

# Had a Gutsful?

There really is a second brain in your gut – and you can make it work smarter, says Dr Michael Mosley. He says improving intestinal health can help you lose weight, boost your immune system, lower the risk of type 2 diabetes, and even lessen anxiety and depression. Sarah Lang reports.

**O**n one summer morning in 2012, Dr Michael Mosley – the award-winning British television journalist, producer and presenter of programmes on biology and medicine – strolled into London's Science Museum to film a segment for a BBC special.

Overseen by a gastroenterologist, Mosley swallowed a centimetre-long capsule, which contained a tiny camera that takes pictures of the gastrointestinal tract (a procedure known as a capsule endoscopy). The “pillcam” was linked to a screen that broadcast images of Mosley's gut in action to their human host and a live audience.

This journey through his insides is threaded through Mosley's just-released book *The Clever Guts Diet: How To Revolutionise Your Body From The Inside Out* (Simon & Schuster, \$35).

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No dry scientific tome, it's a funny, fascinating tour of the gut – and the 30-50 trillion microbes (mainly bacteria) that live there and make up your microbiome.

The ancient Greek physician Hippocrates said all disease begins in the gut; it just took a while to figure out he was on to something. More than 2400 years later, humans have reached a new frontier of gut science, thanks largely to the genetic revolution enabling scientists to identify bacteria by looking for fragments of their DNA, and the introduction of the pillcam.

It's still early days, but already strong evidence is emerging that the microbiome is responsible for a lot more than we thought. As Mosley outlines, research indicates that improving your gut health can help you lose weight, boost your immune system, reduce the impact of common conditions such as irritable bowel syndrome (IBS), and even lessen anxiety and depression. The study of the gut-brain axis now has its own name, psychobiotics, and some scientists have even proposed classifying the microbiome as a distinct organ.

Where there's a gut, there's poo. In Europe, trials are under way to determine whether gut microbiome transfer (usually called faecal transplants) can treat obesity and diabetes by repopulating participants' guts with good bacteria. Here in New Zealand, scientists at the University of Auckland's Liggins Institute are giving 80 overweight teens capsules that contain gut bacteria from lean donors. Preliminary results from the Gut Bugs Trial's pilot study are expected later this year.

All this research is aiding understanding of how our bodies work – and how we can help them work better. Rather than waiting for the information to disseminate slowly, Mosley wants to help readers slot the science into their lives right now, whether they have gut conditions or simply want to improve their gut health. *The Clever Guts Diet* details helpful foods and those to avoid, with some surprises on the lists. And it clears up any confusion about what does and doesn't constitute prebiotics (non-digestible plant fibre that encourages the growth of "good" bacteria) and probiotics (live bacteria that parachute into your intestines).

This is also a recipe book, with dishes devised by nutritional therapist Tan-



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ya Borowski and Mosley's GP wife Clare Bailey. Borowski's two-stage remove-and-repair programme for people with mild gut conditions outlines how to eliminate then reintroduce foods to see if symptoms improve, and Mosley also examines how exercise, sleep and stress interlink with your microbiome, and the damage wrought by antibiotic overuse.

We caught up with him the week his book became a UK bestseller and the accompanying website [cleverguts.com](http://cleverguts.com) went live.

**North & South:** Tell me more about swallowing a pill camera at the Science Museum for a big-screen odyssey through your insides.

**Michael Mosley:** It was one of the most interesting and informative experiences of my life. I fasted and took some vile-tasting laxatives so the camera would get a clear view. When the camera got stuck at the bend where the oesophagus meets the stomach, I got a bit panicked that I'd have to go into surgery. But the gastroenterologist with me

said, "Jump up and down, it'll go through," so I did and it did.

The audience was partly enthralled, partly disgusted, but I was fascinated. My stomach reminded me of the surface of Mars, while my small intestine reminded me of snorkelling in a bay full of seaweed. Eight hours after I swallowed it, the camera made it to my large intestine, home to the microbiome. Twenty hours after I swallowed it, the camera ended its journey in my toilet.

