

Supplementary information

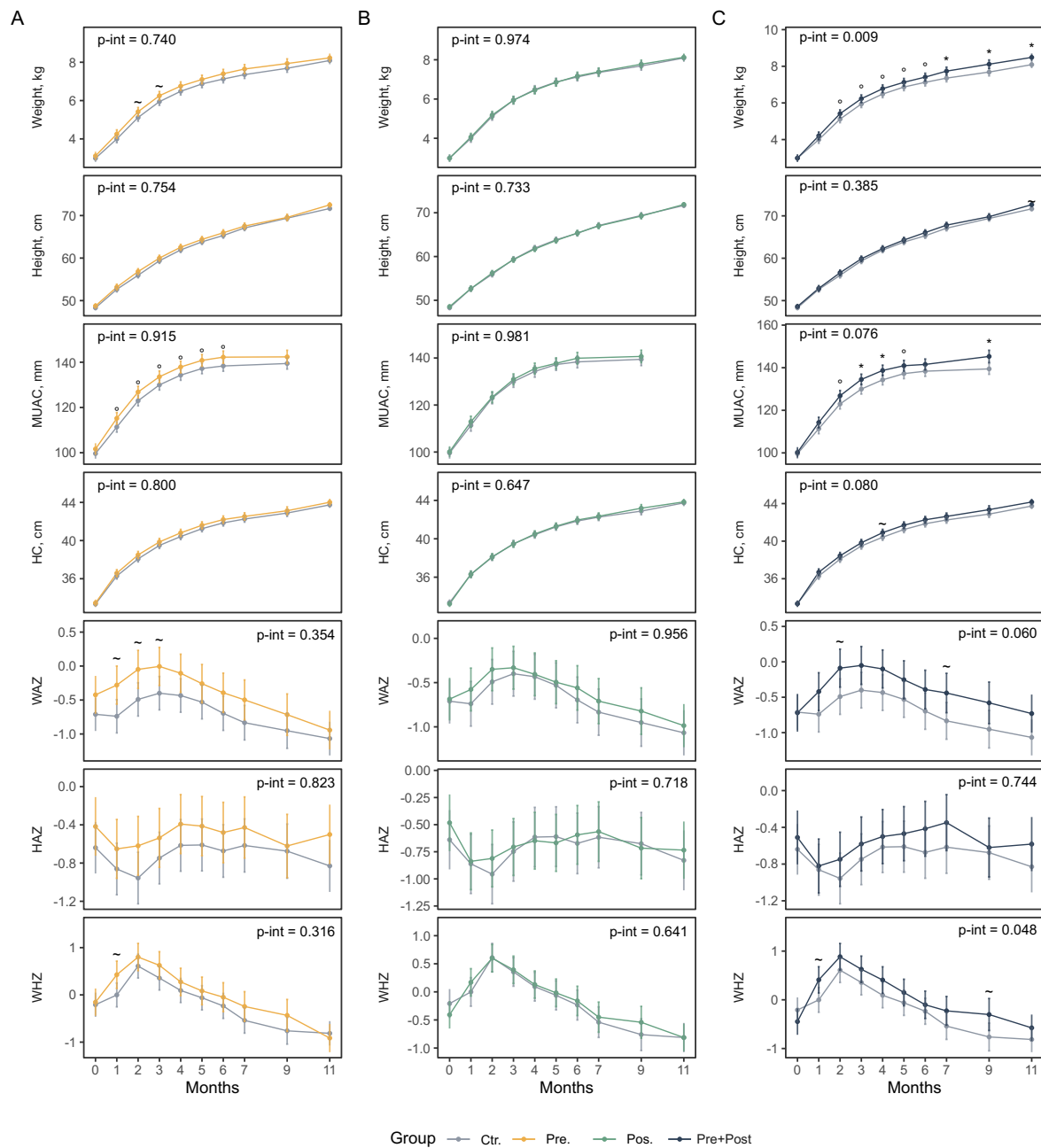


Figure S1. Longitudinal infant growth trajectories across randomized BEP intervention groups.

