

Can disruption of microbiota composition be the chemical basis of Parkinson's disease and schizophrenia?

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Received July 20, 2018; Accepted September 10, 2018; Published online in J-STAGE September 26, 2018

The human body is composed of about 74 trillion cells. Half of these 74 trillion cells are the body's own cells [1], while the other half consists of the microorganisms that form the microbiota in the human body [2]. The human microbiota is home to about 1,000 different species of bacteria and their different subspecies, of which there are more than 7,000 [3]. The mean weight of human microbiota is approximately 0.2 kg [2]. Given that the world's population stands at 7.6 billion, the human body hosts living things that outnumber the world's human population by ten thousand fold [4].

The 7.6 billion people living on Earth compete fiercely for survival [4]. As this intense competition between human beings damages the ecosystem, only those living things which can survive diseases, famine, scarcity, chemicals, and the like, that is, those who can adapt to the new ecosystem, can endure [5]. With its large population of 37 trillion, which is composed of 1,000 species of bacteria and over 7,000 subspecies [3], the human microbiota will inevitably witness one of the fiercest of wars as its members fight for dominance.

Our intention to control our universe (given the obvious situation of the ecosystem with climate change and global warming) means that we also unknowingly govern our own microbiota for better or worse through our dietary habits, the infections we develop, and the antibiotics we use. In other words, the count and composition of bacteria in the microbiota are shaped by dietary habits, lifestyle choices, and sociocultural conditions in humans [6, 7]. The members of the microbiota forged in this way herald the kinds of diseases (including cancer and psychiatric diseases) individuals will suffer in the short, medium, and long-term through the metabolites they produce (chemicals such as N-butyrate, acetate, propionate, serotonin, bile acid, choline, dopamine, GABA, and noradrenalin) [8].

Thus, this short article presents the biochemical mechanism by which Parkinson's disease, schizophrenia, and some neurological disorders may develop as a result of disruption of

the composition of the microbiota [9–12]. Parkinson's disease results from dopamine deficiency in the glial cells of the brain, while schizophrenia is associated with dopamine excess [9]. Many microorganisms have the ability to synthesize neurotransmitter and neuromodulator chemicals [10–12]. *Lactobacillus* spp. and *Bifidobacterium* spp. can synthesize GABA, *Escherichia* spp., and *Candida* spp.; *Streptococcus* spp. and *Enterococcus* spp. can synthesize serotonin; *Bacillus* spp. can synthesize dopamine and noradrenalin; and *Lactobacillus* spp. can synthesize acetylcholine [13, 14]. If the population of *Bacillus* species that are capable of dopamine production increases, dopamine production will rise, leading to an increased possibility of schizophrenia. On the other hand, a fall in the population of *Bacillus* species in the microbiota for any reason will lead to a decrease in dopamine production, and the possibility of Parkinson's disease will increase. It is known that Parkinson's disease presents itself generally with aging. Microbiota compositions change with advancing age. The count of *Bacillus* species may be decrease with age, leading to a lower production of dopamine, which in turn can cause Parkinson's disease. If this is the case, besides the administration of L-3, 4-dihydroxyphenylalanine (L-DOPA) to eliminate Parkinson's disease [15], increasing the count of *Bacillus* species, given their dopamine-producing capability, in the microbiota could be an alternative in the treatment of this disease. In the case of schizophrenia, doing the opposite, that is, restriction of the reproduction of *Bacillus* species, which are capable of producing dopamine, could be a promising treatment.

As the foregoing information suggests, which microorganisms we feed and produce in the microbiota depends on what we eat, whether we suffer from infections or not, whether we use antibiotics or not, which drugs other than antibiotics we take, and the extent to which we allow alternative medical products in our lives [6, 7]. Disruption of the normal composition of the microbiota for whatever reason will ultimately lead to a change in the composition of metabolites (chemicals) produced by these microbes. The changed composition of metabolites will, in turn, bring about diseases. Thus, in order not to become vulnerable to unforeseeable diseases, we must preserve the normal composition of the microbiota.

It is envisaged that helping to restore the healthy microbiota

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after compulsory use of antibiotics will be among the major responsibilities of infection specialists in the future. Someday, it may become routine practice to regularly check the composition of the microbiota and to administer the relevant treatment to maintain healthy microbiota if there is any divergence from normal state. Likewise, it will be possible to prevent a host of diseases by removing aged microbiota from the body and transferring new and healthy microbiota at regular intervals. In other words, just like there are health centers for biological organ transplantations, there will be centers dedicated to microbiota transfer. It is also anticipated that, if we can manage our microbiota populations in a democratic fashion and control invasive types of bacteria, we can ensure that all 37 trillion cells of the human microbiota live in peace and comfort [1, 2] and thus avoid all kinds of diseases, including Parkinson's disease and schizophrenia.

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