

Supplementary Table S1. Method validation for quantification of SCFA in serum

	AMR/Linearity ($\mu\text{mol/L}$)	LOQ ($\mu\text{mol/L}$)	LOD ($\mu\text{mol/L}$)	Precision (CV%)		Calibration curve	
				Intra-day	Inter-day	Slope	r ²
Acetic acid (C2:0)	0.011 – 1828	0.011	0.003	4.9	11.1	1.067	0.998
Propionic acid (C3:0)	0.004 – 101	0.004	0.001	8.8	15.2	0.051	0.999
Isobutyric acid (C4:0)	0.005 – 85	0.005	0.002	4.3	9.8	0.006	0.997
Butyric acid (C4:0)	0.005 – 68	0.005	0.002	4.3	10.5	0.007	0.999

AMR: Analytical measurement range; LOQ: limit of detection; LOQ: limit of quantification.

Supplementary Table S2. Cognitive and temperament mean and adjusted mean scores according to acetic acid levels in first and third trimester

		First trimester					Third trimester						
Bayley Scales Infant Development		Low tertile ^a < 39.686 μM	Medium tertile ^b 39.687-51.972 μM	High tertile ^c > 51.972 μM	F (p)	Sidak	Low tertile ^a < 39.636 μM	Medium tertile ^b 39.637 - 50.667 μM	High tertile ^c > 50.667 μM	F (p)	Sidak		
Cognitive scale	Mean (SD)	101.8 (8.5)	102.4 (8.0)	101.6 (7.7)	0.184 (0.832)	ac (0.031)	101.0 (7.8)	101.8 (7.7)	101.9 (8.0)	0.655 (0.520)	ac (0.042)		
	Estimated mean	101.7	102.3	101.9			100.8	102.0	101.9				
Language scale	Mean (SD)	97.4 (8.2)	97.2 (7.2)	95.2 (9.3)	1.887 (0.153)		97.4 (7.5)	96.6 (8.4)	94.6 (8.2)	2.833 (0.061)			
	Estimated mean	97.3	97.2	95.4			97.4	96.6	94.6				
Receptive	Mean (SD)	10.7 (2.0)	11.0 (2.0)	10.5 (2.3)	1.012 (0.364)		10.9 (1.9)	10.7 (2.1)	10.5 (2.2)	0.712 (0.491)			
	Estimated mean	10.7	10.9	10.5			10.8	10.7	10.5				
Expressive	Mean (SD)	8.4 (1.5)	8.1 (1.5)	7.8 (1.8)	3.308 (0.038)		8.2 (1.5)	8.1 (1.6)	7.7 (1.5)	3.543 (0.030)			
	Estimated mean	8.4	8.1	7.9			8.2	8.1	7.7				
Motor scale	Mean (SD)	108.2 (10.4)	106.3 (13.6)	107.7 (10.5)	0.872 (0.458)		106.7 (14.5)	108.6 (10.5)	107.1 (10.4)	0.937 (0.393)			
