Immunity, Microbiome and Gut Health

STUDIES (2017 - 2020)

1. Echinacea Purpurea Protects Against Restraint Stress-Induced Immunosuppression In Balb/C Mice

This study shows *that Echishield has protective effect against stress-induced changes in immunological function*.

Source: Park S, Department of Nutritional Science and Food Management, Ewha Womans University, Seoul, Korea. Echinacea purpurea protects against restraint stress-induced immunosuppression in Balb/C mice. Journal of Medicinal Food Vol. 21, No. 3. https://doi.org/10.1089/jmf.2017.4073.

2. Interactions Between Intestinal Microbiota And Host Immune Response In Inflammatory Bowel Disease

Inflammatory bowel disease (IBD) is a chronic inflammatory disorder of the gastrointestinal tract. *Recent studies with experimental animal models and clinical patients indicated that the intestinal microbiota is one of the critical environmental factors that influence nutrient metabolism, immune responses, and the health of the host in various intestinal diseases, including ulcerative colitis and Crohn's disease. This review highlights the crosstalk between gut microbiota and host immune response and the contribution of this interaction to the pathogenesis of IBD.* Further, potential therapeutic strategies targeting the intestinal micro-ecosystem in IBD are discussed.

Source: Ming Zhang, State Key Laboratory Of Animal Nutrition, Department Of Animal Nutrition And Feed Science, China Agricultural University, Beijing, China. Interactions Between Intestinal Microbiota And Host Immune Response In Inflammatory Bowel Disease. Front. Immunol., 14 August 2017. https://doi.org/10.3389/fimmu.2017.00942

3. Homeostatic Immunity And The Microbiota

The microbiota plays a fundamental role in the induction, education, and function of the host immune system. In return, the host immune system has evolved multiple means by which to maintain its symbiotic relationship with the microbiota. The maintenance of this dialogue allows the induction of protective responses to pathogens and the utilization of regulatory pathways involved in the sustained tolerance to innocuous antigens. The ability of microbes to set the immunological tone of tissues, both locally and systemically, requires tonic sensing of microbes and complex feedback loops between innate and adaptive components of the immune system. *This study reviews the dominant cellular mediator of these interactions and discusses emerging themes associated with current understanding of the homeostatic immunological dialogue between the host and its microbiota.*

Source: Yasmine Belkaid, Mucosal Immunology Section, Laboratory Of Parasitic Diseases, National Institute Of Allergy And Infectious Diseases, NIH, Bethesda And NIAID Microbiome Program, NIH, Bethesda, USA. Homeostatic Immunity And The Microbiota. Immunity, Volume 46, Issue 4, 18 April 2017, Pages 562-576. https://doi.org/10.1016/j.immuni.2017.04.008

4. Impacts Of Microbiome Metabolites On Immune Regulation And Autoimmunity

New study shows that high salt consumption may prove fatal to certain *gut bacteria which will contribute to high blood pressure and diseases affecting the immune system.*

Source: Ralf A. Linker, Department of Neurology, FriedrichAlexander University, Erlangen, Germany. Impacts of microbiome metabolites on immune regulation and autoimmunity. Immunology. 2018 Jun; 154(2):230-238. https://doi.org/10.1111/imm.1293

5. Cutting Edge: Critical Roles For Microbiota-Mediated Regulation Of The Immune System In A Prenatal Immune Activation Model Of Autism

Researchers have found that mother microbiome is a key contributor to the risk of autism and other neurodevelopmental disorders in her offspring. Study shows that IL-17a molecule a key contributor to the development of autism-like symptoms in lab mice. They found that the microbiome will be modified easily, either through diet, probiotic supplements or fecal transplant and these approaches will restore a healthy equilibrium among the different microorganisms that live in the gut.

Source: Dr John R Lukens, Center for Brain Immunology and Glia, Department of Neuroscience, School of Medicine and Graduate Program in Neuroscience, School of Medicine, University of Virginia, Charlottesville. Cutting edge: critical roles for microbiotamediated regulation of the immune system in a prenatal immune activation model of autism. J Immunol August 1, 2018, 201 (3) 845-850; DOI: https://doi.org/10.4049/jimmunol.1701755

6. Microbiota-Immune Interaction In The Pathogenesis Of Gut-Derived Infection

Study shows that gut-derived infection is among the most common complications in patients who underwent severe trauma, serious burn, major surgery, haemorrhagic shock or severe acute pancreatitis (SAP) and it could cause sepsis and multiple organ dysfunction syndromes (MODS), which are regarded as a leading cause of mortality in these cases. Researcher found that gut-derived infection is commonly caused by pathological translocation of intestinal bacteria or endotoxins, resulting from the dysfunction of the gut barrier. Limited information is available on the roles of intestinal microbial barrier in the development of gut-derived infection. They also found that advances of next-generation DNA sequencing techniques and its utilization has revolutionized the gut microecology, leading to novel views into the composition of the intestinal microbiota and its connections with multiple diseases.

