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The impact of *Bifidobacterium longum/infantis* on infants

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The impact of Bifidobacterium longum/infantis on infants

SHANICE CLARKE

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OUTLINE

Name: Shanice Clarke

Section: 1

My topic: *Bifidobacterium*

I am very intrigued about microorganism and their association with living and non-living organism. I decided to research this topic because I want to become a microbiologist in the future. I am especially interested with the impact of *Bifidobacterium longum/infantis* on infants.

Outline:

Abstract

Keywords

Introduction

Topic 1

The impact of *Bifidobacterium longum/infantis* on infants' gastrointestinal tract

- *B. infantis* is the only *Bifidobacterium* that can digest HMOs in human milk
- *B. infantis* reduce dysbiosis condition in infants
- *B. infantis* limit the colonization of other harmful bacteria in infant

Topic 2

ABSTRACT

This review focuses on the impact of *Bifidobacterium longum/infantis* on infants and to associate these impacts to effect of *B. longum/infantis* on the titers of polio IgA in infants.

Bifidobacterium longum/infantis is a ubiquitous inhabitant of the gastrointestinal tract of infants; these bacteria are the champion colonizer of the gastrointestinal tract blocking out other harmful bacteria from colonizing. *B. longum/infantis* have been shown to improve dysbiosis condition and prevent infants from getting any allergy or harmful disease such as poliomyelitis. This review was aimed to assess the impact *B. longum/B. infantis* has on infants and to associate these impacts to the effect *B. longum/B. infantis* has on polio titers after vaccination. Researchers have determined that infants who were fed with a fermented formula versus infants who were fed with a placebo that the *B. longum/B. infantis* that was present in the stool of the infants was significantly different from the placebo group (0.0399, fisher exact test). There is a positive correlation between *B. longum/B. infantis* with anti-poliovirus.

Keywords

Bifidobacterium longum

Bifidobacterium infantis

Poliomyelitis

Human Milk Oligosaccharides- HMOs

Immunoglobulin

INTRODUCTION

Bifidobacterium, member of the *Actinobacteria* phylum, is a genus of gram-positive bacteria that is anaerobic and a ubiquitous inhabitant of the gastrointestinal tract. *B. longum* subspecies *infantis* is a species of bacteria within the genus of *Bifidobacterium* that is found in the microbiota of infant's gastrointestinal tract and is associated with health benefits for infants. Infants that have high levels of *B. longum/infantis* in their system tend to have an enhanced immune response to viruses such as polio and tend to be a good component for human milk degradation. Infants that were born through C-section tend to have less *B. infantis* in their system and must rely on breast milk or fermented milk to obtain the bacteria that can help prevent numerous illnesses in infants that are colonized by the bacteria. *B. longum/infantis* is prominent in infants that are breast fed or fed with a fermented formula which coincides with the increase in antibody titers of polio viruses (2).

Infants that have lower levels of *B. longum/infantis* are more likely to suffer from allergies and are more susceptible to infections (2,8). Interestingly, mothers with allergies have significantly lower levels of several different species of *Bifidobacterium* in their breast milk (5). Polio virus cases are steadily increasing 5-10 percent in children in the United States. This review focuses on the impact of *Bifidobacterium longum/infantis* on infants and to associate these impacts to the effect of *B. longum/infantis* on the titers of polio IgA in infants.

The impact of *Bifidobacterium longum/infantis* on infants' gastrointestinal tract

Bifidobacterium infantis is a subspecies of *B. longum*; this species of *Bifidobacteria* are mainly found colonizing the gastrointestinal tract of infants, and the older infants get the lower the levels of *B. longum/B.infantis* (2). This may be a result because *B. longum/B.infantis* plays a very vital role in the breakdown of human milk (9). The older one gets the more their diet move from solely consuming human milk to being more diverse. *B. longum/B.infantis* is a ubiquitous inhabitant so they crowd the gastrointestinal tract of infants that can potentially block out other harmful bacteria from colonizing the gastrointestinal tract (8). The presence of *Bifidobacterium longum/infantis* in the gastrointestinal tract of infants will have positive impacts on the infant's gut microbiota.