	Estimated mean	107.8	106.3	108.1			106.4	108.7	107.3				
Fine	Mean (SD)	11.5 (1.8)	11.4 (2.1)	11.5 (1.9)	0.180 (0.835)		11.4 (2.0)	11.6 (2.1)	11.4 (1.7)	0.284 (0.753)			
	Estimated mean	11.4	11.4	11.6			11.4	11.6	11.5				
Gross	Mean (SD)	11.2 (2.4)	10.9 (2.1)	11.0 (2.4)	0.581 (0.560)		11.0 (2.3)	11.2 (2.4)	11.0 (2.3)	0.349 (0.706)			
	Estimated mean	11.2	10.9	11.1			11.0	11.3	11.0				
Early Infant Temperament Questionnaire													
Activity level	Mean (SD)	3.2 (0.7)	3.2 (0.7)	3.2 (0.7)	0.073 (0.929)		3.1 (0.7)	3.1 (0.7)	3.2 (0.6)	0.345 (0.708)			
	Estimated mean	3.2	3.1	3.2			3.2	3.1	3.2				
Rhythmicity	Mean (SD)	3.3 (0.8)	3.4 (0.7)	3.2 (0.7)	1.906 (0.150)		3.2 (0.8)	3.3 (0.8)	3.2 (0.8)	0.211 (0.810)			
	Estimated mean	3.3	3.4	3.2			3.2	3.3	3.2				
Approach	Mean (SD)	2.6 (0.7)	2.6 (0.7)	2.6 (0.7)	0.058 (0.944)		2.7 (0.8)	2.5 (0.7)	2.7 (0.7)	2.460 (0.087)			
	Estimated mean	2.7	2.6	2.6			2.7	2.5	2.7				
Adaptability	Mean (SD)	2.6 (0.6)	2.6 (0.7)	2.6 (0.7)	0.111 (0.895)		2.6 (0.7)	2.6 (0.6)	2.6 (0.7)	0.131 (0.877)			
	Estimated mean	2.6	2.6	2.6			2.6	2.6	2.6				
Intensity	Mean (SD)	3.3 (0.8)	3.4 (0.8)	3.4 (1.0)	0.826 (0.439)		3.4 (0.9)	3.2 (0.8)	3.4 (0.8)	1.703 (0.184)			
	Estimated mean	3.3	3.3	3.4			3.4	3.2	3.4				
Mood	Mean (SD)	2.9 (0.7)	3.1 (0.7)	2.9 (0.6)	2.598 (0.076)		2.9 (0.7)	3.0 (0.7)	2.9 (0.7)	0.643 (0.291)			
	Estimated mean	2.9	3.1	2.9			3.0	3.0	2.9				
Persistence	Mean (SD)	2.9 (0.8)	2.9 (0.7)	3.0 (0.8)	0.130 (0.878)		2.9 (0.8)	2.9 (0.8)	3.0 (0.7)	1.265 (0.284)			
	Estimated mean	2.9	2.9	2.9			2.9	2.9	3.0				
Distractibility	Mean (SD)	2.5 (0.8)	2.6 (0.7)	2.5 (0.8)	0.964 (0.382)		2.5 (0.7)	2.6 (0.8)	2.5 (0.8)	0.225 (0.798)			
	Estimated mean	2.6	2.6	2.5			2.5	2.6	2.5				
Threshold	Mean (SD)	4.1 (0.7)	4.2 (0.7)	4.1 (0.6)	0.172 (0.842)		4.1 (0.7)	4.1 (0.6)	4.2 (0.7)	0.074 (0.929)			
	Estimated mean	4.1	4.2	4.2			4.1	4.1	4.2				

