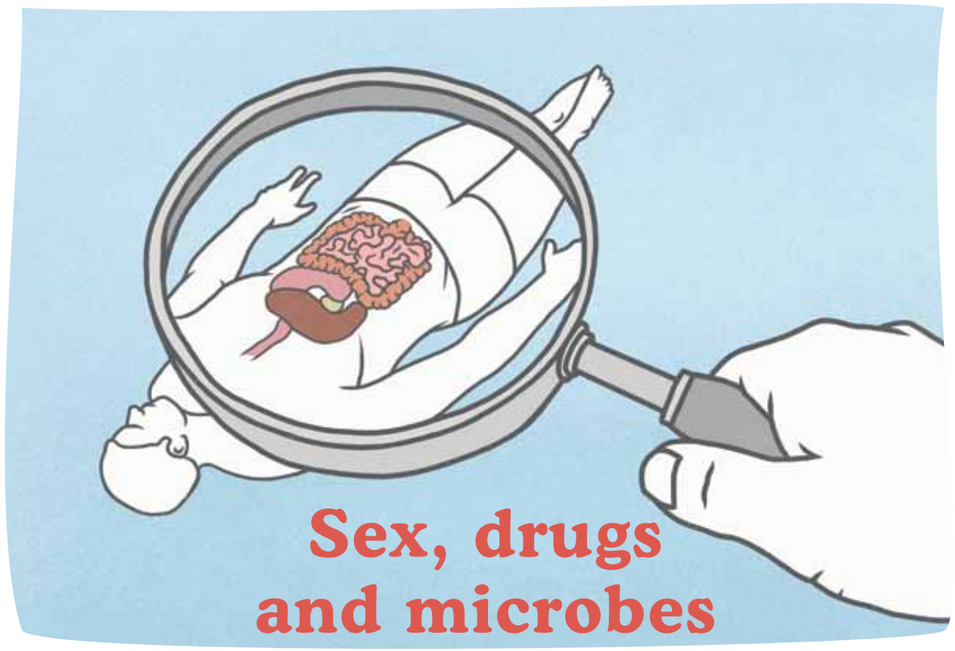

Sex, drugs and microbes

It's Sunday morning and you're feeling dusty. Last night, you drank too many coconut tequilas, had wild sex, a broken sleep, and then woke up feeling nauseous. Sound familiar?

Words Josh Reed

Sometimes, after a big night, not even a double shot of coffee can fix your brain and merry-go-round stomach. After a couple of pain killers, a glass of Hydralyte, two litres of water and Vegemite toast, you're starting to feel a little better ... just. The leaching effects of your hangover will be felt by your liver and gut all week.

I'm sure you've been here and felt this way. You might have even sworn to never drink this much alcohol again ... until your brain somehow forgets your history of hangovers and convinces you to "get lit" once more. And the cycle starts again.

Let's talk alcohol, caffeine, Nurofen (NSAIDs) and other drugs. It's well known these drugs target your nervous system, but have you considered their effects on your gut microbes? These are a complex ecosystem that mediates interactions between yourself (their host) and the environment that surrounds you. The interaction between your gut microbes and drugs is complicated and is actually bidirectional. This means drugs influence the composition of your gut microbes, but your gut microbes can influence the way drugs act on you.

Research has shown that your gut microbes can directly influence the way you respond to specific drugs through enzymatically transforming the drug's structure. In turn, this can alter the drug's bioavailability (absorption), bioactivity (actions) or toxicity. This phenomenon is referred to as pharmacomicrobiomics. And because we all have individual gut microbiota profiles, just like fingerprints, this high interindividual variability likely leads to variations in their metabolic activity, including the way they metabolise drugs. Basically, your gut microbiome is one of the reasons certain drugs may affect you differently to others.

There are hundreds of intrinsic and environmental factors that influence your gut microbiome, including diet, exercise, sleep, stress, genetics and disease. In addition, drugs, including medications, recreational drugs, alcohol, coffee and the like, also significantly influence your microbe profile. For the sake of clarity, drugs are defined as medicines or substances other than food that have physiological effects when ingested or introduced into the body. They are made from plants (cannabis or mushrooms), processed plant products (alcohol or heroin) or synthetic chemicals (ecstacy or amphetamines).

Commonly used medications

The Dutch LifeLines-DEEP cohort study found that PPIs (antacid/reflux medication), statins (cholesterol meds), laxatives, metformin (for diabetes), beta blockers (heart medication), ACE inhibitors (for blood pressure) and SSRIs (antidepressants) were the top microbiome-influencing drugs. For example, the study showed that PPIs were the drugs most associated with a decreased diversity and taxonomical changes in the gut microbiome. To note, a healthy gut microbiome is characterised by a rich diversity of microbes; PPIs were shown to reduce this diversity as well as decrease an individual's resistance to pathogenic bacteria infections such as *Clostridium difficile*. Furthermore, the commonly used diabetic medication Metformin has been shown to significantly increase *E.Coli* levels, lower Intestinibacter abundance and cause gut side effects such as diarrhoea and nausea in up to one-third of individuals.