Infant anthropometric trajectories from birth to 11 months of age comparing each BEP intervention group with the control group. Panels show estimated mean trajectories ($\pm$ s.e.m.) for weight, height, mid-upper arm circumference (MUAC), head circumference (HC), weight-for-age z score (WAZ), height-for-age z score (HAZ), and weight-for-height z score (WHZ).

(A) Prenatal-only supplementation versus control.

(B) Postnatal-only supplementation versus control.

(C) Fully supplemented group (prenatal + postnatal BEP) versus control.

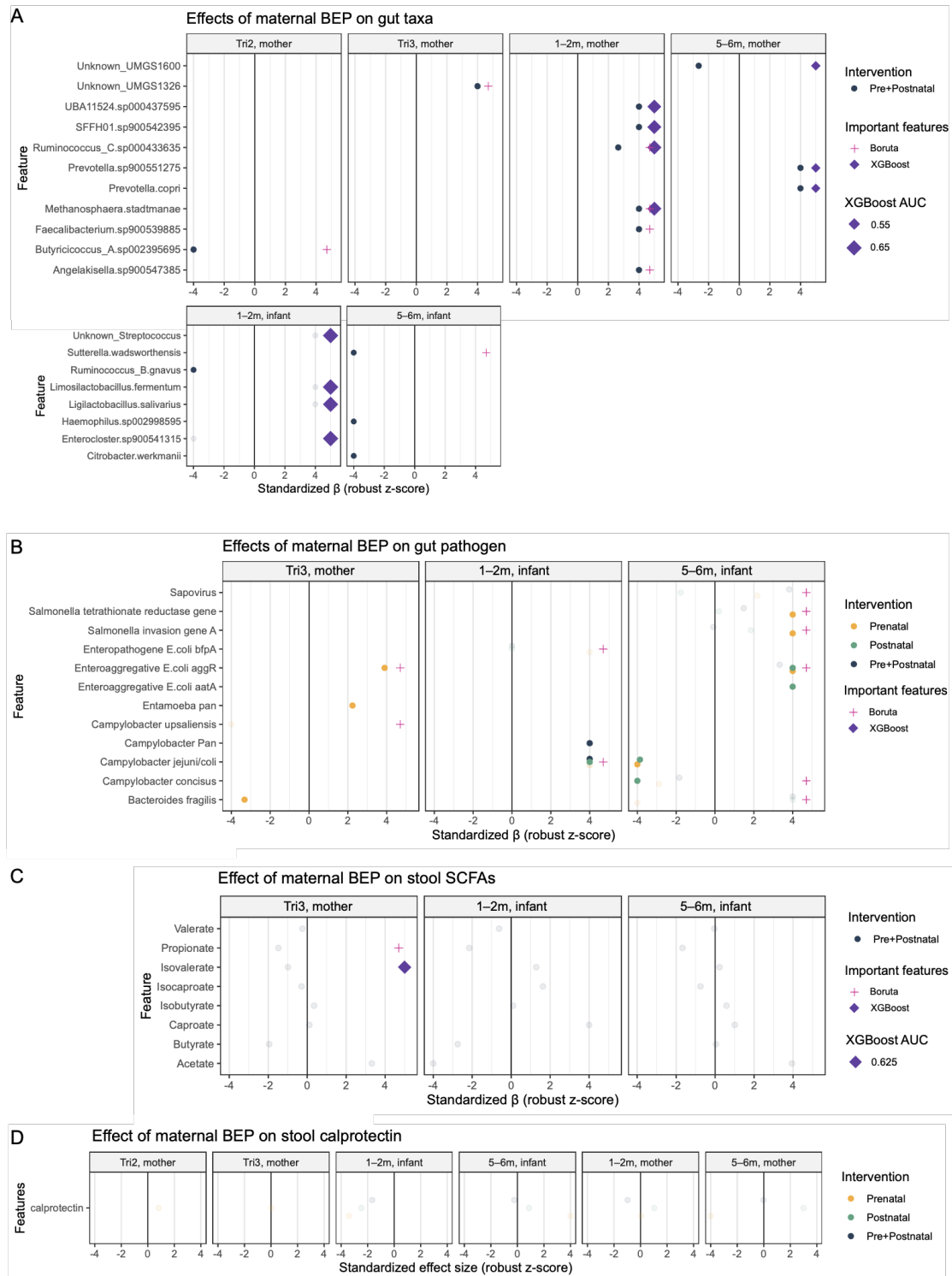


Figure S2. Effect of maternal BEP exposure on gut microbiome, pathogen, stool SCFAs and calprotectin. Associations between intervention and individual gut microbiome, pathogen presence, SCFAs and calprotectin from stool samples collected at multiple timepoints. The x-axis shows standardized effect sizes (robust z-scores of regression coefficients) from linear regression models comparing prenatal, postnatal or combined prenatal + postnatal intervention with the control group, adjusted for prespecified confounders. Point colour denotes intervention contrast, and opacity denotes statistical significance (opaque, $p < 0.05$; semi-transparent, $p \geq 0.05$). Machine-learning-based feature prioritization is overlaid for contextual reference. Points marked with + indicate features selected by Boruta algorithm, and purple diamonds indicate features selected by XGBoost with symbol size proportional to cross-validated model performance (AUC). Feature highlighted by either method are shown as important features. Complete statistical results are provided in Table S4.