Models adjusted by mother's age, family's socioeconomic status, first/third trimester state anxiety, smoking during pregnancy, first/third trimester quality of diet, first/third trimester BMI, mode of delivery, gestational age at birth, infant's birth weight, infant's sex, breastfeeding at 40 days postpartum, and bonding difficulties.

Supplementary Table S3. Cognitive and temperament means and adjusted means scores according to propionic acid levels in first and third trimester

		First trimester					Third trimester				
Bayley Scales Infant Development		Low tertile ^a < 3.120 μM	Medium tertile ^b 3.121 - 3.837 μM	High tertile ^c > 3.837 μM	F (p)	Sidak	Low tertile ^a < 3.033 μM	Medium tertile ^b 3.034 - 3.663 μM	High tertile ^c >3.663 μM	F (p)	Sidak
Cognitive scale	Mean (SD)	101.6 (7.8)	102.7 (8.3)	101.2 (8.0)	1.297 (0.275)		101.4 (8.2)	101.9 (8.0)	101.6 (7.8)	0.100 (0.905)	
	Estimated mean	101.4	102.9	101.4			101.4	101.6	101.9		
Language scale	Mean (SD)	95.7 (8.2)	98.3 (8.4)	95.8 (8.0)	3.188 (0.033)	ab (0.040)	96.4 (8.2)	96.8 (8.7)	95.3 (7.1)	1.352 (0.260)	
	Estimated mean	95.6	98.2	96.0			96.3	97.1	95.2		
Receptive	Mean (SD)	10.5 (2.0)	11.0 (2.0)	10.5 (2.2)	1.765 (0.173)		10.8 (2.0)	10.8 (2.2)	10.5 (2.0)	0.529 (0.590)	
	Estimated mean	10.5	11.0	10.6			10.8	10.8	10.5		
Expressive	Mean (SD)	7.97 (1.6)	8.37 (1.6)	8.03 (1.5)	2.038 (0.132)		7.97 (1.5)	8.15 (1.5)	7.85 (1.6)	1.510 (0.233)	
	Estimated mean	8.0	8.4	8.0			7.9	8.2	7.8		
Motor Scale	Mean (SD)	108.4 (10.9)	109.6 (9.6)	104.5 (13.6)	5.731 (0.004)	bc (0.003)	108.1 (11.0)	108.2 (10.0)	105.9 (14.5)	0.808 (0.447)	
	Estimated mean	107.7	109.9	104.8			108.3	107.9	106.2		
Fine	Mean (SD)	11.5 (2.0)	11.8 (1.9)	11.2 (1.9)	2.449 (0.088)		11.6 (2.0)	11.5 (1.9)	11.3 (2.0)	0.225 (0.799)	
	Estimated mean	11.3	11.8	11.3			11.6	11.4	11.4		
Gross	Mean (SD)	11.3 (2.4)	11.4 (2.1)	10.6 (2.4)	4.342 (0.014)	bc (0.014)	11.1 (2.5)	11.2 (2.0)	11.0 (2.5)	0.084 (0.919)	