As for antibiotics? They certainly don't discriminate. Some would say they are all-inclusive, however discrimination in this context would actually be a positive thing. You see, they don't just act on the bacteria infecting you, they also exert their killing effects on your resident (good) microbes.

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A 2008 study showed that treatment with the antibiotic ciprofloxacin influenced about one-third of bacterial species in individuals who took them. Specifically, they decreased their bacterial richness and diversity. It was noted that even after six months, several of the bacterial taxa had not recovered.

Antibiotics can influence the development of immunological disorders by altering the interaction between gut microbes and the immune system. To put this into perspective, it has been found that children who are exposed to antibiotics in their first year of life have a slightly increased risk of developing asthma, and this risk is increased with the number of antibiotic courses. Other examples of the negative effects of antibiotics on the gut microbiome include depletion of vitamin-producing bacteria; impacts on digestion including altered efficiency of nutrient extraction; reduced diversity of microbes, which increases susceptibility to infection and diarrhoea; and increased inappropriate immune activity including allergies and autoimmune diabetes.

It's important to note that antibiotics definitely have their place, but keep in mind concurrent interventions to remedy their undesirable impacts on your gut microbiome are favourable. For example, concurrent probiotic use and/or dietary prebiotic intake can mediate some of their negative effects.

When drugs are administered orally, they move through your intestinal tract encountering thousands of different microbial species. These consequent interactions not only impact the growth and function of your microbes, but your microbes can also directly influence the actions of the specific drug via enzymatically transforming the drug's structure. A study in 2019 looked into this and found that in the 271 drugs that they incubated with gut microbes, 176 were metabolised to such an extent that the level of the drug dropped by more than 20 per cent. The research in this area is fundamental as individual gut microbiome profiles influence the efficacy of medical drug therapy, hence drug therapy is likely to be optimised by modifying your gut microbiome.

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Alcohol

It has been estimated that approximately two billion people worldwide drink alcohol on a daily basis. Not only does excess alcohol consumption increase the risk of developing cancer, abnormal immune function, pancreatitis, acute and chronic infections and disturbed sleep, it also has a significant influence on disrupting your gut microbiome. Disruption of your gut microbiome, known as dysbiosis or bacterial overgrowth, is associated with numerous conditions including cancers, inflammatory bowel disease, food allergies, neurological conditions, obesity and cardiovascular disease. Studies show that alcohol consumption can promote both dysbiosis and bacterial overgrowth, which in turn can lead to an increase in the release of endotoxins, and endotoxins promote inflammation via activating specific proteins and immune cells.

Numerous studies have shown that excess alcohol consumption influences dysbiosis via altering the ratio of *Bacteroidetes* and *Firmicutes*, as well as increases *Proteobacteria*, a pathogenic bacteria species. Further to this, alcohol consumption can influence bacterial overgrowth through a number of mechanisms, including altering bile-acid metabolism. In addition, alcohol use can interrupt normal circadian rhythms, which has been associated with increasing gut permeability and impacting gut microbe health. Alcohol consumption also decreases SCFA-producing bacteria and disrupts your intestinal barrier integrity via promoting the growth of gram-negative bacteria.

Coffee

Coffee is one of the most consumed beverages worldwide and evidence shows that drinking it can improve your gut microbiome health. Numerous epidemiological studies have found an association with moderate coffee consumption and reduced risk for many diseases, including obesity, type 2 diabetes and some cancers. It is likely these health benefits are, in part, related to the participation of your gut microbes metabolising certain compounds found in coffee, including caffeine, polyphenols and fibres. For example, it has been demonstrated that coffee-derived polyphenols both improve the diversity and health of your gut microbes, as well as deliver greater antioxidant activity after being catabolised by your intestinal microbes. What are you waiting for, wild one? It's time to pour that cup of freshly brewed coffee.

Psychoactives

Although little research exists, a recent study in mice demonstrated that psychoactive drugs, including the amphetamine class of psychostimulants, alter the gut microbiome. The study's results showed that methamphetamine, methcathinone and 4-methylmethamphetamine each caused significant alterations in the diversity and taxonomic structure of the gut microbiome of mice. The predominant changes occurred within the *Firmicutes* and *Bacteroidetes phyla*. In the study, the drugs caused significant changes in the gut microbiome that were rapid in onset and relatively long-lived. In other words, not good.

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5 ways to
ease your hangover stat

1 Probiotics may be beneficial during or after a course of antibiotics. However, evidence is still lacking. Your best bet is to feed your gut microbes prebiotics such as wholegrains, legumes and vegies.

2 Although alcohol is not ideal for your gut, some research shows that a small glass of red wine daily may improve gut microbiota diversity.

3 Dehydration causes many of the symptoms of a hangover, therefore electrolytes such as hydralyte and plenty of water can be helpful.

4 Before drinking too much alcohol, eat a meal with carbohydrates such as sushi or pasta. This will slow the absorption of the alcohol into your system, plus help regulate your blood glucose levels. This is also useful post bender.

5 Excess alcohol consumption can deplete magnesium stores. Magnesium-rich foods include pepitas, quinoa, Brazil nuts, black beans and spinach.