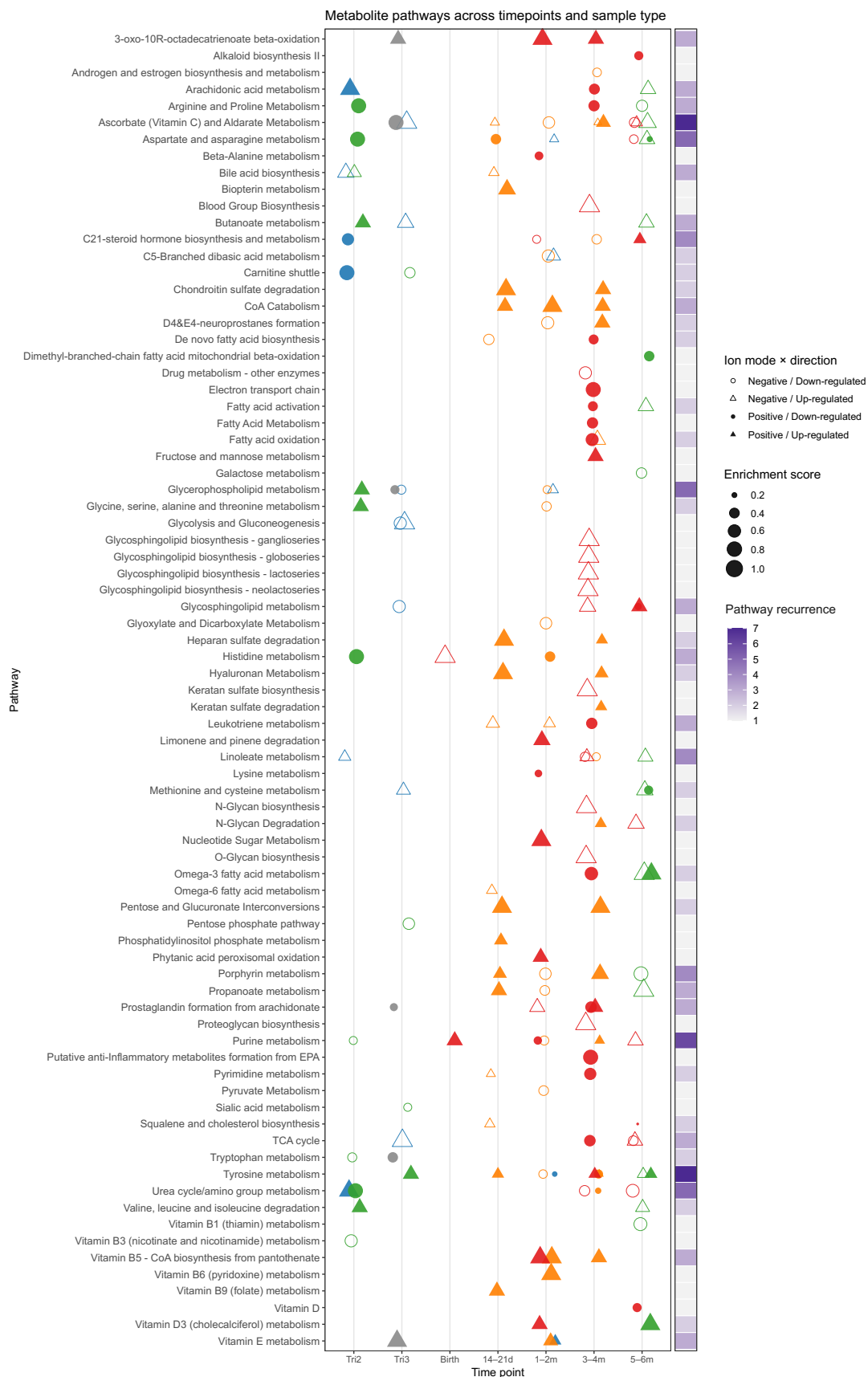


Figure S3. Pathway-level integration of significant metabolomic features across maternal, milk and infant compartments.

In the left panel, each point represents one enriched pathway in at least one sample type–timepoint context; point size scales with enrichment score (overlap size / pathway size), point color denotes sample type, and symbol style encodes ion-mode and direction of BEP association of the metabolomic sets. The right strip shows pathway recurrence (number of distinct contexts in which pathway appears).



Figure S5. Pathway-level integration of selected/significant proteomic features.

Left panel shows enriched pathway across timepoint, with point color indicating sample type (milk, plasma depleted, plasma naïve and fecal), point shape indicating direction of BEP association of the peoteomic sets (down- or up-regulated), and point size proportional to enrichment score. The right strip represents pathway recurrence (number of distinct sample type / timepoint context in which each pathway is detected).

