

Research Article

Microbiota and Probiotics of Breastfeeding and Their Reflection on Infant Lifestyle

Fatimah Z Almilad^{1,2}, Essam Kotb^{1,2*}, Nora Aljaleud¹, Noor A Alzaki¹, Noor K Alnaboud¹, Zahraa A Alnasfan¹, Noor M Alshammari¹, Zahra Alshikh^{1,2}

¹Department of Biology, College of Science, Imam Abdulrahman Bin Faisal University (IAU), P.O. Box 1982, Dammam 31441, Saudi Arabia

²Basic and Applied Scientific Research Center (BASRC), Imam Abdulrahman Bin Faisal University (IAU), P.O. Box 1982, Dammam 31441, Saudi Arabia

*Correspondence author Nora Aljaleud, Department of Biology, College of Science, Imam Abdulrahman Bin Faisal University (IAU), P.O. Box 1982, Dammam 31441, Saudi Arabia; Email: naljaleud@iau.edu.sa; drnasaj@gmail.com

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Abstract

Microbiota is one of the most important supplements that have a impact on human health and immunity that is delivered through breastfeeding. Well-established scientific papers have proved the existence of many microbiota differences between breastfed and formula-fed newborn babies. Moreover, studies have revealed microbiome variation between different formulas. Mother's breastmilk composition is changing as the child is getting old, this is to adapt to the best of child benefits. The microbiome is an integral aspect of human health. The newborn gut microbiome supplied has a positive impact on a proper sleeping cycle that leads to the body and brain rest which is a critical function for healthy development. Breastmilk contains probiotics, which are live bacteria that are transmitted through the placenta or it can be swallowed to provide health advantages. Probiotic bacteria have been shown to improve the health of breastfed babies as compared to formula-fed babies in terms of metabolism, immunity and behavior, especially in the homeostasis of the gut.

Keywords: Microbiota; Breastfeeding; Immunity; Circadian Clock

Introduction

According to a long-held belief, during healthy pregnancies the in-utero environment is sterile as well as the fact that foetus wasn't colonized with bacteria until it is born [1]. The validity of the theory is being challenged as more and more evidence by increasing the numbers of reports that demonstrate the presence of microbes in the placenta, fetal membranes, umbilical cord and amniotic fluid [2]. This notion holds true for breast milk as well, In the past, microbes found in breast milk were thought to originate from the mother's skin and the baby's mouth [3].

However, it is now generally acknowledged that breast milk contains a distinct microbiome

made up largely of commensal microorganisms [4]. After delivery, the infant's gut inoculated with bacteria and breast milk is essential for this [4]. It also contains white blood cells supporting the baby's body against any illnesses. Newborns start developing an immune system based on the mother's immunity history which is transferred through breastmilk based on the available antibodies in the milk [5]. The nutritional benefits of breast milk and breastfeeding are significant. In addition, to providing a source of infant nutrition breast milk contains a myriad of biologically active ingredients. These molecules play an important role in the development of the immune system and intestinal microbiota. Breast milk protects against microbes as well as a separate clinical disorder (e.g., necrotizing enterocolitis, bacteremia, meningitis, respiratory disease, diarrhea disease and otitis media) [6]. Many different factors in breast milk work together to protect against infection. Little has been elucidated about various mechanisms of immune protection in infants, including, reduced pathogen colonization, improved functioning immune cells (e.g., neutrophils and mac) The immune response is modified by the reduced inflammatory response [6]. The critical period for immunologically immature newborns is largely a result of colostrum and dairy milk providing a significant amount of biologically active ingredients to the infants' mucous membrane immune systems. Colostrum is the most powerful natural

immune booster known to science. Infants who are breastfed are protected from infection, primarily by secretory IgA antibodies [7]. Numerous studies demonstrate that the microbiota of breastfed and non-breastfed individuals varies during infancy and adulthood [8]. Based on studies, new-borns who are exclusively breastfed have less microbial variety than those who are formula-fed, whose gut microbiota is more varied and is similar to that of older ones [9]. In addition to being supportive of infants' health, breast milk may be a primary contributor in a lower gut bacteria diversity. However, it is positive to infant health. Eczema and asthma are two conditions that have been linked to a decreased microbial diversity in newborns [9]. Sleeping is an important activity in human beings' daily routines. During the sleeping phase, the body and brain rest which is a critical function for healthy development. Lack or discomfort of proper sleep causes memory issues, mood disorders, emotional distress, obesity, diabetes and hypertension [10]. Sleeping patterns are different from one person to another and we can generalize them based on the age factor. For example, children do sleep more than adults [11]. Furthermore, various research studies have discovered a connection between sleep disturbances (fragmentation and circadian rhythm) and the gut microbiome. The interconnection with circadian clock rhythms is related to microbiota-gut-brain axis via the vagus nerve [12]. Breastfeeding is a critical period of life that has an impact on long-term health. In neonates, gut microbial diversity was connected to the functional connectivity of various brain regions. [13]. The objective of this review is to epitomize the role of the gut microbiome in relation to breastfeeding, immunity and the circadian clock.

