Prebiotic oligosaccharides scGOS/lcFOS (9:1) in infant and preterm formulas

A selection of key findings, compiled from >40 studies

NUTRICIA

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FOREWORD

Human milk oligosaccharides (HMOs) are a crucial component of breast milk and play a significant role in overall health and development of infants. HMOs are complex carbohydrates, the third largest component of breast milk after lactose and fat. To date, >200 different HMOs have been identified and their concentration in mother's milk varies with lactation period, mother's genetic secretor status, geographical location, Lewis blood type, maternal dietary habits and length of gestation (preterm or term).

HMOs influence gut health by acting as 'prebiotics' promoting the growth of beneficial gut bacteria such as Bifidobacteria including B. *infantis,* B. *bifidum,* B. *breve and* B. *longum* and their metabolites which have health enhancing properties. HMOs enhance the immune system by influencing the establishment of beneficial gut microbiota. They prevent harmful bacteria from binding to the gut lining and thus prevent severe infections.

Prebiotic oligosaccharides, such as galacto-oligosaccharides (GOS) and fructo-oligosaccharides (FOS) are prebiotics commonly added to infant formula and have a long history of safe use in term and preterm infants. Nutricia's GOS/FOS prebiotic oligosaccharide blend is designed to closely reflect the quantity, diversity (>100 different structures of short chain and long chain types in a ratio of 9:1) and functionality of HMOs in breast milk. In addition, GOS/FOS has proven clinical effects on the gut microbiota and the immune system.

Parental education and increasing awareness about the gut-immune health link amongst health care professionals can help informed decision-making and promote the use of prebiotic oligosaccharides, like GOS/FOS supplemented formula in those families who choose or need to formula feed.

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INTRODUCTION

Gut microbiota development after birth

The first 1,000 days of an infant's life (from conception to two years of age) represent a critical window for development of the gut microbiota, which is essential for the maturation of their immune system and overall health.[1]

The gut microbiota refers to the composition of microorganisms populating the gastrointestinal (GI) tract.[2] The GI tract is the centre of the immune system, containing around 100 trillion bacteria[3] which are essential for immune system development.[4]

As soon as an infant is born, microbial colonisation of their gut microbiota begins.[5] During this period, maternal and environmental factors shape the infant gut microbiota:

Some of these factors above have the potential to cause gut microbiota disruptions in early life.[5] These disruptions or imbalances in microbial diversity are referred to as 'gut dysbiosis',[7] which can result in lifelong health problems, such as obesity and allergic diseases.[6,8-12]

Amongst all the factors that influence the gut microbiota, early life nutrition plays a fundamental role from birth throughout the lifespan.[13] Specifically in the first days after birth, the type of nutrition significantly influences the gut microbiota composition.[5]

The standard for healthy infant gut microbiota development is considered one that is dominated by species of *Bifidobacterium* observed in healthy, full term, vaginally delivered and exclusively breastfed infants.[14] Formula fed infants typically exhibit more diversity and less stability in their gut microbiota composition.[15] However, some infant formula now includes specific oligosaccharides to support formula fed infant's gut microbiota development that is rich in *Bifidobacterium.*[5]

Breast milk composition – human milk oligosaccharides

Nothing compares to breast milk. It is the gold standard nutrition for infants.[16]
Breast milk is rich in bioactive compounds such as human milk oligosaccharides (HMOs).[17,18,5] HMOs play an important role in stimulating the growth of *Bifidobacterium*, thereby influencing the infant's gut microbiota composition.[19]

HMOs are structurally complex glycans (sugars), constituting the third most abundant solid component of breast milk, after lactose and fat.[20] Over 200 HMO structures have been identified in detail, consisting of short chain and long chain structures found in a 9:1 ratio; however it is estimated there are more than 1,000 different structures in breast milk.[21-23]

Generally, HMOs are at their highest concentration immediately after birth in colostrum (up to 25g/L), which then decreases over the lactation period, with concentrations ranging between 5-22g/L in mature breast milk.[20]

HMOs resist digestion in the GI tract and therefore serve as prebiotics by providing a substrate for fermentation by gut bacteria,[24] which enables the optimal intestinal conditions in which beneficial bacteria can grow (prebiotic effect).[14]

While the functionality of individual HMOs varies, HMOs work cleverly together to yield the following benefits:[25]

- Gut microbiota development[26]
- Healthy stool characteristics[27]
- Immune benefits[28]

Prebiotic oligosaccharides scGOS/lcFOS (9:1)

In 2002, Danone Research and Innovation was the first to introduce a prebiotic blend of short chain galacto-oligosaccharides and long chain fructo-oligosaccharides (scGOS/lcFOS) in a 9:1 ratio in infant formula. Typically, the **QUANTITY** of scGOS/lcFOS (9:1) used is at a level of 8g/L.

The 9:1 ratio refers to 90% short chain galacto-oligosaccharides (derived from cow's milk) and 10% long chain fructo-oligosaccharides (derived from chicory inulin). This ratio was inspired by the **DIVERSITY** of >1000 different HMO structures found in breast milk consisting of short chain and long chain structures in a 9:1 ratio.[26,29]

scGOS/lcFOS (9:1) has a proven prebiotic effect, as recognised by the International Scientific Association for Probiotics and Prebiotics (ISAPP).[30,31] Furthermore, this prebiotic blend, scGOS/lcFOS (9:1), is the most researched in infant formula globally with clinical benefits in gut and immune health.[27,32,33]

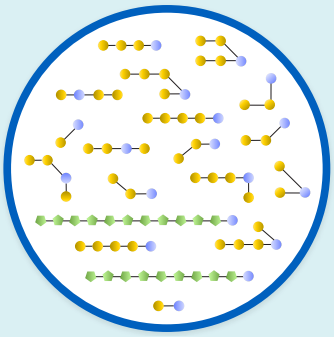
scGOS/lcFOS (9:1) was created to help mimic the quantity, diversity and functionality of the diverse pool of HMOs in breast milk:[29,34,35]

QUANTITY

High quantity of oligosaccharides[29]

DIVERSITY

More than 100 structures of short and long chain oligosaccharides[34,29]



scGOS/lcFOS (9:1)