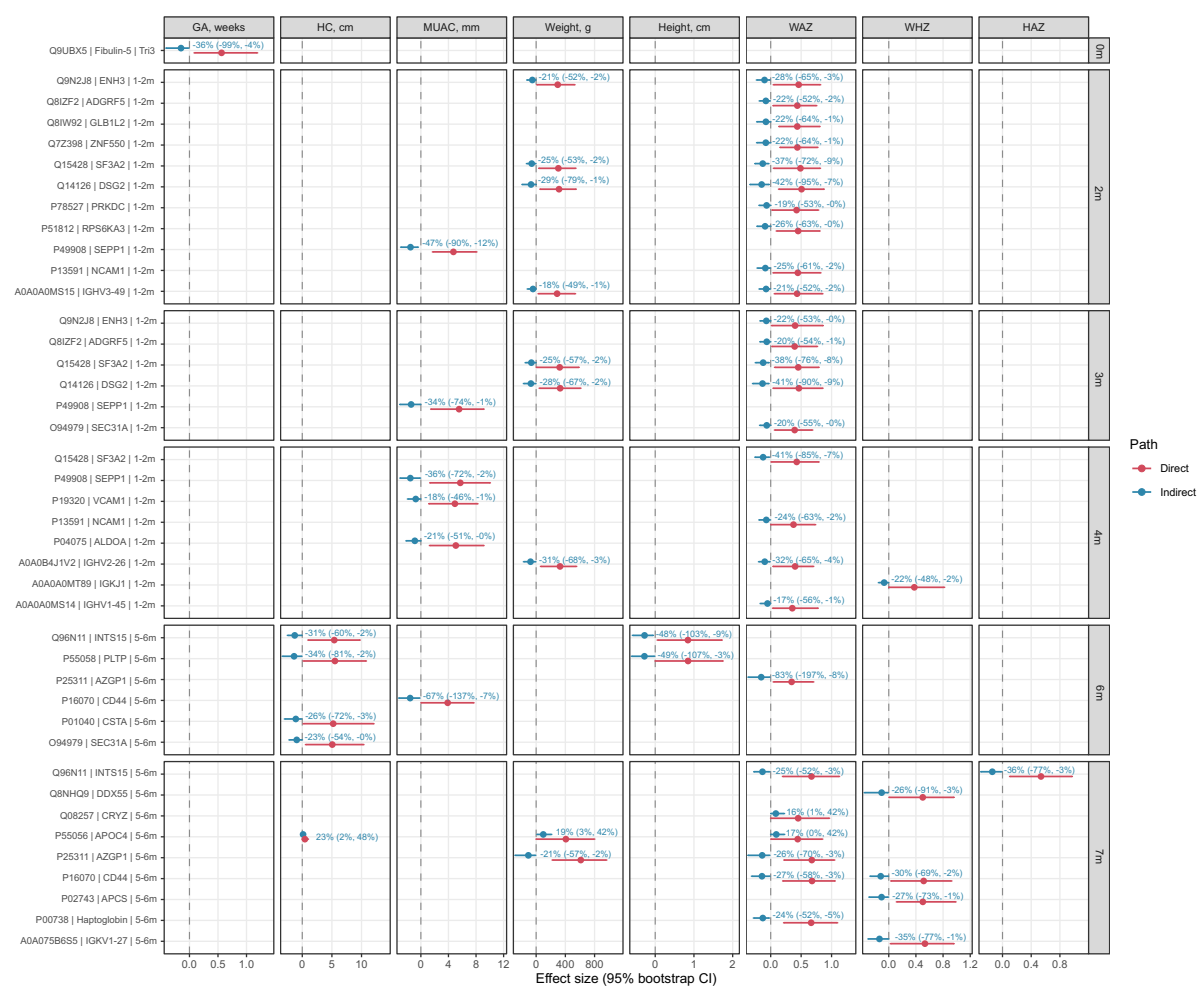


Figure S6. Maternal proteomic mediation of prenatal BEP effects.

Forest plots of significant maternal proteomic mediators showing direct and indirect effects from mediation models for infant anthropometric outcomes. Points indicate effect estimates and horizontal lines indicates 95% bootstrap confidence intervals (CIs). Only features with indirect and direct CIs not crossing 0 retained in the figure. Rows represent milk component and sampling timepoint; columns represent anthropometric outcomes and follow-up month.

Table S1: Nutritional values of the BEP supplement for pregnant and lactating women¹.

	Mean for 72g (serving size)
Total energy (kcal)	393
Lipids (g)	26
Linoleic acid (g)	3.9
α -Linoleic acid (g)	1.3
Proteins (g)	14.5
Carbohydrates (g)	23.3
Calcium (mg)	500
Copper (mg)	1.3
Phosphorus (mg)	418
Iodine (μ g)	250
Iron (mg)	22
Selenium (μ g)	65
Manganese (mg)	2.1
Magnesium (mg)	73
Potassium (mg)	562
Zinc (mg)	15
Vitamin A (μ g RE) ²	770
Thiamin (mg)	1.4
Riboflavin (mg)	1.4
Niacin (mg)	15
Vitamin B5 (mg)	7
Vitamin B6 (mg)	1.9
Folic acid (μ g)	400
Vitamin B12 (μ g)	2.6
Vitamin C (mg)	100
Vitamin D (μ g cholecalciferol) ³	15
Vitamin E (mg α -tocopherol) ⁴	18
Vitamin K (μ g)	72

¹Ingredients: vegetable oils (rapeseed, palm, soy in varying proportions), defatted soy flour, skimmed milk powder, peanuts, sugar, maltodextrin, soy protein isolate, vitamin and mineral complex, stabilizer (fully hydrogenated vegetable fat, mono and diglycerides).

