



Temporal response patterns of human gut microbiota to dietary fiber

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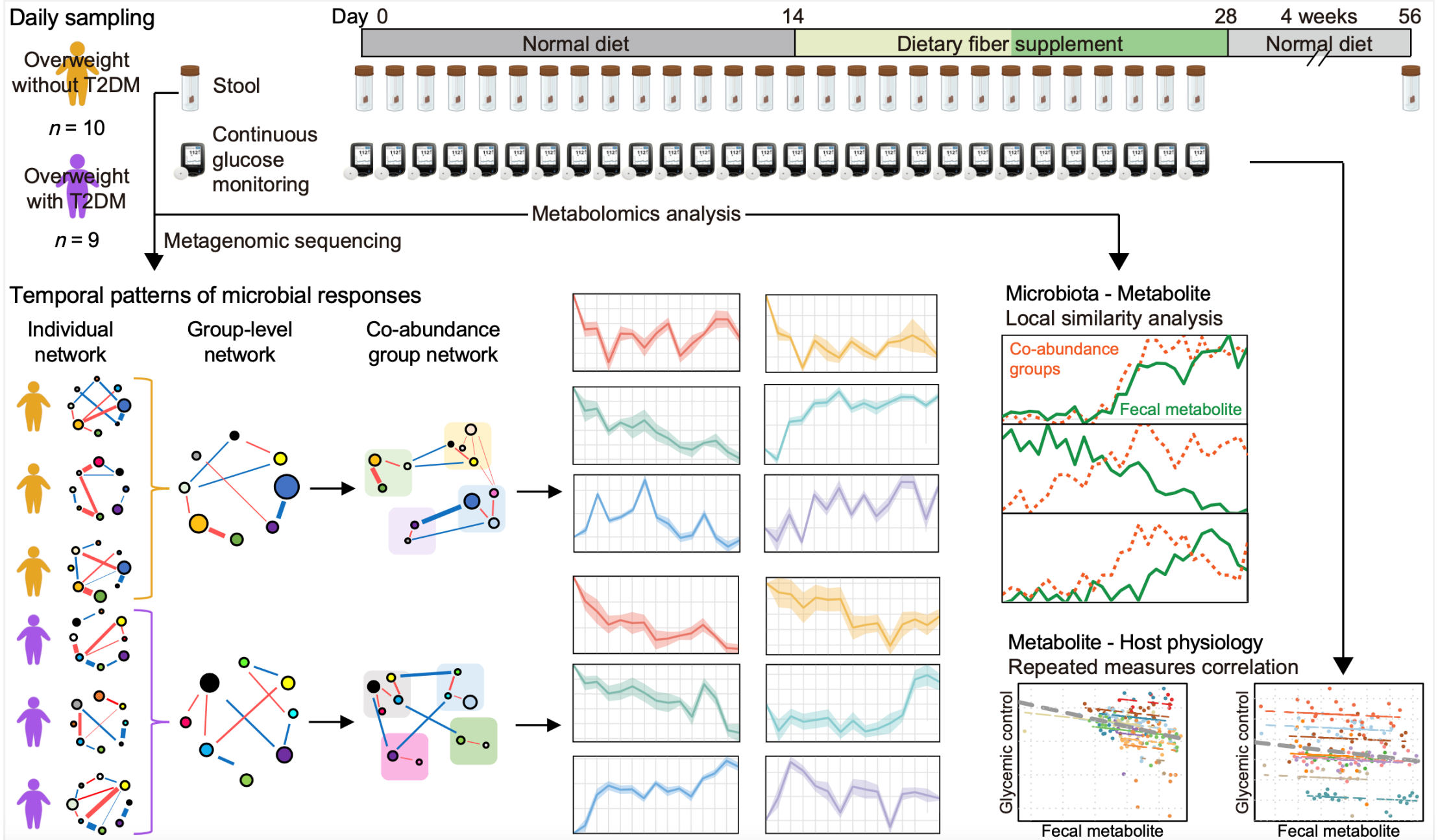
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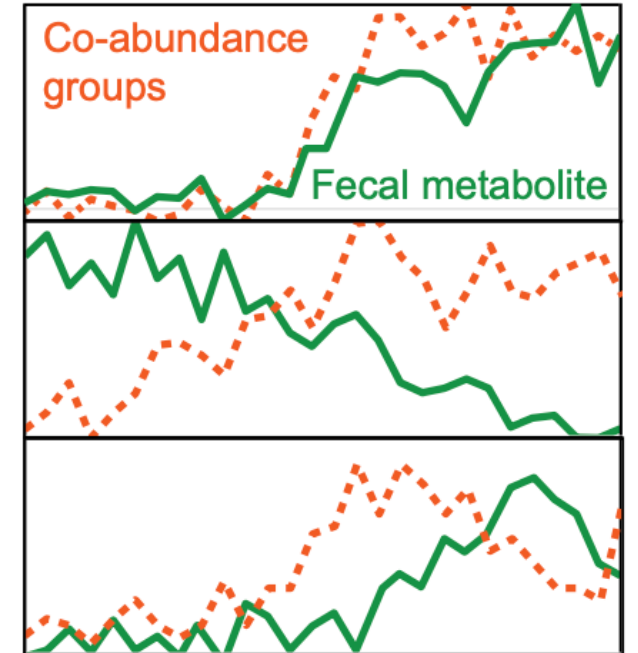
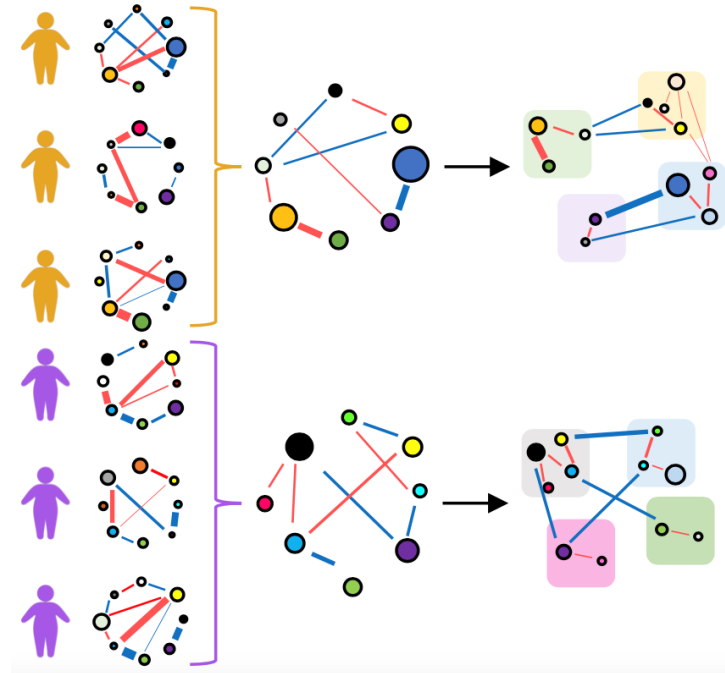
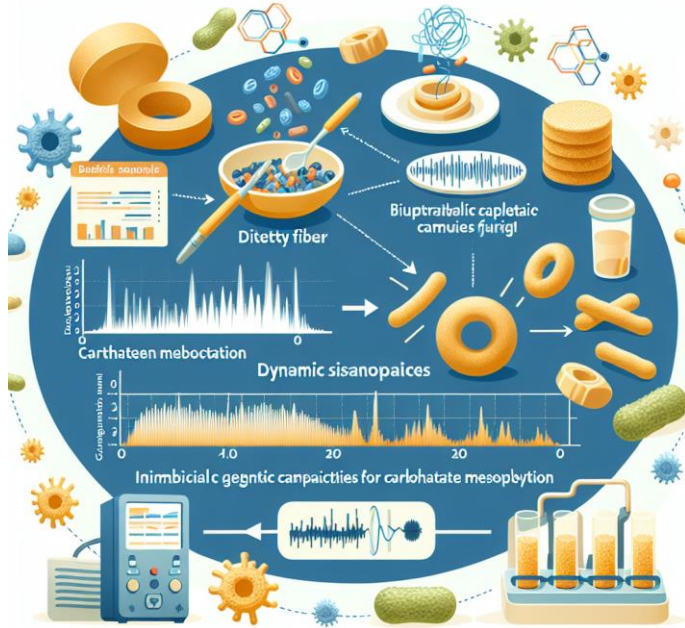