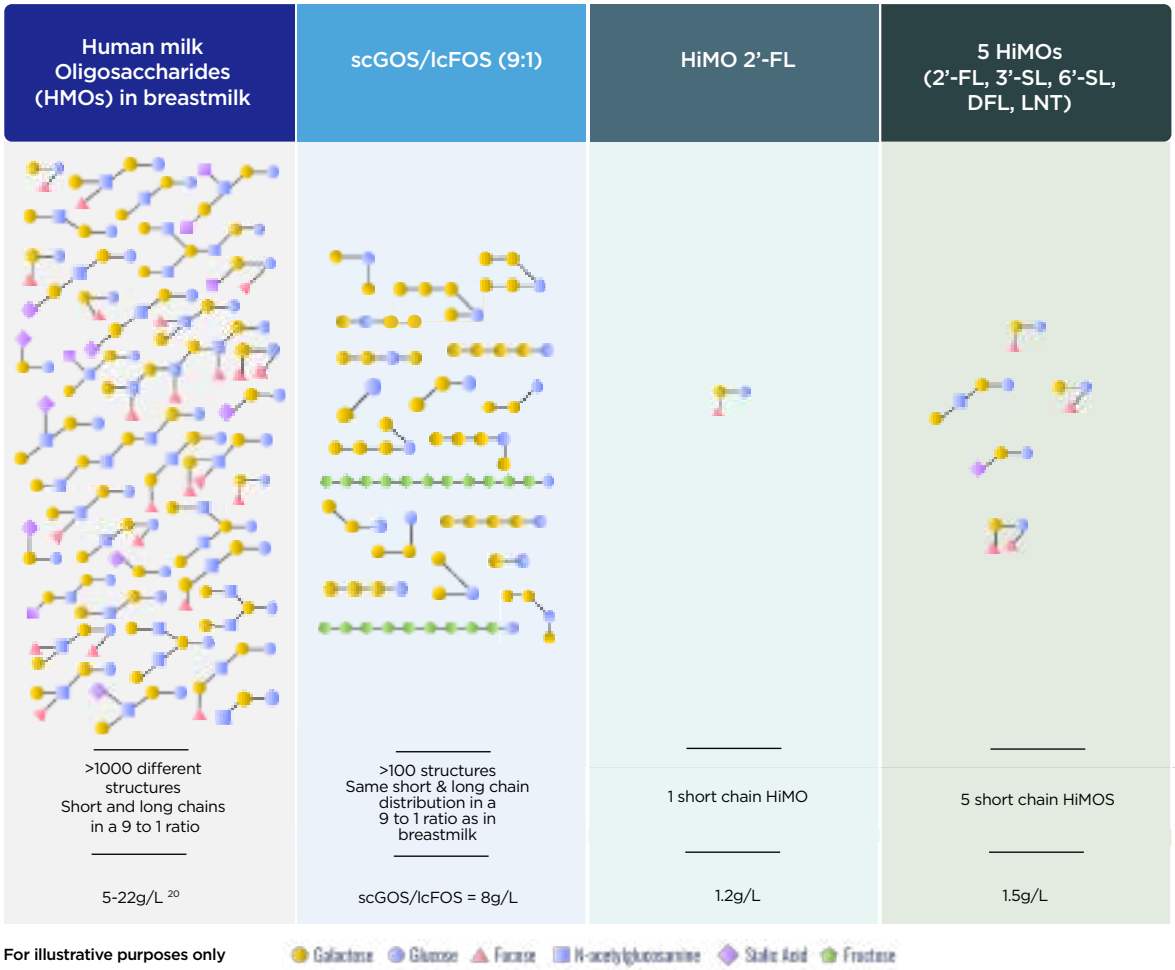
FUNCTIONALITY

scGOS/lcFOS (9:1) has been shown to support a healthy gut and immune system development by:

- Stimulating growth of beneficial bacteria[37,38]
- Stool softening closer to that of breastfed infants[27,37]
- Suppressing growth of pathogens[38,39]
- Reducing the risk of infections[40,41]

For illustrative purposes only. Schematic representation of scGOS/lcFOS (9:1).
*short-chain galacto-oligosaccharides (scGOS)/long-chain fructo-oligosaccharides (lcFOS) (9:1).

HMOs are an exciting area with new research emerging, and both our understanding and research will continue to evolve. The number of commercially available synthetic HMOs, referred to as Human identical Milk Oligosaccharides (HiMOs), is increasing, however it is not yet possible to mimic the diverse and complex pool of HMOs in breast milk:[24,36]



PUBLICATIONS IN TERM INFANTS

Author/s	Amount of scGOS/lcFOS (9:1)	Key outcomes	Page
Moro, G., et al. 2002[37]	4 g/L and 8 g/L	Dose dependent stimulating effect on the gut microbiota and softer more regular stools	7
Knol, J., et al. 2005[38]	8 g/L	Stimulating effect on the gut microbiota	9
Bruzzese, E., et al. 2009[33]	4 g/L	Reduced intestinal and possibly respiratory infections, with reduced use of antibiotics	11
Scholtens, PA., et al. 2008[39]	6 g/L	Higher faecal SIgA concentrations and stimulating effect on the gut microbiota	13
Arslanoglu, S., et al. 2007[40]	8 g/L	Reduced the number of infectious episodes and the incidence of recurrence, particularly respiratory infections	15
Arslanoglu, S., et al. 2008[32]	8 g/L	Sustained reduction in allergic manifestations and infections up to 2 years of age	17
Arslanoglu, S., et al. 2008[42]	8 g/L	Sustained reduction in allergic manifestations up to 5 years of age	19

Supports immunity Supports gut microbiota Digestive comfort

PUBLICATIONS IN PRETERM INFANTS

Author/s	Amount of scGOS/lcFOS (9:1)	Gestational age and/or birth weight	Key outcomes		Page
Westerbeek, EAM., et al. 2011[43]	Increasing doses of 80% scGOS/ lcFOS and 20% AOS* up to a maximum of 1.5g/ kg/day	<32 weeks and/ or birth weight <1500g	Reduced stool viscosity and stool pH with a trend towards increased stool frequency		21
Boehm, G., et al. 2002[44]	10 g/L	<32 weeks and birth weight <1600g	Stimulating effect on the gut microbiota and stool characteristics similar to a preterm infant fed breast milk	 	23
Mihatsch, WA., et al. 2006[45]	10 g/L	birth weight <1500g	Reduced stool viscosity and accelerated gastrointestinal transit		26

*Acidic oligosaccharides

Dosage-Related Bifidogenic Effects of Galacto- and Fructooligosaccharides in Formula-Fed Term Infants

Moro, G., et al. 2002

BACKGROUND:

This randomised controlled trial (RCT), was a proof-of-concept study designed to investigate the dosage-related bifidogenic effects of an experimental prebiotic oligosaccharides blend consisting of low molecular weight galacto-oligosaccharides and high molecular weight fructo-oligosaccharides, at two different concentrations, in formula-fed term infants.

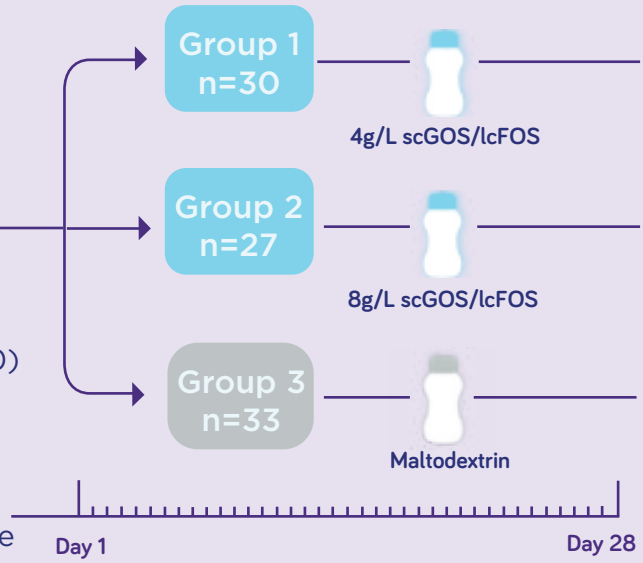
4 g/L and 8 g/L scGOS/lcFOS (9:1)

Dose dependent stimulating effect on the gut microbiota and softer more regular stools

STUDY DESIGN:

Randomised, control intervention study

- Term infants (n = 90)
- All infants initially breastfed, then when the mother couldn't or didn't want to continue the infant was randomly assigned to 1 of 3 study groups.



Infants evaluated on day 1 and day 28 of intervention period.

Primary outcome:

- Faecal species
- Colony forming units (CFU)
- Stool pH
- Stool characteristics

RESULTS:

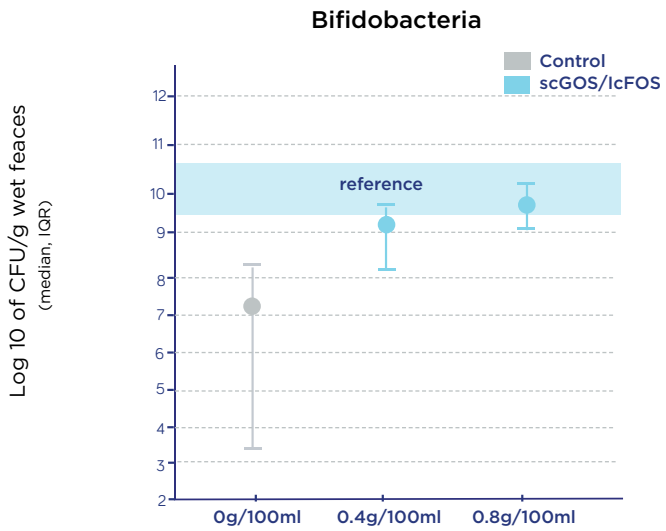


Fig 1: scGOS/IcFOS increases the number of faecal bifidobacteria

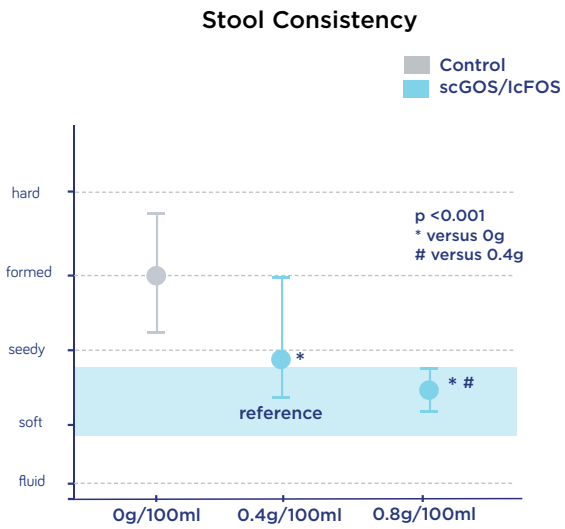


Fig 2: scGOS/IcFOS promotes softer stools

KEY FINDINGS:

- The number of Bifidobacteria significantly increased in the prebiotic supplemented groups in a dose dependent manner ($p<0.01$) while levels remained almost unchanged in the control group.
- The number of Lactobacilli was significantly higher in the prebiotic supplemented groups compared to the control group ($p<0.01$), but there was no significant difference between the two different concentrations.
- Stool characteristics, such as stool pH and stool consistency, improved in a dose-dependent manner, similar to that observed in a healthy, breastfed infant.