²1 μ g vitamin A RE = 3.333 IU vitamin A.

³1 μ g cholecalciferol = 40 IU vitamin D.

⁴1 mg α -tocopherol = 2,22 IU vitamin E.

IU, international unit; RE, retinol equivalent

Table S2: Baseline characteristics of MISAME-III participants and Biospé subset participants

	MISAME-III	Biospé Subset				
Characteristics	Overall (n = 1897)	Control (n = 82)	Prenatal (n = 71)	Postnatal (n = 85)	Both (n = 71)	P valu e
Health center catchment area, n (%)						0.99
Boni	433 (22.8)	11 (13.4)	11 (15.5)	14 (16.5)	11 (15.5)	
Dohoun	200 (10.5)	9 (11.0)	9 (12.7)	11 (15.5)	9 (12.7)	
Dougoumato II	346 (18.2)	13 (15.9)	10 (14.1)	14 (19.7)	16 (22.5)	
Karaba	193 (10.2)	10 (12.2)	8 (11.3)	12 (16.9)	9 (12.7)	
Kari	350 (18.5)	19 (23.2)	16 (22.5)	18 (25.4)	15 (21.1)	
Koumbia	375 (19.8)	20 (24.4)	17 (23.9)	16 (22.5)	11 (15.5)	
Household level						
Household food insecurity*, n (%)	1277 (67.5)	48 (58.5)	42 (59.2)	53 (62.4)	44 (62.0)	0.95
Wealth index, 0 to 10 points	4.59 ± 1.76	4.64 ± 1.87	5.08 ± 1.76	4.44 ± 1.83	4.70 ± 1.67	0.17
Household size, number	6.26 ± 4.38	6.51 ± 4.88	6.72 ± 4.37	6.35 ± 5.09	6.56 ± 5.14	0.97
Number of children under five	1.05 ± 0.98	1.09 ± 1.07	1.17 ± 1.00	1.02 ± 1.12	1.11 ± 1.12	0.87
Improved water, n (%)	1193 (62.9)	50 (61.0)	40 (56.3)	55 (64.7)	38 (53.5)	0.50
Improved sanitation, n (%)	1135 (59.8)	54 (65.9)	43 (60.6)	55 (64.7)	45 (63.4)	0.92
Mother						
Ethnic group, n (%)						0.40
Bwaba	1086 (57.3)	44 (53.7)	44 (62.0.)	53 (62.4)	35 (49.3)	
Mossi	662 (34.9)	27 (32.9)	22 (31.0)	24 (28.2)	28 (39.4)	
Others	148 (7.8)	12 (14.6)	5 (7.0)	8 (9.4)	8 (11.3)	
Religion of pregnant woman, n (%)						0.91
Animist	432 (22.8)	18 (22.0)	17 (23.9)	20 (23.5)	16 (22.5)	
Muslim	801 (42.2)	36 (43.9)	29 (40.8)	34 (40.0)	34 (47.9)	
Catholic	261 (13.8)	5 (6.1)	6 (8.5)	7 (8.2)	5 (7.0)	
Protestant	335 (17.7)	21 (25.6)	16 (22.5)	22 (25.9)	14 (19.7)	
No religion, no animist	68 (3.6)	2 (2.4)	3 (4.2)	2 (2.4)	2 (2.8)	
Primary education and above, n (%)	797 (42.0)	37 (45.1)	33 (46.5)	45 (52.9)	27 (38.0)	0.36
Number of jobs, %						0.33
0	1152 (60.7)	40 (48.8)	42 (59.2)	53 (62.4)	46 (64.8)	
1	671 (35.4)	35 (42.7)	28 (39.4)	26 (30.6)	24 (33.8)	
2 and above	74 (3.9)	3 (3.7)	1 (1.4)	6 (7.1)	1 (1.4)	
Parity, %						0.41
0	429 (22.6)	17 (20.7)	22 (31.0)	21 (24.7)	21 (29.6)	
1-2	654 (34.5)	32 (39.0)	22 (31.0)	39 (45.9)	24 (33.8)	