Introduction





Highlights

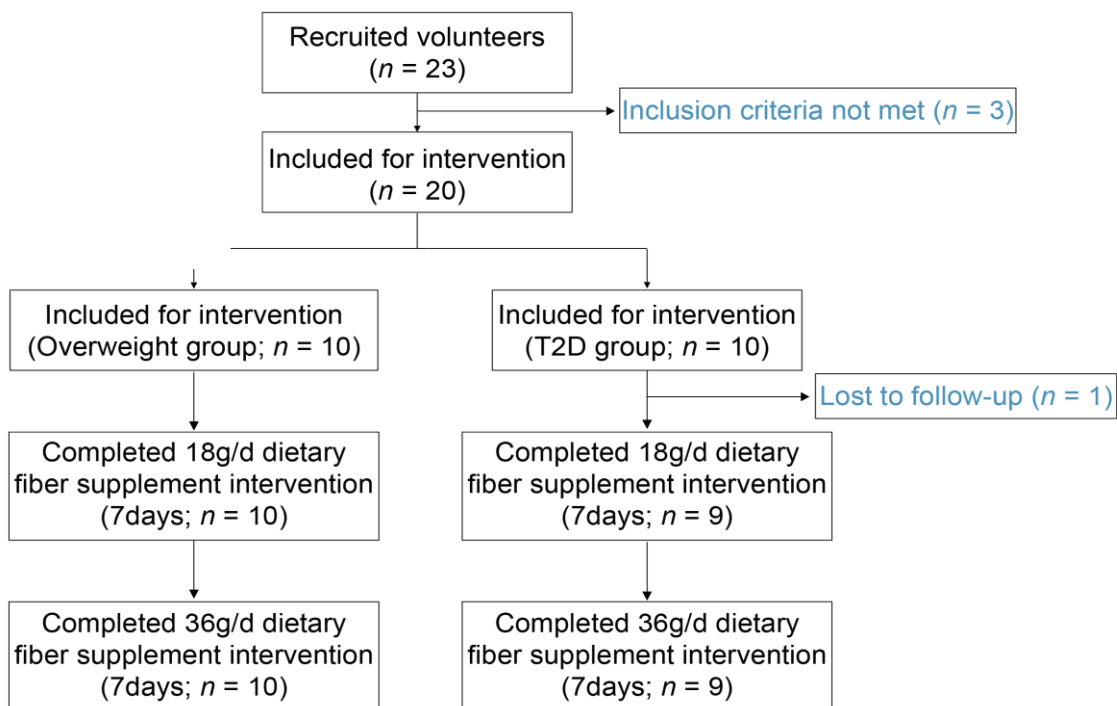
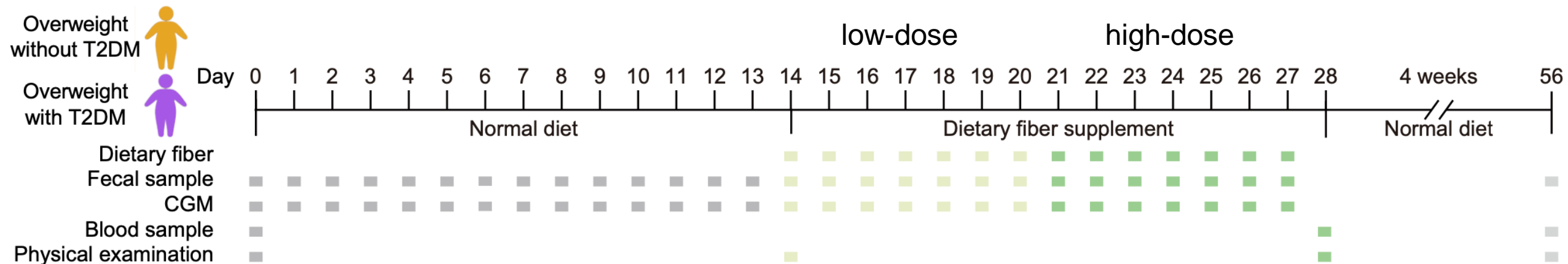