CONCLUSION:

Supplementation of a term infant's formula with scGOS/lcFOS has a dose-dependent stimulating effect on the growth of Bifidobacteria and Lactobacilli in the intestine, as well as their stool consistency.

Colon microflora in infants fed formula with galacto- and fructo-oligosaccharides: more like breast-fed infants

Knol, J., et al. 2005

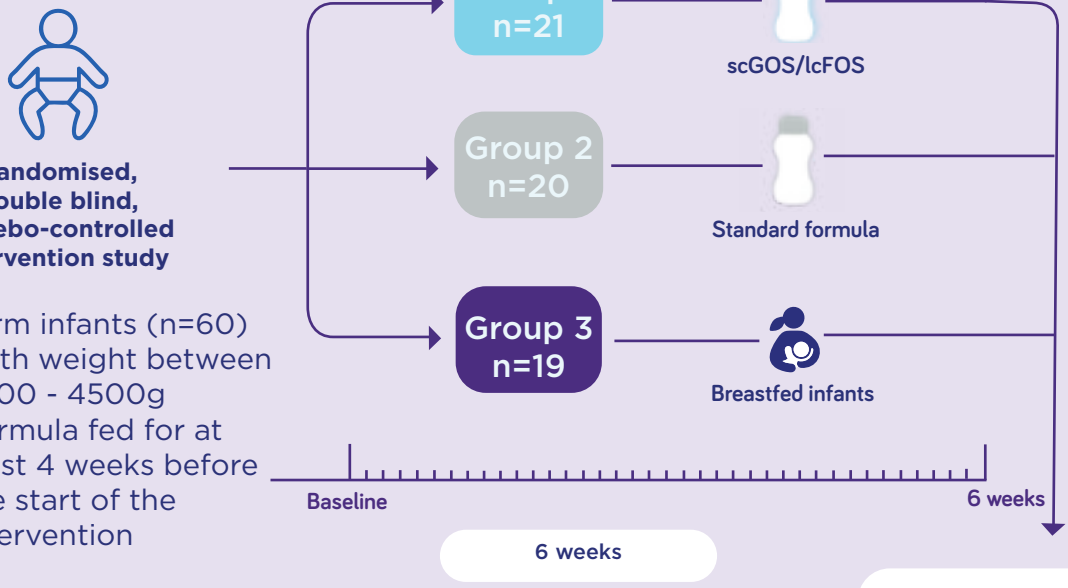
BACKGROUND:

This randomised control trial was designed to determine whether infant formulas supplemented with scGOS/lcFOS can establish a Bifidobacteria-dominant microbiota closer to that of a breastfed infant, measured from composition of microbiota, stool frequency and pH.

8g/L scGOS/lcFOS (9:1)

Stimulating effect on the gut microbiota

STUDY DESIGN:



- Term infants (n=60)
- Birth weight between 2600 - 4500g
- Formula fed for at least 4 weeks before the start of the intervention

Primary outcome:

- Microbiota composition
- Stool frequency
- Stool characteristics

RESULTS:

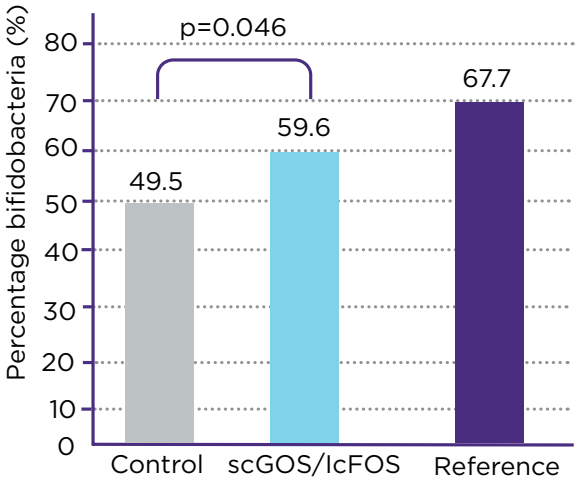


Fig 3: scGOS/lcFOS significantly increases the numbers of faecal bifidobacteria after 6 weeks

KEY FINDINGS:

- After 6 weeks, the prebiotic supplemented group had a significantly higher proportion of Bifidobacteria compared to the control group.
- Stool pH was significantly lower in the prebiotic supplemented group compared to the control group ($p<0.001$).
- The main short chain fatty acid found in all infant's stools was acetate, which was found to be significantly higher in the prebiotic supplemented group ($p<0.001$).

CONCLUSION:

The addition of scGOS/lcFOS to infant formula has a stimulating effect on Bifidobacteria growth and on the metabolic activity of the gut microbiota, resulting in changes in short chain fatty acids and stool pH, similar to that observed in a breastfed infant.

A formula containing galacto- and fructo-oligosaccharides prevents intestinal and extra-intestinal infections: An observational study[33]

Bruzzese, E., et al. 2009

BACKGROUND:

This study was designed to determine whether infant formula supplemented with scGOS/lcFOS may have clinically relevant effects such as a reduced incidence of intestinal and respiratory infections in healthy formula-fed term infants.

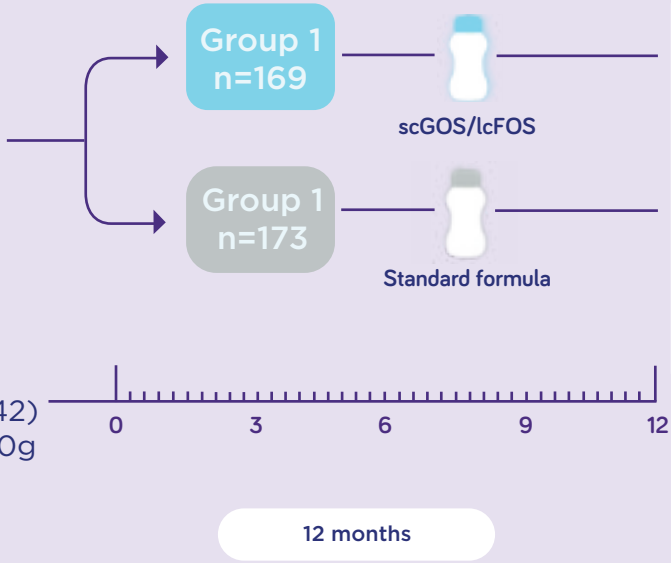
4g/L scGOS/lcFOS (9:1)

Reduced intestinal and possibly respiratory infections, with reduced use of antibiotics

STUDY DESIGN:

Multi-centre, prospective, randomised placebo-controlled open study

- Term infants (n=342)
- Birth weight >2500g



Primary outcome:

- Incidence of acute diarrhoea
- Incidence of upper and lower respiratory tract infections
- Number of antibiotic courses prescribed for respiratory infections

RESULTS:

