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Efficacy of Rejuvenation of Human Gut microbiome for Covid and Chronic Illnesses

By Aditi Irabattin

Abstract
When the world was stricken by Covid-19 there was no known cure to this disease due to its unexplored nature, a lot of trial-and-error methods were used for not curing this disease but keeping the numbers substantial. Drugs like remdesivir, hydrochloroquinine and more exploratory drugs were initially used to keep the disease under control, soon all of that failed and then the urge for vaccine production grew at an alarming rate Serum institute, Pfizer were only of the first few companies to launch their products. Two shots of vaccines terms for a fully vaccinated person who is immune to the virus but the mutation is how the virus lives, it mutates in order to live, every time the virus mutates it changes its chemical and as the structure the effect that it has on the human body is different and administering vaccine every time is not exactly feasible and the biological impact that it would have on the human body is beyond imagination, thus a nature cure is of utmost importance. This paper elucidates the importance of prebiotics and the beneficial, long-term impact that it has on the body. The human body has inbuilt wonderful mechanism called self -defence or self- healing mechanism which can set itself right without need of medication, provided it is given a chance to heal itself as per Nature Cure principles. Food has very important role in natural healing specially eradication of toxic elements regularly. It has been evident that Nature Cure has great emphasis on "Food as Medicine" in not only for healing but maintenance of vital energy levels seamlessly. This paper takes a holistic approach towards looking at this problem instead of a reductionist approach, instead of focusing on one approach to cure, it looks from multiple perspective like nature cure, medications, and lastly vaccines.
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This paper elucidates the importance of prebiotics and the beneficial, long-term impact that it has on the body. The human body has inbuilt wonderful mechanism called self -defence or self- healing mechanism which can set itself right without need of medication, provided it is given a chance to heal itself as per Nature Cure principles. Food has very important role in natural healing specially eradication of toxic elements regularly. It has been evident that Nature Cure has great emphasis on "Food as Medicine" in not only for healing but maintenance of vital energy levels seamlessly.

This paper takes a holistic approach towards looking at this problem instead of a reductionist approach, instead of focusing on one approach to cure, it looks from multiple perspective like nature cure, medications, and lastly vaccines.

1. Introduction of the Human Gut Microbiome

Sometimes do we ever feel lonely at nights and start thinking about aliens and other creatures that might surround us, well no, our human body has neighbours of its own – its nothing but the microbes, Skin is the largest organ that is present, this epithelial layer acts as a host to billions and billions of bacteria, these microbes are present everywhere on our body – skin, nasal cavities, vaginal cavities but majority of these microbes are present in the human gut.

The human gut is a highly intricate system which is host to trillions of bacterias, viruses, and protozoa which are collectively known as the GUT MICROBIOTA. The human microbiome has trillions of bacterias. The human gut microbiota hosts a lot of very important bacterias which aid in the digestive process and, the microbiome has a lot of good bacteria as well as bacteria, to name a few *Firmicutes* (which contains *lactobacilli*), *Bacteroidetes, Actinobacteria* (which contains *bifidobacteria*), and *Proteobacteria* – these are good bacteria; *Staphylococcus, clostridium perfringens, E.coli* are a few bad bacteria that are present in the gut microbiome.

When we are in the womb and as soon as the amniotic fluid sac breaks open and if in vaginal birth, we get exposed to these microbes in the vagina of the birth giver and if is cesarean birth/ C-Section, we get exposed to these bacterias via the hands of the caregiver. Once we grow up, we are exposed to all kinds of bacteria on a daily basis.

These microbes that exist are really helpful and responsible for breaking down food that we consume, for providing the gut with energy, making vitamins, breaking toxins that we may consume and and most importantly providing protection against the invasion of foreign bodies (antigens), the gut microbiome also trains the immune system as it has a broad variety of bacterias that co-exist.

After the huge success of the Human Genome Project (HGP) the Human Microbiome Project (HMP) was launched. The HMP is a logical conceptual and experimental extension of the HGP. It is hoped that the HMP will not only identify new ways to determine health and predisposition to diseases but also define the parameters needed to design, implement and monitor strategies for intentionally manipulating the human microbiota, to optimise its performance in the context of an individual's physiology.

There is very little that we know about the Human Microbiome as much of it still remains unexplored, but we know the repercussions when the gut microbiome goes out of whack. The following changes can be observed in the body:

- Obesity - Lower bacterial diversity can lead to obesity. In a study carried out by Washington University, wherein mice were fed with diets which corresponded to lean women and fat women, it was found out that the mice who had a fat diet gained weight and were heavier than the lean mice and they had less bacterial diversity.

- It was also found out that Gut microbiome also plays a role in Anxiety and Depression, these microbes that are present also produce neurochemicals thus establishing a connection with the CNS.

One of the more important and interesting roles that these microbes play is in TRAINING THE IMMUNE SYSTEM. As aforementioned, the microbiota has a broad spectrum of bacteria which are both good and bad. These microbes prevent the entry of pathogenic bacteria and do not allow them to have an impact on out body, in a sense have resistance towards them, if there exists an imbalance in their levels we might get exposed to some diseases.

1.1 Diet and Gut Microbiome

The food that we eat affects the gut microbiome, by food we mean the quality of the food that the eat has a huge impact on us. Long term protein, animal-based diet and plant-based diet full of fibre are divided into two different types of enterotypes. " e.g., meat (drives *Bacteroides* in the West) and dietary fiber (drives *Prevotella* in non-Westernized populations)" [1]

[1] *Makki, Kassem. The Impact of Dietary Fiber on Gut Microbiota in Host Health and Disease, https://www.sciencedirect.com/science/article/pii/S193131281830266X.*

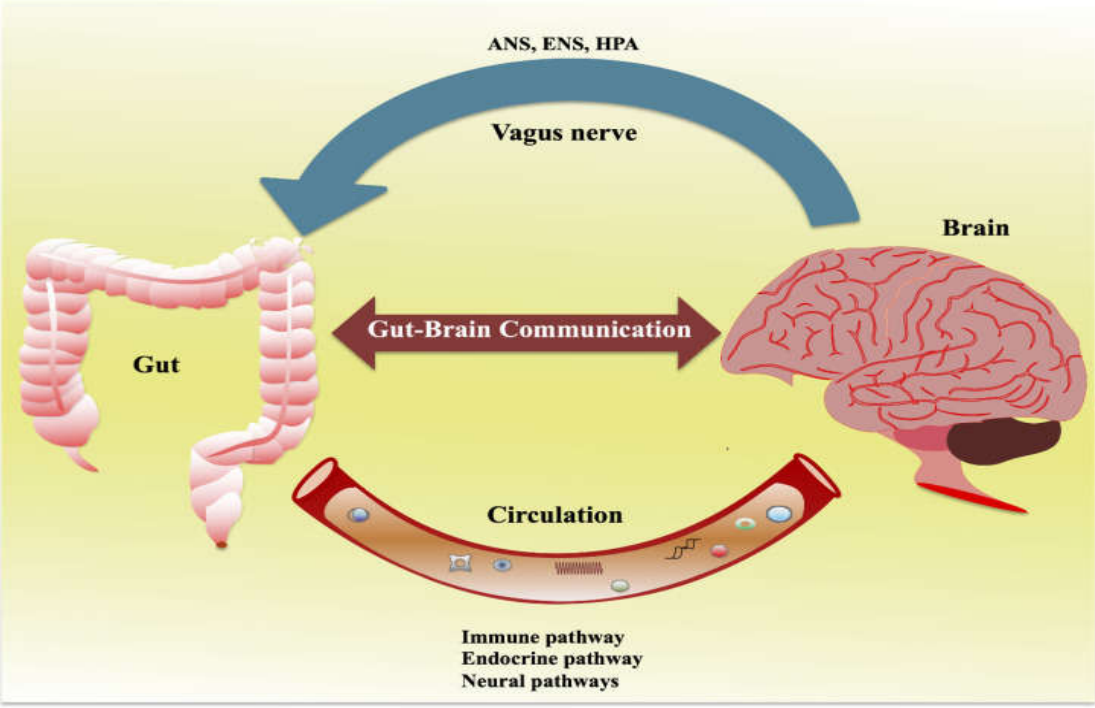
The level of microbes can be maintained externally by the ingestion of probiotics, prebiotics and synbiotics.

