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Letter to Editor

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Dynamics of Chrononutrition and Gut Microbiome Interactions: An Editorial Letter

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Letter to the Editor

Growing evidence from chronobiology and nutritional sciences suggests that the timing of food intake is as critical as dietary composition in regulating metabolic health. Chrononutrition, defined as the alignment of eating patterns with endogenous circadian rhythms, has emerged as a key modifiable determinant of glucose metabolism, insulin sensitivity, and systemic inflammation[1,2]. Circadian misalignment caused by late-night eating or irregular meal timing has been consistently associated with an increased risk of obesity, type-2 diabetes, and metabolic syndrome[1]. Despite these advances, the underlying biological pathways linking nutrient timing to metabolic dysfunction remain incompletely understood.

Recent progress in gut microbiome research has demonstrated that intestinal microbial community's exhibit pronounced diurnal oscillations driven largely by feeding–fasting cycles. These rhythmic microbial fluctuations influence metabolite production, immune signaling, and host energy metabolism[3]. However, most human nutrition studies continue to prioritize dietary composition over temporal eating patterns, leaving the interaction between chrononutrition and microbial rhythmicity insufficiently explored. Disruption of this host–microbe temporal alignment may represent an underrecognized contributor to metabolic disease pathogenesis.

Emerging experimental and observational evidence indicates that late-evening consumption of high-glycemic foods adversely affects metabolic outcomes by reshaping gut microbial composition. Studies have shown that evening carbohydrate-rich meals shift the relative abundance of *Bacteroides* species and reduce the production of short-chain fatty acids (SCFAs), particularly butyrate and propionate[4]. Given the established role of SCFAs in maintaining gut barrier integrity, modulating inflammation, and improving insulin sensitivity, reduced SCFA availability may partly explain the impaired postprandial glucose handling observed following late-night eating[3,4].

Beyond microbial metabolites, circadian hormones play a critical role in mediating the metabolic consequences of nutrient timing. Melatonin secretion follows a robust circadian rhythm and is closely linked to glucose regulation and insulin secretion. Disruption of melatonin signaling through late-night food intake has been associated with impaired glucose tolerance and altered metabolic responses[5]. Similarly, dysregulated cortisol rhythms may interact with feeding time and microbial metabolism, further contributing to circadian misalignment and metabolic dysfunction.

To advance this field, we propose an integrative research framework combining longitudinal metagenomic profiling with controlled feeding windows and time-resolved metabolomic analyses. Synchronizing microbiome sampling with defined eating periods would enable the characterization of microbial rhythmicity in response to nutrient timing**.** The inclusion of targeted metabolomics of SCFAs, bile acids, and circadian hormones may further elucidate host–microbe cross-talk across the diurnal cycle. Advanced time-series and causal inference models could help disentangle temporal relationships between meal timing, microbial dynamics, and metabolic outcome[6].

Ultimately, such integrative approaches may facilitate the development of personalized nutrient-timing strategies based on an individual's microbial "chronotype." Aligning dietary intake with both host circadian rhythms and microbial activity cycles could represent a novel preventive and therapeutic avenue for metabolic disorders, including type-2 diabetes and metabolic syndrome[1,6,7]**.** We hope that this perspective will stimulate interdisciplinary collaboration among nutrition scientists, microbiologists, and systems physiologists and encourage the incorporation of chrononutrition principles into future clinical nutrition guidelines.

Ethical Considerations

Not applicable.

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Not applicable.

Conflict of Interest

The authors declare that they have no conflicts of interest.

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References

1. Reytor-González, Claudia, Daniel Simancas-Racines, Náthaly Mercedes Román-Galeano, Giuseppe Annunziata, Martina Galasso, Raynier Zambrano-Villacres, Ludovica Verde, Giovanna Muscogiuri, Evelyn Frias-Toral, and Luigi Barrea. Chrononutrition and Energy Balance: How Meal Timing and Circadian Rhythms Shape Weight Regulation and Metabolic Health. Nutrients. 2025; 17(13): 2135. doi: 10.3390/nu17132135

2. Alum, Esther Ugo. Circadian nutrition and obesity: timing as a nutritional strategy. Journal of Health, Population and Nutrition. 2025; 44(1): 367. doi: 10.1186/s41043-025-01102-y

3. Melville, Dominik W., Magdalena Meyer, Corbinian Kümmerle, Kevin A. Alvarado-Barrantes, Kerstin Wilhelm, Simone Sommer, Marco Tschapka, and Alice Risely. Delayed feeding disrupts diurnal oscillations in the gut microbiome of a neotropical bat in captivity. FEMS Microbiology Ecology. 2025; 101(2): fiaf012. doi: 10.1093/femsec/fiaf012

4. Zheng, Boyang, Liwei Wang, Shilin Sun, Xingxing Yuan, and Qun Liang. The molecular interplay between the gut microbiome and circadian rhythms: an integrated review. Frontiers in Microbiology. 2025; 16: 1712516. doi: 10.3389/fmicb.2025.1712516

5. Bautista, Jhommara, and Andrés López-Cortés. Chronobiome medicine: circadian regulation of host-microbiota crosstalk in systemic physiology. Frontiers in Endocrinology. 2025; 16: 1691172. doi: 10.3389/fendo.2025.1691172

6. Zhang, Yueliang, Sara B. Noya, Yongjun Li, Jichao Fang, and Amita Sehgal. The microbiome interacts with the circadian clock and dietary composition to regulate metabolite cycling in the Drosophila gut. eLife. 2025; 13. doi: 10.7554/eLife.97130

7. Zhang, Mingliang, Caiyuan Zhou, Xinguo Li, Hui Li, Qi Han, Zhong Chen, Wenjie Tang, and Jie Yin. Interactions between gut microbiota, host circadian rhythms, and metabolic diseases. Advances in Nutrition. 2025: 100416. doi: 10.1016/j.advnut.2025.100416