Mode of Birth

There are three main ways that the infant's microbiome is populated during and shortly after birth: vaginal delivery, breastfeeding and through contact with the mother's skin [2]. Skin-to-skin contact is very important for all neonates, but it appears to be particularly important for new-born via cesarean delivery, as they are not exposed to the mother's microbiome during delivery [13]. The gut microbiota is essential from birth up to early childhood [15]. Mode of delivery plays a primary role in influencing composition of microbiota during the first year of life [16]. Numerous studies have reported the differences of Baby's gut microflora depending on delivery mode. Infant born by caesarean section have significantly different early gut microbial compared to vaginally delivered infants [15]. Microbiota differences in infant guts may be partially explained by initial maternal vaginal contact. Vaginally delivered baby is exposed to probiotics present in birth canal such as *Lactobacillus reuteri* and *L. rhamnosus* so their bacterial communities are similar to those of the maternal vaginae [17]. The microbiome of those born from caesarean section is colonized by bacteria present on the mother's skin and they have higher proportion of antibiotic-resistant genes. The diversity of gut microbiota in neonates was thought to decrease following C-section delivery, resulting in dysbiosis. Due to the possibility that breast milk could help correct dysbiosis caused by cesarean section, this situation may improve to the level found in infants born vaginally at one month of age [17]. Breast milk influences infant gut bacteria greatly because of its carbohydrates, including Human Milk Oligosaccharides (HMOs), known to promote the growth of *Bifidobacterium* [18]. According to several studies, when compared with non-breastfed infants' gut microbiota, breastfeeding infants have higher levels of *Bifidobacterium* and *Lactobacillus*. The phyla Bacteroidetes (especially Bacteroides) and Firmicutes (especially in the Clostridiales) and the genera *Eubacterium* and *Veillonella* have increased in nonexclusively breastfed infants. Based on studies, infants exclusively breastfed for 6 months who were delivered by caesarean section have partial repair in their gut microbiome and becoming like infants born by vaginal delivery [9]. The vaginal microbiome develops and changes over the years of female life from childhood through puberty and menopause (Fig. 1) [19]. The details of prominent vaginal microbiota compositions in different stages of life are revealed in Table 1 [19]. The most common genus in a normal, healthy vaginal microbiome is *Lactobacillus sp.* These flora aids in the prevention of various uropathogens by maintaining a low pH environment that acts as a barrier against pathogen multiplication and survival [20].

Periparturition	<i>Lactobacillus</i>
Infancy and childhood	<i>Bacteroides</i> , <i>Fusobacterium</i> , <i>Veillonella</i> , <i>Bifidobacterium</i> , <i>Actinomyces</i> , <i>Propionibacterium</i> , <i>Peptococcus</i> , <i>Peptostreptococcus</i> , <i>S. aureus</i> , <i>S. epidermidis</i> , <i>S. viridans</i> , <i>E. faecalis</i> , and <i>E. coli</i> .
Early puberty	<i>Prevotella</i> , <i>Anaerococcus</i> , <i>Dialister</i> , <i>Peptoniphilus</i> , and <i>Fingoldia</i> .
Late puberty and reproductive age	<i>Lactobacillus</i> .
Menstrual cycle: Menstruation	<i>Prevotella</i> , <i>Anaerococcus</i> , <i>Dialister</i> , <i>Peptoniphilus</i> , <i>Fingoldia</i> , <i>Peptostreptococcus</i> , and <i>Streptococcus</i> .
Menstrual cycle: Proliferative phase	<i>Lactobacillus</i> , <i>Ureaplasma</i> , <i>Streptococcus</i> , and <i>Fingoldia</i> .
Pregnancy: 1 st trimester	<i>Atopobium</i> , <i>Prevotella</i> , <i>Sneathia</i> , <i>Aerococcus</i> , <i>Gemella</i> , <i>Parvimonas</i> , <i>Megasphaera</i> , and <i>Gardnerella</i> .
Pregnancy: 2 nd trimester	<i>Lactobacillus</i> , <i>Megasphaera</i> , and <i>Gardnerella</i> .
Pregnancy: 3 rd trimester	<i>Lactobacillus</i> , and <i>Gardnerella</i> .
Postmenopause	<i>Gardnerella</i> , <i>Atopobium</i> , <i>Megasphaera</i> , <i>Anaerococcus</i> , <i>Prevotella</i> , <i>Peptoniphilus</i> , and <i>Streptococcus</i> .