1. High-frequency sampling revealed dynamic gut microbiota responses to dietary fiber

2. Guild-based analyses of individual-level networks

3. Time-delayed analyses identified microbiota–metabolite associations with host health

Summary of Clinical Study



Dietary fiber supplement

Low-dose phase: 18 g/day
High-dose phase: 36 g/day

Nutritional values	Insoluble dietary fiber		Soluble dietary fiber	
	Per 100 g	Per portion (3 g)	Per 100 g	Per portion (3 g)
Energy (kJ)	1283	38.5	823	24.7
Protein (g)	20.5	0.6	0	0
Fat (g)	6	0.2	0	0
Carbohydrate (g)	23.2	0.7	6.2	0.2
Dietary fiber (g)	39.8	1.2	89.7	2.7
Sodium (mg)	0	0	0	0



Dietary fiber induced rapid glycemic control improvements

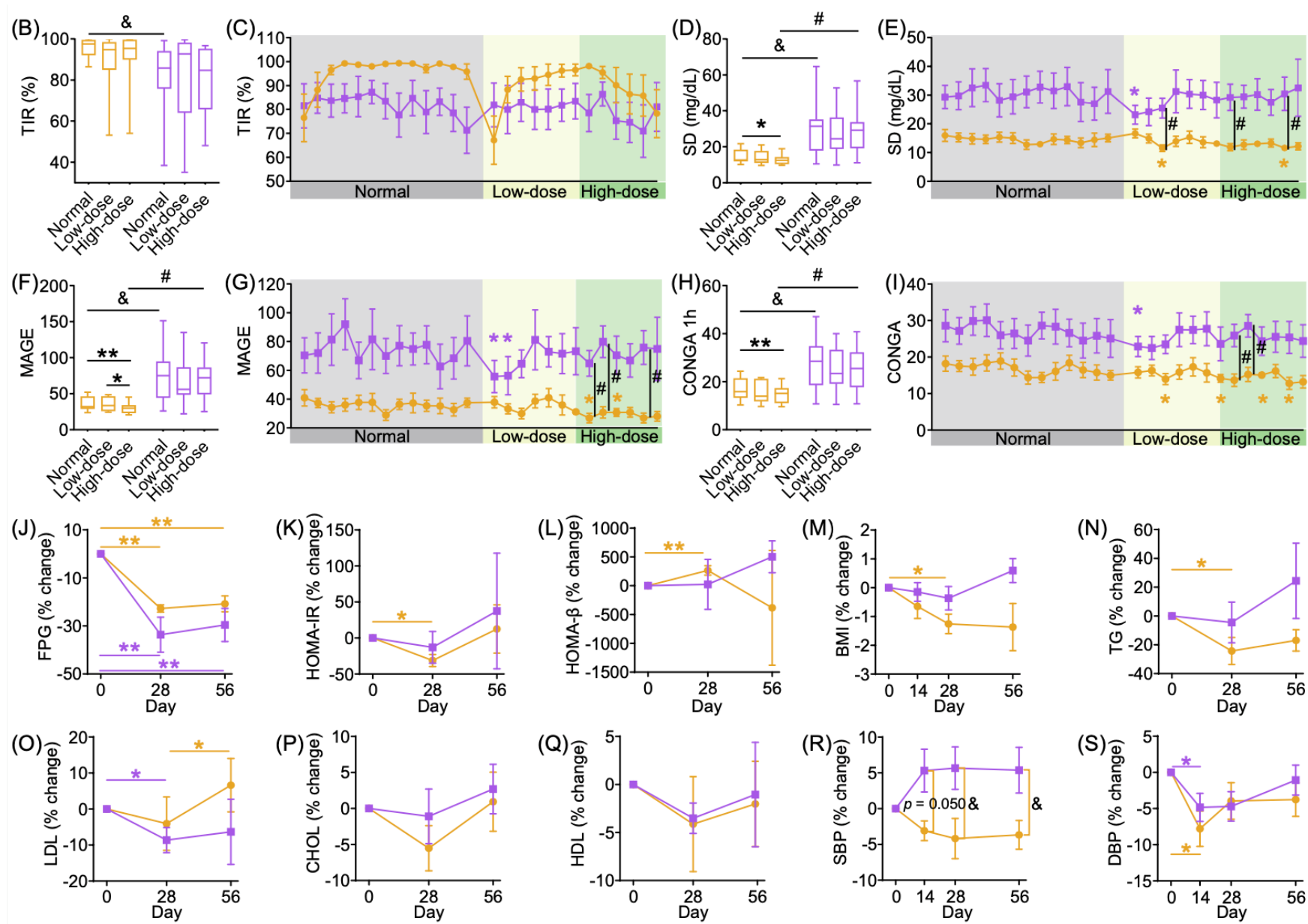


Figure 1 Dietary fiber rapidly enhanced participants' glucose stability.