Probiotics	**Prebiotics**	**Synbiotics**
Probiotics are live, naturally growing bacteria that are present in the body. Because microbes used as probiotics already exist naturally in your body, probiotic foods and supplements are generally considered safe. They may trigger allergic reactions, and may also cause mild stomach upset, diarrhea, or flatulence (passing gas) and bloating for the first few days after starting to take them. Some foods which are rich in probiotics are kefir, kombucha, yogurt etc.	Prebiotics are special plant fibers that help healthy bacteria grow in your gut. Prebiotics are a source of food for your gut's healthy bacteria. They're carbs your body can't digest. So they go to your lower digestive tract, where they act like food to help the healthy bacteria grow. Probiotics are live yeasts and good bacteria that live in your body and are good for your digestive system. You can take probiotics as supplements or get them through food. Prebiotics are types of fiber that feed the friendly bacteria in the digestive system.Some food items rich in prebiotics are apples, asparagus, bananas etc.	Synbiotics are mixtures of probiotics (helpful gut bacteria) and prebiotics (non- digestible fibers that help these bacteria grow). Specifically, they're combinations of these two things that work together(synergistically) in our digestive tract. Some food items rich in synbiotics are kimchi and sauerkraut.

External administration of prebiotics can help increase the gut flora. External factors (such as antibiotic consumption, dietary component, physiological and psychological factors) and host factors can induce dysbiosis in the human gut microbiome. Dysbiosis is likely to impair the normal functioning of gut microbiota in maintaining host wellness, and potentially induce selective-enumeration of certain microbiota member including pathobionts, leading to dysregulated production of microbial-derived products or metabolites which might be harmful to the host, causing diverse range of diseases on the local, systemic or remote organs. Dietary patterns and environmental factors have a profound effect on shaping gut microbiota in real time. Diverse populations of intestinal bacteria mediate their beneficial effects through the fermentation of dietary fiber to produce short-chain fatty acids, endogenous signals with important roles in lipid homeostasis and reducing inflammation.

It is well known that the gut has a strong connection with the Central Nervous System (CNS) in the context of health and disease. A healthy gut with diverse microbes is vital for normal brain functions and emotional behaviors. In addition, the CNS controls most aspects of GI physiology. Growing evidence suggests that the gut has strong bidirectional communication with the brain, which is vital for maintaining the brain functions and gut homeostasis. Neurological disorders, such as Parkinson's disease (PD), Alzheimer's disease (AD), multiple sclerosis (MS), autism spectrum disorder (ASD), and stress are believed to induce changes in the bidirectional relationship, which results in the induction of brain–gut disorders, such as irritable bowel syndrome (IBS) among other things.

Bidirectional relationship that is strongly influenced by multiple pathways, including the autonomic nervous system (ANS), enteric nervous system (ENS), hypothalamic–pituitary–adrenal (HPA), immune pathways, endocrine pathways, and neural pathways.



The ANS imparts direct neurological responses to the gut via CNS, resulting in changes of the gut physiology. The gut microbiota communicates with each other through their metabolites that are sensed by the host cells and thereby interact with the ANS gut synapses. Moreover, the ANS can affect the mechanisms of the gut epithelium that participates in the activation of the immune system directly by modification of the response of gut immune cells to microbes or indirectly via alternation of microbes to the gut immune cells.

The gut microbiota could communicate with the CNS/ENS through the production of several metabolites/ neurotransmitters with neuromodulatory properties.

The two ways through which the gut microbiota communicates with the brain is:

(i) The Vagus Nerve(VN) and/or the spinal cord
(ii) Endocrine glands

Vagus Nerve (VN)is an important part of the parasympathetic nervous system, the nerve is composed of both the afferent as well as efferent nerves, "the VN, because of its role in interoceptive awareness, is able to sense the microbiota metabolites through its afferents, to transfer this gut information to the central nervous system where it is integrated in the central autonomic network, and then to generate an adapted or inappropriate response" (Bonaz, 2018)[2] The colon is where maximum of the microbes rest, the vagus afferent nerves are spread throughout this region of the digestive wall but these nerves they never cross the epithelial layer

Stress both interoceptive and exteroceptive is deemed to modify the gut microbiome. Moussaoui et al stated that early life stress induces dysbiosis in rats by increasing the intestinal permeability which can lead to later on visceral hypersensitivity "Classically, stress inhibits the VN and stimulates the sympathetic nervous system through autonomic-related projection neurons of the PVH to the dorsal motor nucleus of

[2] "*The Vagus Nerve at the Interface of the Microbiota-Gut-Brain Axis." NCBI, 7 February 2018, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5808284/. Accessed 27 June 2022.*

the VN and sympathetic pre-ganglionic neurons of the spinal cord" (Bonaz, 2018). The Vagus Nerve has an anti-inflammatory effect on the human body whereas stress has pro-inflammatory effect on the body. Stress can counterbalance all the protective functions that are performed by the vagus nerve on the epithelial layer and induce dysbiosis by disrupting the homeostasis of the epithelial layer.

It has been proven that the vagus nerve influences the pathophysiology of the brain during psychiatric disorders, other chronic illnesses like rheumatoid arthritis(RA), obesity and other anti-inflammatory diseases. [3]

2. Coronavirus History

Our lives were normal, happy going, all of us were following a routine which we were comfortable with until December of 2019, when the paradigm shifted, our lives were changed forever, a global pandemic hit, all of us were forced to work from home, wear mask, shift to an online mode, all due to SARS-CoV-2 virus which belongs to the family of coronavirus, which causes an acute respiratory syndrome, which affected millions of humans that inhabit this planet. Many theories were published concerning the origin of this virus, but the most commonly accepted theory is that it originated in bats which were then consumed by humans residing in the province of Wuhan, China.

WHO stated that the disease is spread by human-to-human transmission via their bodily droplets. The virus causes mild infections in younger people and most of the time, medical attention is not required but in older people who have certain underlying conditions like hypertension, diabetes, cardiovascular diseases the contraction of the virus can cause more serious illness. Most common symptoms of the disease are fever, cold, cough, tiredness, milder symptoms include sore throat, headache, irritation in the eyes, serious symptoms of covid include shortness of breath, chest pain, etc. [4]

To avoid this deadly virus getting vaccinated is preferable, staying at least 1 metre or 10 feet away from people, avoiding touching eyes, mouth and nose, covering out mouth and nose when coughing and sneezing is unequivocal.

SARS-CoV-2 belongs to the coronavirus family; the first strain of coronavirus was found in 1930 in chickens. It is believed that corona virus only affects animals like chickens, bats, camels, cats etc and that it didn't affect humans until 1960 when it was first found in humans. "Occasionally, viruses that infect one species can mutate in such a way that allows them to start infecting another species. This is called "cross-species transmission" or "spillover"[5]

2.1 Vaccines

Due to its unexplored nature and having no treatment flow; people started relying on scientists for finding a cure which can be in the form of a vaccine or some sort of a pill, shortly after a while, vaccines were developed. Some of the most common vaccines available today in the market are Corbevax, Covaxin, Covishield, Johnson and Johnson, Moderna Novavax, Sputnix light, Sputnix V and Zydus Cadila vaccine.