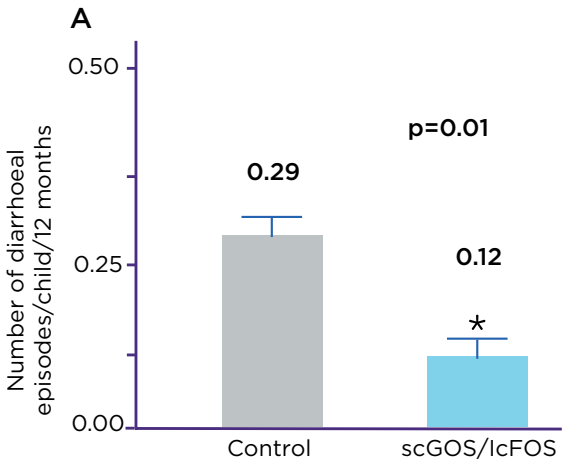


Fig 4: scGOS/icFOS leads to significant lower number of gastroenteritis

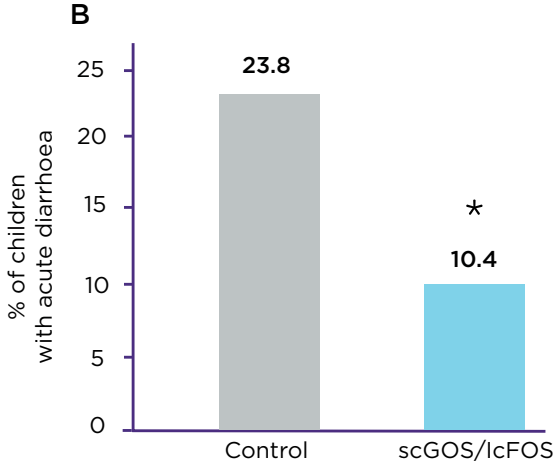


Fig 5: scGOS/icFOS results in 58% less acute diarrhea

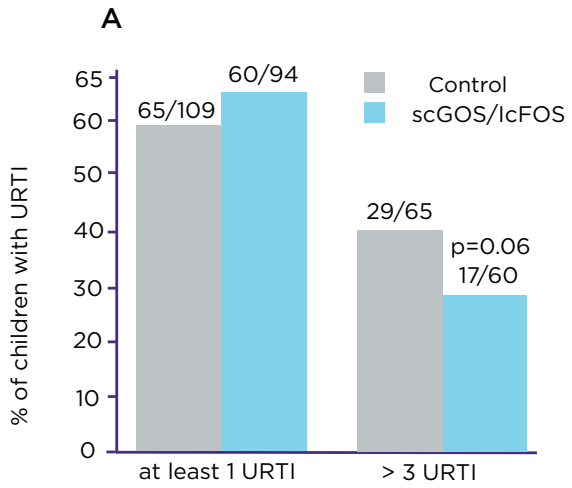


Fig 6: Lower proportion of children with >3 episodes of URTI was observed in scGOS/lcFOS

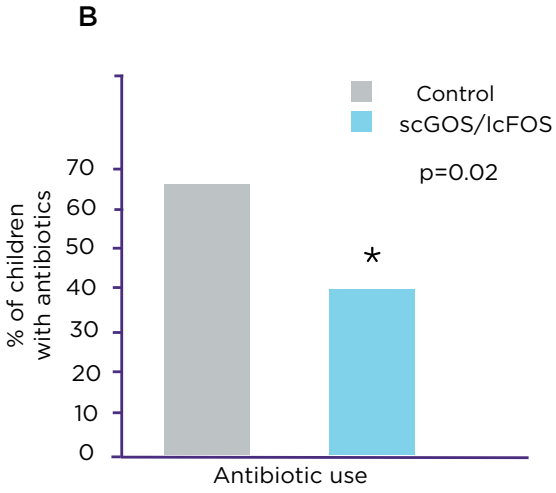


Fig 7: scGOS/lcFOS results in 39% less use of antibiotics for URTI

KEY FINDINGS:

After 12 months, infants who received the infant formula supplemented with scGOS/lcFOS demonstrated:

- Softer stools and significantly fewer episodes of diarrhoea (per infant) (p=0.015)
- Significantly lower average incidence of gastroenteritis (p=0.01)
- Significantly lower antibiotic prescriptions (p=0.038)
- The number of episodes of upper respiratory infection (URTI) was lower but not significant (p=0.4) however among the children with recurrent URTI (>3 episodes in 12 months) was lower in the prebiotic supplemented group, which was close to significant (p=0.06)

CONCLUSION:

Infant formula supplemented with scGOS/lcFOS is associated with a lower incidence of intestinal infections and lower antibiotic prescriptions.

Fecal secretory immunoglobulin A is increased in healthy infants who receive a formula with short chain galacto-oligosaccharides and long-chain fructo-oligosaccharides[39]

Scholtens, PA., et al. 2008

BACKGROUND:

Newborn infants are dependent on passive immunity, such as the maternal secretory immunoglobulin A (sIgA) transferred through breastfeeding, while their immune system matures and they gradually develop acquired immunity. This study was designed to investigate the effect of an infant formula enriched with scGOS/lcFOS on the faecal sIgA response and the gut microbiota composition in healthy term infants.

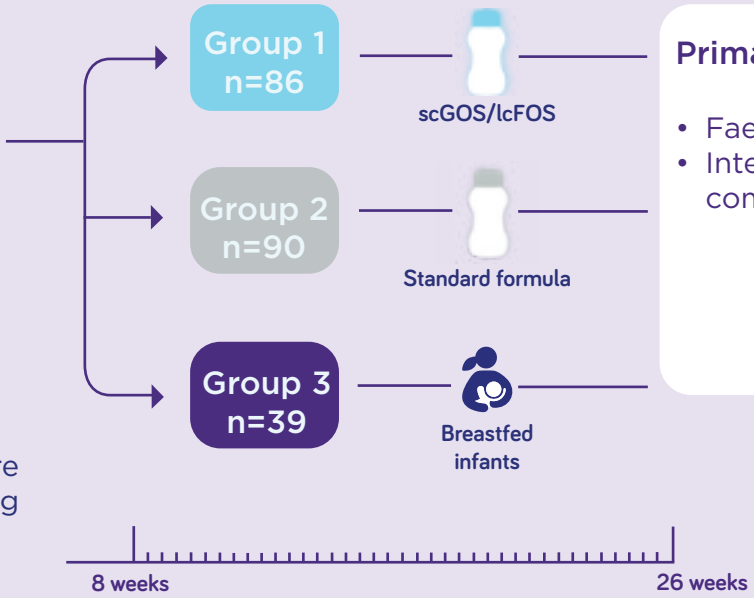
6g/L scGOS/lcFOS

Higher faecal sIgA concentrations and stimulating effect on the gut microbiota

STUDY DESIGN:

Double-blind, randomised, placebo-controlled study

- Term infants (n=215)
- Some infants were mixed fed during the study



Primary outcome:

- Faecal sIgA response
- Intestinal microbiota composition

RESULTS:

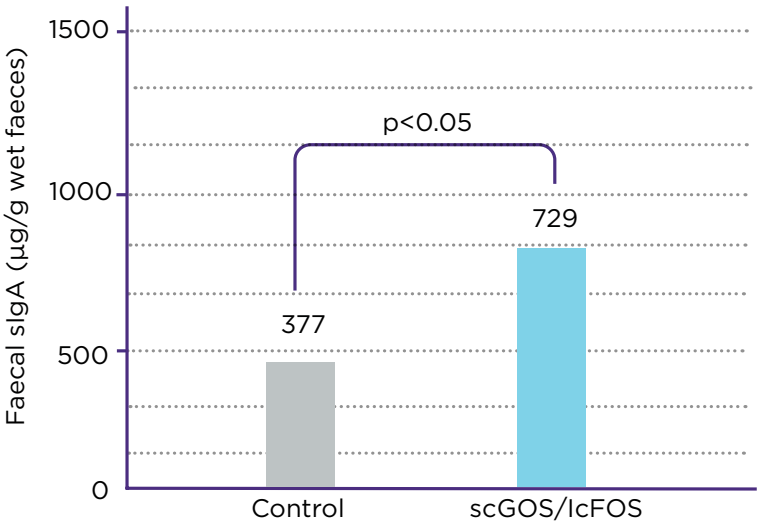


Fig 8: scGOS/lcFOS significantly increases sIgA in faeces after 26 weeks in the whole group of infants

KEY FINDINGS:

After 26 weeks, an infant formula supplemented with scGOS/lcFOS, compared to the control formula, resulted in:

- Significantly higher concentrations of faecal sIgA ($p<0.001$)
- Significantly higher percentages of Bifidobacteria ($p=0.04$)
- Lower percentages of E. coli and Clostridium spp.
- Significantly lower stool pH ($p<0.05$)

CONCLUSION:

Infant formula supplemented with scGOS/lcFOS resulted in high faecal sIgA concentrations, which is suggestive of a positive effect on the gut metabolic activity and in turn, mucosal immunity.

Early Supplementation of Prebiotic Oligosaccharides Protects Formula-Fed Infants against Infections during the First 6 Months of Life

Arslanoglu, S., et al. 2007

BACKGROUND:

The authors at the time of this study explored alternatives to mimic the prebiotic effect of HMOs. They decided to use the prebiotic mixture of scGOS/lcFOS in the 9:1 ratio since it had already been shown[37,38] to have a stimulating effect on the gut microbiota, similar to that observed in a breastfed infant. This study was established to determine whether scGOS/lcFOS has an influence on the immune system during the first 6 months of life by modifying the gut microbiota.