Dietary fiber induced rapid microbiota shifts

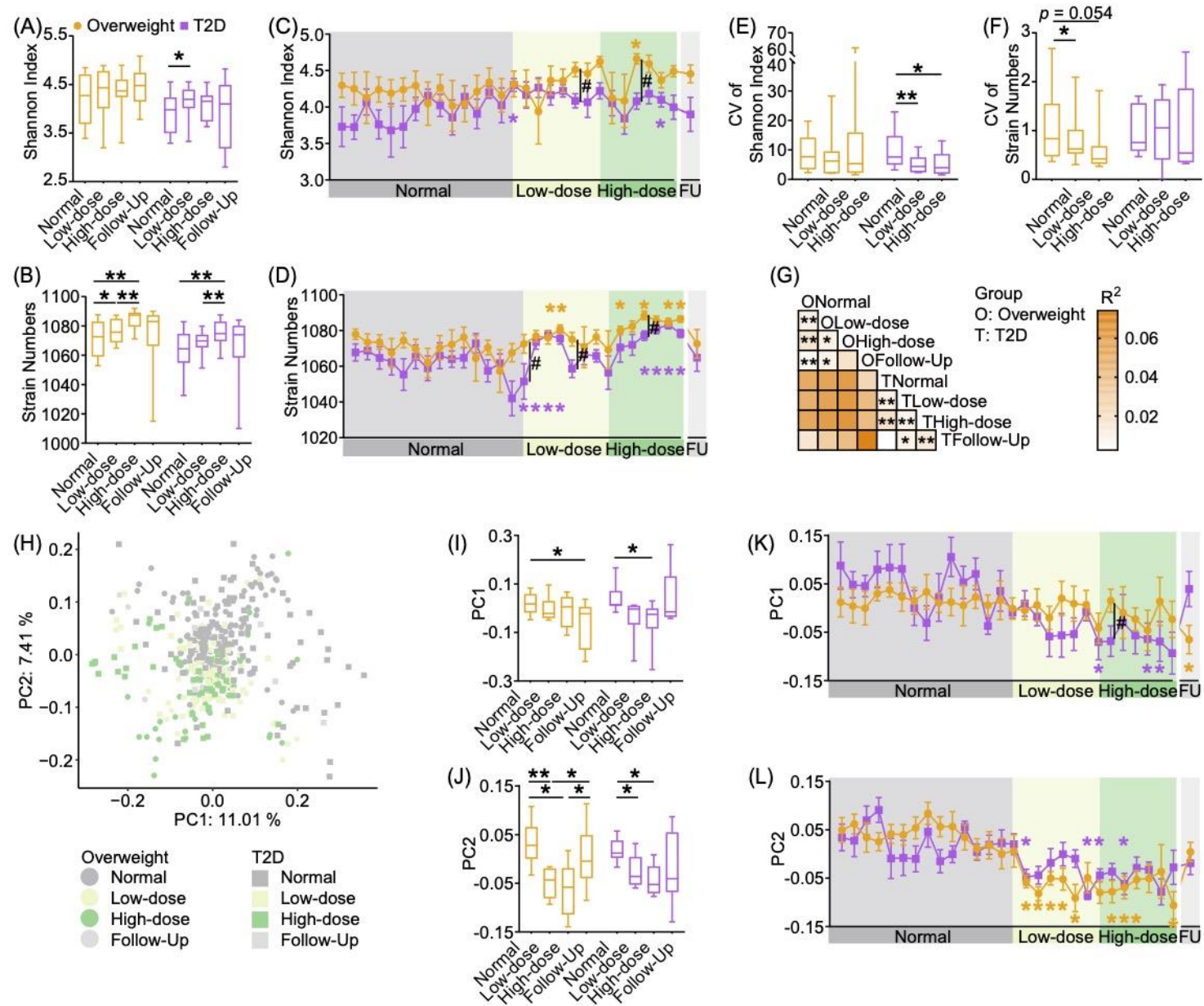


Figure 2 Dietary fiber rapidly increased participants' gut microbiota α -diversity and altered structure.