Source: Qiurong Li, Research Institute of General Surgery, Jinling Hospital, Medical School, Nanjing University, Nanjing, China. Microbiota-Immune Interaction In The Pathogenesis Of Gut-Derived Infection. Front. Immunol., 07 August 2019. https://doi.org/10.3389/fimmu.2019.01873

7. The Microbiota Protects From Viral-Induced Neurologic Damage Through Microglia-Intrinsic TLR Signaling

Researchers found that gut microbes produce compounds which help prime immune cells to destroy harmful viruses in the brain and nervous system. Findings of the study shows that a healthy and diverse microbiota is essential for quickly clearing viruses in the nervous system to prevent paralysis and other risks associated with diseases such as multiple sclerosis.

Source: June L Round, Department of Pathology, Division of Microbiology and Immunology, University of Utah School of Medicine, Salt Lake City, United States. The microbiota protects from viral-induced neurologic damage through microglia-intrinsic TLR signaling. eLife 2019;8:e47117. https://doi.org/10.7554/eLife.47117.001

8. The Effects Of Vegetarian And Vegan Diets On Gut Microbiota

Study shows that a plant-based diet appears to be beneficial for human health by promoting the development of more diverse and stable microbial systems.

Researchers have found that vegans and vegetarians have significantly higher counts of certain ***Bacteroidetes***-related operational taxonomic units compared to omnivores, fibres (that is, non-digestible carbohydrates, found exclusively in plants) most consistently increase lactic acid bacteria, such as ***Ruminococcus, E. rectale, and Roseburia***, and reduce ***Clostridium and Enterococcus species*** and polyphenols (abundant in plant foods) increase ***Bifidobacterium and Lactobacillus***, which provide anti-pathogenic and anti-inflammatory effects and cardiovascular protection. They also found that high fibre intake also encourages the growth of species that ferment fibre into metabolites as ***short-chain fatty acids (SCFAs),*** including ***acetate, propionate, and butyrate***.

Study indicates that the positive health effects of SCFAs are myriad, including improved immunity against pathogens, blood-brain barrier integrity, provision of energy substrates, and regulation of critical functions of the intestine and thus a vegetarian/vegan diet is effective in promoting a diverse ecosystem of beneficial bacteria to support both human gut microbiome and overall health.

Source: Tomova A, Faculty of Medicine, Institute of Physiology, Comenius University in Bratislava, Slovakia. The effects of vegetarian and vegan diets on gut microbiota. Front Nutr. 2019; 6: 47 (2019). https://doi.org/10.3389/fnut.2019.00047

9. Effects of Fish n-3 PUFAs On Intestinal Microbiota And Immune System

Study shows that thousands of different microbial species are present in the human gut, and that there has been a significant variability of taxa in the microbiota composition among people. Researcher found that several factors such as gestational age, mode of delivery, diet, sanitation and antibiotic treatment influence the bacterial community in the human gastrointestinal tract, and among these diet habits play a crucial role. They also found that the disturbances in the gut microbiota composition, i.e., gut dysbiosis, have been associated with diseases ranging from localized gastrointestinal disorders to neurologic, respiratory, metabolic, ocular, and cardiovascular illnesses. ***Experimental studies reveal that gut microbiota, n-3PUFAs, and host immune cells work together to ensure the intestinal wall integrity and this review indicate the current evidence concerning the links among gut microbiota, n-3 PUFAs intake, and human inflammatory disease.***

Source: Cinzia Parolini, Department of Pharmacological and Bimolecular Sciences, Università degli Studi di Milano, Italy. Effects of fish n-3 pufas on intestinal microbiota and immune system. Mar. Drugs 2019, 17(6), 374. https://doi.org/10.3390/md17060374

10. Skin Exposure To Narrow Band Ultraviolet (UVB) Light Modulates The Human Intestinal Microbiome

This study shows that B ultraviolet light (UVB) is able to modulate the composition of the gut microbiome in humans, putatively through the synthesis of vitamin D. Vitamin D production was the main driver of the shift in the microbiome and skin UVB exposure and significantly increased gut microbial diversity. The largest effect was on increase in the relative abundance of Lachnospiraceae bacteria after the UVB light exposures. ***The study also revealed that both phototherapy and vitamin D supplementation influence the immune system and identified a novel skin-gut axis that may contribute to the protective role of UVB light exposure in chronic inflammatory diseases like multiple sclerosis (MS) and inflammatory bowel disease (IBD), but more research is warranted***.