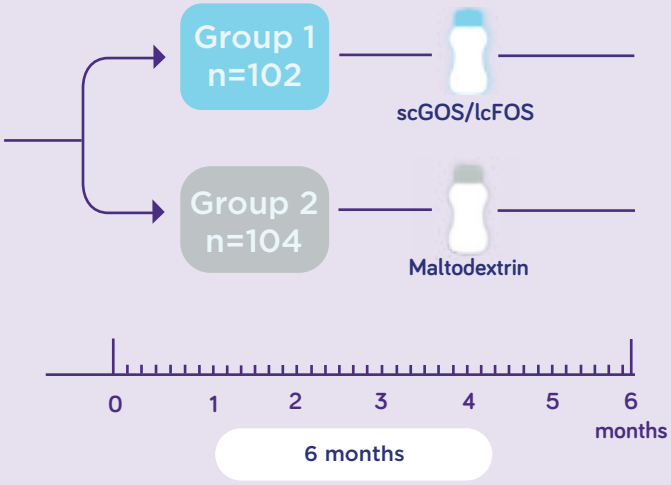
8g/L scGOS/lcFOS (9:1)

Reduced the number of infectious episodes and the incidence of recurrence, particularly respiratory infections

STUDY DESIGN:

Prospective, randomised, double-blind, placebo-controlled study

- Healthy term infants (n=206) with a parental history of atopy
- Infants received a hypoallergenic formula (eHF)
- Formula feeding started within the first 2 weeks of life



Primary outcome:

- Infectious episodes
- Number of infections requiring antibiotics
- Cumulative incidence of 1 or more infectious episodes
- Incidence of infectious episodes over time

RESULTS:

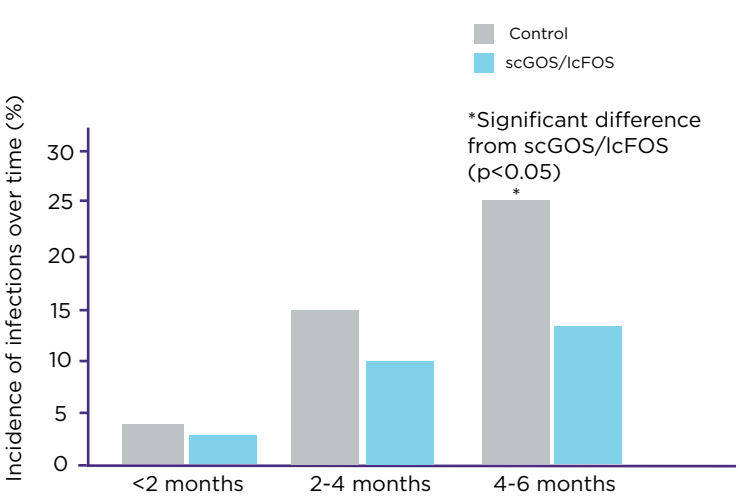


Fig 9: scGOS/IcFOS results in lower incidence of infections over time

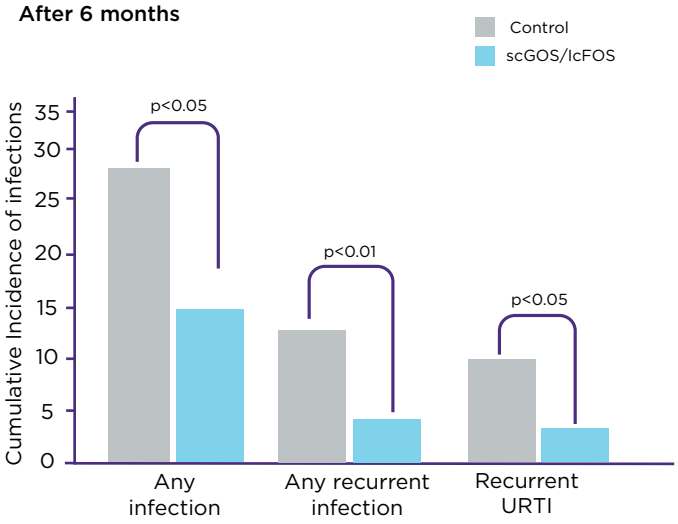


Fig 10: scGOS/IcFOS results in lower incidence of recurrent URTI

KEY FINDINGS:

An infant formula supplemented with scGOS/lcFOS, compared with the control group, resulted in:

- Significantly lower incidence of infectious episodes during the first 6 months of life
- Significantly lower cumulative incidence of recurring infections, and recurring respiratory infections during the first 6 months of life

CONCLUSION:

Infants who received an infant formula supplemented with scGOS/lcFOS for the first 6 months of life exhbitied a lower incidence of infectious episodes, recurrent infectious episodes and recurrent upper respiratory tract infections.

Follow-up studies were recommended to determine whether the effects of an infant formula supplemented with scGOS/lcFOS shown in this study, may be long-lasting. Hence the authors conducted subsequent studies in the same population, which are detailed in Arslanoglu, S., et al. 2008[32] and Arslanoglu, S., et al. 2012.[42]

Early Dietary Intervention with a Mixture of Prebiotic Oligosaccharides Reduces the Incidence of Allergic Manifestations and Infections during the First Two Years of Life

Arslanoglu, S., et al. 2008

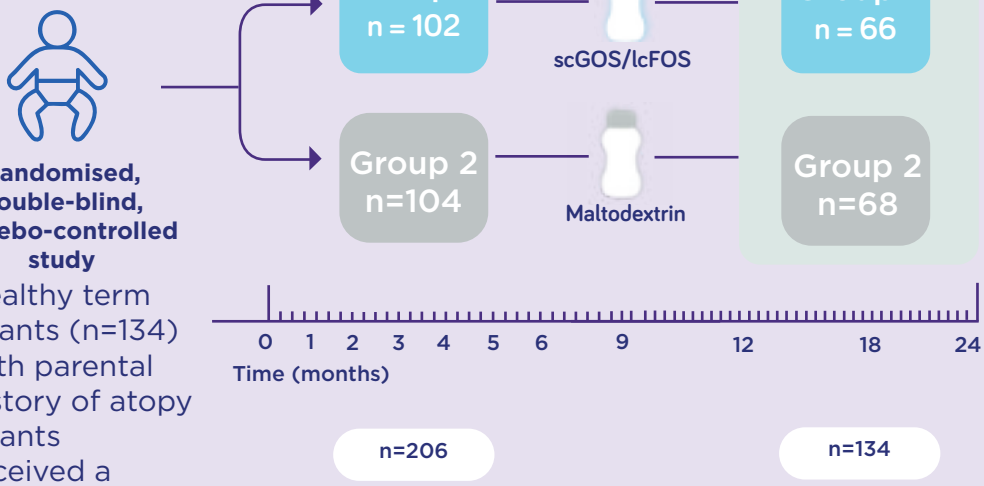
BACKGROUND:

The authors designed a series of prospective trials targeting different outcomes at different intervals. In their earlier studies[40] they demonstrated scGOS/lcFOS led to a significant reduction in infections during the first 6 months of life. This study reports on the long-term effects that a prebiotic mixture scGOS/lcFOS may have on allergic manifestations and infections during the first 2 years of life.

8g/L scGOS/lcFOS (9:1)

Sustained reduction in allergic manifestations and infections up to 2 years of age

STUDY DESIGN:



Randomised, double-blind, placebo-controlled study

- Healthy term infants (n=134) with parental history of atopy
- Infants received a hypoallergenic formula (eHF)
- Formula feeding started within the first 2 weeks of life
- Duration of nutritional intervention was 6 months

Primary outcome:

- Cumulative incidence of allergic manifestations at 2 years of age (atopic dermatitis, recurrent wheezing, allergic urticaria)

Secondary outcome:

- Number of infectious episodes
- Growth

RESULTS:

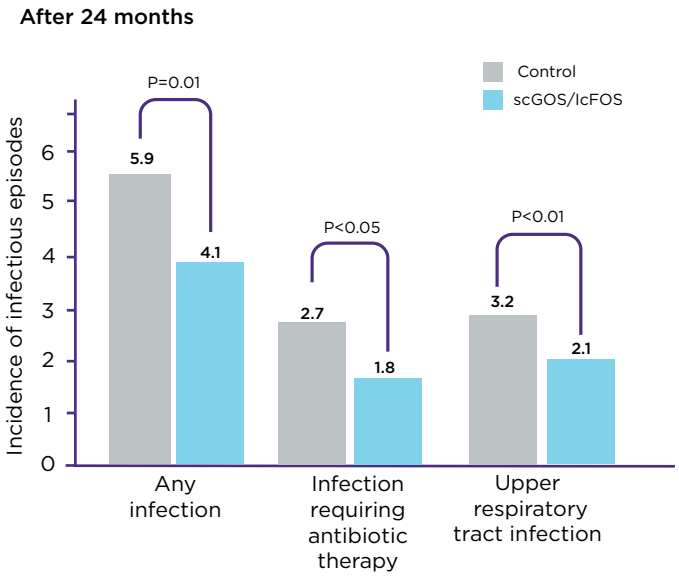


Fig 11: scGOS/IcFOS results in significantly lower number of overall infections, URTI and infections requiring antibiotics