**N&S:** Where is it now?

**MM:** By my bedside in a little box. I hand it around at talks sometimes. Well-cleaned up, I promise.

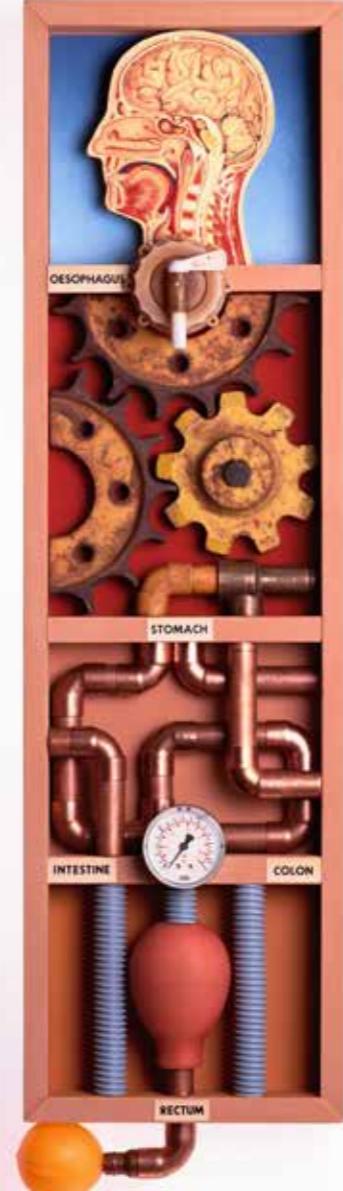
**N&S:** You've never heard anyone say they want to dedicate their life to the unglamorous gut. Are you suggesting that poo's "ew" factor is one reason why research in this field has been neglected until recently?

**MM:** That squeamishness is certainly true of the public but less true of the medical profession. Widespread ignorance about the microbiome is mainly down to the inability, until recently, to explore the gut with new technology. That's been helped by the introduction of the pill camera. Prior to that it was really guesswork, or you had to stick a tube all the way up or down, so you needed volunteers to be very keen indeed. Technology has utterly transformed this field. It's like Galileo inventing the telescope and suddenly being able to see the stars.

**N&S:** You spent a year talking to experts and researchers around the world. What did you learn that surprised you the most?

**MM:** There's the surprising link between your immune system and your gut. I talked to a researcher who said some of the strongest evidence behind the use of probiotics is the treatment of lung infections. I wouldn't have thought your lungs and your gut were at all linked. The other thing that really surprised me was the gut-brain axis.

**N&S:** The fact we have a second brain in our intestines?



**MM:** Yes, also called the enteric system. I find it oddly amusing that there are as many neurons in your gut – 100 million – as in the head of a cat. The brain in your gut communicates with the brain in your head via the vagus nerve. There's evidence that your microbes can hack into this system and talk directly to your brain, and they also produce hormones and neurotransmitters that reach your brain via your bloodstream, influencing things like mood and appetite. We've underestimated bacteria as small and stupid, when they're actually the most astonishing chemists, out to control their environment and kill their enemies.

They have the motive and the means to manipulate us. It's quite an odd thought that my gut bacteria may be altering my decision-making.

**N&S:** So we've been railing against McDonalds and Magnum ads, but our gut bacteria have nefarious motives, too? How sure are we that microbes can alter our behaviour?

**MM:** Right now, the most convincing evidence for that in particular comes from animal studies, but watch this space.

**N&S:** You write, "Can your microbiome make you fat? It certainly can." Isn't this a bit simplistic and doesn't it undermine personal responsibility for your weight?

**MM:** If anyone wants to challenge that, the book has an extended index. I am reasonably careful – obesity is complex, with various causes – but animal and human studies show a clear link between obesity and gut bacteria. Some gut bacteria extract more energy from the food you eat than others, and they can influence your blood-sugar levels, making you likely to eat more.

But we're not doomed. Mine is a message of hope. You can influence your microbiome by changing the foods you eat, which in turn influence the signals you get. Say you eat a mostly junk-food diet: that's influenced by advertising and by what you're used to eating, but also influenced by the domination of gut microbes that thrive on and generate cravings for junk food, so they're saying to your brain, "Give me more of those chips." If you switch to healthier foods, they'll say, "Give me more of that broccoli."

**N&S:** You admit in the book that, on the face of it, some of your claims are outrageous.

Do you expect a lot of criticism?

**MM:** We'll see. If you make extraordinary claims, you have to justify them and I believe I have. What I meant by that is that these things are still quite controversial. For instance, the idea of a link between depression and diet is only just being explored now.

A recent Australian study showed the Mediterranean diet significantly improved symptoms of depression.

**N&S:** So should people chuck out their antidepressants and stop seeing their psychologists?

**MM:** Absolutely not. There needs to be treatment on different fronts and, while I'm writing about the importance of gut bacteria, I want people to appreciate the complexities of these issues.

**N&S:** You write that a lot of recent gut research has been misinterpreted, exaggerated and overhyped by both the media, and food and supplement manufacturers. Is your book an attempt to set the record straight?

**MM:** Absolutely. One of the anxieties of people working in this field is that manufacturers of certain foods and supplements, like fish oils, have jumped on the gut-health bandwagon. It's just fantasy to think that one or two bacteria in a milky drink will solve your gut problems. My book points people to the best information about prebiotics and probiotics, and I'll constantly update that on the website.