Source: Bruce A. Vallance, Department of Pediatrics, BC Children's Hospital Research Institute, University of British Columbia, and BC Women's Hospital and Health Centre, Women's Health Research Institute, Vancouver, BC, Canada. Skin exposure to narrow band ultraviolet (uvb) light modulates the human intestinal microbiome. Front Microbiol. 2019; 10: 2410. https://doi.org/10.3389/fmicb.2019.02410

11. Human Fetal Lungs Harbor a Microbiome Signature

This study confirms the presence of a human fetal microbiome DNA signature in the early stage of pregnancy i.e. first trimester. Researchers found that there is a temporal change in fetal lung microbiome diversity during development which suggests maturational change with advancing gestational age. They also found the existence of a placental microbiome that bears some overlap with the corresponding human fetal lung microbiome based on overall microbiome analysis, as well as alpha and beta diversities. ***Materno-fetal microbial DNA transfer (and perhaps of other microbial products and whole live or dead bacteria) is a realistic possibility which may serve as a prime for the developing innate immune system of the fetus and help in establishment of a normal host-commensal relationship.***

Source: Charitharth Vivek Lal, Women and Infant Centre University of Alabama, Pediatrics, Birmingham, Alabama, United States. Human fetal lungs harbor a microbiome signature. Am J Respir Crit Care Med. 2020 Jan 3. https://doi.org/10.1164/rccm.201911-2127LE

12. Microbiota-Targeted Maternal Antibodies Protect Neonates From Enteric Infection

This study shows that neonatal mice that lack the capacity to produce (Immunoglobulin G) IgG are protected from infection with the enteric pathogen enterotoxigenic Escherichia coli by maternal natural IgG antibodies against the maternal microbiota when antibodies are delivered either across the placenta or through breast milk. It has been found that IgG derived from breast milk are crucial for protection against mucosal disease induced by enterotoxigenic E. coli. IgG also provides protection against systemic infection by E. coli. Pups used the neonatal Fc receptor to transfer IgG from milk into serum. The maternal commensal microbiota can induce antibodies that recognize antigens expressed by enterotoxigenic E. coli and other Enterobacteriaceae species. Induction of maternal antibodies against a commensal Pantoea species confers protection against enterotoxigenic E. coli in pups. ***Further, role of the microbiota in eliciting protective antibodies to a specific neonatal pathogen represents an important host defence mechanism against infection in neonates.***

Source: Dennis L. Kasper, Department of Immunology, Harvard Medical School, Boston, USA. Microbiota-targeted maternal antibodies protect neonates from enteric infection. Nature 577, 543–548 (2020). https://doi.org/10.1038/s41586-019-1898-4

13. Therapeutic Methods Of Gut Microbiota Modification In Colorectal Cancer Management – Fecal Microbiota Transplantation, Prebiotics, Probiotics, And Synbiotics

In this review the link between gut microbiota and the development of colorectal cancer has been investigated. An imbalance in the gut microbiota promotes the progress of colorectal carcinogenesis via multiple mechanisms, including inflammation, activation of carcinogens, and tumorigenic pathways as well as damaging host DNA. Several therapeutic methods are available with which to alter the composition and the activity of gut microbiota, such as administration of prebiotics, probiotics, and synbiotics; these can confer various benefits for colorectal cancer patients. Nowadays, fecal microbiota transplantation is the most modern way of modulating the gut microbiota. Even though data regarding fecal microbiota transplantation in colorectal cancer patients are still rather limited, it has been approved as a clinical method of treatment-recurrent Clostridium difficile infection, which may also occur in these patients. ***The major benefits of fecal microbiota transplantation include modulation of immunotherapy efficacy, amelioration of bile acid metabolism, and restoration of intestinal microbial diversity.*** Nonetheless, more studies are needed to assess the long-term effects of fecal microbiota transplantation. In this review, the impact of gut microbiota on the efficiency of anti-cancer therapy and colorectal cancer patients' overall survival is discussed.

Source: Karolina Kazmierczak-Siedlecka, Department of Surgical Oncology, Medical University Of Gdsank, Poland. Therapeutic Methods Of Gut Microbiota Modification In Colorectal Cancer Management – Fecal Microbiota Transplantation, Prebiotics, Probiotics, And Synbiotics. Gut Microbes, Volume 11, Issue 6, 2020, Page no. 1518-1530. https://doi.org/10.1080/19490976.2020.1764309

14. Microbial–Host Molecular Exchange And Its Functional Consequences In Early Mammalian Life

This review article has compiled the latest knowledge of the extent to which the maternal intestinal flora is involved in the development of the child's immune system. Scientists have also found evidence that the effects of plant-based substances that pregnant women ingest through diet have so far been underestimated in research and may pose a potential risk to the unborn.