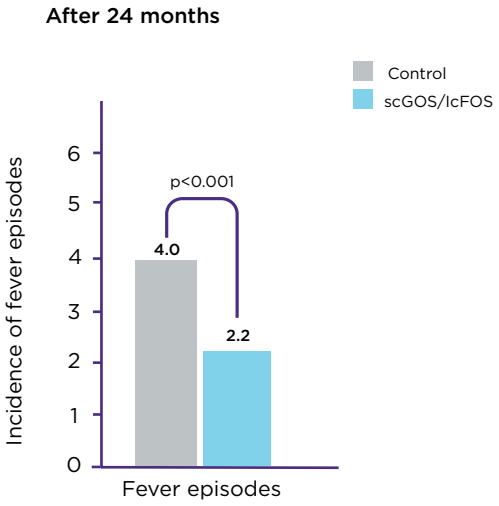


Fig 12: scGOS/IcFOS results in significantly lower number of fever episodes

KEY FINDINGS:

An infant formula supplemented with scGOS/lcFOS was shown to have the following effects, up to 2 years of age, compared with the control group:

- A significantly lower cumulative incidence of allergic manifestations (atopic dermatitis, recurrent wheezing, allergic urticaria) ($p<0.05$)
- Significantly fewer infectious episodes of overall and upper respiratory infections ($p<0.01$), fever episodes ($p<0.00001$) and antibiotic prescriptions ($p<0.05$)

CONCLUSION:

Infants with a family history of atopy who received an infant formula supplemented with scGOS/lcFOS during the first 6 months of life exhibited a sustained reduction in allergic manifestations and infections, lasting beyond the intervention period, up to 2 years of age, which is suggestive of an immune modulating effect through the gut microbiota.

Early neutral prebiotic oligosaccharide supplementation reduces the incidence of some allergic manifestations in the first 5 years of life[42]

Arslanoglu, S., et al. 2012

BACKGROUND:

The rise and progression of infant allergy to atopic diseases, e.g. atopic dermatitis, asthma, in Western societies has been termed the 'allergic march'. While several strategies have been developed to tackle the allergic march, modification of the gut microbiota and thus the immune response, has led researchers to focus more research efforts in this area, particularly since allergic infants exhibit gut dysbiosis in early life. This publication reports the results of the 5-year follow-up of the same cohort[32,40] investigating the long-term effects that a prebiotic mixture scGOS/lcFOS may have on allergic manifestations.

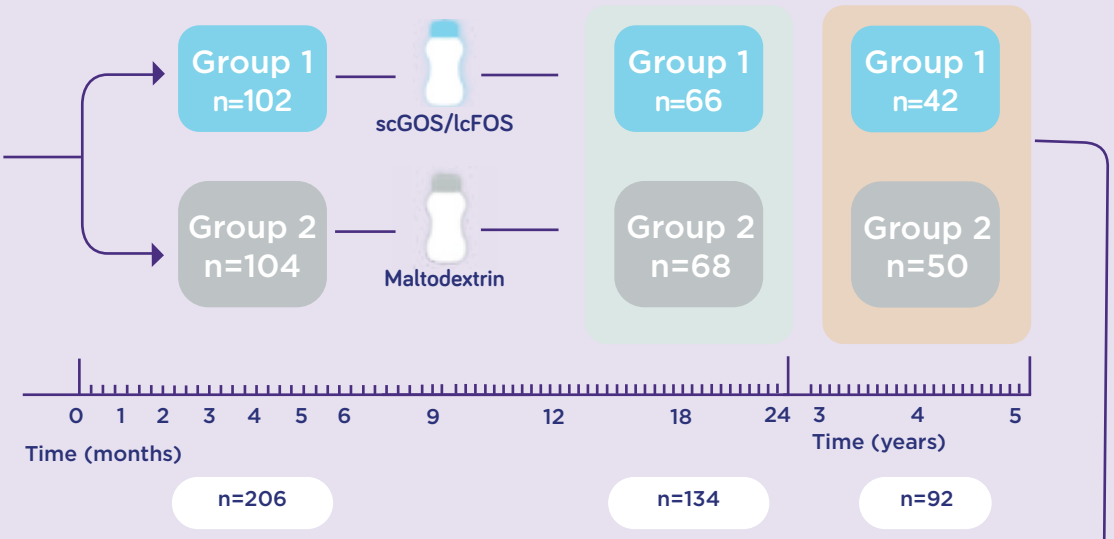
8g/L scGOS/lcFOS (9:1)

Sustained reduction in allergic manifestations up to 5 years of age

STUDY DESIGN:

Randomised, double-blind, placebo-controlled study

- Healthy term infants (n=92) with parental history of atopy
- Infants received a hypoallergenic formula (eHF)
- Formula feeding started within the first 2 weeks of life
- Duration of nutritional intervention was 6 months



Primary outcome:

- Cumulative incidence of allergic manifestations at 5 years of age
- Prevalence of allergic and persistent allergic manifestations at 5 years of age
- Prevalence of allergic manifestations at 5 years of age in relation to atopic dermatitis presence in the first 6 months of life

RESULTS:

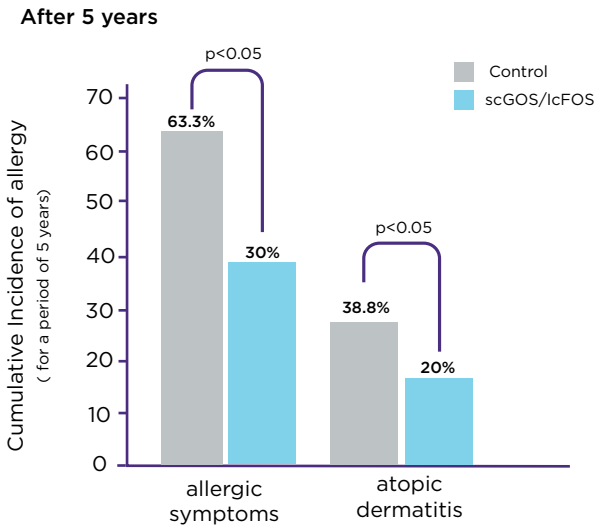


Fig 13: scGOS/IcFOS leads to significantly lower incidence of atopic dermatitis and any allergic symptoms

KEY FINDINGS:

An infant formula supplemented with scGOS/lcFOS was shown to have the following effects, up to 5 years of age, compared with the control group:

- A significantly lower cumulative incidence of any allergic manifestation ($p<0.01$) and atopic dermatitis ($p<0.05$)
- A significantly lower prevalence of any persistent allergic manifestation ($p<0.01$) and rhinoconjunctivitis ($p=0.05$), and a non-significant lower prevalence of persistent atopic dermatitis ($p=0.09$)

CONCLUSION:

Infants with a family history of atopy who received an infant formula supplemented with scGOS/lcFOS in early life (during the first 6 months of life) exhibited a sustained reduction in allergic manifestations, lasting beyond the intervention period, up to 5 years of age, which is suggestive of an immune modulating effect through the gut microbiota.

The effect of neutral and acidic oligosaccharides on stool viscosity, stool frequency and stool pH in preterm infants[43]

Westerbeek, EAM., et al. 2011

BACKGROUND:

Preterm infants receiving breast milk have softer, more fequent stool consistency than those who are formula fed, and this is attributed to HMOs. Breast milk contains approximately 80% neutral oligosaccharides and approximately 20% acidic oligosaccharides*. Non-human pectin derived acidic oligosaccharides (pAOS) were developed to support against intestinal infections. Since the way that pAOS and neutral oligosaccharides like scGOS/lcFOS act in the gut may be different, this study was designed to use the two in combination to measure the combined effect on stool consistency, frequency and faecal pH.