	Estimated mean	11.2	11.4	10.6			11.1	11.2	11.0		
Early Infant Temperament Questionnaire											
Activity level	Mean (SD)	3.2 (0.7)	3.2 (0.7)	3.2 (0.7)	0.060 (0.942)		3.1 (0.7)	3.2 (0.7)	3.2 (0.7)	1.426 (0.242)	
	Estimated mean	3.2	3.2	3.1			3.1	3.2	3.2		
Rhythmicity	Mean (SD)	3.3 (0.8)	3.2 (0.8)	3.3 (0.8)	1.214 (0.299)		3.2 (0.8)	3.3 (0.8)	3.3 (0.8)	1.074 (0.343)	
	Estimated mean	3.3	3.2	3.3			3.2	3.3	3.2		
Approach	Mean (SD)	2.6 (0.7)	2.6 (0.8)	2.7 (0.7)	1.540 (0.216)		2.6 (0.7)	2.6 (0.7)	2.7 (0.8)	0.866 (0.422)	
	Estimated mean	2.6	2.7	2.7			2.6	2.6	2.7		
Adaptability	Mean (SD)	2.6 (0.6)	2.5 (0.7)	2.7 (0.7)	0.959 (0.384)		2.5 (0.7)	2.6 (0.6)	2.7 (0.7)	1.281 (0.279)	
	Estimated mean	2.6	2.5	2.7			2.5	2.6	2.7		
Intensity	Mean (SD)	3.3 (0.7)	3.3 (0.9)	3.4 (0.9)	1.244 (0.290)		3.3 (0.8)	3.4 (0.8)	3.4 (0.8)	0.253 (0.777)	
	Estimated mean	3.3	3.3	3.4			3.3	3.4	3.4		
Mood	Mean (SD)	3.0 (0.7)	2.8 (0.6)	3.1 (0.7)	2.975 (0.038)	bc (0.037)	2.9 (0.7)	3.0 (0.6)	3.1 (0.6)	2.092 (0.125)	
	Estimated mean	3.0	2.9	3.1			2.9	3.0	3.1		
Persistence	Mean (SD)	3.0 (0.9)	2.8 (0.7)	3.0 (0.8)	2.468 (0.086)		2.9 (0.8)	3.0 (0.85)	3.0 (0.8)	0.097 (0.908)	
	Estimated mean	3.0	2.8	3.0			2.9	3.0	3.0		
Distractibility	Mean (SD)	2.6 (0.8)	2.4 (0.8)	2.6 (0.8)	0.565 (0.569)		2.5 (0.7)	2.5 (0.7)	2.6 (0.8)	0.595 (0.552)	
	Estimated mean	2.5	2.5	2.6			2.5	2.6	2.6		
Threshold	Mean (SD)	4.1 (0.7)	4.1 (0.6)	4.2 (0.6)	0.989 (0.373)		4.1 (0.6)	4.1 (0.8)	4.2 (0.6)	0.079 (0.924)	
	Estimated mean	4.1	4.1	4.2			4.1	4.1	4.2		

Models adjusted by mother's age, family's socioeconomic status, first/third trimester state anxiety, smoking during pregnancy, first/third trimester quality of diet, first/third trimester BMI, mode of delivery, gestational age at birth, infant's birth weight, infant's sex, breastfeeding at 40 days postpartum, and bonding difficulties.

