Beyond 12 Months Core Sugars in Breast Milk Fuel Gut and Brain Health

A group of researchers synthesized and quantified concentrations of core human milk oligosaccharides (HMOs) at 12 months and beyond and examined temporal patterns across lactation.

Study

This study followed Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) methods to identify studies that quantified HMOs at or beyond one year of lactation. The literature search concluded on January 31, 2025. Eligible peer-reviewed articles reported concentrations at colostrum, six months, 12 months, or later. Across included studies, data were harmonized to grams per liter (g/L), and total HMO concentration was computed by summing measured oligosaccharides when not explicitly reported.

Analytical platforms spanned high-performance anion-exchange chromatography with pulsed amperometric detection (HPAEC-PAD) and nuclear magnetic resonance (NMR), among others. For comparability, six frequently reported "core" HMOs were assessed: 2'-fucosyllactose (2'-FL), 3-fucosyllactose (3-FL), lacto-N-tetraose (LNT), lacto-N-neotetraose (LNnT), 3'-sialyllactose (3'-SL), and 6'-sialyllactose (6'-SL). Where available, secretor status was recorded, and non-secretor values for 2'-FL were excluded because levels are typically near zero. Timepoints were binned when studies reported ranges (for example, 300–400 days grouped near 12 months). Group means were synthesized as mean-of-means; variability was summarized as standard deviation.

Changes across time points were evaluated using analysis of variance (ANOVA) with Tukey's multiple comparisons, and the findings were interpreted with attention to heterogeneity in sampling, geography, and assay coverage. Assays also employed high-performance liquid chromatography with tandem mass spectrometry (HPLC-MS) and liquid chromatography with mass spectrometry (LC-MS), as applicable.

Findings

In total, 13 eligible studies covered 4,786 samples and 42 unique HMOs. Ten HMOs were analyzed in at least half the studies, but only six—2'-FL, 3-FL, LNT, LNnT, 3'-SL, and 6'-SL—met the ≥10-study "core" threshold. Across colostrum, six months, and 12 months, these six accounted for more than 70% of the total HMO poolv, simplifying comparisons across heterogeneous methods. 2'-FL was consistently the most abundant component, averaging 3.00 g/L in colostrum and remaining slightly higher than 3-FL at 12 months (1.59 g/L vs 1.45 g/L). In

contrast to the general downward trend, 3-FL rose nearly fourfold from colostrum (0.38 g/L) to 12 months (1.45 g/L), highlighting dynamic fucosylation late in lactation.

LNT and LNnT declined from colostrum to 12 months (for example, LNT from 1.31 to 0.50 g/L), and 6'-SL tapered sharply (0.52 to 0.06 g/L), while 3'-SL remained relatively stable (≈0.20–0.24 g/L). Total HMOs decreased from 7.72 g/L in colostrum to 5.34 g/L at 12 months, after which concentrations were reported to plateau from 12 through 24 months, although this was based on only two studies and broad collection windows. Limited measurements beyond 12 months suggested mean totals of approximately 8.47 g/L (range, 7.2–10.1 g/L), warranting caution.

Two reports extended sampling beyond one year; one tracked total HMOs monthly for 17 months, and another quantified individual structures at 18 and 24 months, enabling inferences about persistence. In this review, comparative analyses and statistics for individual HMOs were capped at 12 months; only the total number of HMOs was aggregated beyond 12 months. Sampling attrition was common, with cohort sizes dropping by 61% between six and 12 months, which, together with diverse analytical panels, likely inflated variance. Secretor phenotype, inconsistently defined across studies, differentially shaped 2'-FL abundance, and geographic differences may contribute to inter-study spread. Because many studies preferentially measured these six "core" HMOs, their apparent dominance may also be influenced by assay coverage.

Even with these caveats, the persistence and relative dominance of the six core HMOs through the first year and into the second indicate sustained biological availability during periods when complementary foods are introduced.

These sugars may continue to support microbial maturation, epithelial defense, and neurodevelopmental pathways described in infant literature. Families who extend breastfeeding and programs that bank or fortify donor milk can take confidence that oligosaccharide exposure remains beyond infancy. Where breastfeeding is not possible, young-child formulas and supplements that include 2'-FL and LNnT could plausibly bridge the exposure gap during the transition to family diets. However, direct trials beyond 12 months are scarce.

In public health terms, understanding late-lactation profiles is crucial for countries where breastfeeding is common until 24 months and for health systems planning the use of donor milk; clarity is essential for shaping equitable nutrition policies and parental counseling.

Conclusion

Collectively, evidence indicates that total HMOs remain at biologically relevant levels through 12 months and, based on limited data, may persist into months 13–24. Six core structures, 2'-FL, 3-FL, LNT, LNnT, 3'-SL, and 6'-SL, dominate the pool and show distinct trajectories, with 3-FL increasing over time. Standardized, longitudinal sampling after one year, consistent secretor phenotyping, and harmonized analytical panels are needed to link late-lactation profiles to growth, infection, cognition, and clinical microbiome endpoints.

In practice, these findings support continued breastfeeding where possible and inform composition targets for donor milk processing and young-child products when breastfeeding is not feasible.

Source:

https://www.news-medical.net/news/20250908/Core-sugars-in-breast-milk-fuel-gut-and-brain-health-beyond-12-months.aspx