**N&S:** You're not shy of indicting food and supplement manufacturers whose products are ineffective. Are you expecting the wrath of Yakult or Actimel, who sell so-called "probiotic" dairy drinks, to rain down upon you?

**MM:** It's possible. But everything I've said is based in fact. Those companies were asked to retract their claims by the European Food Standards Authority, and experts tell me the companies' studies that claim benefits aren't good enough. Plus, if you write a book about something, you might as well say what you think.

**N&S:** What do you say to those people who bemoan the modern obsession with food and diet, and that we should just go back to what our grandparents ate?

**MM:** There's no going back. Our lifestyles have changed so much. Speaking generally, our foods are different and probably less diverse

**"That stuff about eating refined carbs being fine is blindingly untrue. Their glycaemic load is similar to mainlining sugar."**



than our grandparents' food; we do less physical activity; we sleep an hour to an hour-and-a-half less. People talk about everything in moderation, but we've lost all sense of what moderation means. Your moderation might be completely different to mine. That's why it [diet] needs to be a bit prescriptive. And in some ways I'm advocating a return to basics, by saying avoid processed foods, and eat fermented foods, which people did for centuries. It's also about fibre, vegetables, good-quality protein. Eating eggs or fish for breakfast keeps me pleasantly full for far longer than exactly the same calories in cereal or toast. When I eat, I consider what it will do to my microbiome.

**N&S:** There are a few surprises on the recommended list, including tea and coffee, which contain gut-friendly polyphenol antioxidants. Hallelujah.

**MM:** I'm a big fan of coffee, too, and big studies have suggested coffee drinkers have an increased life expectancy, but don't drink more than two to three cups a day.

**N&S:** You seemed quite pleased that modest amounts of red wine are beneficial to the microbiome.

**MM:** Ah yes. I was. The evidence is pretty strong – again, no more than two or three glasses, with a meal.

**N&S:** You slam the "deadly substance" of sugar. Do you eat any?

**MM:** I wish I didn't, but I do. I do like the stuff. We don't have sugar itself in the house, but I do have dark chocolate around and it is in some food. I must admit I have the occasional doughnut. As for sugar-free drinks, they're vile. They can lead to inflammation in the gut and an increased risk of obesity.

**N&S:** You're not a fan of refined carbohydrates like white pasta, white rice and white bread, as they're low in fibre and see our blood sugar levels spike then crash. But I just read an article where a dietitian said it's fine to eat these, because our bodies are equipped to cope with increased blood-sugar levels.

**MM:** Some dietitians are bang up-to-date, but some base their information on out-of-date textbooks. That stuff about eating refined carbs being fine is blindingly untrue. Their glycaemic load is similar to mainlining sugar. New Zealand has some of the world's worst type 2 diabetes rates, and there's a quite strong emerging link between your gut bacteria and your risk of developing type 2 diabetes. Without a single doubt, your ability to bring blood-sugar levels down is one of the biggest determinants of your future health. Your blood-sugar numbers are more important than your cholesterol numbers in terms of life expectancy.

**N&S:** You have the appropriate caveats about this book being a guideline rather than gospel, and that anyone with an underlying health problem should consult a professional. But until doctors and dietitians catch up with new research, should people with less serious problems seek out this information themselves?

**MM:** I certainly think so. The problem is all the unbelievably terrible advice out there. When newspapers run contradictory headlines, it's very difficult to distinguish good science from bad science. I have tremendous sympathy for people who throw their hands up in the air. That's why I write these books on the best and most



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up-to-date science. Here, I wanted to share what I'd learned about an unbelievably exciting area of research in a very practical way.

**N&S:** If weight loss isn't the book's primary purpose, why use the word "diet" in the title?

**MM:** I agonised over that. I could have just called it *Clever Guts*, but would people know what that meant? And, for instance, the Mediterranean diet isn't a weight-loss regime but a way of eating, and that's what I mean by diet. But if you adopt the foods

and lifestyle I suggest, I have little doubt you'll lose any excess weight.

**N&S:** As you explain, traditional weight-loss regimens are sabotaged by the fact that, as you shed fat, levels of a hunger hormone rise, and levels of appetite-suppressing hormones fall. Should we even bother trying?

**MM:** The good news is those appetite hormones will reset. The bad news is you need to tough it out until they do. There's this widely quoted figure that 95 per cent of diets fail, but I've

discovered that's a completely made-up figure. Most of the 50,000 diets out there are absolute rubbish, but the credible ones, like the Mediterranean diet, have very good science demonstrating people can lose weight and keep it off. You just need to give it time and have an achievable plan.