"Vaccines contain weakened or inactive parts of a particular organism (antigen) that triggers an immune response within the body. Newer vaccines contain the blueprint for producing antigens rather than the antigen itself. Regardless of whether the vaccine is made up of the antigen itself or the blueprint so that the body will produce the antigen, this weakened version will not cause the disease in the person receiving the vaccine, but it will prompt their immune system to respond much as it would have on its first reaction to the actual pathogen."[6]

Apart from the normal benefit of protecting oneself from the Covid-19 disease, there are several benefits of taking vaccines which include building herd immunity – by taking vaccine one is not only protecting themselves but the others around them as well thus inching closer towards achieving herd immunity. It was also found out by carrying out various experiments that when expecting mothers

[3] *"Vagus Nerve as Modulator of the Brain–Gut Axis in Psychiatric and Inflammatory Disorders." Frontiers, 13 March 2018, https://www.frontiersin.org/articles/10.3389/fpsyt.2018.00044/full. Accessed 27 June 2022.*

[4] *"Coronavirus disease (COVID-19)." WHO | World Health Organization, https://www.who.int/health-topics/coronavirus#tab=tab_3. Accessed 8 June 2022.*

[5] *Broadbent, Lindsay. "Coronaviruses – a brief history." The Conversation, 15 April 2020, https://theconversation.com/coronaviruses-a-brief-history-135506. Accessed 8 June 2022.*

[6] *"How do vaccines work?" WHO | World Health Organization, 8 December 2020, https://www.who.int/news-room/feature-stories/detail/how-do-vaccines-work. Accessed 8 June 2022.*

take a dose of the Covid-19 vaccine they produce antibodies which can then be passed down to their foetus via the amniotic sac.

In January of 2022, the health department of Haryana (a state in India) revealed that the fatalities of the people who had taken the covid vaccine was 5 times more than the ones who had not taken the vaccine thus attacking the efficacy of the vaccines.

Once someone gets recovered from Covid-19 their body produces antibodies against the covid-19 virus, this is known as natural immunity. Natural immunity is much stronger and much better than the immunity that we gain by taking vaccines. That's why priority should be given to naturally acquired immunity over vaccine- acquired immunity.

""There is no long-term data on delayed side-effects and it has now been shown to have no efficacy against infection or transmission of the Covid-19 illness."" says Joe Stanton who was a NHS nurse who resigned due to the vaccine mandate imposed by the NHS. Another nurse who works for the NHS Foundation stated that actually taking the vaccine eliminates our chances of developing herd immunity, studies also show that the people who have already taken the vaccine against Covid-19 have higher levels of transmission. [7]

Across the globe, vaccinations have been started for kids above the age of 12 but a senior AIIMS epidemiologist argues that this strategy is unscientific and wouldn't make a dent in covid deaths due to the low severity of covid infections in kids. [8]

Many people who took the vaccine had adverse effects on their health, one of which is blood clotting which was mostly caused due to the Johnson & Johnson vaccine and the Oxford- AstraZeneca vaccine. The blood clotting although was very rare. [9]

Another study was carried out wherein the effect of vaccination was studied on the menstrual cycle of women. Snowballing sampling was used to collect data wherein it was concluded that women who had regular flow of blood pre-vaccination had no whatsoever impact on their menstrual cycle post vaccination whereas heavy bleeding was observed within women who had heavier blood flow before vaccination and these women were much older, were hispanic or latino or had given birth or have been pregnant. [10]

Apart from the aforementioned benefits of vaccines there are certain drawbacks to it as well, for the younger and healthier generation whose immunity hasn't been well developed yet, the effects of vaccination would be more adverse, and it is not required as well. Having taken the vaccine will only provide short term immunity from Covid-19 and soon booster shots would need to be administered (this has already been started in countries all over the world).

There are so many studies that talk about the Covid-19 vaccine effectiveness, which is usually done through observational studies and based on false negatives but what these reports fail to mention is the tendency of the patient being infected via different respiratory diseases.

The Covid-19 fear was inflated by two primary sources – firstly it was the wrong death rate that was being shown to the public so as to instil fear and secondly the inappropriate use of RT-PCR reports.

The fear of Covid-19 got amplified among people due to the wrong death rate, Professor John Ioannidis of Stanford University, one of the most credible scientists in the world published a paper wherein he stated that the fatality rate was 0.00- 0.57 % only and less that 0.05% for people who were under 70.

RT-PCR short for Reverse Transcriptase Polymerase Chain Reaction has been widely used all throughout the covid-19 for testing. PCR works on the principle that the small sample of RNA that is acquired can be amplified and replicated over time so that we can get a sufficient amount of the sample so that it can be tested. The fear of inflation of covid was increased due to this. The RT-PCR is hypersensitive and it is susceptible to errors due to contamination when it is

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[7] *"Covid-19: 'I quit my NHS job because I don't want the jab.'" BBC, 27 January 2022, https://www.bbc.com/news/uk-england-norfolk-60111926. Accessed 8 June 2022.*

[8] *"Covid vaccination for children 'unscientific': senior AIIMS epidemiologist." Hindustan Times, 26 December 2021, https://www.hindustantimes.com/world-news/covid-vaccination-for-children-unscientific-senior-aiims-epidemiologist-101640517308206.html. Accessed 8 June 2022.*

[9] *Ledford, Heidi. COVID vaccines and blood clots: five key questions, https://www.nature.com/articles/d41586-021-00998-w.*

[10] *Saha, Nidhi. "Study finds menstrual bleeding changes after SARS-CoV-2 vaccination." News-Medical.net, 15 October 2021, https://www.news-medical.net/news/20211015/Study-finds-menstrual-bleeding-changes-after-SARS-CoV-2-vaccination.aspx. Accessed 8 June 2022.*

performed by the people who are not highly trained. "Case inflation also occurs from use of excessive number of rounds of amplification cycles (termed CT) which amplifies non-infectious viral fragments and cross-reacting nucleotides from non-Covid coronaviruses/other respiratory viruses. These become mis-labelled as Covid. Even Dr Fauci confirms that a positive result using CT above 34 is invalid (Twitter thread, Jeff Nelson @vegsource 30 October 2020) but in the UK CTs may go up to 45, as confirmed by Professor Carl Heneghan of Oxford University's Center for Evidence-Based Medicine: (House of Commons Science & Tech Committee, 17 Sep, 2020 YouTube.)" [11]

Before the launch of vaccines, several trial-and-error courses of treatments were used.

One of the first drugs that was used against Covid-19 was hydroxychloroquine, this was engineered by lobbies which feared the success of this drug.

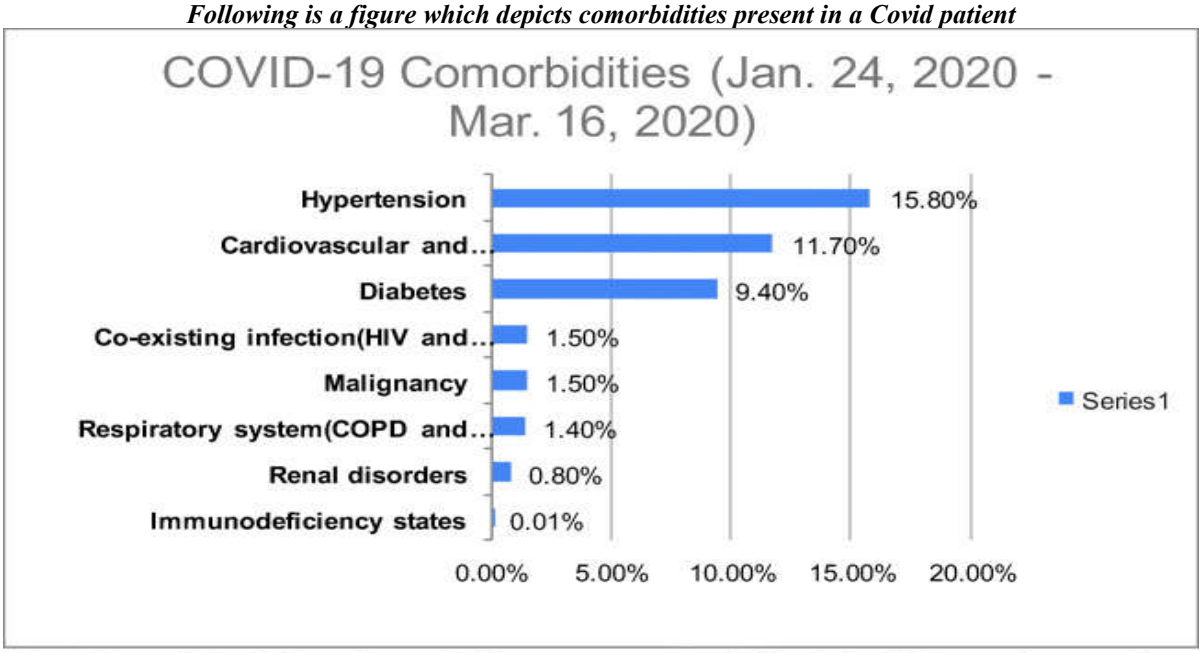
Another drug which was used was ivermectin which is an antiparasitic drug was also administered within the state of Uttar Pradesh which has twice the population of Maharashtra and had 1/5th the covid deaths as compared to the state of Maharashtra.