Dynamics of microbial responses to dietary fiber

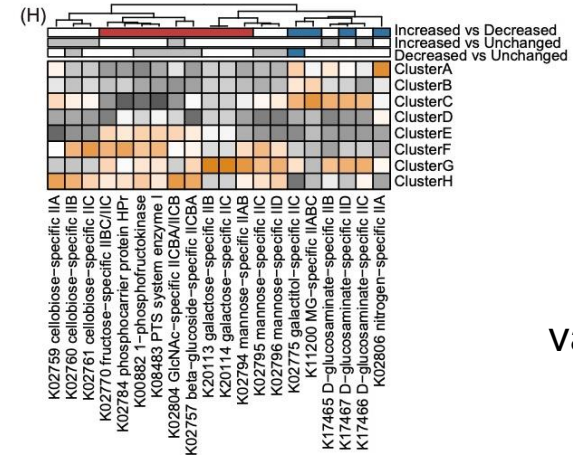
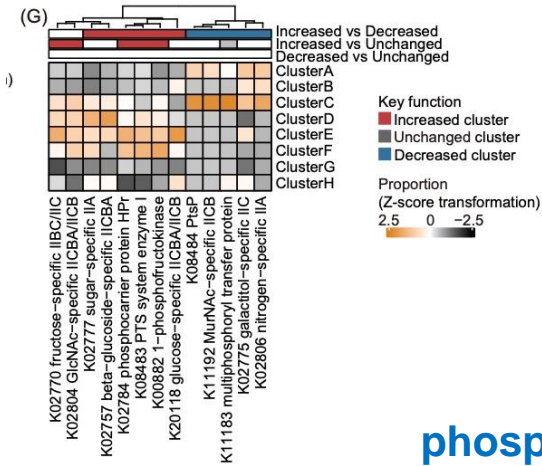
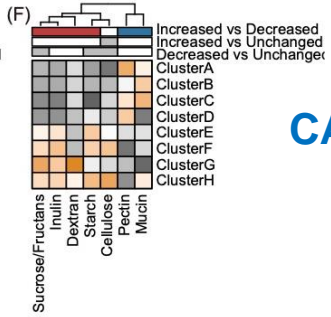
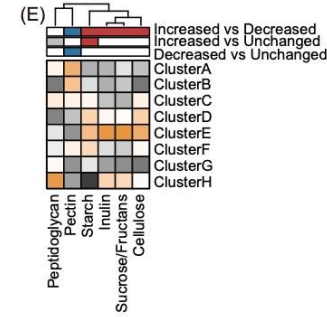
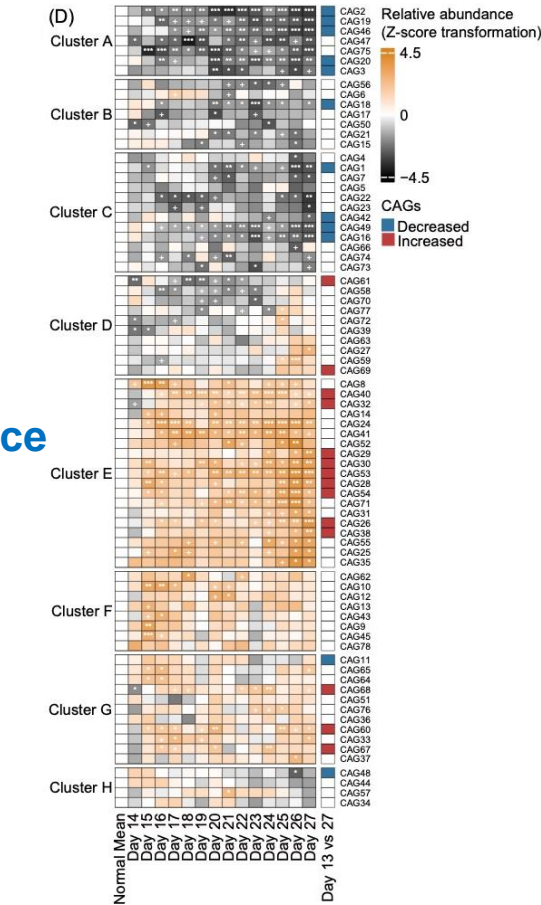
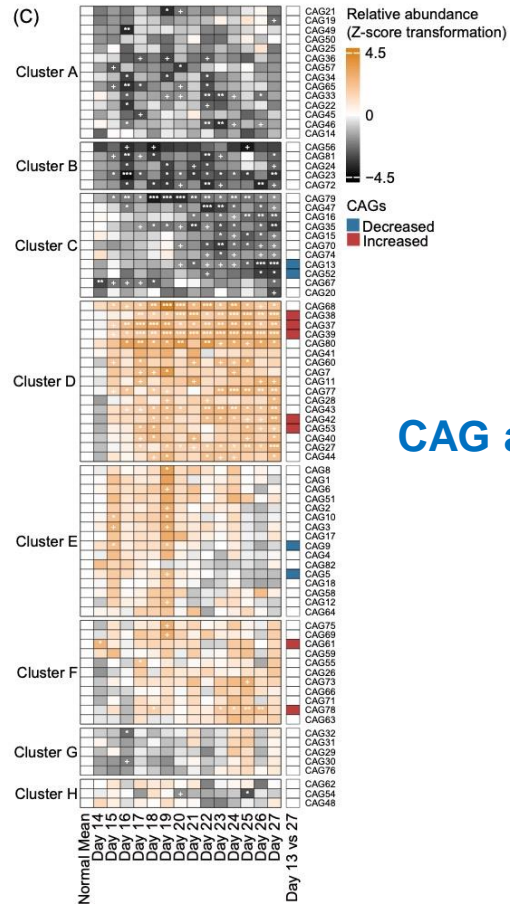
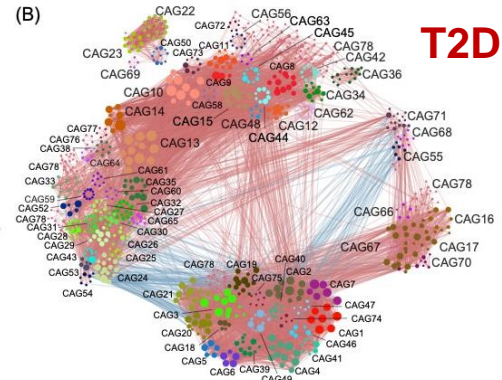
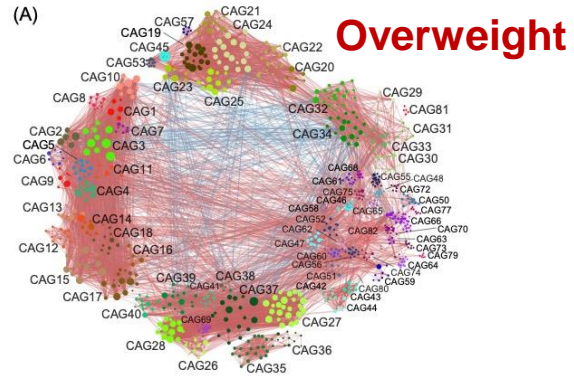


Figure 3 CAGs exhibited various temporal response patterns to dietary fiber.

