

# Milk Matters in Malnutrition

Dairy protein and dairy sugar (lactose) are important in improving weight gain in moderately malnourished children but do not improve gut health.

The Project Peanut Butter (PPB) team is treating severely and moderately malnourished children in Sierra Leone. PPB has conducted many studies in Sierra Leone, all focused on researching the best treatment for recovery of malnourished children. It is clear that therapeutic and supplementary foods that contain milk products restore malnourished children to normal nutritional status more quickly than other foods. It is unknown, however, which components of milk might be responsible for these effects, and what mechanisms underlie milk's benefits. This research project, funded by Danish Dairy Research Foundation, was conducted to determine whether dairy protein, lactose, or both are responsible for milk's benefits, and whether they improve small intestinal permeability or alter the fecal microbiome or metabolome.

## The Human Gut

All carbohydrates are chains of simple sugars. When carbohydrates reach the human gut, they are digested and broken down into simple sugars and then used for energy by the body. Proteins are also broken down in the gut into their component pieces and then absorbed into the body. Digestion and absorption of nutrients is one of three essential functions of the gut. The second essential function is to provide a barrier that does not allow disease causing microbes to enter the body, as there are many of these in the environment. The third function is to hold and cultivate the microbes that provide necessary nutrients and bioactive molecules for human health, collectively referred to as the microbiome. When children become malnourished, they often develop leaky, damaged gut surfaces, known as environmental enteric dysfunction (EED), leading to worsened malnutrition due to malabsorption of nutrients.

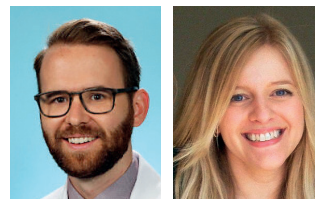
## The Study

Conducted in Pujehun District in Southern region of Sierra Leone where malnutrition is common and consumption of animal-sourced foods such as milk is uncommon. A total of 1067 children 6-59 months of age with a mid-upper arm circumference (MUAC)

< 12.5 cm and  $\geq$  11.5 cm indicating moderate malnutrition were provided one of four different food aid products. The four food aid products are ready-to-use supplementary foods (RUSFs) that contain varying protein and sugar content to determine the best combination for treatment of MAM children. The different foods contain a milk protein and milk sugar combination (skimmed milk powder), a milk protein (whey protein isolate) and vegetable sugar (maize flour) combination, a vegetable protein (soy flour) and milk sugar (whey permeate) combination, and a vegetable protein and vegetable sugar combination (maize and soy flour). A subset of children (413) with MUAC  $\geq$  12.0 cm at enrollment underwent urine and stool sample collection after 1 month of consuming the food. Urine was collected to measure leaky gut using a sugar absorption test. Stool was collected to undergo 16S rRNA sequences to analyze microbiome configuration. Fecal metabolomics analysis was done using multiple extraction methods and four liquid chromatography-mass spectrometry methods.

## Milk Sugar or Milk Protein?

The research showed that the food with milk protein and milk carbohydrate led to faster weight gain than the all-vegetable food. Despite this, none of the foods in the study repaired the pathologi-



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## Short Abstract

In this clinical trial, four different peanut-based supplementary foods were compared for treating moderate acute malnutrition. The primary focus was their effects on recovery from malnutrition, gut permeability, and composition of the fecal microbiome and metabolome. We hypothesized that:

- 1) Lactose and milk protein would improve weight gain.
- 2) Children receiving milk protein would demonstrate reduced intestinal permeability.
- 3) Children receiving milk sugar would exhibit changes in their fecal microbiome and metabolomic profiles.

The results showed that milk protein and milk sugar increased weight gain but had no impact on intestinal permeability or alterations in fecal microbiome or metabolic profiles.

## Project Info

*Titel:* Milk Matters in Malnutrition

*Project Manager:* Mark Manary, M.D.

*Participants:* Kevin Stephenson & Donna Wegner,  
Washington University, School of Medicine

*Project Period:* November 2019-March 2023

*Objective:* The objective of this project was to conduct a feeding trial with supplementary foods among moderately malnourished children in Sierra Leone to determine if lactose, dairy protein, or both affect intestinal permeability and fecal microbiome. The sub-objective will be to elucidate how lactose and milk protein affect the fecal metabolomic configuration in moderately malnourished children.

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cally leaky gut – this is not the way milk products help. Surprisingly, there were no noticeable differences in microbial populations between the food groups. The untargeted fecal metabolomics did not reveal any significant differences pertaining to functional pathways or biologically important metabolites in the gut lumen.

### Further Research Needed

This study confirms that milk powder in food aid products helps undernourished children gain weight. Nevertheless, additional research is necessary to understand how milk protein and milk sugar impact the health of the gut. The fact that the leaky gut condition didn't improve raises questions such as 'Could we speed up the restoration of gut health by using an anti-inflammatory/ antimicrobial agent?' and 'Could a longer nutritional program lead to better long-term gut health?' Additionally, the 16S sequencing conducted might be too shallow to detect more subtle differences and a deeper sequencing is available to test this hypothesis.

### How Can the Industry Benefit from This Research?

In prior studies, milk has been found to stimulate child growth. Milk protein contains all essential amino acids and has a very high protein quality. In



this study affirmed that using milk protein and lactose is an effective method for improving the condition of malnourished children by increasing rate of weight gain. This is good news for the dairy industry because it highlights the essential nature of dairy in children's growth and development, demonstrating its efficiency in addressing malnutrition. ●