Supplementary Table S4. Cognitive and temperament mean and adjusted mean scores according to butyric acid levels in first and third trimester.

		First trimester					Third trimester				
		Low tertile ^a < 0.613 μM	Medium tertile ^b 0.614-0.862 μM	High tertile ^c >0.862 μM	F (p)	Sidak	Low tertile ^a <0.682 μM	Medium tertile ^b 0.683-0.971 μM	High tertile ^c >0.972 μM	F (p)	Sidak
Bayley Scales Infant Development											
Cognitive scale	Mean (SD)	102.4 (6.7)	102.5 (8.3)	100.8 (8.0)	1.452 (0.236)	ac (0.050)	102.1 (7.5)	100.5 (9.0)	101.8 (7.4)	0.456 (0.634)	
	Estimated mean	102.3	102.5	100.9			102.0	100.9	101.6		
Language scale	Mean (SD)	96.8 (8.1)	96.8 (7.9)	96.5 (8.8)	0.003 (0.997)		97.4 (8.0)	95.3 (8.4)	95.8 (7.8)	1.568 (0.210)	
	Estimated mean	96.7	96.7	96.7			97.3	95.4	95.7		
Receptive	Mean (SD)	10.7 (2.0)	10.8 (2.1)	10.6 (2.3)	0.134 (0.875)		11.0 (2.0)	10.5 (2.2)	10.5 (1.9)	1.390 (0.251)	
	Estimated mean	10.7	10.8	10.7			10.9	10.6	10.5		
Expressive	Mean (SD)	8.2 (1.7)	8.1 (1.5)	8.2 (1.5)	0.140 (0.870)		8.1 (1.5)	7.9 (1.6)	8.0 (1.6)	0.776 (0.461)	
	Estimated mean	8.2	8.1	8.2			8.1	7.9	8.0		
Motor scale	Mean (SD)	109.1 (10.3)	108.1 (10.2)	105.2 (13.9)	3.061 (0.048)		107.6 (9.7)	107.4 (10.9)	107.5 (15.2)	0.003 (0.997)	
	Estimated mean	108.8	108.2	105.3			107.5	107.5	107.6		
Fine	Mean (SD)	11.7 (1.8)	11.6 (1.8)	11.2 (2.1)	1.161 (0.314)		11.4 (1.9)	11.6 (1.9)	11.4 (2.1)	0.454 (0.636)	
	Estimated mean	11.6	11.6	11.3			11.4	11.6	11.4		
Gross	Mean (SD)	11.3 (2.3)	11.1 (2.3)	10.8 (2.4)	1.255 (0.286)		11.1 (2.1)	10.9 (2.4)	11.4 (2.4)	1.504 (0.224)	
	Estimated mean	11.3	11.1	10.8			11.0	10.9	11.5		
Early Infant Temperament Questionnaire											
Activity level	Mean (SD)	3.1 (0.7)	3.1 (0.7)	3.2 (0.7)	0.953 (0.387)	ac (0.007) bc (0.008)	3.1 (0.7)	3.2 (0.7)	3.2 (0.6)	0.043 (0.958)	
	Estimated mean	3.1	3.1	3.2			3.2	3.2	3.2		
Rhythmicity	Mean (SD)	3.2 (0.7)	3.3 (0.7)	3.3 (0.8)	0.283 (0.754)		3.1 (0.8)	3.3 (0.8)	3.3 (0.7)	1.262 (0.285)	
	Estimated mean	3.2	3.3	3.2			3.2	3.3	3.3		
Approach	Mean (SD)	2.6 (0.7)	2.6 (0.7)	2.6 (0.8)	0.050 (0.952)		2.6 (0.7)	2.6 (0.7)	2.7 (0.7)	0.451 (0.637)	
	Estimated mean	2.7	2.6	2.6			2.6	2.7	2.7		
Adaptability	Mean (SD)	2.6 (0.7)	2.6 (0.7)	2.6 (0.7)	0.077 (0.926)		2.6 (0.6)	2.6 (0.7)	2.6 (0.7)	0.305 (0.737)	
	Estimated mean	2.6	2.6	2.6			2.6	2.6	2.6		
Intensity	Mean (SD)	3.3 (0.8)	3.2 (0.9)	3.6 (0.9)	6.294 (0.002)		3.2 (0.9)	3.4 (0.8)	3.4 (0.8)	1.045 (0.353)	
	Estimated mean	3.2	3.2	3.6			3.2	3.4	3.4		
Mood	Mean (SD)	2.9 (0.6)	3.0 (0.7)	3.0 (0.7)	1.373 (0.255)		2.9 (0.6)	3.0 (0.7)	3.0 (0.7)	0.482 (0.618)	
	Estimated mean	2.9	3.0	3.0			2.9	3.0	3.0		
Persistence	Mean (SD)	2.9 (0.8)	3.0 (0.8)	2.9 (0.8)	2.853 (0.059)		2.9 (0.8)	2.9 (0.9)	3.0 (0.7)	0.087 (0.916)	
	Estimated mean	2.8	3.1	2.9			2.9	2.9	3.0		
Distractibility	Mean (SD)	2.5 (0.7)	2.5 (0.8)	2.5 (0.8)	0.275 (0.760)		2.5 (0.7)	2.5 (0.8)	2.5 (0.8)	0.065 (0.937)	
	Estimated mean	2.5	2.6	2.5			2.5	2.5	2.5		
Threshold	Mean (SD)	4.1 (0.6)	4.1 (0.6)	4.2 (0.7)	0.769 (0.464)		4.1 (0.6)	4.2 (0.7)	4.1 (0.7)	0.562 (0.571)	
	Estimated mean	4.1	4.1	4.2			4.1	4.2	4.2		