Dietary fiber rapidly altered participants' fecal metabolomics profiles

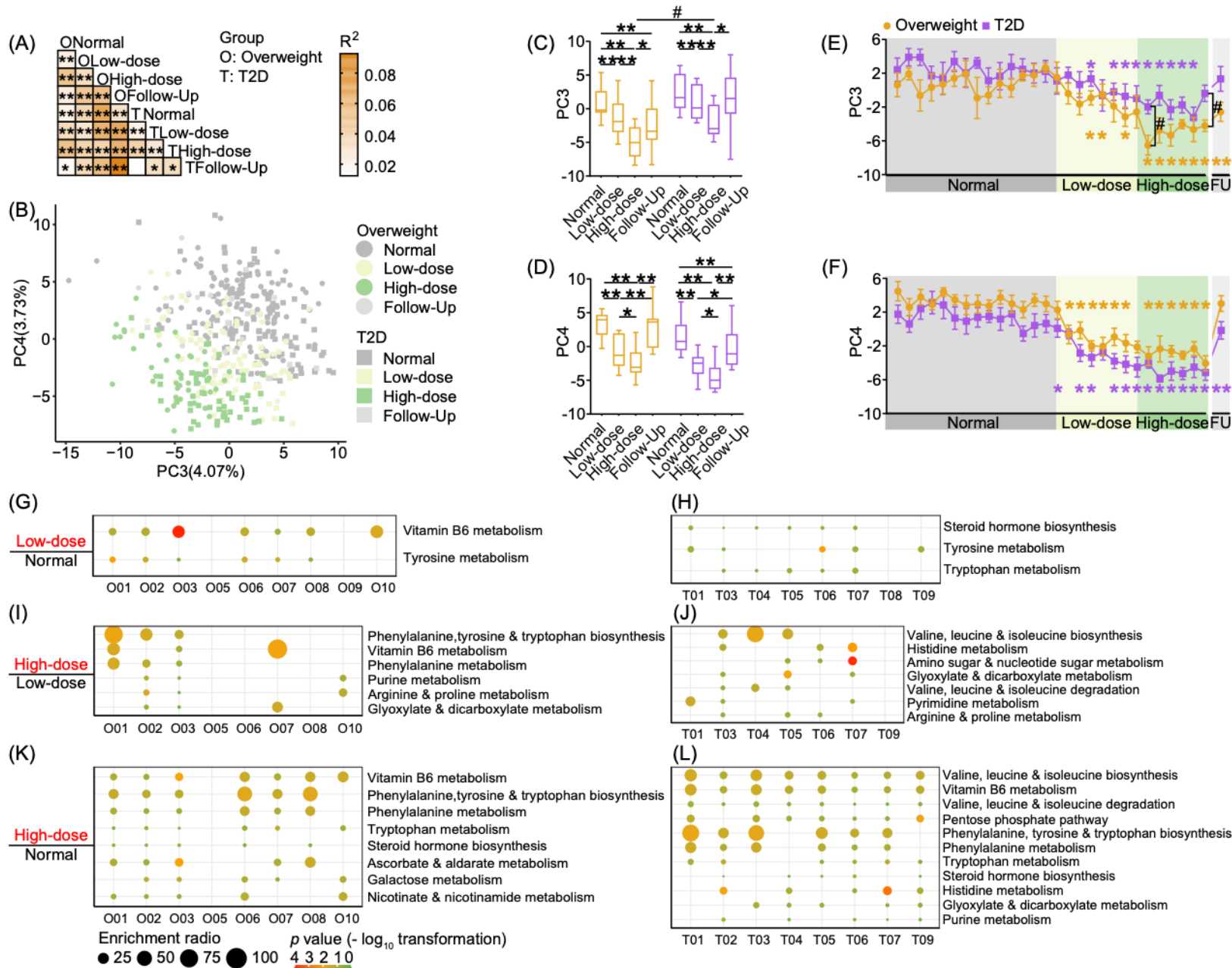


Figure 4 Dietary fiber rapidly altered participants' fecal metabolomics profiles.