As mentioned before studies show that people with chronic illnesses or comorbidity are more likely to contract the severe form of the SARS-Cov-2 virus, it is has also been proven that people with COPD (Chronic Obstructive Pulmonary Disease), Bronchitis or any other various respiratory problems are more likely to get the serious form of this deadly virus. The risk of contracting COVID-19 in patients with COPD is found to be 4-fold higher than patients without COPD[12]

[11] *King, Eshani. Covid-19: politicisation, "corruption," and suppression of science, https://www.bmj.com/content/371/bmj.m4425/rr-31.*

[12] *"Comorbidity and its Impact on Patients with COVID-19." NCBI, 25 June 2020, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7314621/. Accessed 8 June 2022.*

Following is a figure which depicts comorbidities present in a Covid patient



Note: Data obtained from Research Square, a meta-analysis of the 2019 novel coronavirus, showing clinical comorbidities observed in patients, as of April 8, 2020 [10].

It is true that patients who have the underlying condition of moderate to severe Asthma are at an disadvantage because the virus affects their respiratory tract which can lead to more asthmatic attacks, pneumonia and problems related to breathing.

Following is a figure talks about the mortality rate in the patients with certain comorbid conditions which are pretty common

Leading comorbidities among COVID-19 deaths in NY, USA

Comorbidities	Death %
Hypertension	55.4%
Diabetes	37.3%
Hyperlipidemia	18.5%
Coronary artery disease	12.4%
Renal disease	11.0%
Dementia	9.1%
COPD	8.3%
Cancer	8.1%
Atrial fibrillation	7.1%
Heart failure	7.1%

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Data reported by hospitals, nursing homes, and other health facilities to the New York State Department of Health, as of April 6, 2020 [26]

It has also to be noted that:

- People with cardiovascular comorbid conditions have been poorly linked with the outcomes of Covid-19 *however* this might be because of the condition or the various other conditions along with it.
- People with Type 2 Diabetes had to have more hospital intervention as compared to people who did not have the condition. It was also shown that poorer control over the blood glucose level led to higher mortality rates as compared to the people who did have a better control over their blood glucose concentration level.

Even after vaccination people can contract the Covid-19 virus and consequently the disease – these cases are known as the breakthrough cases. Breakthrough covid cases are the cases wherein a person contracts the disease after two weeks of vaccination. Due to the rise in breakthrough cases, a debate over the efficacy of the vaccines has sparked. This was cleared by a WHO doctor Dr. Katherine O'brien who stated that when any data over any vaccine trial has been collected it is to be mentioned that it wouldn't be possible that the results apply to the 100 percent of the population as there would exist some people who are rare, which makes up 20-30 percent of the population.[13]

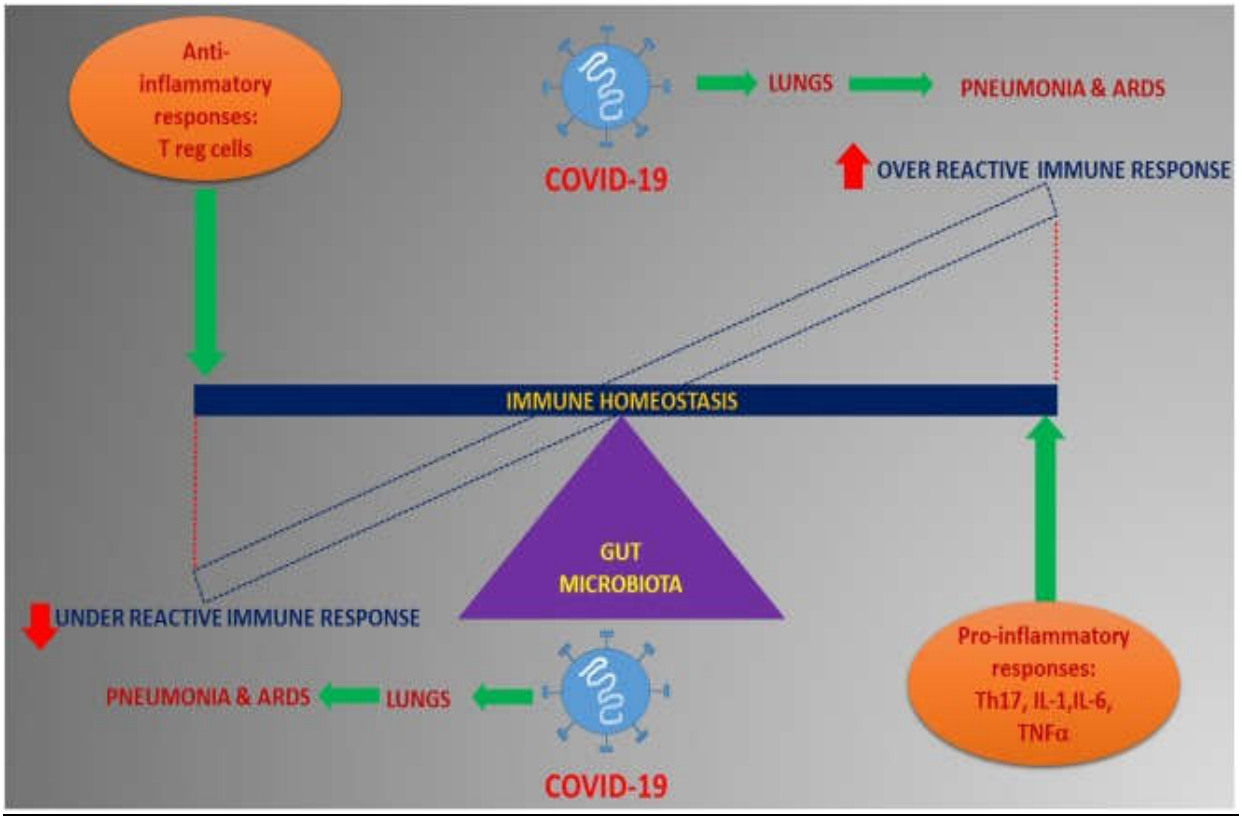
2.2 Covid-19 and Gut Microbiota

SARS-CoV-2 is a virus belonging to the coronavirus family which causes acute respiratory syndrome, the virus attacks the lung, particularly the ACE2 receptor cells that are present on the alveolar epithelial layer of the lung the immune system of the patient ha"You are what you eat" said a very famous French gastronome, this is very true, what we eat and the composition of the food we eat determines been compromised. Immunity can be strengthened by consuming healthy food, trying to live a stress free live and exercising on a regular basis etc.

The microbiota of the human gut is home to 10^14 types of microorganisms which includes bacterias, viruses, archaea, fungi etc. One of the more important roles of the human gut microbiome is providing protection against pathogens. Thus, the human immune system is heavily influenced by the gut microbiome of the gastrointestinal tract thus aiding to maintain the immune homeostasis. Any alteration in the immune habitat can lead to dysregulation and thus causing autoimmune disease.
The bidirectional interaction between the respiratory mucosa and the gut microbiome is termed as the gut-lung axis. In a study carried out in the Zhejiang province of China, 11.4% of 651 participants who had a confirmed diagnosis of Covid-19 had at least 1 symptom of Gastrointestinal symptom, most common of which was diarrhoea. [14]

[13] *"Episode #49 - Can I get infected after vaccination?" WHO | World Health Organization, 13 August 2021, https://www.who.int/emergencies/diseases/novel-coronavirus-2019/media-resources/science-in-5/episode-49-can-i-get-infected-after-vaccination. Accessed 8 June 2022.*

[14] *"Microbiota Modulation of the Gut-Lung Axis in COVID-19." Frontiers, 24 February 2021, https://www.frontiersin.org/articles/10.3389/fimmu.2021.635471/full. Accessed 24 June 2022.*



Higher mortality rates is found in the patients who have covid as well as gut dysbiosis as the imbalance in the microbiota can increase inflammation and lack of viruses which have anti-inflammatory properties in the lung, this pointing out the pivotal relationship between the lungs and the gut.