Models adjusted by mother's age, family's socioeconomic status, first/third trimester state anxiety, smoking during pregnancy, first/third trimester quality of diet, first/third trimester BMI, mode of delivery, gestational age at birth, infant's birth weight, infant's sex, breastfeeding at 40 days postpartum, and bonding difficulties.

Supplementary Table S5. Cognitive and temperament mean and adjusted mean scores according to isobutyric acid levels in first and third trimester.

		First trimester			F (p)	Sidak	Third trimester			F (p)	Sidak
		Low tertile ^a < 0.390 μ M	Medium tertile ^b 0.391-0.507 μ M	High tertile ^c >0.507 μ M			Low tertile ^a <0.331 μ M	Medium tertile ^b 0.332-0.463 μ M	High tertile ^c >0.463 μ M		
Bayley Scales Infant Development											
Cognitive scale	Mean (SD)	103.4 (7.3)	101.3 (8.4)	101.3 (8.4)	2.690 (0.069)		101.9 (7.3)	101.0 (8.3)	101.8 (8.4)	0.686 (0.505)	
	Estimated mean	103.4	101.2	101.4			101.9	100.8	102.0		
Language scale	Mean (SD)	97.1 (8.3)	96.6 (8.2)	96.0 (8.3)	0.272 (0.762)		97.2 (7.2)	95.1 (8.9)	96.5 (8.1)	1.220 (0.297)	
	Estimated mean	97.0	96.6	96.2			96.9	95.2	96.6		
Receptive	Mean (SD)	10.7 (2.0)	10.8 (2.2)	10.6 (2.1)	0.246 (0.782)		10.9 (1.9)	10.6 (2.2)	10.7 (2.2)	0.325 (0.723)	
	Estimated mean	10.7	10.8	10.6			10.9	10.6	10.7		
Expressive	Mean (SD)	8.2 (1.6)	8.0 (1.5)	8.1 (1.7)	0.402 (0.669)		8.2 (1.4)	7.7 (1.7)	8.1 (1.5)	1.591 (0.206)	
	Estimated mean	8.2	8.0	8.1			8.1	7.8	8.1		
Motor scale	Mean (SD)	109.9 (10.2)	107.3 (13.6)	105.4 (10.7)	3.722 (0.025)	ac (0.021)	109.0 (14.6)	107.2 (10.0)	106.2 (10.3)	1.286 (0.278)	
	Estimated mean	109.7	107.2	105.6			109.0	107.0	106.5		
Fine	Mean (SD)	11.8 (1.9)	11.5 (1.9)	11.2 (2.1)	1.806 (0.166)		11.8 (1.9)	11.4 (2.0)	11.2 (2.0)	2.404 (0.092)	
	Estimated mean	11.7	11.5	11.2			11.8	11.3	11.3		
Gross	Mean (SD)	11.5 (2.3)	11.1 (2.3)	10.6 (2.2)	4.824 (0.009)	ac (0.006)	11.4 (2.5)	11.0 (2.1)	10.8 (2.2)	1.564 (0.211)	
	Estimated mean	11.5	11.1	10.6			11.4	11.0	10.8		
Early Infant Temperament Questionnaire											
Activity level	Mean (SD)	3.1 (0.7)	3.2 (0.7)	3.2 (0.7)	0.277 (0.758)		3.1 (0.7)	3.1 (0.7)	3.3 (0.7)	3.089 (0.050)	
	Estimated mean	3.1	3.2	3.2			3.1	3.1	3.3		
Rhythmicity	Mean (SD)	3.4 (0.8)	3.2 (0.7)	3.2 (0.7)	2.003 (0.137)		3.2 (0.8)	3.3 (0.7)	3.3 (0.8)	0.608 (0.545)	
	Estimated mean	3.4	3.2	3.2			3.2	3.3	3.3		
Approach	Mean (SD)	2.6 (0.7)	2.6 (0.7)	2.7 (0.7)	1.162 (0.314)		2.6 (0.7)	2.7 (0.7)	2.6 (0.7)	1.252 (0.287)	
	Estimated mean	2.6	2.6	2.7			2.7	2.7	2.6		
Adaptability	Mean (SD)	2.5 (0.6)	2.6 (0.7)	2.7 (0.7)	0.418 (0.659)		2.6 (0.7)	2.5 (0.6)	2.7 (0.6)	1.378 (0.254)	
	Estimated mean	2.6	2.6	2.6			2.6	2.5	2.7		
Intensity	Mean (SD)	3.3 (0.8)	3.3 (0.8)	3.4 (1.0)	0.532 (0.588)		3.4 (0.8)	3.3 (0.8)	3.4 (0.9)	0.837 (0.434)	
	Estimated mean	3.3	3.3	3.4			3.4	3.3	3.4		
Mood	Mean (SD)	2.9 (0.7)	3.1 (0.7)	3.0 (0.6)	1.195 (0.304)		3.0 (0.7)	3.0 (0.6)	3.0 (0.7)	0.385 (0.681)	
	Estimated mean	2.9	3.1	3.0			3.0	3.0	3.0		
Persistence	Mean (SD)	2.9 (0.8)	2.9 (0.8)	3.0 (0.8)	1.426 (0.242)		2.9 (0.8)	2.9 (0.8)	3.0 (0.8)	0.278 (0.758)	
	Estimated mean	2.9	2.9	3.0			2.9	2.9	3.0		
Distractibility	Mean (SD)	2.5 (0.8)	2.5 (0.8)	2.5 (0.8)	0.075 (0.928)		2.5 (0.8)	2.5 (0.7)	2.6 (0.8)	0.606 (0.546)	
	Estimated mean	2.5	2.5	2.5			2.5	2.5	2.6		
Threshold	Mean (SD)	4.1 (0.7)	4.1 (0.7)	4.2 (0.6)	0.631 (0.533)		4.2 (0.7)	4.1 (0.6)	4.1 (0.7)	0.422 (0.656)	
	Estimated mean	4.1	4.1	4.2			4.2	4.1	4.2		

Models adjusted by mother's age, family's socioeconomic status, first/third trimester state anxiety, smoking during pregnancy, first/third trimester quality of diet, first/third trimester BMI, mode of delivery, gestational age at birth, infant's birth weight, infant's sex, breastfeeding at 40 days postpartum, and bonding difficulties.