Temporal correlation of microbiota and fecal metabolites in glycemic regulation

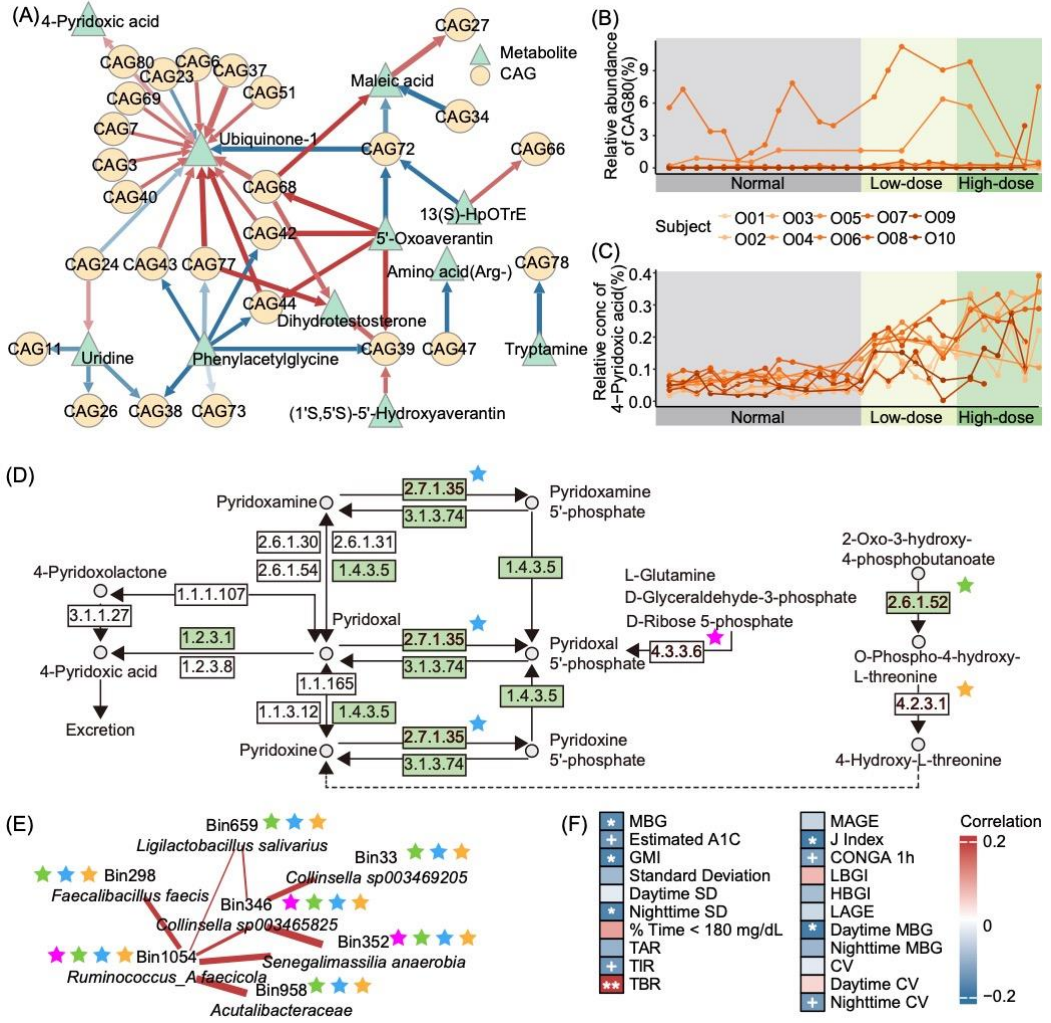


Figure 5 Role of 4-Pyridoxic acid in the association between gut microbiota and host glycemic stability in the Overweight group.

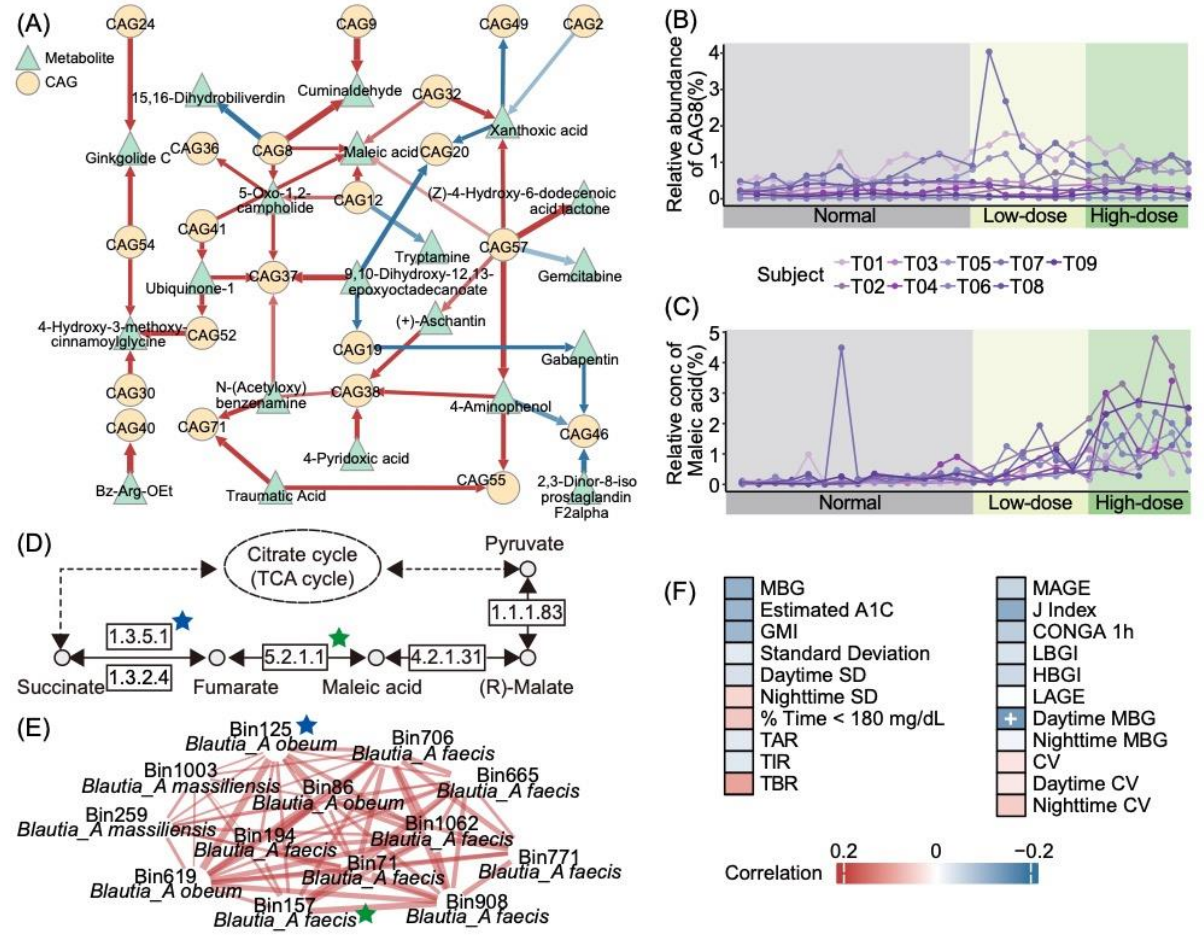


Figure 6 Role of maleic acid in the association between gut microbiota and host glycemic stability in the T2D group.