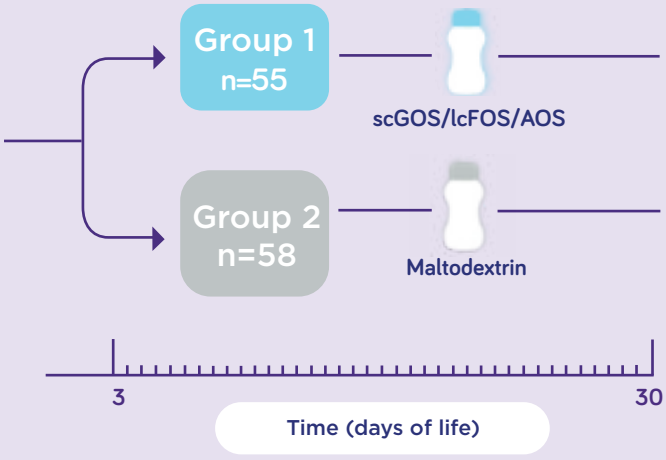
Increasing doses of 80% scGOS/lcFOS and 20% AOS* up to a maximum of 1.5g/kg/day

Softer stool consistency and stool pH with a trend towards increased stool frequency

STUDY DESIGN:

Explorative, randomised, double-blind, placebo-controlled study

- Stable, healthy preterm infants (n=113) <32 weeks ans/or birth weight<1500g
- Full enteral feeding with breast milk or preterm formula



Primary outcome:

- Stool pH
- Stool viscosity
- Stool frequency

RESULTS:

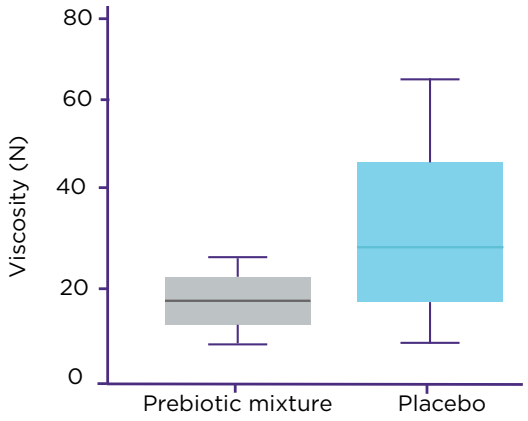


Fig 14: At day 30, stool viscosity was lower in the prebiotic supplemented group (p=0.03)

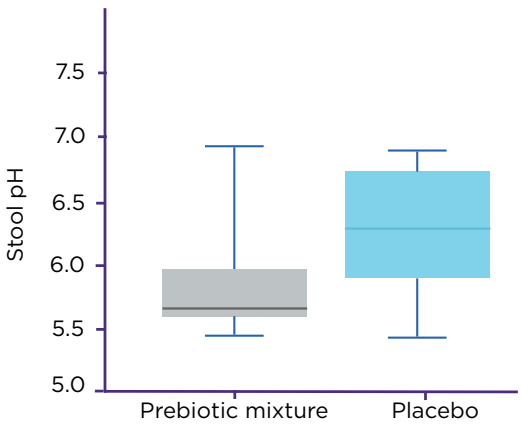


Fig 15: At day 30, stool pH was lower in the prebiotic supplemented group (pH 5.9) compared with placebo (pH 6.2) (p=0.009)

KEY FINDINGS:

- Stool viscosity was lower in the prebiotics group compared to the placebo group (p = 0.03).
- Higher stool frequency was demonstrated in the prebiotics group compared to the placebo group (p = 0.15)
- Stool pH at day 30 was lower in the prebiotics group compared to the placebo group (p = 0.009).
- The incidence of necrotizing enterocolitis was not different between the prebiotics and placebo group.

CONCLUSION:

Enteral supplementation of a prebiotic mixture of neutral (scGOS / lcFOS) and acidic oligosaccharides (pAOS) decreases stool viscosity and stool pH with a trend towards increased stool frequency in preterm infants. Increased stool frequency after prebiotic supplementation aligns with Mihatsch et al.'s 2006[45] findings, that accelerated gastrointestinal transit time may be mediated by small chain fatty acids.
The inclusion of pAOS to a formula with scGOS/lcFOS does not provide additional benefits for stool viscosity, frequency, pH, or feeding tolerance.

Supplementation of a bovine milk formula with an oligosaccharide mixture increases counts of faecal bifidobacteria in preterm infants[44]

Boehm, G., et al. 2002

BACKGROUND:

Preterm infants are particularly vulnerable to intestinal infections and studies have shown a delayed colonisation with Bifidobacteria. Therefore, establishing a balanced gut microbiota composition is desirable in the preterm population. This study was designed to investigate the effect of preterm formula supplemented with scGOS/lcFOS on the gut microbiota (Bifidobacteria concentration) and stool characteristics

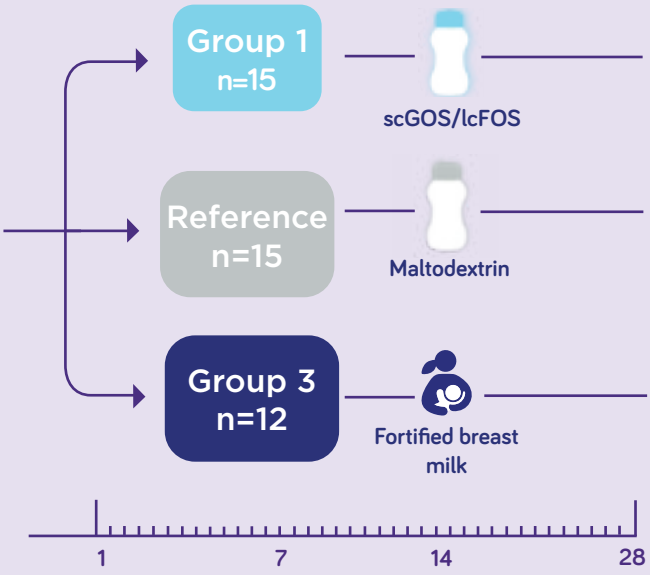
10g/L scGOS/lcFOS (9:1)

Stimulating effect on the gut microbiota and stool characteristics similar to a preterm infant fed breast milk

STUDY DESIGN:

Randomised, placebo-controlled study

- Stable, healthy preterm infants (n=30)
- <32 weeks and birth weight <1600g
- Full enteral feeding with preterm formula



Primary outcome:

- Faecal flora
- Stool characteristics
- Growth
- Possible side effects

RESULTS:

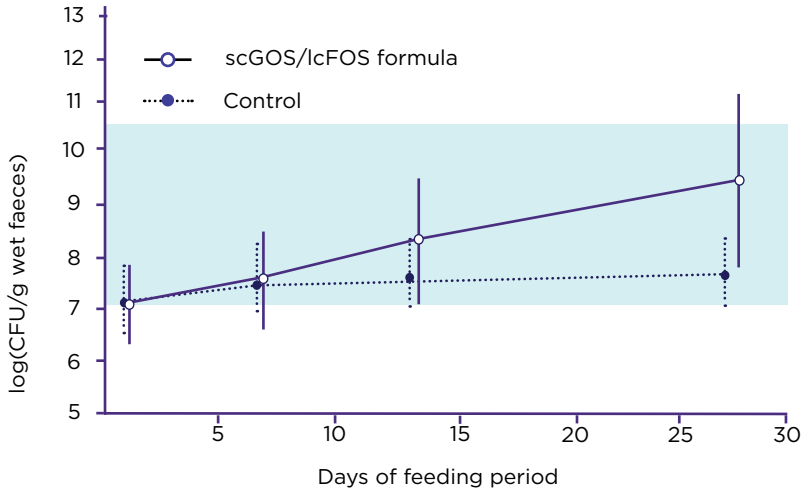


Fig 16: The number of Bifidobacteria (mean (SD)) log of colony forming units (CFU/) after 28 days (p=0.0008). The shaded area illustrates the reference range for infants fed fortified breast milk.