"The crucial step of the virus entry into the host organism is through the angiotensin converting enzyme 2 (ACE2) cell receptor and the successful infection also requires the transmembrane protease serine 2 (TMPRSS2), in a cleavage step of the viral S-protein on the host cell membrane, thus allowing efficient viral fusion. Both ACE2 and TMPRSS2 have elevated coexpression in the oesophageal upper epithelia and gland cells, besides in the absorptive enterocytes of the ileum and colon from healthy subjects or Covid-19 patients. Furthermore, human intestinal epithelial cells (hIECs) can be successfully infected by SARS-CoV-2 and then both intestinal epithelial cell lines and human colon organoids could be potential targets for virus replication, thus potentially contributing to the augmented viremia and spreading of SARS-CoV-2 infection." ("Microbiota Modulation of the Gut-Lung Axis in Covid-19")

As stated before the SARS-CoV-2 virus enters the host organism's through the AEC2 enzyme whose high concentration are found in the oral mucosa and the tongue epithelial cells thus again elucidating that the gastrointestinal tract is an important target of the virus. ("Microbiota Modulation of the Gut-Lung Axis in Covid-19")

2.3 Connection between Chronic illnesses and human gut microbiome

There has been much research that has gone into developing an association between the human gut microbiome and chronic illnesses. As stated before, the human gut composition influences the homeostasis of the body and any alteration in this composition can trigger autoimmune response which can be very fatal thus it appears that it is very important for us to learn about the impact in terms of health and also these molecular level interactions that take place in the gut.

In this paper, focus has been much put on diseases like Diabetes Type I, Hypertension, Alzeihmers, Rheumatoid Arthritis and Non alcoholic fatty liver disease.

SARS-CoV-2 is a virus belonging to the coronavirus family which causes acute respiratory syndrome, the virus attacks the lung, particularly the ACE2 receptor cells that are present on the alveolar epithelial layer of the lung the immune system of the patient "You are what you eat" said a very famous French gastronome, this is very true, what we eat and the composition of the food we eat determines been compromised. Immunity can be strengthened by consuming healthy

food, trying to live a stress free live and exercising on a regular basis etc.

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Type I Diabetes

Type I Diabetes is the type of disease wherein the human body specifically the pancreas cannot produce insulin and due to the lack of production of insulin the body glucose levels are high. There is no treatment that is available for the disease but the research for whether this condition can be reversed by using stem cells is being studied. In order to maintain normal blood glucose level (that is 3.9 mmol/L to 5.6 mmol/L) external injections of insulin have to be taken, these have to be typically taken before meals and frequently monitoring blood glucose levels is ideal.

A study carried out across all the ethnic groups aiming to find some common element relating to type I Diabetes at the molecular level concluded that the gut has increased the number of bacteroides species and reduced the number of bacteria that produce SCFA(Short chain fatty acids). "Specifically, the butyrate producer Faecalibacterium prausnitzii has been found to be decreased in abundance in children with diabetes-related autoantibodies." [15] Before even this the patients report more intestinal permeability and a reduction in gut diversity.

In animal models, "antibiotic-induced dysbiosis, altered microbial lipid metabolism, and suppressed enteric Th17 and T-reg cell populations have led to increased incidence of T1DM-like disease in mice" (Vijay, Valdes)

In animals models the impact of dietary changes on non obese mice were also studied and it was found out that the rats who had a better diet released acetate and butyrate which gave them almost immunity against the Type I Diabetes disease. Thus, elucidating the importance of diets.

Asthma

Asthma is an autoimmune respiratory disease which causes the lungs to narrow and also produces excess mucus which creates difficulty in breathing. As of today, no known cure for asthma exists.

Asthma is a genetic disorder, many cases of asthma are prevalent in industrialised countries, but the rise in the cases of asthma cannot fully be blamed on the genetics, few other environmental exposures also influence this disease.

The gut microbiota has an influence on immune cell maturation and resistance to pathogens, some environmental factors which affects the gut microbiome is caesarean birth, antibiotics usage, formula usage and airborne toxins.

Observational studies in humans have identified *Proteobacteria* to be the most dominant phylum overrepresented in patients with asthma compared with nonasthmatic volunteers across several studies. The effects of the gut microbiota on asthma are at least partially mediated by bacterial metabolites, which may influence immune responses in distal parts of the body. The most known metabolites with demonstrated protective properties in human airway inflammation are SCFAs. Children with high amounts of butyrate and propionate in faeces at 1 year of age have significantly less atopic sensitization and are less likely to have asthma between 3 and 6 years . In addition, soluble fibre may ameliorate the effects by exerting anti-inflammatory action via SCFAs binding to associated G-protein-coupled receptors (GPCRs)

Although the mechanisms mediating communication between the gut and lungs are still unclear, it has been suggested that epithelial cells, other structural cells, and immune cells absorb signals from the gut endothelium to form a local cytokine microenvironment, which leads to changes in immune responses at distal sites. Specifically, SCFAs derived from gut bacteria have inhibitory effects on proinflammatory responses in the lungs.[16]

Alzheimer's Disease

A neurodegenerative disease(is a form of dementia) which causes the brain to atrophy and the nerve cells to shrink leading to memory loss, hallucinations among other things. This disease heavily impacts the person's behavioural abilities, thinking abilities and social abilities thus literally draining the life out of the person and entering the phase of dependency.[17]

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[15] *Vijay, Amrita, and Ana Valdes. Role of the gut microbiome in chronic diseases: a narrative review, https://www.nature.com/articles/s41430-021-00991-6.*

[16] *"Asthma - Diagnosis and treatment." Mayo Clinic, 5 March 2022, https://www.mayoclinic.org/diseases-conditions/asthma/diagnosis-treatment/drc-20369660. Accessed 21 June 2022.*

[17] *"Alzheimer's disease - Symptoms and causes." Mayo Clinic, 19 February 2022, https://www.mayoclinic.org/diseases-*

There exists no hard and fast treatment for the disease but certain drugs can slow down the progression of the disease, but frequent MRI scans can help us to track the progression of the disease and also some reflex exercises can prevent augur.

A group of scientists led by Moira Marizzoni were able to confirm a correlation " in humans, between an imbalance in the gut microbiota and the development of amyloid plaques in the brain, which are at the origin of the neurodegenerative disorders characteristic of Alzheimer's disease." [18] The scientists had two explanations on how intestinal bacterias can cause this neurodegenerative . First being these bacterias can indeed have an effect on the brain's chemical composition and also have the ability to alter this composition and thus consequently "modify the interaction between the immune system and the nervous system" ("Link between Alzheimer's disease and gut microbiota is confirmed"). Secondly it can produce metabolites which have short acid fatty chains – which have neuroprotective and anti-inflammatory properties which can have an impact on the brain directly or indirectly.

Marizzoni carried out a study in which they studied whether inflammation mediators and bacterial metabolites constitute a link between the gut microbiota and amyloid pathology in Alzheimer's disease. In order to do this they studied a cohort of participants which consisted of almost 100 participants aged between 65 years of age to 85 years of age some of who were suffering from alzheimers and others from various other neurodegenerative diseases which all of which cause memory loss. The participants were then asked to get PET scan so as to measure their amyloid deposition and their blood was also drawn so as to quantify the presence of various inflammation markers and proteins in their blood which are produced by the intestinal bacterias such as lipopolysaccharides and short-chain fatty acids.