Serum metabolite mediation effect in microbiota-induced host metabolic improvement

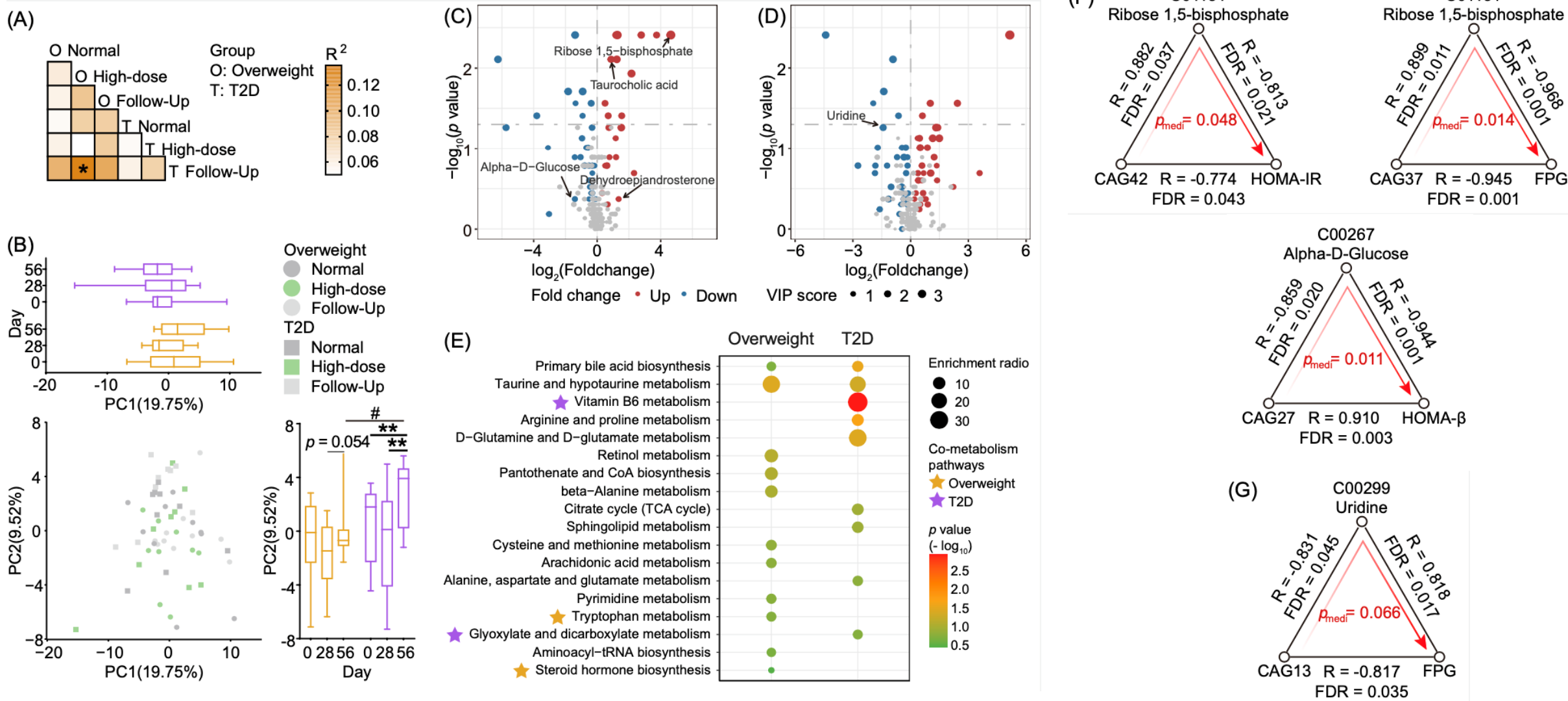


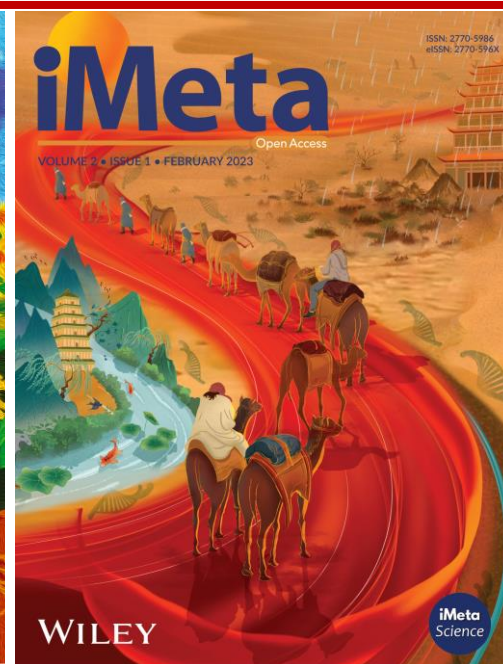
Figure 7 Significant changes in serum metabolome following dietary fiber intervention.



Summary

- Our study underscores the necessity of high-frequency sampling in gut microbiota dynamics research, which is often overlooked by conventional sampling approaches.
- Integrated daily sampling, guild-level, and time-series analyses to reveal distinct response patterns among various microbiota members linked to varied genetic capacities for carbohydrate metabolism.
- Time-delayed analysis of longitudinal multi-omics data revealed specific metabolites that potentially mediate interactions between fiber-responsive gut microbiota and host metabolic improvement.
- Our comprehensive framework provides reliable targets for mechanistic investigations and lays a foundation for precision therapeutic interventions.

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