Table 1: The vaginal microbiome developing over the years of female life.

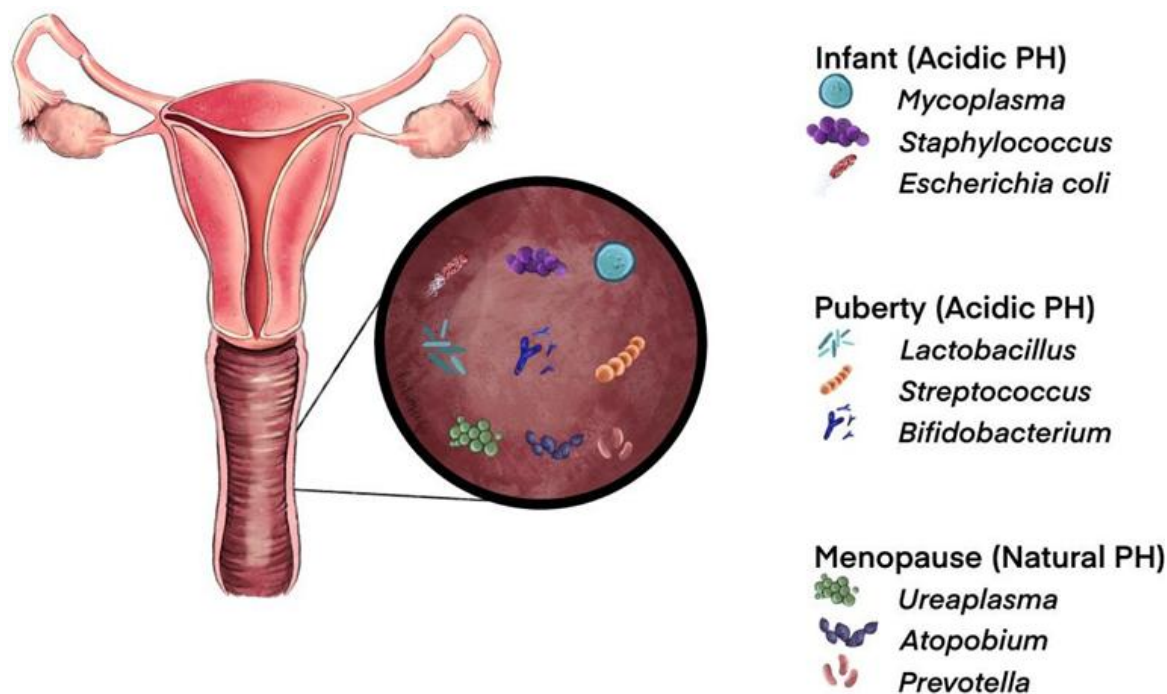


Figure 1: Vaginal microbiota across woman's lifetime. There is a connection between pH and the stages of female growth. *Mycoplasma*, *Staphylococcus* and *Escherichia coli* are some of the microorganisms that are present during the infant stage when pH is acidic. *Lactobacillus*, *Streptococcus* and *Bifidobacterium* are microorganisms that are found during puberty when the pH is also acidic. However, during menopause when pH becomes neutral the microbiota *Ureaplasma*, *Atopobium* and *Prevotella* are prevalent.

The female reproductive tract is composed of lower (cervicovaginal) and upper (uterine cavity, fallopian tube and ovary) parts. The ordinary physiological vaginal microbiota turned into first defined as homogenous, which includes the most effective Gram-positive bacilli of the *Lactobacillus* genus that emerge from the gut Table 2 [19]. represents examples of microbiomes found in different parts of the female reproductive system.