**N&S:** Let's talk about poo. Specifically, faecal microbial transplants from a healthy donor to a patient, usually done via a colonoscopy.

**MM:** We have really good evidence now for faecal transplants being effective for *C. diff* [*Clostridium difficile*] infections, but the evidence in other areas isn't great yet. Various European researchers are doing faecal-transplant trials for obesity and type 2 diabetes, and we'll know the results in a year or two. It's also being trialled for IBS and leaky gut syndrome. But I just can't picture a future where we're all disappearing off for a lovely faecal transplant, can you?

**N&S:** It's poo's "ew" factor again. And you do say "squirted" with poo in the book.

**MM:** Perhaps not the best choice of verb. It's funny, there's both a revulsion to poo but also an interest in it. I wasn't sure whether to use faeces, stool or poo in the book, but I've mainly used poo, and sometimes faeces, as stool makes me think of a three-legged seat.

**N&S:** What about taking a poo pill, aka a faecal transplant in capsule form?

**MM:** Clearly it would be much, much more appealing to take a pill, but maybe there's something in poo that can't be captured in a pill.

**N&S:** Speaking of poo, you sent off a stool sample to get your microbiome sequenced?

**MM:** Yes. Several reputable companies will sequence your microbiome for under £100 [\$NZ185]. My results were certainly interesting. For instance, I had lower-than-average levels of firmicutes, which are linked to obesity, and just over half my gut bacteria were bacteroidetes, associated with a lean body type, less gut inflammation and a better immune response.

**N&S:** Did these results make you feel lucky?

**MM:** Yes. You inherit your microbiome from your mother, and my mother was lean, so there's a strong element of chance. But there's also strong evidence that changing your foods and lifestyle will alter your microbiome and, in turn, alter you.



There are a few surprises on Mosley's recommended list, including tea, coffee, red wine and dark chocolate, which are all rich in gut-friendly polyphenol antioxidants.

**N&S:** Did those results make you more sympathetic to overweight people who have more "bad" bacteria?

**MM:** I have tremendous sympathy for people who struggle with their weight – my dad was significantly overweight and I was, too, until recently. I'd love to know if my microbiome has changed dramatically since I lost 10 kilos. I suspect it has. So I do not underestimate the [weight-loss] challenge at all. That's why I fly into a rage when people say "It's just calories in, calories out." That's utter nonsense and unbelievably smug. It's usually said by people who, for whatever reason, don't struggle with their weight.

**N&S:** You found a correlation between having a diverse microbiome, and being slimmer and healthier?

**MM:** Yes. I think of the microbiome as a rainforest full of different species – around a thousand – but many of those species are in decline, partly because we eat so narrowly. Seventy-five per cent of the world's food comes from just 12 plants and five animal species. I encourage

people to eat a wider range of foods, especially colourful fruit and vegetables. Another reason for the decline is the widespread overuse of antibiotics, to treat us and put weight on the animals we eat. It's a tragedy. It's like the Americans carpet-bombing Afghanistan, but the collateral damage is killing the good bacteria, too. Already 700,000 people die every year from antibiotic-resistant diseases and that's projected to rise to a million by 2050. I met a guy in a hospital whose gut infection is resistant to all known antibiotics. My poo samples show I have resistance to three of the best-known antibiotics. The problem is we collectively worry about antibiotic resistance, but individually we just swallow them. People are just starting to appreciate the long-term impact of antibiotics, particularly for kids under three. Experts say, when you have to hit young children with antibiotics, give them probiotics: fermented foods.

**N&S:** You write that, living in India as a child, numerous courses of antibiotics almost certainly saved your life but may have contributed to the fact you later developed type 2 diabetes.

**MM:** When I found out I had diabetes in 2012, rather than start on medication I spoke to scientists to see if I could reverse the diabetes. Scientists told me about intermittent fasting: reducing your calories fairly dramatically a couple of days a week. For my documentary *Eat, Fast and Live Longer*, I cut my calories to around 600 a day for two days a week, over eight weeks. I found it surprisingly easy, lost 10kg and reversed my diabetes. Five years on, I've maintained both the weight loss and the improved blood-sugar levels. I bang on about the benefits of fasting in my book *The Fast Diet*, now known as the 5:2 diet.

**N&S:** You're often a human guinea pig for your books and docs. Why? To put your money where your mouth is? Because you're curious? To improve your health?

