受賞講演 2

乳児の腸内ビフィズス菌は母親から受け継がれる

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乳児期のビフィズス菌の早期定着とそれに伴う腸内環境の変化は，生涯にわたって宿主の健康に関わることが報告されている．これら乳児期に定着するビフィズス菌の由来については，母親の腸内細菌叢や母乳が起源の 1 つとして挙げられているが，母から子への菌株の伝播を証明した報告はない．我々は，ビフィズス菌の母子伝播の有無を菌株レベルで調べた．

ベルギー在住の健康な妊婦 109 名から母乳（出産前・初乳・出生 7 日後・30 日後）と出産前の糞便（2 回）を，各々の子供からは糞便（胎便・出生 3 日後・7 日後・30 日後・90 日後）を採取し，それらよりビフィズス菌株を単離した後に，菌株識別法（MLST 法）を用いて各分離株の系統関係を解析した．

まず，母親の腸内に棲息するビフィズス菌株が乳児の腸内へ伝播しているか否かを検証した．結果，自然分娩出産した母子において，出産前の母親と各々の乳児の糞便から同一系統のビフィズス菌株が認められた．これら同一菌株のなかには，出生直後から 90 日後まで経時的に検出された菌株も認められたことから，伝播後に腸内へ定着したものと考えられた．一方帝王切開出生児では，ビフィズス菌の母子伝播は認められなかった．

特定のビフィズス菌株が乳児の腸内と母乳の間で共有されていることも，菌株レベルで認められた．これら同一菌株の分離時期を精査した結果，いずれも乳児糞便から先に，あるいは同時期に検出され，母乳から先に検出された例はなかった．また，出産前の乳汁や初乳からビフィズス菌は分離されなかった．これら同一菌株の伝播の方向に関する直接的な知見は，未だ報告されていないが，本研究において，授乳開始前および開始直後の母乳中からはビフィズス菌が 1 株も検出されず，また同一菌株が母乳よりも先に乳児の糞便から分離されたことから，授乳時に乳児から母乳へ移行した可能性が高いと考えられた．

本研究では，出産前の母親と乳児より経時的にビフィズス菌を分離し，それらの同一性を菌株レベルで検証したことで，ビフィズス菌が母から子へ受け継がれていることを明確に示すことができた．我々のデータは，母親が保有するビフィズス菌が乳児期の腸内菌叢形成における重要な構成要素の 1 つであることも示している．妊婦の腸内細菌が子供にも受け継がれることから，母親の腸内環境を良好に維持することは，生まれ来る子供の健康のためにも重要であると考えられた．

Bifidobacterial strains in the intestine of newborns originate from their mothers

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Bifidobacteria are one of the major components of the infant's gut microbiota. Colonization with bifidobacteria in early infancy is suggested to be important for health in later life. It has been assumed that these microbes are derived from mothers and from other environmental sources which come into contact at birth. However, there was no definitive evidence of bacterial transmissions from a mother and/or any other environmental sources to the infant's gut. The aim of our study was to verify whether mother-to-infant transmission is occurring among bifidobacteria in the infant's gut microbiota.

Fecal and breast milk samples were collected from healthy 109 mother-infant pairs {Mother feces: twice before delivery; Infant feces: first feces (meconium), 3, 7, 30, and 90 days of age; Breast milk: once before delivery, first breast milk (colostrum), 7, and 30 days after delivery}, living in Belgium. Bifidobacterial strains were isolated from these samples, and were discriminated by a strain-level analysis (MLST).

First, vertical transmission from mothers to their infants was investigated. Stains isolated from vaginally delivered infants and their mothers were identified to be monophyletic. This finding confirms that these strains were transferred from the intestine of a mother to that of her infant. These mother-infant monophyletic strains were continuously detected over time from the infant feces, sometimes as early as the first day of life (meconium). These results indicate that the transmitted strains stably colonized the infant's gut immediately after birth. Between C-section delivered infants and their mothers, monophyletic strains were not observed.

Next, we investigated whether specific strains are shared sustainably between maternal milk and infant's gut. No viable bifidobacteria were detected in mother's milk collected before delivery, or in colostrum; viable strains were isolated only from milk samples obtained 7 days after birth or later. In contrast, as described above, bifidobacterial strains were obtained from infant's feces throughout the study period. MLST analysis showed that several bifidobacterial strains were monophyletic between infant's feces and mother's milk. Moreover, monophyletic strains were isolated from infant's feces at the same time point or earlier than from mother's milk, and none were isolated earlier from mother's milk than from infant's feces. Although it remains unclear whether human milk is the first source of microbes for infants or vice versa, our results showing that none of these monophyletic strains were isolated earlier from the mother's milk than from infant's feces, and that no strain was isolated from the human mother's milk collected before delivery or the colostrum, do not confirm that bifidobacteria are transmitted from human milk to the infant's gut, as suggested by several studies.

This study confirmed that mothers transmit their unique bifidobacterial strains to their infants shortly after birth. The transmitted strains become one of the predominant bacteria during early infancy, suggesting that mother's intestinal bifidobacteria are an important source of the infant's gut microbiota. Therefore, the maintenance of a healthy and balanced gut microbiota during pregnancy is to be considered as an important factor to positively influence the newborn's gut microbiota.