Female genital tract		Microbiome
Lower genital tract	Vagina	<i>Lactobacillus</i>
		<i>Gardnerella</i>
		<i>Atopobium</i>
		<i>Prevotella</i>
		<i>Streptococcus</i>
		<i>Corynebacterium</i>
		<i>Gemella</i>
		<i>Dialister</i>
		<i>Pseudomonas</i>
		<i>Bacteroides</i>
Upper genital tract	Cervical canal	<i>Lactobacillus</i>
		<i>Acinetobacter</i>
		<i>Prevotella</i>
		<i>Corynebacterium</i>
	Endometrium	<i>Lactobacillus</i>
		<i>Pseudomonas</i>
		<i>Acinetobacter</i>
		<i>Vagococcus</i>
		<i>Sphingobium</i>
		<i>Comamonadaceae</i>
	Fallopian tube	<i>Arthrobacter</i>
		<i>Dysgonomonas</i>
		<i>Staphylococcus</i>
		<i>Acinetobacter</i>
		<i>Comamonas</i>
		<i>Pseudomonas</i>
		<i>Pseudomonadaceae</i>
		<i>Vagococcus</i>
		<i>Comamonadaceae</i>
		<i>Arthrobacter</i>
		<i>Dysgonomonas</i>
		<i>Shewanella</i>
		<i>Pseudomonadaceae</i>
	Ovary	<i>Acinetobacter</i>
		<i>Sphingomonas</i>
		<i>Methylobacterium</i>
		<i>Lactococcus</i>
		<i>Corynebacterium</i>
		<i>Blautia</i>
		<i>Escherichia</i>
		<i>Lactobacillus</i>
		<i>Trabulsiella</i>

Table 2: Microbiome of different parts of the female genital tract.

Feeding Methods

According to a World Health Organization report in 2013, formula-fed babies scored lower on IQ (Intelligence Quotient) tests than breastfed babies [21]. The immune system of infant is strengthened and shaped by breast milk. Proteins, carbohydrates and fats play significant roles in protecting infants from infection; breast milk contains immune factors that are specifically targeted

to protect the newborns [22]. 132 The development of brain and central nervous system is directly impacted by breast milk. healthy nervous system, the development of brain and intelligence have all been linked to Docosahexaenoic Acid (DHA), lactose, other breast milk fats and cholesterol [23]. Breastfeeding protects against premenopausal breast cancer, ovarian cancer and endometrial cancer. It also benefits the health of the nursing mother. Additionally, it guards against osteoporosis, metabolic syndrome, type 2 diabetes and cardiovascular disease [24]. Breastfeeding fosters closeness, promotes health, improves sleep quality and quantity and lowers the risk of postpartum depression and inflammation [25]. Formula, on the other hand, is deficient in essential nutrients that increase a child's body's resistance to illnesses and infections. As a result, children who rely on artificial feeding are more likely to develop intestinal diseases. This means intestinal microbiota of infants with artificial feeding are less strong and cannot be resistance to infections and diseases. Subsequently, two major problems typically result. Intestinal diseases might be happening as a result of colonization with *C. difficile*. Furthermore, systemic disease may occur because of expansion of the rest bacterial pathogens in the gastrointestinal tract [26]. It is crucial that formula is properly reconstituted because the powdered formula is not sterile and may contain the pathogenic bacterium *Cronobacter sakazakii* (previously known as *Enterobacter sakazakii*). Sepsis and meningitis can be brought on by *Cronobacter sakazakii* [27]. From an environmental point of view, the formula is not environmentally friendly. 153 A lot of energy and resources are used during the formula manufacturing process, including land for dairy farming, agricultural land for formula ingredients, clean water and fuel for transporting raw materials and finished products [28]. Along with producing millions of feeding bottles and teats, the manufacture of formula also produces millions of single use metal cans and plastic containers for waste disposal. Contrarily, breast milk is produced sustainably, has no negative environmental effects and doesn't require packaging [29]. Therefore, breastfeeding is the most frequently advised method of feeding a newborn and offers the best nutrition for both the breastfeeding mother and the babies. However, 161 some factors might lead moms to consider formula feeding knowing the aforementioned 162 impact and lost benefits, i.e., the baby was born premature, the mother's body is not making enough breast milk or the baby is at day-care [30].

Infant Immunity and Microbiota

Maternal-Neonatal Interactions

Breastfeeding affects the development of intestinal flora in early childhood, which has prolonged positive effects on health. The first drop of milk that a mother produces after the birth of her child is called colostrum, which is structurally and functionally different from mature milk [31]. Colostrum has immune properties because it contains high concentrations of immunoglobulin A (IgA) and lactoferrin, white blood cells and certain growth factors as well as small amounts of lactose, potassium and calcium a period ranging from 5 day to two weeks after birth, transitional milk with some properties of colostrum is produced then mature milk, is formed two weeks after birth which contains the necessary immune factors to protect the new-born from inflammation and infection, also contains beneficial microorganisms that contribute in the formation of the first gut microbiome inside [32-36].