They found out that "certain bacterial products of the intestinal microbiota are correlated with the quantity of amyloid plaques in the brain" and "high blood levels of lipopolysaccharides and certain short-chain fatty acids (acetate and valerate) were associated with both large amyloid deposits in the brain. Conversely, high levels of another short-chain fatty acid, butyrate, were associated with less amyloid pathology." ("Link between Alzheimer's disease and gut microbiota is confirmed")

Rheumatoid Arthritis

Rheumatoid Arthritis is an autoimmune disease which occurs when the body mistakenly attacks its own tissues thus causing inflammation and damaging the lining of joints, which can eventually progress and cause the degeneration of the bones and joint deformity. This disease causes damage to a wide plethora of body systems including the lungs, eyes, heart, brain etc. apart from the obvious damage, it can also cause inflammation in those body organs (this is how this disease is different from osteoarthritis).[19]

Course of treatments include the consumption of NSAIDs (non-steroidal anti-inflammatory drugs) which include ibuprofen, naproxen sodium etc.

Recently it was studied that certain environmental factors can have an impact on the onset of the disease such as diet, smoking and exercise among other factors. The resistance of germ-free mice towards the disease elucidates the role of the gut microbiome on the pathogenesis of the disease, the gut microbiota of the patients affected by rheumatoid arthritis is very less diverse than control patients.

"Chen et al. reported that compared with healthy controls, patients with RA show decreased gut microbial diversity, which correlates with autoantibody levels and disease duration" along with those patients with the disease on a compositional level show an increase *Prevotella* species, including *Prevotella copri* which is associated with inflammation, this level was particularly high in the intestine which causes intestinal dysbiosis foreshadowing the rheumatoid arthritis disease.

Faecalibacterium which is a beneficial bacterium is also decreased which is associated with chronic inflammation. The relative abundance of *Collinsella* was found to be increased. "Interestingly, inoculation of *Collinsella* into collagen-induced arthritis (CIA)-susceptible mice induces severe arthritis. In vitro experiments showed that *Collinsella Aerofaciens* increases gut permeability and induces IL-17A expression, a key cytokine involved in the pathogenesis of RA, suggesting that *Collinsella* is a candidate

conditions/alzheimers-disease/symptoms-causes/syc-20350447. Accessed 21 June 2022.

[18] *Link between Alzheimer's disease and gut microbiota is confirmed." ScienceDaily, 13 November 2020, https://www.sciencedaily.com/releases/2020/11/201113124042.htm. Accessed 21 June 2022.*

[19] "Rheumatoid arthritis - Symptoms and causes." *Mayo Clinic*, 18 May 2021, https://www.mayoclinic.org/diseases-conditions/rheumatoid-arthritis/symptoms-causes/syc-20353648. Accessed 21 June 2022."Rheumatoid arthritis - Symptoms and causes." *Mayo Clinic*, 18 May 2021, https://www.mayoclinic.org/diseases-conditions/rheumatoid-arthritis/symptoms-causes/syc-20353648. Accessed 21 June 2022.

arthritogenic bacterium in the human intestine. In summary, *Prevotella copri* and *Collinsella* are the dominant gut microbiota in patients with early RA and may be involved in its pathogenesis." (Vijay and Valdes)

A correlation between SCFA (short- chain fatty acids) and rheumatoid arthritis was found in mice wherein the SCFA play an important role in suppression of inflammation of Rheumatoid arthritis and the mice who were deficient in SCFA showed more inflammation. "Butyrate, one of the most abundant SCFAs, acts as an endogenous histone deacetylase (HDAC) inhibitor and has been shown to decrease inflammation in animal models of RA and other inflammatory diseases. A recent study has revealed a role for intestinal barrier function, and specifically for zonulin, a peptide that controls epithelial tight junction permeability, in regulating the onset of joint disease in mice with collagen-induced arthritis (CIA) and potentially also in patients with RA. Increased levels of zonulin have been associated with leaky intestinal barrier, dysbiosis, and inflammation. Restoration of the intestinal barrier in the period before clinical arthritis, either by dietary supplementation with the SCFA butyrate or pharmacological agents such as a zonulin antagonist may help delay disease onset and reduce the severity of RA." (Vijay and Valdes)

Non- alcoholic fatty liver disease [NAFLD]

NAFLD is a term associated with people who have a little too much fat in their liver if they consume little to no alcohol. Severe cases of NAFLD can lead to chronic liver diseases, liver cirrhosis.

As of today, there is no drug treatment that is approved by the US Food and Drug Administration, but some "natural" course of treatment includes almost 10% of their weight by changes in their diet and also by exercising. Fat reduction surgery can be offered to patients who need to lose a great deal of weight. [20]

There is enough evidence which links the gut-liver axis and the development of Non-alcoholic fatty liver disease. Gut dysbiosis can lead to increased intestinal permeability as a consequence of the epithelial layer deterioration , tight junction alterations and bacterial translocation which might cause the bacterias which causes endotoxemia and thus causing these bacterias to reach the portal vein.

"Case control studies have reported consistent altered microbial signatures at phylum level such as increased *Proteobacteria*, at family level such as increased *Enterobacteriaceae* and genera such as an increase in the abundance of *Collinsella sp*, *Escherichia*, *Dorea* and a decrease in the abundance of *Coprococcus*, *Eubacterium*, *Faecalibacterium* and *Prevotella*" (Vijay and Valdes)

There are several hypotheses which give an insight into the mechanics behind how gut microbiota cause NAFLD. "Specific microbial species such as *Collinsella sp*. have been shown to metabolise bile acids to oxo-bile acid intermediates which may increase intestinal permeability and contribute to the development of NAFLD. Increased intestinal permeability may lead to lipopolysaccharide (LPS) release to the host, which can trigger tissue and systemic inflammation. Furthermore, the action of microbially-produced metabolites (including TMAO, choline or ethanol) and bile acid signalling can also affect host immunity. Interestingly, unlike other diseases, SCFAs appear to prevent but also promote the development of NAFLD and NASH depending on the signalling pathway or mechanism they activate. Amongst the SCFAs, acetate was found to be enriched in faecal samples from adults with more advanced stages of NAFLD (i.e. fibrosis) , whereas butyrate and propionate were enriched in faecal samples from adults with mild or moderate NAFLD. This may suggest that levels and subtypes of SCFAs correlate with the severity of fatty liver disease. Since each SCFA exerts specific and somehow different metabolic effects, assessing their balance both at the faecal and systemic level in patients and after a dietary intervention using different substrates may help provide more information on their overall role in NAFLD development, exacerbation or improvement." (Vijay and Valdes)

3 Kefir Grains

Kefir grains which were originated in the Balkan states of Europe and in the Caucasus are acidic- alcoholic milk fermented product. Kefir grains are white to yellow coloured gelatinous balls which have variable sizes, they are composed of a mix between acetic acid bacteria, lactic acid bacteria wound up in a polysaccharide matrix, it also contains yeast and fungi. "Kefir can be produced by fermenting milk with commercial freeze-dried kefir starter cultures, traditional kefir grains, and the product that remains after the removal of kefir grains" [21] ("Milk kefir:

[20] *"Nonalcoholic fatty liver disease - Symptoms and causes." Mayo Clinic, 22 September 2021, https://www.mayoclinic.org/diseases-conditions/nonalcoholic-fatty-liver-disease/symptoms-causes/syc-20354567. Accessed 21 June 2022.*

[21] *"Milk kefir: composition, microbial cultures, biological activities, and related products." Frontiers, 30 October 2015, https://www.frontiersin.org/articles/10.3389/fmicb.2015.01177/full. Accessed 25 June 2022.*

composition, microbial cultures, biological activities, and related products") Kefir has splendid antitumor, antifungal, antibacterial properties.

Traditionally kefir is produced by using cow, buffalo's milk. In soviet countries kefir was used to treat diseases, it not only replenishes the microbiota of the gut but releases some organic acids which are really useful to the body. "In kefir grains the main polysaccharide is kefiran, which is a heteropolysaccharide composed by equal proportions of glucose and galactose and is mainly produced by Lactobacillus kefiranofaciens" [22] ,it has been demonstrated that kefirans improve the viscosity and viscoelastic properties of the acid milk gel, which gives the milk to form viscoelastic gels at lower temperatures this is the reason why kefir grains are used in the making of fermented products like yoghurt and cheese.

