

Table S1 Primer sequences

	Forward primer	Reverse primer
<i>Runx2</i>	CACAAGTGCGGTGCAAACCTT	AATGACTCGGTTGGTCTCGG
<i>Bmp2</i>	TGCTTCTTAGACGGACTGCG	GGGGAAGCAGCAACACTAGA
<i>Smad1</i>	TGACTGGGAACGGATCGGA	GGTCTTCGGTTCGGAAAGGT
<i>Smad5</i>	TGTTGGGCTGGAAACAAGGT	GTGACACACTTGCTTGGCTG
<i>Smad8</i>	CTACCCGCACAACCGGAG	GGTCAGCGGCAAGTATCTGT
<i>Rank</i>	CCGTCGGAACACGGAGTG	ACACGGTATCCACGTTGAGCT
		G
<i>Rankl</i>	AGGCTGGGCCAAGATCTCTA	GATAGTCCGCAGGTACGCTC
<i>Opg</i>	GTATCAGGTGCACGAGCCTT	AGCCAAGTCTGCAACTCGAA
<i>Fxr</i>	CACTGACACGCCCTTTTTGC	TGGAGGATAAAACGAGGCGG
<i>Abst</i>	CCATCGCAGGTGCAATTCTC	CCTGTACCAGGGTTGACCAG
<i>Osta</i>	ATGAGGCTTGTTTACCGCCA	AGGAAATCCACGCTCTTCCG
<i>Ostβ</i>	GAGGAAAACACAGAAACCAGGG	CCTGGTTAAGACGTCTCTGGG

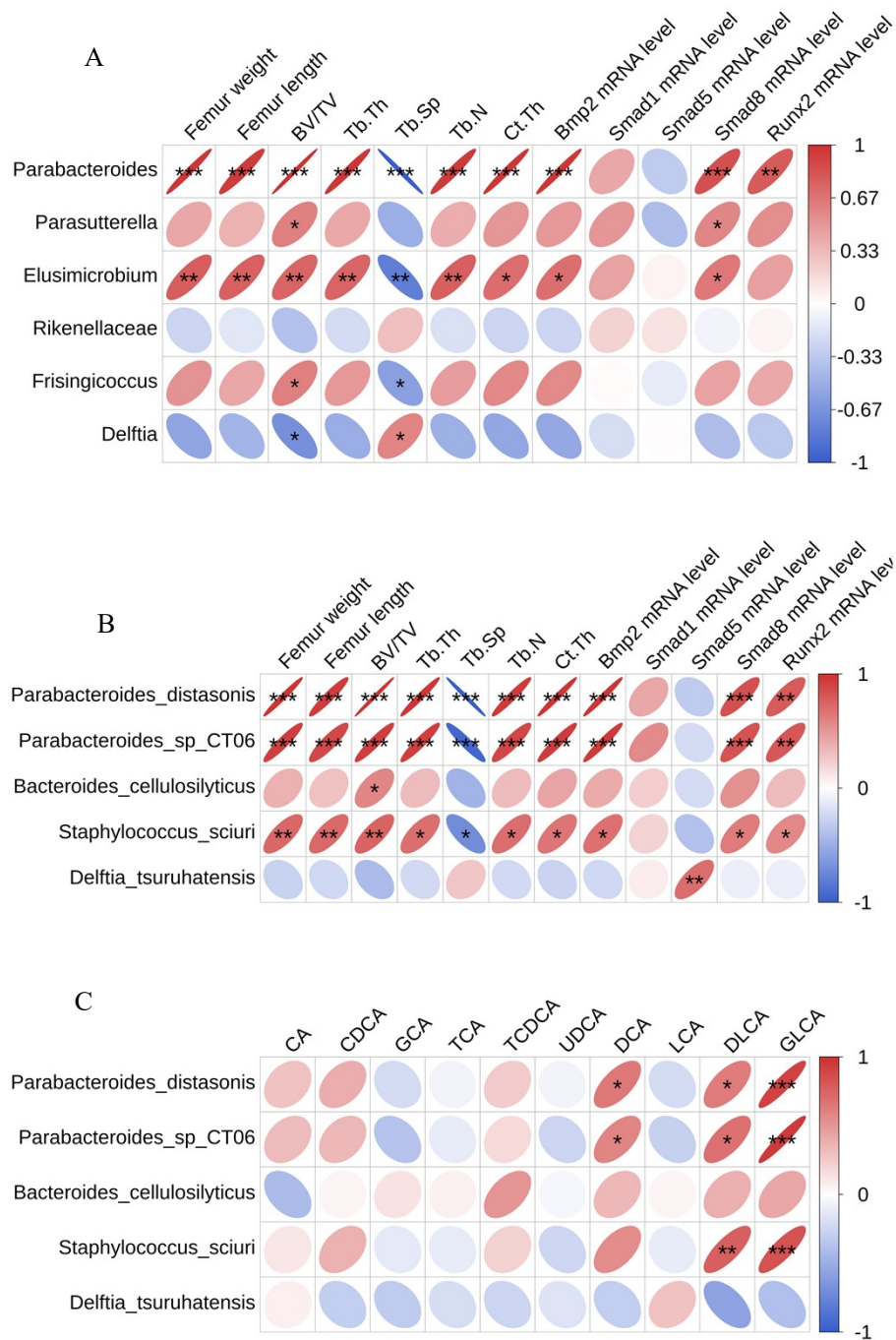


Figure S1 (A-B) The correlations between the relative abundance of the most important gut microbiota and the bone growth index. **(C)** The correlations between the relative abundance of the main alarmed gut microbiota and bile acid levels.