According to the established findings, microbiota is transferred from mothers to newborns through direct contact with the maternal microbiota during birth and by the provision of breast-milk bacteria during nursing [37]. The new-immune born's system is modulated by the microbiota found in breast milk (Fig. 2). These microbes promote anti-inflammatory responses by increasing the formation of specific cytokines, which lowers the risk of developing a wide range of inflammatory diseases and delays the onset of immune disorders like atopic dermatitis and asthma [38].

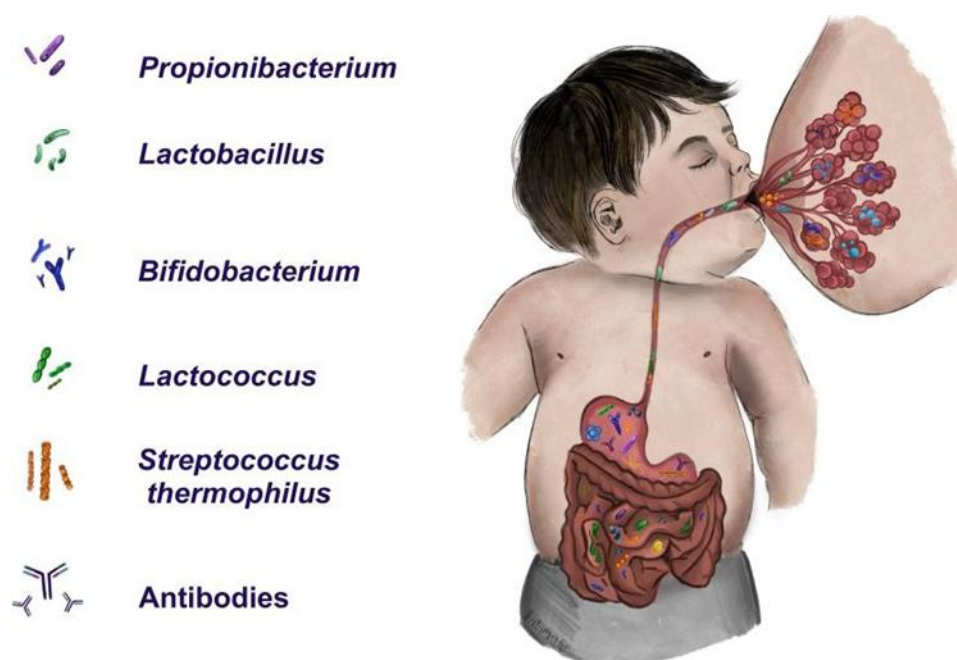


Figure 2: Variations in human milk composition: impact on immune development. Breastfeeding transmits protective antibodies and various probiotics, including *Propionibacterium*, *Lactobacillus*, *Bifidobacterium*, *Lactococcus* and *Streptococcus thermophilus*.

How Long Do Babies Carry Their Mother's Immunity?

During the final three months of pregnancy, mothers' antibodies are transferred to their fetuses through placenta; this type of immunity is referred to as passive immunity since the baby is given antibodies rather than producing them by itself [39]. The immunity of newborns is only temporary and starts to wane after the first few weeks or months [40]. It is interesting to note that the defense factors found in human milk work without causing inflammation; some of these components are even anti-inflammatory in nature. 196 Protection against infections may manifest during lactation against, acute prolonged diarrhea and respiratory infections, including otitis media, urinary tract infections, septicemia and enterocolitis [41]. The immune content of milk changes over time. IgA, anti-inflammatory factors and cells that are more likely to be immunologically active, support the newborn's immature immune system in the early stages of lactation. Following this time, breast milk keeps adjusting remarkably to the child's ontogenesis and nutritional and immune needs [7]. As a result, breastfeeding should be encouraged, at least for the first six months of a child's life in order to achieve the best possible growth, development and health [7]. The relationship between gut bacteria and human health is increasingly recognized. Due to healthy intestinal flora, there is a great deal of overall health. The gut microbiota of an infant starts to resemble that of an adult by the age of three [42]. There are variations over time and space in the microbial distribution from the esophagus to the rectum during an individual's life span. The intestinal flora is closely involved in numerous aspects of normal host physiology, behavior, nutritional status and stress response [42]. In addition, a central or a contributing cause of many diseases, affecting both near and far organ systems [43]. To ensure the balance or lack of in the intestinal mucosa, it is crucial to consider the overall composition of the gut microbial community as well as the presence or absence of key species capable of producing the desired reaction. During the first six months of a newborn, the microbiota in breast milk varies from mother to mother. After 6 months, when breastfeeding is no longer an infant's sole source of nutrients, the divergence limits [43].