**MM:** All those things. Long before they won the Nobel Prize, I made

a doco about Dr Barry Marshall and Dr Robin Warren, who found stomach ulcers were caused by the gut bacteria *Helicobacter pylori*. They were ridiculed for this theory, so to prove it, Marshall drank *H. pylori* in some broth and had endoscopies and a biopsy done. Before this, you were on a drug for life or had your stomach removed. That utterly transformed the lives of millions. Also, I've personally got huge benefit from self-experimenting, especially the 5:2 diet.

**N&S:** You're also a fan of going hungry at times, even when not fasting?

**MM:** There's very good evidence to support the benefits of being hungry at times, and not eating between meals. Unfortunately we've embraced a culture where we feel we need to snack every two hours or we'll faint. That's just awful for you. Also, before writing this book, I didn't know there was very strong evidence that intermittent fasting boosts levels of the *Akkermansia* bacteria, which is strongly associated with being lean and reduced gut inflammation.

**N&S:** You distinguish the underdiagnosed coeliac disease from non-coeliac gluten sensitivity, aka gluten intolerance. Are you convinced the latter isn't just a fad?

**MM:** I'm still very sceptical about food intolerances, and we've been eating wheat for thousands of years. But, for a TV show, I looked at a revealing experiment organised by the University of Worcester. Flatulence and bloating were worse during the weeks we slipped gluten-loaded pasta into participants' diet, unbeknown to them.

**N&S:** As for IBS, you say the medical profession isn't very good at treating it. Why?

**MM:** Many diseases have been dismissed as psychosomatic when they're not, including IBS, which doctors often prescribe drugs for. Many people with IBS are left floundering. My wife, a GP, has found these gut-health ideas are helping her patients. It's

important to go through the two-stage repair-and-replace regime outlined in the book, eliminating then reintroducing various foods to see if symptoms improve. Some foods that are incredibly good for a healthy bowel irritate the hell out of others. There's probably another book needed for people with IBS and other conditions, given this one doesn't cover them in depth.

**N&S:** Do you see the book as a taster, so to speak, and the website as an ongoing resource?

**MM:** Yes. When I wrote *The Fast Diet* and *The 8-Week Blood Sugar Diet*, communities formed online, sharing their experiences, and that's what I hope happens here. It's also a place where I can share the latest information.

**N&S:** Is the website effectively unpaid work for you?

**MM:** Yes, and I also have doctor friends who donate their time. It's not a money-spinner, but it's worth doing. Also, I want to use it for recruiting. I'm a bit of an insomniac and there's decent evidence from animal studies and a small human trial that fibre-rich meals and fibre supplements aid deep sleep. Mine won't be a scientific trial, but I'd like to recruit people through the website to try potato starch, which I found markedly improved my sleep.

**N&S:** Couldn't that be the placebo effect?

**MM:** Yes, except I also took poo samples simultaneously, and as my gut bacteria changed, my deep sleep intensified.

**N&S:** Have you found natural sleep supplements aren't backed up by scientific research?

**MM:** Absolutely. This is the first thing I've come across that actually has science behind it. Insomnia's a big issue, and our gut health and our sleep are intrinsically linked and incredibly interesting. The book looks at sleep, stress management and exercise as the three pillars for improving your microbiome and health. You need to do all three simultaneously.

**N&S:** You also write about the science behind mindfulness meditation, which has helped you stay calmer and sleep better?

**MM:** Tests before and after my six weeks of mindfulness practice showed decreased activity on the right side of my frontal cortex, associated with pessimism, neuroticism and anxiety. I was amazed by the results. Some friends in Oxford study mindfulness and we'd like to do a trial taking poo samples before and after a mindfulness course, and see if the microbiome changes. No one's ever looked into it.

**N&S:** Does the future hold diets tailored to each individual, particularly their microbiome?

**MM:** I believe so. At the moment dietary advice is broadly useful, but not personalised. However, the Personalised Nutrition Project at Israel's Weizmann Institute is creating the first truly personalised diets. They've established beyond all reasonable doubt that your mix of gut bacteria alters how your body responds to food. So, wow, say if I knew my blood sugars would soar if I ate bread, I'd probably give up the bread. If it made no difference, I'd enjoy my sandwiches.

**N&S:** Isn't it just well-off people who can access these foods and information?

**MM:** This is absolutely not aimed primarily at an elite. My wife is a GP working in a deprived area and her patients get it. They want to change things. They don't want to take a bunch of drugs. People at all levels of income and education want to know this stuff, and it isn't hard to grasp.

**N&S:** You're very optimistic about the potential for this field to improve our health?

**MM:** I am. Science moves relatively slowly, but we have the technology, and I think this field will eventually change the way we treat a wide range of conditions from obesity and diabetes to depression. This is already one of the most exciting areas of modern medicine – and it's just the beginning.