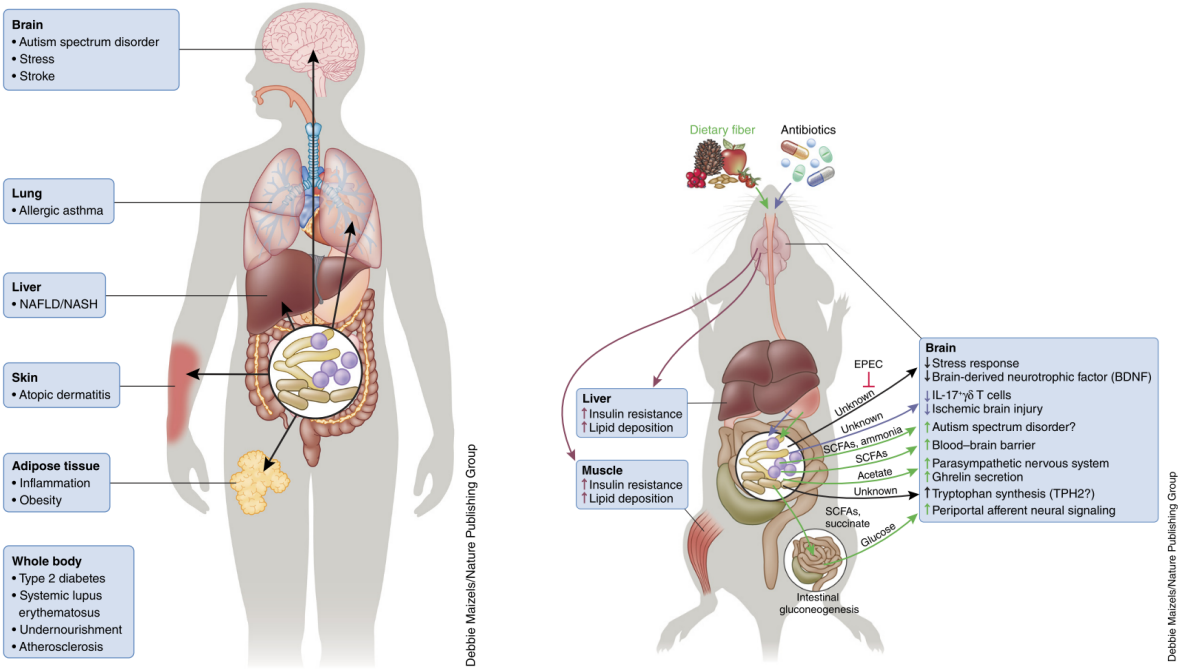
肠道菌群和人体其他器官的联系/ 肠道菌群如何影响人体中的其他器官?

Signals from the gut microbiota to distant organs in physiology and disease 【end】



(L) 肠道菌群与人体的多种疾病相关

肠道菌群的组成，多样性以及它们衍生代谢物的改变能够影响人体的不同的器官且和疾病相关。肠道细菌致病作用的证据在代谢性疾病中最明显。

(R) 肠道菌群通过肠-脑轴和大脑进行交流

相比较有微生物定植的小鼠，年轻的无菌小鼠（GF, 缺少微生物的小鼠）增加了应激反应和脑源性神经营养因子（BDNF）的表达。给无菌小鼠定植致肠病的大肠杆菌（EPEC）可以通过未知的机制加重应激反应[1]（黑色箭头）。抗生素处理改变肠道菌群组成（紫色箭头），减少了 IL-17^{+}γδ T 细胞向脑膜的募集，进而减少了缺血性脑损伤[2]。膳食纤维（绿色箭头）由结肠的肠道菌群发酵产生短链脂肪酸（SCFAs）和琥珀酸。在患有自闭症谱系障碍的儿童中观察到短链脂肪酸如乙酸，丙酸，丁酸，异丁酸，戊酸和异戊酸以及氨的水平增加[3]。然而短链脂肪酸的致病作用仍然有待确认。短链脂肪酸能使血脑屏障变得更加紧密[4]，同时，短链脂肪酸乙酸能够激活副交感神经系统，导致胃饥饿素的分泌增加与肝脏和肌肉中的胰岛素耐受和脂质沉积[5]（红色箭头）。短链脂肪酸丁酸和丙酸以及琥珀酸可以激活肠道糖异生，进而通过肠-脑神经回路改善中心代谢（central metabolic）[6]。肠道菌群也可能通过色氨酸羟化酶2（TPH2）依赖的方式调节大脑中的色氨酸合成[7]。

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