Kefir is a probiotic primarily due to its composition, it has almost a cell-free structure due to which it can easily digest lactose. Kefir can also lower cholesterol level, it does so by:

- Producing free and breaking down bile acids.
- The inhibition of enzyme HMG- CoA reductase.
- By binding to and absorbing before entering the human body. ("Milk kefir: composition, microbial cultures, biological activities, and related products")

"The microorganisms in the kefir grains produce lactic acid, antibiotics and bactericides, which inhibit the development of degrading and pathogenic microorganisms in kefir milk (Liu et al., 2002)[23]. Kefir acts against the pathogenic bacteria *Salmonella, Helicobacter, Shigella, Staphylococcus, Escherichia coli, Enterobacter aerogenes, Proteus vulgaris, Bacillus subtilis, Micrococcus luteus, Listeria monocytogenes, Streptococcus pyrogenes, (Lopitz et al., 2006)* [24] *, Streptococcus faecalis KR6, Fusarium graminearum CZ1* , and the fungus *Candida albicans*."

Using kefir grains for the production of fermented products have the following advantages[25]:

- Kefir is primarily a probiotic which means that it reinstates the microbiome of the gut thereby improving gut health and aids in better digestion. As stated before kefir breaks down the lactose that is present in milk thus the milk can be consumed by people who are lactose intolerant.
- Helps reduce obesity as obesity is caused due to the imbalance in the gut microbiota.
- Traditional kefir grains are produced via cow's milk which can also help in improving bone density, as as we grow the bone density decreases.
- Inflammatory bowel disorder (IBD) and/or rheumatoid arthritis which are inflammatory diseases can be reversed by the consumption of products which contain kefir as it has anti-inflammatory properties.

Besides the obvious benefits of kefir there are some disadvantages as well which include:

- Researchers have found out that kefir has low to moderate glycemic index but it has a high insulinemic score, this essentially means that it produces more insulin as compared to other food products. [26]
- As kefir is produced via anaerobic method, one of the products of its respiration is alcohol, this can be harmful for children and adults who are undergoing recovery. It has to be kept in mind that the concentration of alcohol is less than one percent. [27]

<u>People who should avoid the consumption of kefir:</u>

It is a myth that just because kefir is a natural product everyone should consume it, there are certain people who should avoid the consumption of kefir or before the consumption they should take advice from their

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[22] *Zajšek, K., Goršek, A., and Kolar, M. (2013). Cultivating conditions effects on kefiran production by the mixed culture of lactic acid bacteria imbedded within kefir grains. Food Chem. 139, 970–977. doi: 10.1016/j.foodchem.2012.11.142*

[23] *Liu, J. R., Wang, S. Y., Lin, Y. Y., and Lin, C. W. (2002). Antitumor activity of milk, kefir and soya milk kefir in tumor bearing mice. Nutr. Cancer 44, 183–187. doi: 10.1207/S15327914NC4402_10*

[24] *Lopitz, F. O., Rementeria, A., Elguezabal, N., and Garaizar, J. (2006). Kefir: una comunidad simbiótica de bacterias y levaduras con propiedades saludables. Rev. Iberoam. Micol. 23, 67–74. doi: 10.1016/S1130-1406(06)70016-X*

[25] *Lewin, Jo. "Top 4 health benefits of kefir." BBC Good Food, https://www.bbcgoodfood.com/howto/guide/health-benefits-kefir. Accessed 25 June 2022.*

[26] *Muinos, Lacey. "The Disadvantages of Kefir | livestrong." Livestrong, 16 September 2019, https://www.livestrong.com/article/489781-the-disadvantages-of-kefir/. Accessed 25 June 2022.*

[27] *"Why Is Kefir Bad for You? Side Effects, Disadvantages." MedicineNet, 21 April 2022, https://www.medicinenet.com/why_is_kefir_bad_for_you/article.htm. Accessed 25 June 2022.*

doctors. People who should avoid kefir are as follows[28] :

- People who have recently undergone organ transplantation, when we receive organs the doctors usually put the patient on immunosuppressants in order to ensure that the receiver's body does not reject the organ, because kefir is a probiotic it promotes immunity and it also strengthens the immune system because it has immune-activation properties.
- People who have severe milk intolerance should completely avoid milk kefir, they are advised to switch to kefir that is made by water or coconut milk.
- People who suffer from diabetes are advised to abstain from consuming kefir as it can increase the glucose level in the blood.
- People who suffer from Candida infection should avoid it because kefir contains yeast, and the infection already causes an overgrowth of yeast.
- Alcoholics who take the medicine Disulfiram should avoid kefir as during the fermentation process a small amount of alcohol is produced (the quantity varies from 0.1% to 1% – this is dependent on the time during which it has been allowed to ferment).

During the production process of curd/ yoghurt only 1-3 varieties lactobacillus family whereas during the production process of kefir grains it involves 60 different types of bacterias and yeast which includes many essential strains like *Bifidobacterium, Streptococcus thermophilus, Lactococcus lactis*, and dozens of other strains all of which play a vital role in the gastrointestinal tract (GIT).

4 Casein Protein in Milk and Lactose intolerance

Milk contains protein, 80 percent of the protein in milk is accounted for by casein, there are different types of casein protein one of which is beta-casein this is further subdivided into A1 and A2. A1 and A2 milks have different impacts on the body, it is usually deemed that A2 is most similar to breast milk.

"When A1 protein is digested in the small intestine, it produces a peptide called beta-casomorphin-7 (BCM-7). The intestines absorb BCM-7, and it then passes into the blood. Doctors have linked BCM-7 to stomach discomfort and symptoms similar to those experienced by people with lactose intolerance." [29]

Certain benefits of consuming A2 milk are as follows[30]:

- A2 milk contains Strontium which boosts the immune system, promotes healthy blood level sugar, avoids inflammatory bowel syndrome (IBS)
- Contains omega- 3 fatty acids which reduce cholesterol levels and thus increase heart health
- A2 milk contains cerebrosides which increase brain function

A study carried out by sun jiangin et al to study the *Effects of milk containing only A2 beta casein versus milk containing both A1 and A2 beta casein proteins on gastrointestinal physiology, symptoms of discomfort, and cognitive behaviour of people with self-reported intolerance to traditional cows' milk* revealed that "Compared with milk containing only A2 β-casein, the consumption of milk containing both β-casein types was associated with significantly greater PD3 symptoms; higher concentrations of inflammation-related biomarkers and β-casomorphin-7(produced by A1 type milk); longer gastrointestinal transit times and lower levels of short-chain fatty acids; and increased response time and error rate on the SCIT. Consumption of milk containing both β-casein types was associated with worsening of PD3 symptoms relative to baseline in lactose tolerant and lactose intolerant subjects. Consumption of milk containing only A2 β-casein did not aggravate PD3 symptoms relative to baseline (i.e., after washout of dairy products) in lactose tolerant and intolerant subjects." [31]

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[28] *"What are kefir grains?" KefirWala, https://www.kefirwala.in/what-are-kefir-grains/. Accessed 25 June 2022.*

[29] *Kubala, Jillian. "A2 milk: Benefits, vs. A1 milk, side effects, alternatives, and more." Medical News Today, https://www.medicalnewstoday.com/articles/318577#Potential-benefits-of-A2-milk. Accessed 25 June 2022.*

[30] *Kumar, Karthik. "What Is the Difference Between A2 Milk and Regular Milk?" MedicineNet, 13 October 2021, https://www.medicinenet.com/difference_between_a2_milk_and_regular_milk/article.htm. Accessed 25 June 2022.*

[31] *"Effects of milk containing only A2 beta casein versus milk containing both A1 and A2 beta casein proteins on gastrointestinal physiology, symptoms of discomfort, and cognitive behavior of people with self-reported intolerance to traditional cows' milk ..." Nutrition Journal, 2 April 2016,*

Thus, they then concluded that "Consumption of milk containing A1 β-casein was associated with increased gastrointestinal inflammation, worsening of PD3 symptoms, delayed transit, and decreased cognitive processing speed and accuracy. Because elimination of A1 β-casein attenuated these effects, some symptoms of lactose intolerance may stem from inflammation it triggers and can be avoided by consuming milk containing only the A2 type of beta casein." ("Effects of milk containing only A2 beta casein versus milk containing both A1 and A2 beta casein proteins on gastrointestinal physiology, symptoms of discomfort, and cognitive behavior of people with self-reported intolerance to traditional cows' milk ...")