Researchers have found evidence that metabolic products from the diet cannot only directly reach the maternal organism and thus into the developing foetus, but that this often only occurs after metabolism through the intestinal flora. This also applies to the intake of herbal products, such as superfoods that are considered particularly healthy during pregnancy, such as goji berries or chia seeds. Further, studies are required to investigate which natural substances could have a beneficial or negative effect on the development of the unborn child and what influence differences in the maternal intestinal flora can have on this process.

Source: Andrew J. Macpherson, Bern University Hospital, Department For Biomedical Research (DBMR), University Of Bern, Switzerland. Microbial–Host Molecular Exchange And Its Functional Consequences In Early Mammalian Life. Science 08 May 2020:Vol. 368, Issue 6491, pp. 604-607. DOI: 10.1126/science.aba0478

15. Interaction Between Microbiota And Immunity In Health And Disease

The interplay between the commensal microbiota and the mammalian immune system development and function includes multi-fold interactions in homeostasis and disease. The microbiome plays critical roles in the training and development of major components of the host's innate and adaptive immune system, while the immune system orchestrates the maintenance of key features of host-microbe symbiosis. In a genetically susceptible host, imbalances in microbiota-immunity interactions under defined environmental contexts are believed to contribute to the pathogenesis of a multitude of immune-mediated disorders. ***This study review features of microbiome-immunity crosstalk and their roles in health and disease,*** while providing examples of molecular mechanisms orchestrating these interactions in the intestine and extra-intestinal organs. It also highlights the aspects of the current knowledge, challenges and limitations in achieving causal understanding of host immune-microbiome interactions, as well as their impact on immune-mediated diseases, and discusses how these insights may translate towards future development of microbiome-targeted therapeutic interventions.

Source: Eran Elinav, Immunology Department, Weizmann Institute Of Science, Rehovot, Israel And Cancer-Microbiome Division, Deutsches Krebsforschungszentrum (DKFZ Heidelberg, Germany. Interaction Between Microbiota And Immunity In Health And Disease. Cell Res 30, 492–506 (2020). https://doi.org/10.1038/s41422-020-0332-7

16. Gut Bacteria Support Antiviral Immunity

A healthy gut microbiome is linked to protection from a variety of ills and to a properly functioning immune system. A new study extends its role to supporting antiviral immunity, providing protection from infection and dissemination with Chikungunya virus (CHIKV) an emerging, mosquito-transmitted alphavirus. ***The study shows that perturbation of the microbiome dampens antiviral type I interferon (IFN) responses, which could be restored by a single Clostridium symbiont and it's associated secondary bile acid. The researchers found that depletion of plasmacytoid dendritic cells (pDCs) (which are a known source of type I IFNs) reduces the effect of microbiome disruption on CHIKV viraemia. Gene expression analysis showed an altered antiviral, but not basal, immune response in pDCs. Thus, the microbiome provides antiviral protection through a bile acid–pDC–IFN signalling axis.***

Source: Bird, L. Gut Bacteria Support Antiviral Immunity. Nat Rev Immunol (2020). https://doi.org/10.1038/s41577-020-00412-y

17. The Gut Microbiome: An Unexpected Player In Cancer Immunity

Numerous independent studies link gut microbiota composition and disease and imply a causal role of select commensal microbes in disease etiology. In the gut, commensal microbiota or pathobionts secrete metabolites that underlie pathological conditions, often impacting proximal tissues and gaining access to the bloodstream. ***This study focusses on extrinsic and intrinsic factors affecting composition of gut microbiota and their impact on the immune system, as key drivers of anti-tumor immunity.***

Source: Ze'ev A Ronai, Sanford Burnham Prebys Medical Discovery Institute, La Jolla, United States. The Gut Microbiome: An Unexpected Player In Cancer Immunity. Current Opinion in Neurobiology, Volume 62, June 2020, Pages 48-52. https://doi.org/10.1016/j.conb.2019.09.016

18. Maternal Leukocytes And Infant Immune Programming During Breastfeeding

The fetal immune system develops in a rather sterile environment relative to the outside world and, therefore, lacks antigenic education. Soon after birth, the newborn is exposed to the hostile environment of pathogens. Recently, animal and limited human-based studies have indicated that help from the mother, upon transfer of leukocytes and their products via breast milk feeding, greatly assists the new-born's immune system. ***The present study discussed the newest advances on how milk leukocytes impact early life immunity, with an emphasis on the development of the infant T cell repertoire and early immune responses in the periphery and gut-associated lymphoid tissue.*** A deeper understanding of these novel mechanistic insights may inform potential translational approaches to improving immunity in infants.

Source: Amale Laouar, Surgery Department And The Child Health Institute Of New Jersey, Robert Wood Johnson Medical School - Rutgers University, New Brunswick, USA. Maternal Leukocytes And Infant Immune Programming During Breastfeeding. Trends in Immunology, Volume 41, Issue 3, March 2020, Pages 225-239. https://doi.org/10.1016/j.it.2020.01.005

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