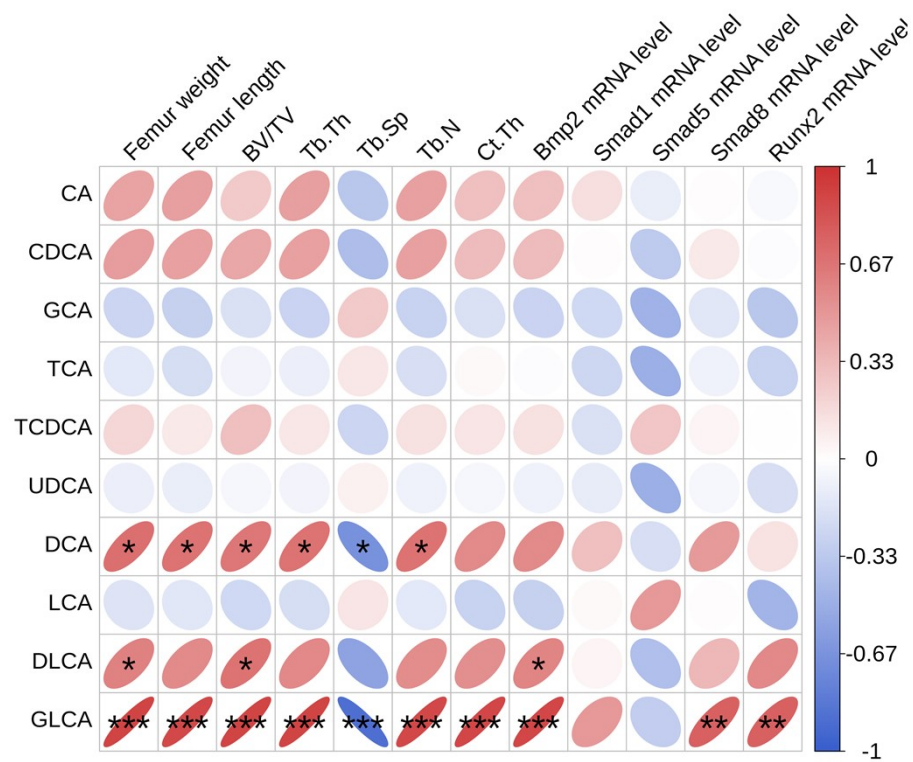


Figure S2 The correlations between the bile acid levels and the bone growth index.

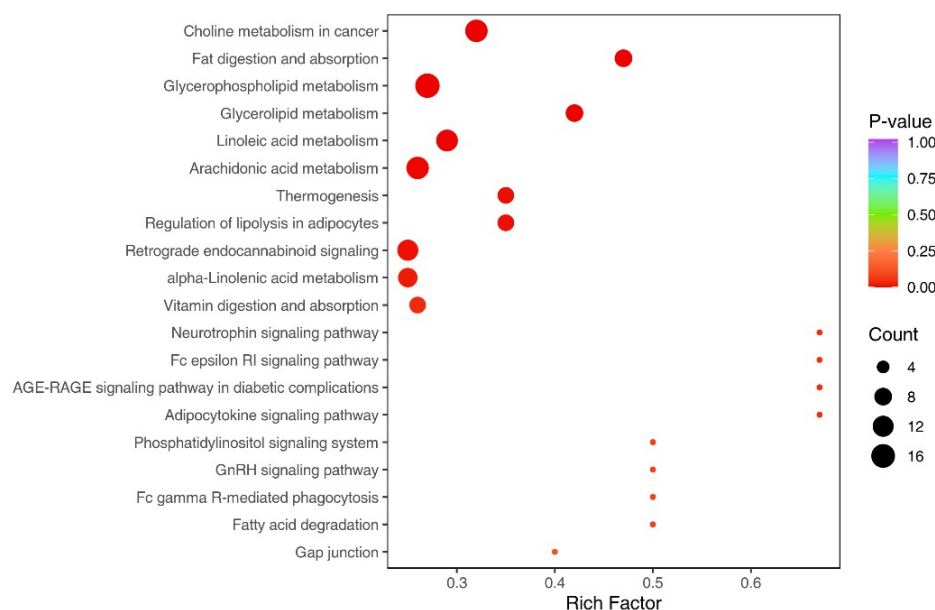


Figure S3 Bubble plot showing pathway enrichment analysis of significantly altered metabolites by LPN supplementation. Node size is proportional to the number of metabolites in a given pathway and is based on hits of each identified metabolite in a given pathway. Node color is graded according to its p-value in the pathway enrichment analysis. Metabolic pathway impact factor map in serum metabolomics.

Table S2 Rat experimental diet energy supply indicators

Ingredient composition		□	□
Corn, wheat, expanded soybean meal, fish meal, chicken meal, multivitamins, trace elements, etc.	Percentage of crude protein, %		20.8
	Percentage of crude fat, %		5.6
	Percentage of carbohydrates, %		58
	Gross energy, kcal/kg		3656
	Protein-to-energy ratio, %		22.8
	Fat-to-energy ratio, %		13.8
Carbohydrates-to-energy ratio, %			63.4