Breastfeeding Helps Prevent Illness

Infections are fought off by the antibodies in breast milk. As previously mentioned, the first milk to emerge from the breast following childbirth is called colostrum and it contains high concentrations of these antibodies [5]. On the other hand, antibodies are present in breast milk throughout the mothers breastfeeding period. Mothers can offer some defense against previous infections and infections picked up while breastfeeding. Breast milk can provide babies with some assistance in preventing and fighting disease through these antibodies [44]. Other proteins, carbohydrates, fats and even white blood cells are found in breast milk and help fight disease in many ways. Given that breast milk directly reaches the baby's stomach and intestines when the infant eats, they are especially helpful in treating gastrointestinal infections. The various agents in breast milk act directly on the

intestinal lining before being absorbed and reaching the rest of the body [40].

A healthy, protective immune system that aids in recognizing and combating infections and other diseases long after breastfeeding has ended is also made possible by this. Other elements of breast milk that directly stimulate and support the immune system include lactoferrin and interleukin -6, -8 and -10, which regulate the inflammatory response of the immune system, which is required for immune function but becomes overactive and harmful [45]. There is even proof that COVID-19 vaccine recipients who are breastfeeding can transmit the virus' antibodies through breast milk [46]. Although it has not been definitively proven, these antibodies may help protect children who are too young to receive the vaccine. Breast milk also contains probiotic elements. Breastfed newborn has a lower risk of developing ear infections, vomiting, diarrhea, pneumonia, urinary tract infections and certain types of meningitis due to the abundance of immune-stimulating substances in breast milk. Likewise, studies show that infants who are breastfed for longer than six months have a lower risk of developing childhood leukemia and lymphoma than infants who are fed formula, but this is partially due to the fact that these cancers are impacted by immune system disorders [5].

The Sleep-Gut Axis

Circadian Rhythm

Sleeping is a universal behavior that all beings share, it is a process in which the restoration of the body, brain and memory activation occurs. All of these are fundamental for the healthy growth of the life cycle, but the function of sleep in learning and memory is the focus here [47, 48]. Likewise, research has connected sleep specifically to neural re-organization and brain development [49-51]. As for the inner circadian clock, it is defined as the innate mechanism that regulates an important body function including hormone secretion (e.g., cortisol, melatonin), blood pressure and heartbeat, in addition to mood states [52]. Recent studies show that the gut microbiome has a major role in affects metabolic also regulates sleep in three cases (sleep disturbances, sleep quality and sleep duration) and mental states. It has been hypothesized based on a study about Obstructive Sleep Apnea (OSA) which is a type of sleep disorder, that it is related to changes in gut microbial communities. Numerous findings point to the gut microbiota's fundamental impact on the brain [53].

Variations in gut microbiota have been correlated with an extensive range of brain disorders, such as Alzheimer's disease, autism, depression and complex disorder attributed to lifestyle, besides this, the gut microbiota helps to control peripheral pain responses, visceral pain responses and perception of pain [54]. On a very specific health aspect, there is evidence for how obesity may affect the interactions between brain microstructure, cognition and gut microbiota composition. Animals that aren't exposed to germs exhibit abnormal anxiety-like behaviors that seem amenable to microbial intervention [55]. Compelling evidence is piling up that gut microbiota plays a crucial part in how the human brain develops [56,57].

Microbiota-Gut-Brain Axis (MGBA)

The expressions "gut feeling" and "gut-wrenching decisions" are frequently used to connect to the gut and emotions [58]. All of this evidence relates to the Microbiota-Gut Brain Axis (MGBA) (Fig. 3), which is primarily made up of the nervous system, endocrine system and immune system and is strongly aligned to physiological stress and circadian clock rhythms [59].

