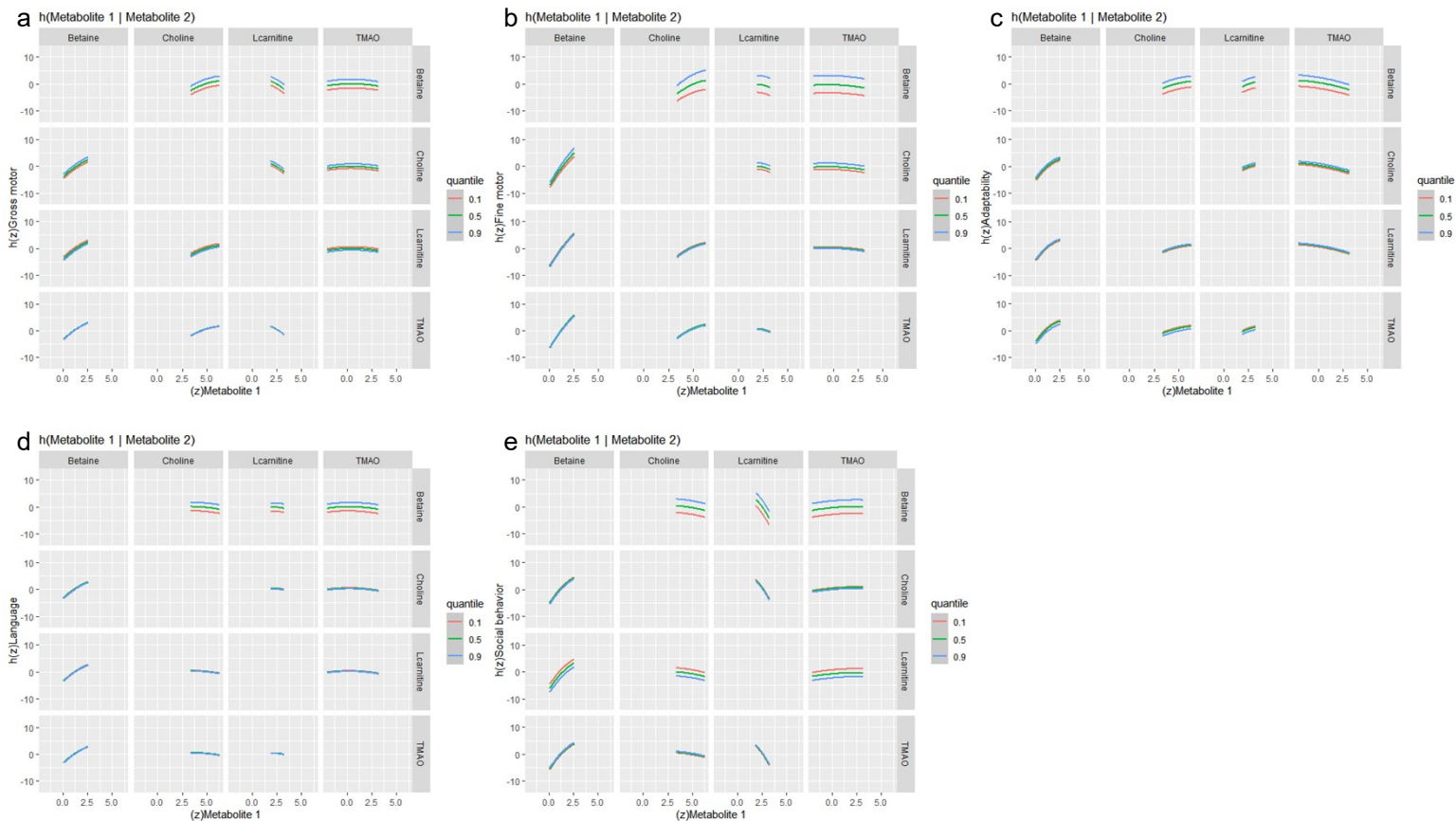


Figure S1. Bivariate exposure-response relationships of each metabolite with the developmental quotient scores of each functional area of neurobehavior in offspring. a: Gross motor; b: Fine motor; c: Adaptability; d: Language; e: Social behavior. Data were adjusted for control variables such as offspring sex, birth weight, gestational age at birth, only child or not, feeding mode, delivery mode, pregnancy type, maternal age, maternal pre-pregnancy BMI, paternal age, paternal BMI, maternal education level, paternal education level, quality of sleep during pregnancy and annual per capita household income.