***B. infantis* is the only *Bifidobacterium* that can digest HMOs in human milk**

Human Milk Oligosaccharides (HMOs) is a solid component found in human breast milk. HMOs are complex carbohydrates that infants cannot digest, because the human gut does not have the required enzymes to cleave the linkage between HMO molecules (8). There was an uncertainty of the importance of HMOs to infants, since humans cannot digest these molecules, until studies linked these HMOs to *B. infantis* (8). *B. infantis* have a gene called HMO cluster 1 that allows it to grow on a medium that contains HMOs more than any other form of *Bifidobacteria* (8), and can cleave HMOs and deconstruct human milk glycan (8). Underwood and German (8) concluded that infants that were colonized by *B. infantis* not only can deconstruct human milk, but can also out compete other *Bifidobacteria* and other pathogenic bacteria in the gut lumen of breast-fed milk. Premature infants did not have any species of

Bifidobacteria, but had a diversity of other bacteria, and premature infants were more susceptible to Necrotizing enterocolitis (NEC) which is a dysbiosis condition (8). Dysbiosis is an imbalance between the type of organisms present in one's natural microflora. Probiotics is a possible treatment for premature infants, because it contains *B. infantis* and will decrease NEC in infants (8).

***B. infantis* reduce dysbiosis condition in infants**

Dysbiosis is a condition characterized by the imbalance between the bacteria that is good for you and the bacteria that is bad for you. The development of infant's gut microbiota at the beginning stage of their life will play a vital role in the long-term health of the infant (8). Probiotics has been a treatment option to correct the imbalance of bacteria in the body (8, 10). It has proven that probiotics that have *B. infantis* would lead to persistent colonization of infants that were breast fed, which will eventually change the composition of the gut microbiota (8). Infants guts whose colonized by *B. longum/B. infantis* showed higher levels of Antipoliiovirus IgAs when vaccinated with polio virus (2). This may be a result of the fact that *B. infantis* is a ubiquitous inhabitant crowding the gut microbiota blocking out other harmful bacteria from colonizing. (Frese, 2017) In conclusion, infants fed with *B. infantis* had increased levels of *B. infantis* in their gut microbiota and fecal microbiota. The infants that were not fed with any probiotics did not have any *Bifidobacteria* growing in their microbiota (10). Thirty days after infants were treated with *B. infantis*; the bacteria were still present in the gut microbiota and was one of the major colonizers of the gut (10). This may be a result of the gene that *B. infantis* have adapted to cleave HMOs, infants' diet is mainly consisting of milk and it has been proven no other species of *Bifidobacterium* can digest the HMOs. The

presence of *B. infantis* have many positive impacts on infant's gut microbiota, making it a friendly bacterium; this is a bacterium that one would like their child to have.

***B. infantis* limit the colonization of other harmful bacteria in infant**

Infants obtain *B. longum/B.infantis* when they are born through the vagina or skin when being delivered via C-section. These bacteria are present in the gut microbiota of the infant after delivery, but they are not activated. Breast milk activates the *Bifidobacterium* to start colonizing the gastrointestinal tract of infants. *B. longum/B.infantis* can change the fecal component of infants which will in turn prevent diarrhea (2). The levels of *B. infantis* are lower in infants that are delivered via C-section since the infant would not be exposed to as much *Bifidobacteria* through delivery (2). Babies from more developed countries experience more dysbiosis condition than those babies from less developed countries. This might be explained because C-section delivery is not common in underdeveloped countries, and most infants delivered vaginally will be more exposed to *Bifidobacterium longum/ infantis* stabilizing the colonization of the gut microbiota (2).

Higher levels of *B. longum/B.infantis* have a positive impact on infants; *B. infantis* is the only species of *Bifidobacterium* that can digest HMOs which prove helpful in human milk degradation and *B. longum/B.infantis* plays a vital role in treating NEC (8). Lower level of *B. longum/ infantis* have a negative impact on infant's gut microbiota, this is because other bacteria may colonize the infants gut microbiota that may be harmful to the infant and infants that have lower levels of *B. longum/B.infantis* are more susceptible of having dysbiosis condition (2, 8).

The immunological response of high level of *B. longum/infantis* to polio titers in infants

Poliomyelitis, also called polio, is a disease that can affect both adults and infants. Polio viruses can enter the body through the mouth, by hands or other body parts that have come in contact with the feces of someone who has the polio virus. In order to prevent from getting the polio virus, a polio vaccine was created and is recommended and sometimes required. Infants that are predominantly colonized by *B. longum/B. infantis* correlate with higher levels of polio titers when vaccinated with the polio vaccine (2, 11). Stool from infants with high levels of polio titers had higher levels of *B. longum/B. infantis* (2, 11). Higher levels of *Bifidobacterium longum* subspecies *infantis* and also *longum* will have a positive association with polio titers in infants.