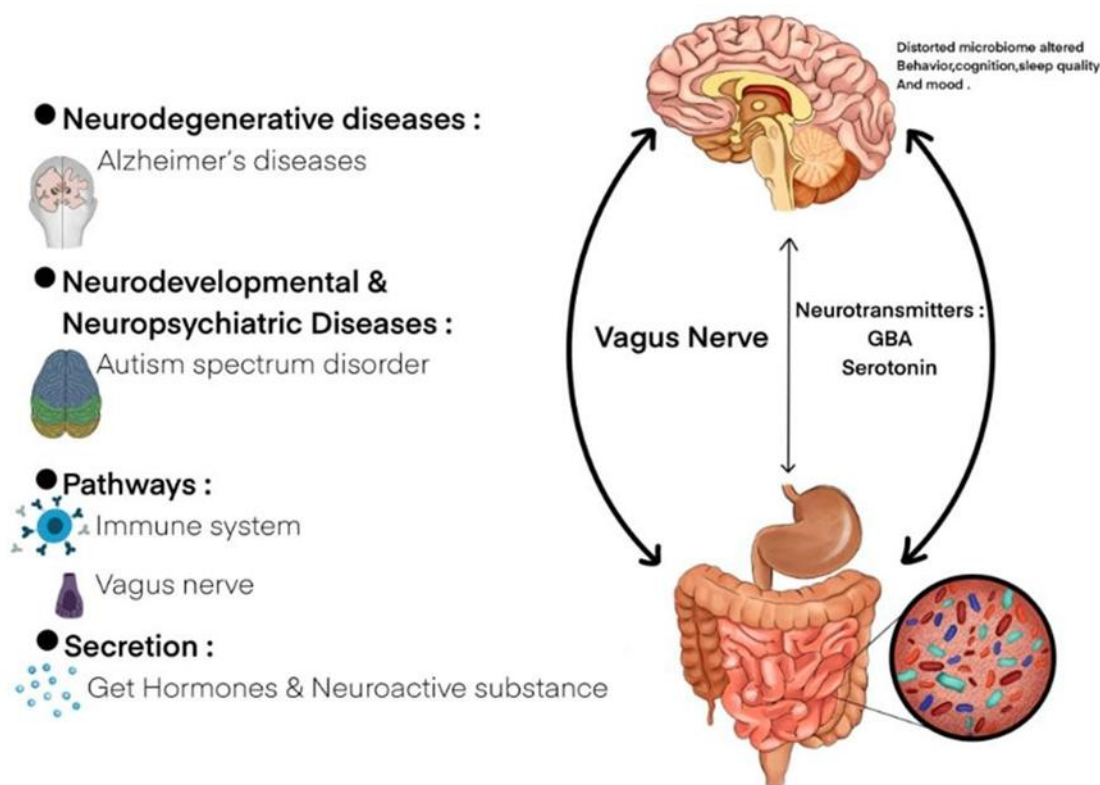


Figure 3: Microbiota-Gut-Brain Axis (MGBA). Through the microbiota-gut-brain axis, neuro-transmitters and gut microbes had a significant influence. Numerous routes, including the immune system and the vagus nerve, mediate the bidirectional connection between the brain and gut bacteria. Gut hormones and neuroactive chemicals are found along the paths of these compounds. Metabolites can affect the neurodevelopment and neurodegeneration of many disorders, including Alzheimer's disease, autism spectrum disorder, depression, anxiety and stress, when entering the brain.

Alterations in intestinal permeability, immune system activation, inflammation and bacterial diversity have an impact on sleep quality, cognition and behavior. Additionally, a number of neurotransmitters, cytokines and metabolites, including dopamine, Gamma-Aminobutyric Acid (GABA), Short-Chain Fatty Acids (SCFA) and melatonin, are produced directly by the gut microbiota. These metabolites influence the Central Nervous Systems (CNS's) activity by directly affecting the vagus nerve and the enteric nervous system. Importantly, a few species of *Bifidobacterium* and *Lactobacillus* can produce GABA. Patients with depression and insomnia frequently show abnormal GABA mRNA expression. One important channel for communication between gut bacteria and the brain is the vagus nerve [60]. Due to disruptions in the gut-brain axis, gut bacteria have also been linked to neurodevelopmental disorders and mental health problems. For instance, growing evidence suggests that gut bacteria play a role in autism spectrum disorder [61]. What's more, regulating the microbiota has therapeutic effects for anxiety disorders like obsessive-compulsive disorder, post-traumatic stress disorder and panic attacks. The gut microbiota also plays a significant role in the etiology of these disorders [62-65]. Microbiota abnormalities have a real association with bipolar disorder [66, 67]. Insufficient sleep and circadian misalignment can induce alterations in gut microbial diversity, which can lead to a shift in microbial structure and function. Gut dysbiosis emerges when the diversity of gut microorganisms' changes, resulting in an imbalance of destructive and protective microbes. Many clinical conditions associated with insufficient sleep and circadian misalignment also occur in gut dysbiosis, including cardiometabolic diseases (obesity, type II diabetes, heart disease). Furthermore, Probiotics and prebiotics supplementation was already found to improve sleep patterns in intervention studies [68].