5 Replenishing the Gut Microbiota by Dairy Products and its Derivatives

Dairy plays a quintessential role in the day to day lives of everybody, since we were a child we have been advised to consume dairy products – especially milk on a daily basis. Milk is a versatile dairy product.

Some state that drinking milk on a daily basis is quite harmful as it causes acne and may also lead to inflammation. But again there are some positive impacts on drinking milk such as increase in bone density, the risk of lowering diabetes and it can also help you reduce weight.[32]

The gut microbiota is a diverse metabolic pathway which has both localised functions as well as an impact on the peripheral organs. The major impact of the health impact by dairy products are due to the differences in their nutritional composition as well as have an impact on the calorific content. The functionality of the gut microbiota is influenced by the diet, age, sex. Milk which contains fat and protein has a slightly different impact on the gut microbiota than dairy derivatives(cheese, yoghurt) which contains casein and whey but both of these products can trigger compositional changes in the gut microbiota.[33]

Fernandez-Raudales studied the effect of cow milk to two different types of soy milk (low glycine soy milk and conventional soy milk) for a period of three months. This study was carried out in obese participants, the composition of the gut was determined by qPCR and bTEFAP. The qPCR test revealed that the concentration of *lactobacillus* was significantly higher than *bifidobacterium* in the cow milk condition at the end of the study.

The bTEFAP revealed that the bacterial diversity was significantly reduced in both the cow milk, soy milk conditions. [34]

Link- Amster et al reported that the consumption of fermented yoghurt increased the concentration of lactobacillus and bifidobacterium during the three weeks intervention period.[35]

These various studies prove the point that dairy products have the capability of altering the gut microbiota by changing the composition of microbes that exist. Dairy products contain A1 beta casein protein which can trigger the gastrointestinal tract trigger time and trigger GI inflammation by producing opioid peptides. One study tried to study the effect of casein on the GI tract but failed to study its impact on the GI tract. ("The effects of dairy and dairy derivatives on the gut microbiota: a systematic literature review")

Milk, kefir and yoghurt seem to increase the concentration of lactobacillus and bifidobacterium which inturn strengthens the host's health. The quantity of dairy and dairy derivatives (casein and whey) has no whatsoever significant impact on the gut microbiota.

6 ELISA Test of Milk and Cheese and Yoghurts[36]

In the study titled ***"Detection of Rota and Corona Viruses in Raw Milk and Milk Products"*** which was carried out by Abd-ELsamei Mohamed Hamdi et al, they carried out ELISA test for ROTA and coronavirus on 100 different raw milk samples, 60 cheese samples and 50 yoghurt samples which were derived from 3 different districts within Egypt which were Cottour, El-Mehalla El-Kobra and Tanta.

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https://nutritionj.biomedcentral.com/articles/10.1186/s12937-016-0147-z. Accessed 25 June 2022.

[32] Seaver, Victoria. "What Happens to Your Body If You Drink Milk Every Day." EatingWell, 28 April 2022, https://www.eatingwell.com/article/7961444/what-happens-to-your-body-if-you-drink-milk-every-day/. Accessed 25 June 2022.

[33] "The effects of dairy and dairy derivatives on the gut microbiota: a systematic literature review." NCBI, 23 August 2020, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7524346/. Accessed 25 June 2022.

[34] Fernandez-Raudales D, Hoeflinger JL, Bringe NA, Cox SB, Dowd SE, Miller MJ, Gonzalez de Mejia E. Consumption of different soymilk formulations differentially affects the gut microbiomes of overweight and obese men. Gut Microbes. 2012;3:490–500. doi: 10.4161/gmic.21578. Accessed 25 June 2022.

[35] Link-Amster H, Rochat F, Saudan K, Mignot O, Aeschlimann J. Modulation of a specific humoral immune response and changes in intestinal flora mediated through fermented milk intake. FEMS Immunol Med Microbiol. 1994;10:55–63. doi: 10.1111/j.1574-695X.1994.tb00011.x. Accessed 25 June 2022.

[36] Hamdi, Abd-ELsamei Mohameda. "Detection of Rota and Corona Viruses in Raw Milk and Milk Products."

As stated before, coronavirus originated in the 1930's and was first found in animals. It can be transmitted to the milk product due to some contamination or mishandling of the product.
Milk contaminated by rota and corona viruses by faecal contamination due to bad hygienic measures in the milking place. Infected milk and milk products act as vehicles for transmission of rota and corona viruses. The rota and corona viruses could survive in the contaminated milk after high temperature short time (HTST, 71.7C for15s) pasteurisation and induce public health hazard in dairy products such as yoghurt and cheese *(Vanden Berg, 1986, Panon et al., 1988 and Hazel Appleton 2010)*.

The results for the same are as follows

Table 1 - Detection of rota and corona viral antigen in milk samples from randomly markets by ELISA test at El-Gharbia Governorate in Egypt

Districts	Number of Samples	Detection of ROTA virus antigen in Milk		Detection of CORONA virus antigen in Milk	
		+ve	-ve	+ve	-ve
Couttor	25	4	21	2	23
El-Mehalla El Kobra	50	9	41	3	47
Tanta	25	2	23	-	25
Total	100	15	85	5	95

Table 1 depicts that only 15/100 milk samples collected tested positive for ROTA whereas only 5/100 tested positive for coronavirus "The results pointed out that the milk contaminated by fecal contamination (exogenous mean) because the rotavirus and coronavirus not shedding in milk from infected and carrier animals but the two viruses was shedding in faces of diarrheic neonatal calves or from apparent healthy calves and cattle these results were in agreement with those reported by Lu et al. (1991), Abou El Hassan et al. (1995), Barboi and Turcu (1995), Abd El Rehim (1997), Sahna et al. (2005) and Abrams and Hilmers (2008). The positive results obtained may be due to seasonal factors during collection of samples, and bad hygienic measures." **(Hamdi 5)**

Table 2 – Comparison between ROTA and CORONA virus antigen in the same examined Milk samples by ELISA test

Districts	Number of Samples	Mixed Infection	ROTA	CORONA
Couttor	25	2	4	2
El-Mehalla El Kobra	50	2	9	3
Tanta	25	-	2	-
Total	100	4	15	5

Table 2 depicts that the milk samples are more likely to be infected by rotavirus than coronavirus thus also suggesting that rotavirus is more stable than coronavirus.

Table 3 – Detection of ROTA and CORONA viral antigen in different types of Cheese from randomly marketed at El-Gharbia Governorate by ELISA test

Types of Cheese	Number of Samples	Detection of ROTA virus antigen in Cheese		Detection of CORONA virus antigen in Cheese	
		+ve	-ve	+ve	-ve
Kariesh cheese	30	5	25	2	28
White cheese from unknown source	20	2	18	1	19
Canned white cheese	10	-	10	-	10
Total	60	7	53	3	57

Table 3 shows that out of 60 cheese samples that were collected 7 and 3 tested positive for rotavirus and coronavirus respectively, thus suggesting that the milk that was used for the process was infected with the virus.

Table 4 – Detection of ROTA and CORONA viral antigen in different types of Yoghurt at El-Gharbia Governorate by ELISA test

Types of Cheese	Number of Samples	Detection of ROTA virus antigen in Yoghurt		Detection of CORONA virus antigen in Yoghurt	
		+ve	-ve	+ve	-ve
Balady yoghurt	40	3	37	-	40
Canned yoghourt	10	-	10	-	10
Total	50	3	47	-	50

Table 4 depicts that out of 50, 3 and 0 yoghurts depicted positive for rotavirus and coronavirus.

From all the above results it is evident that milk and milk products are important when it comes to the transmission of disease which pose a threat to the general public.

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