3 or more	814 (42.9)	33 (40.2)	27 (38.0)	25 (29.4)	26 (36.6)	
Age, years	25.0 ± 6.17	25.17 ± 5.51	24.17 ± 5.75	23.65 ± 5.81	23.37 ± 5.56	0.20
Weight, kg	58.17 ± 8.67	60.21 ± 12.18	57.72 ± 9.01	56.59 ± 8.75	57.73 ± 8.30	0.11
Height, cm	162.54 ± 6.03	162.72 ± 6.73	162.80 ± 6.75	161.72 ± 5.46	162.13 ± 4.96	0.63
Body mass index, kg/m²	21.99 ± 2.87	22.64 ± 3.74	21.70 ± 2.52	21.62 ± 3.07	21.97 ± 3.16	0.16
Mid-upper arm circumference, mm	262.02 ± 26.63	267.04 ± 32.61	257.94 ± 24.10	257.49 ± 26.53	260.23 ± 24.54	0.10
Hemoglobin, g/dL	11.34 ± 1.51	11.58 ± 1.46	11.33 ± 1.46	11.77 ± 1.43	11.88 ± 1.38	0.10
Gestational weight gain, kg	6.17 ± 3.52	6.74 ± 3.54	7.35 ± 3.22	6.47 ± 3.39	6.06 ± 3.96	0.19
Dietary diversity score, 0 to 10 points	3.96 ± 1.61	4.10 ± 1.17	4.18 ± 1.40	4.14 ± 1.46	3.85 ± 1.2	0.44
Infant						
Sex, male, n (%)	862 (49.6)	37 (45.1)	30 (42.3)	36 (42.4)	40 (56.3)	0.28
Born in lean season, n (%)	527 (31.8)	27 (32.9)	25 (35.2)	35 (41.2)	29 (40.8)	0.76
Birth weight, kg	3.01 ± 0.44	2.99 ± 0.49	3.11 ± 0.43	2.98 ± 0.42	2.99 ± 0.46	0.29
Birth length, cm	48.29 ± 2.19	48.30 ± 2.33	48.73 ± 2.02	48.53 ± 2.09	48.61 ± 2.04	0.67
Birth head circumference, cm	34.42 ± 1.58	33.37 ± 1.64	33.46 ± 1.52	33.20 ± 1.48	33.34 ± 1.43	0.77
Birth mid-upper arm circumference, mm	100.76 ± 8.29	99.62 ± 8.84	101.54 ± 8.40	100.00 ± 9.08	100.25 ± 8.42	0.62
Gestational age at birth, weeks	39.91 ± 1.75	39.64 ± 1.78	39.90 ± 1.20	39.80 ± 1.43	40.04 ± 1.63	0.43
Exclusively breastfeeding duration, months	5.61 ± 1.67	5.68 ± 1.20	5.93 ± 0.90	5.70 ± 1.10	5.91 ± 0.74	0.31
Hemoglobin level at 6 months, g/dL	10.41 ± 1.36	10.33 ± 1.22	10.52 ± 1.31	10.35 ± 1.18	10.13 ± 1.25	0.45
Morbidity at 6 months, times	6.40 ± 1.77	6.24 ± 0.91	6.02 ± 1.13	6.12 ± 0.79	6.07 ± 0.90	0.51

Data are presented as n (%) for categorical variables and mean ± sd for continuous variables.

Comparisons were performed using Fisher's exact test for categorical variables and ANOVA for continuous variables.

Table S3. Effect of maternal BEP exposure on milk targeted components (nutrients, metabolites, microbiome)

Table S4. Effect of maternal BEP exposure on stool biomarkers

Table S5. Metabolomic and proteomic pathway enrichment analyses

Table S6. Mediation analyses of prenatal BEP supplementation on infant growth

Table S7. Inter-omic correlation network of multi-omic mediators of prenatal BEP effects on infant growth