Sleep Brain-Gut Linkage in Infancy

Contemporary studies used several systematic steps to investigate the possibility of a sleep-brain-gut connection in infancy and test the probability of a dynamic link between it and outcomes of behavioral development. With the help of interdisciplinary techniques, 162 healthy infants were longitudinally evaluated at 3, 6 and 12 months for their development in four key areas: sleep patterns, gut microbiota, behavioral development and sleep neurophysiology [59]. The findings of this research back up

the presence of a sleep brain-gut axis in infancy, which is important for behavioral development. The findings show that both sleep and gut microbiota go through rapid maturational shifts, demonstrating the dynamic link between the two. At 3 months of age, the strongest links between sleep patterns, gut microbiota and behavioral outcomes were discovered, potentially suggesting an early sensitive phase for subsequent sleep rhythm and gut microbial balance functionality. Re-normalization of the sleep-brain-gut links' maturation trajectories should help prevent developmental abnormalities in children who are at risk [59].

Probiotics' Impact on Sleep Quality

A new demonstration proved that probiotics have a positive impact on sleep quality. Modifying the microbial environment, for instance, using probiotics, has been proposed to boost mood, cognitive abilities and anxiety in patients with chronic fatigue syndrome and depression. The microbiota-gut-brain axis has been identified as an important mechanism that influences cognition [70]. Sleep deprivation has been linked to a deterioration in cognitive function and memory problems, as well as changes in the gut flora, according to a large body of data. Probiotic therapies with various *Lactobacillus* and/or *Bifidobacterium* species/strains have been proven to increase memory and cognition in mice and humans, which is fascinating. As a result, it appears that there is a relationship between sleep, cognition, probiotics and communication along the microbiota-gut-brain axis [71].

Effect of Environmental Pollutants on Microbiota of Breastfeeding and Their Reflection on Infants

The term "breast-gut axis" pertains to the connection between breast milk and the formation and maintenance of infants' gut microbiota due to elements present in breast milk. This idea also involves a two-way connection between the gut microbiota and breast milk generation [72]. Studies have demonstrated that the composition of breast milk changes as time progresses, with fluctuations in nutrient levels and bioactive constituents to suit the infant's requirements [73]. However, milk serves as a biological fluid that may harbor environmental contaminants, potentially impacting the immune system and subsequently affecting various bodily organs. Among these pollutants are polychlorinated biphenyls, organic substances that have been identified in human milk [74]. These substances possess a propensity for fat solubility, enabling their infiltration into fatty milk and eventually reaching the digestive tract of newborns. Another noteworthy concern pertains to the presence of heavy metals such as arsenic, lead, cadmium and mercury in milk. These elements can disrupt the production of cytokines, pivotal immunomodulatory agents, thereby inducing either stimulation or suppression of these compounds [74]. Furthermore, these compounds can also influence the microbiota of infants and interfere with their crucial function for overall health [75]. Certain chemicals in this category also possess neurotoxic properties and since infants have an underdeveloped blood-brain barrier and nervous system, they are particularly susceptible to these effects. Although, breastfeeding undeniably offers substantial advantages to infants, it's imperative not to overlook the potential repercussions of the amalgamation of chemicals present in breast milk. Human milk contains minute quantities of environmental contaminants and the combined exposure to these substances could significantly influence children's growth and well-being [75].

Conclusion

Breast milk is not only the biofluid that feeds neonates, but also contains immunological benefits to support the development of healthy microbial gut which plays a significant role in infant lifestyle. Within the gastrointestinal tract, an ecosystem of huge microbes is denominated as a microbiome [72]. Intriguingly, it undergoes a large transition in infancy and childhood. The relevance of gut microbiota on metabolism, immunity and behavior is gradually becoming highlighted. The gut microbiome has been used as a health marker [59]. Infant general health is influenced by pregnancy, the mother's health, the mode of delivery, breastfeeding and breast milk composition. The study investigated the significance of milk microbiota and the importance of breastfeeding.

Conflict of Interest

The authors declare that there is no conflict of interest.

Author Contributions

All authors have contributed equally to the final manuscript.

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