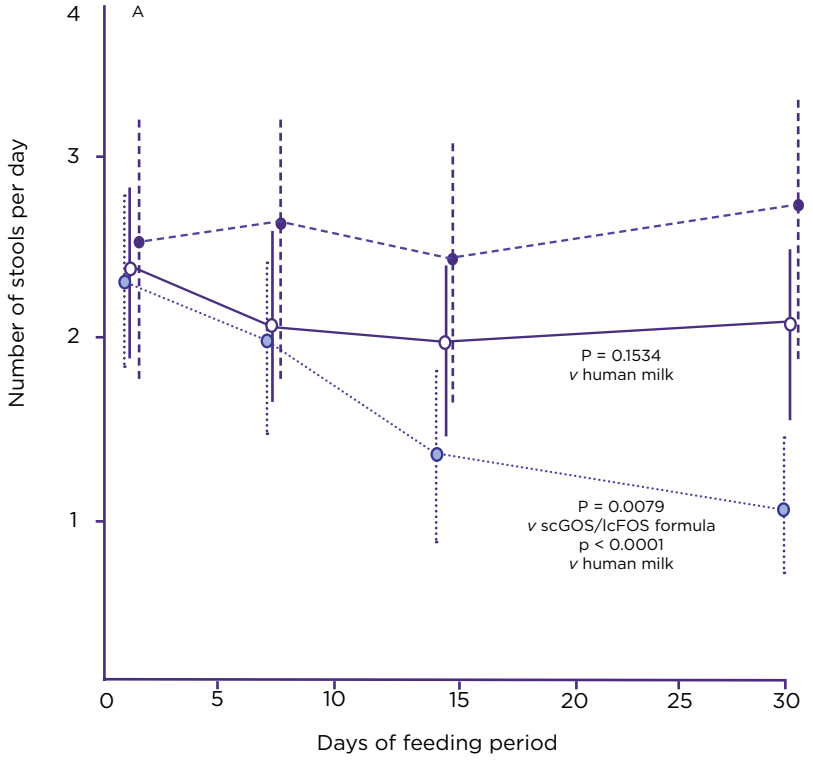


Fig 17: Stool frequency during the 28-day study period in comparison with the infants fed fortified breast milk

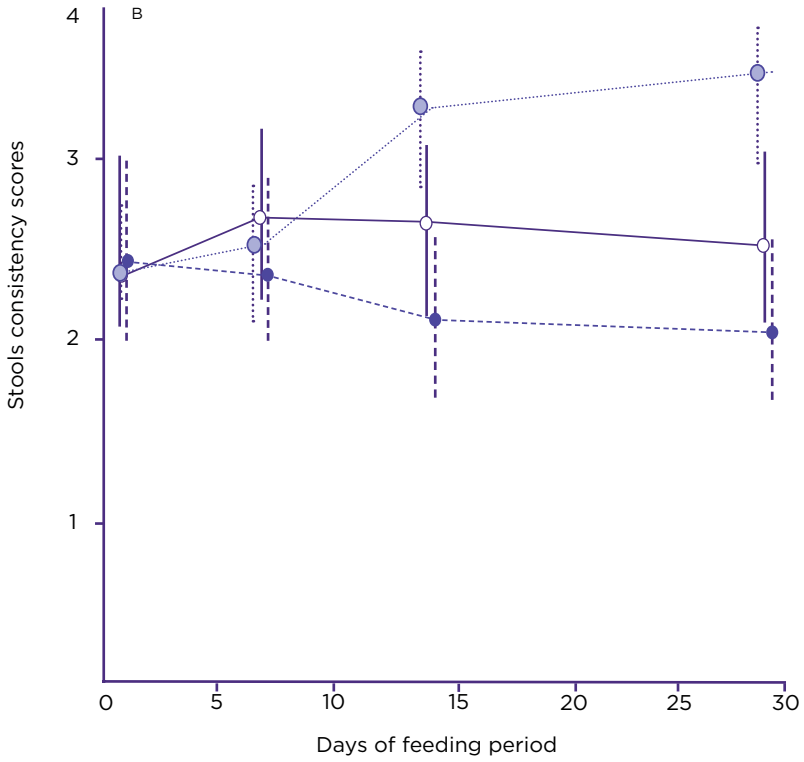


Fig 18: Stool consistency during the 28-day study period in comparison with the infants fed fortified breast milk, where 1=fluid; 2=soft; 3=seedy; 4=formed; 5=hard.

KEY FINDINGS:

Preterm infants who consumed the preterm formula supplemented with scGOS/lcFOS for 28 days led to:

- Significantly higher numbers of Bifidobacteria (P=0.0008) with quantities falling within the upper range of the breastfed reference group
- Similar stool consistency and frequency to breastfed preterm infants in the reference group

CONCLUSION:

After 28 days, preterm infants who used a preterm formula supplemented with scGOS/lcFOS demonstrated growth of Bifidobacteria, and showed stool characteristics, such as softer and frequent stools, similar to those observed in a preterm breastfed infant.

Prebiotic oligosaccharides reduce stool viscosity and accelerate gastrointestinal transport in preterm infants[45]

Mihatsch, WA., et al. 2006

BACKGROUND:

Preterm infants who are formula fed often experience hard stools, delayed GI transit and constipation. These problems can delay enteral feeding tolerance; hence it is desirable to attain a reduction of stool viscosity and acceleration of GI transit. This study was designed to investigate whether scGOS/lcFOS would improve feeding tolerance in preterm infants by reducing stool viscosity and accelerating GI trans

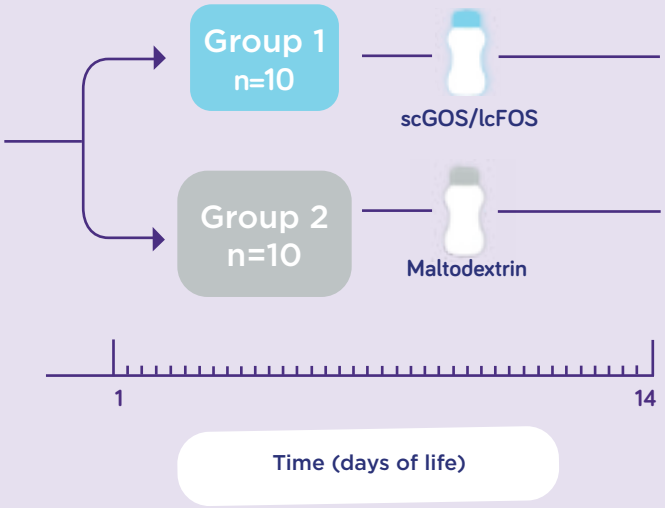
10g/L scGOS/lcFOS (9:1)

Reduced stool viscosity and accelerated gastrointestinal transit

STUDY DESIGN:

Randomised, double-blind, placebo-controlled study

- Stable, healthy preterm infants (n=20)
- Birth weight <1500g
- Full enteral feeding with preterm formula



Primary outcome:

- Stool viscosity
- GI transit time

RESULTS:

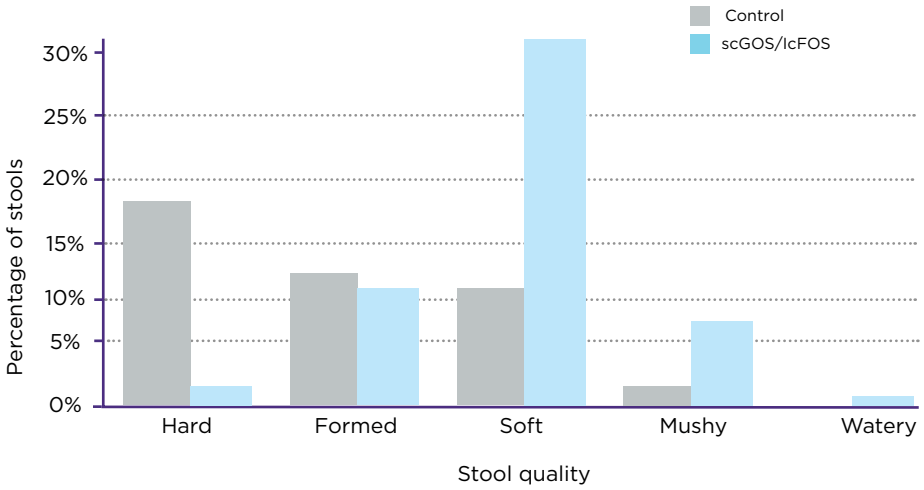


Fig 19: The scGOS/lcFOS group had a higher proportion of soft stools.

KEY FINDINGS:

Preterm infants who consumed the preterm formula supplemented with scGOS/lcFOS for 14 days led to:

- Significantly reduced stool viscosity (P=0.004)
- Higher proportion of soft stools and lower stool pH (6.4 at study entry and 5.1 on day 14)
- Significantly shortened gastrointestinal transit time (p=0.037)

CONCLUSION:

After 14 days, preterm infants who used a preterm formula supplemented with scGOS/lcFOS showed stool characteristics and GI transit time similar to those observed in a preterm breastfed infant.

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FOR HEALTHCARE PROFESSIONAL USE ONLY. This information is a guide only and healthcare professionals should rely on their own skill and judgement when diagnosing and treating patients.

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