***Bifidobacterium* (especially *B. longum* subspecies *infantis*) increase response to oral polio virus vaccine early in infant's life.**

Immunization prevent infants and adults from getting infectious diseases such as poliomyelitis. Studies have analyzed the association between vaccine responses and levels of bacteria find in infants' stool. For example, another member of the *Actinobacteria* phylum have a positive association with oral polio virus specific T-cell proliferation and oral polio virus specific immunoglobulin G responses (11). Also, infants with higher Oral Polio Virus CD4 molecule responder also had higher levels of *B. longum/B. infantis* (11). CD4 molecules are a type of T-cell helper; which are proteins on antibodies that come in contact with antigens to produce an immune response when the body encounter an antigen. Infants with higher level of Oral Polio Virus CD8 molecule responder also had higher-levels of *B. longum* (11). Interestingly, stools from those infants with high Oral Polio Virus vaccine responses, were predominantly colonized

by *B. longum* subspecies *infantis* (11). This result, indicated that the gut composition of the microbiota of infants may play a vital role in which the infant's immune system may interact with oral or parental vaccines, because high levels of *B. longum*/*B. infantis* result in increased immunological response to vaccines (11). In fact, infants that have a more diverse gut microbiota (and less Bifidobacteria) have lower responses to vaccines and may suffer from systematic inflammation (11).

Secretory IgA in breast milk protects newborns from all infection

Breast milk is said to protect newborns from infection (2). Infants obtain *B. longum*/*B. infantis* when they are born (2, 8), breast milk is what activates the bacteria. Once activated, Bifidobacteria will colonize the infant's gastrointestinal tract (2). Breast milk also contains secretory immunoglobulin titers; which are antibodies that serve as the first line of defense against antigens (2). Therefore, infants that were breast fed immune system prime sooner than infants that were not breast fed. Colonization by Bifidobacteria, mainly *B. longum*/*B. infantis*, can trigger an immune response in infants (2). In order to test if the gut microbiota can trigger an immune response, there was a study carried out with inactivated poliovirus vaccine to determine if there is an increase in the fecal immunoglobulin A titers before and after vaccination (2). Infants were either fed with fermented formula or placebo. Both groups had an increase in the levels of *B. longum*/*B. infantis* in the infant's feces, but the group that was treated with the fermented formula had higher levels than the placebo (2). There was also a correlation between the increased polio specific intestinal antibody response to higher levels of *B. longum*/*B. infantis* in infants that were fed with fermented formula (2). Infants that were fed with fermented formula (FIF) have a higher level of fecal bifidobacterial the longer they were being treated, which may result in those infants having an increase in the Anti-poliovirus IgA titers (2,11). Fermented

formula can trigger an Anti-poliovirus response which in turn favors intestinal Bifidobacteria in infants (2).

CONCLUSION

This review focuses on the impact of *Bifidobacterium longum/infantis* on infants and to associate these impacts to effect of *B. longum/infantis* on the titers of polio IgA in infants. Based on the results gathered from each peer-reviewed article it is safe to say *Bifidobacterium longum/infantis* is a friendly bacterium that you would want your child to have. *B. longum/B. infantis* helps protect infants from dysbiosis and diseases including poliomyelitis. *B. infantis* is the only bacteria that can digest HMOs which is very crucial for infants. *B. longum/B. infantis* is more prominent in infants and are associated with higher levels of polio IgA titers when vaccinated with the polio vaccine; infants that have lower levels of anti-poliovirus titers also have lower levels of *B. longum/B. infantis* in their feces. Furthermore, infants who have higher levels of anti-poliovirus titers also have higher levels of *B. longum/B. infantis* in their feces, which indicates that there is a positive correlation between anti-poliovirus IgA and *B. longum/B. infantis*.

It was determined that higher levels of *B. longum/infantis* will be present in infants that were fed with infant fermented formula and those infants also have a higher level of antipoliavirus titers. I accept the results that were determined in the peer-reviewed and I believe that there will be a positive correlation with antipoliavirus titers and the levels of *B. longum/infantis* in infants that was fed with fermented formula.

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