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Commentary

Increasing pregnancy duration, fetal and early postnatal growth in LMIC: The importance of a gut microbiome that exploits dietary staples

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Globally, approximately 15 million babies are born before 37 weeks gestation annually of whom one million die in their first year of life according to the WHO. The number of preterm births, and the associated life-long consequences, disproportionally affect women and infants in low-income and middle-income countries (LMIC), with the highest rates in Africa and South Asia [1]. While risk factors for preterm birth are known and include ethnicity, teenage pregnancy and advanced maternal age, smoking, and infectious disease as well inadequate nutrition and placental dysfunction [2], there are few successful intervention strategies, beyond prevention of infections, to prevent preterm birth. Birthweight is a reflection of intrauterine growth as well as gestational age at delivery. Poor fetal growth can be caused by inadequate maternal energy intake, poor placental function and the presence of toxins. This can have long-term consequences for body size, metabolism and even mental health. Furthermore, if maternal energy intake is a representation of the available nutrient supply, poor intrauterine growth can be followed by poor postnatal growth and result in stunting, which itself is associated with poor (neuro)developmental outcomes [3]. Nutritional interventions in early childhood have had variable effects on improving the developmental outcomes [3]. This may be partially due to the interactions between the effects of the supplementation, especially iron supplements, and the pro-inflammatory state of the colon and the composition of the gut microbiome [4].

The composition and the function of the microbiome is dependent on the nutrients that are available to it in each body site. In pregnancy, changes occur to the composition of the gut microbiome that are thought to contribute to the maternal weight gain and insulin resistance that ensure adequate energy supply to the developing fetus [5]. Infections associated with bacteria from the vaginal (bacterial vaginosis) and the oral (periodontal disease) microbiomes have been associated with increased risk of preterm birth [6]. However, the relationship between the maternal gut microbiome composition in pregnancy and preterm birth and birthweight is still relatively unknown. A Norwegian analysis showed that increased gut microbiome diversity and higher abundances of *Bifidobacteriaceae, Ruminoccoceae, Streptococcaceae* and *Mogibacteriaceae* lowered the risk of preterm delivery [7]. Given the effects of dietary intake on gut microbiome composition and the large differences in dietary intake between pregnant women in the western world and in LMIC, investigations focusing on the gut microbiome in these most vulnerable populations are critically important.

In this issue of EBioMedicine, Gough et al. [8] investigated the impact of the maternal microbiome composition on gestational age at birth, birthweight, and infant growth in the first month of life in a Zimbabwean sub-cohort of the larger SHINE (Sanitation, Hygiene, Infant Nutrition efficacy) study. SHINE aimed to improve infant growth by reducing environmental enteric dysfunction through a nutrition intervention from six months of age and through a sanitation intervention, which provided latrines, water treatment and general hygiene education in a 2 × 2 factorial design. The overall study results indicated that the nutritional but not the sanitation intervention improved infant growth [9]. In the current analysis of a subset of the Zimbabwean participants, there were clear relationships between microbial functional capacity and birthweight and early postnatal growth and these were seen to a lesser extent with gestational age as well [8]. The ability of the maternal microbiome to degrade resistant starch, which is mainly consumed in the form of maize as a mainstay of the diet in Zimbabwe, was associated with significant increases in birthweight (by 200g) and weight for age z-scores at one month of age (by up to 0.75 standard deviations). The relationship was however not linear and appeared to be present only in those with high functional abundance. Furthermore, these results were not impacted by the sanitation intervention, the HIV status of the participants or by the trimester of pregnancy at which the samples were taken. The risk of preterm birth and (very) low birthweight in women with HIV is increased [10] but this apparently is not through a change in the capacity of the microbiome to degrade resistant starch.

These results indicate that the gut microbiome can make a significant contribution to birthweight by increasing energy availability of nutrients that cannot be accessed by host enzymes. They also suggest that this capacity may be present prior to pregnancy given that pregnancy stage was not associated with changes to the capacity to ferment resistant starch. The current study did not investigate which factors determine the starch-degrading capacity of the maternal microbiome in pregnancy nor the mechanism by which increased

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starch degradation affects gestational length and fetal/infant growth. Given the large effects on birth weight and early growth, these determinants need to be investigated so that interventions to increase microbiome capacity for starch degradation can be investigated, especially in LMIC where the reliance on high-starch staples is high.

Declaration of Competing Interest

MDN has no conflicts of interest to declare.

References

[1] Blencowe H, Cousens S, Oestergaard MZ, Chou D, Moller AB, Narwal R, et al. National, regional, and worldwide estimates of preterm birth rates in the year 2010 with time trends since 1990 for selected countries: a systematic analysis and implications. Lancet 2012;379(9832):2162–72.
[2] Vogel JP, Chawanpaiboon S, Moller A-B, Watananirun K, Bonet M, Lumbiganon P. The global epidemiology of preterm birth. Best Pract Res Clin Obstetr Gynaecol 2018;52:3–12.
[3] Perkins JM, Kim R, Krishna A, McGovern M, Aguayo VM, Subramanian SV. Understanding the association between stunting and child development in low- and middle-income countries: next steps for research and intervention. Soc Sci Med 2017;193:101–9.
[4] Jonker FAM, te Poel E, Bates I. Boele van Hensbroek M. Anaemia, iron deficiency and susceptibility to infection in children in sub-Saharan Africa, guideline dilemmas. Br J Haematol 2017;177(6):878–83.
[5] Koren O, Goodrich JK, Cullender TC, Spor A, Laitinen K, Kling Backhed H, et al. Host remodeling of the gut microbiome and metabolic changes during pregnancy. Cell 2012;150(3):470–80.
[6] Dunlop AL, Mulle JG, Ferranti EP, Edwards S, Dunn AB, Corwin EJ. Maternal microbiome and pregnancy outcomes that impact infant health: a Review. Adv Neonat Care 2015;15(6).
[7] Dahl C, Stanislawski M, Iszatt N, Mandal S, Lozupone C, Clemente JC, et al. Gut microbiome of mothers delivering prematurely shows reduced diversity and lower relative abundance of Bifidobacterium and Streptococcus. PLoS One 2017;12(10):e0184336.
[8] Gough E, Edens TJ, Geum H, Baharmand I, Gill SK, Robertson RC et al. Maternal fecal microbiome predicts gestational age. EBioMedicine. 10.1016/j.ebiom.2021.103421
[9] Pickering AJ, Null C, Winch PJ, Mangwadu G, Arnold BF, Prendergast AJ, et al. The WASH Benefits and SHINE trials: interpretation of WASH intervention effects on linear growth and diarrhoea. Lancet Glob Health 2019;7(8):e1139–e46.
[10] Strydom K, Nel DG, Dhansay MA, Van Niekerk E. The effect of maternal HIV status and treatment duration on body composition of HIV-exposed and HIV-unexposed preterm, very and extremely low-birthweight infants. Paediatr Int Child Health 2018;38(3):163–74.