

Chapter 18: Sleep, Exercise, and Therapy

Summary

The gut-brain axis does not switch off when you fall asleep, lace up your running shoes, or sit down with a therapist. This chapter explains how your body's internal clock and the stages of sleep connect to inflammation, gut microbes, and gut symptoms, and why teens need more sleep than most of them get. It then looks at what exercise really does for gut movement and mood, and at the best-studied brain-gut psychotherapies for IBS, including cognitive behavioral therapy and gut-directed hypnotherapy, plus mindfulness and slow breathing. Finally, it teaches you to keep a symptom diary like a scientist: noticing patterns without jumping to conclusions that a week of data can't support.

Concepts Covered

1. Circadian Rhythm
2. Sleep Architecture
3. Teen Sleep Need
4. Sleep and Inflammation
5. Microbiome Daily Rhythm
6. Sleep Hygiene
7. Physical Activity
8. Exercise and Gut Transit
9. Exercise and Mood
10. Psychotherapy
11. Brain-Gut Psychotherapy
12. Mindfulness
13. Slow Breathing
14. Heart Rate Variability
15. Self-Monitoring
16. Behavior Change

Prerequisites

- [Chapter 2: The Vagus Highway](#) (the parasympathetic "rest and digest" pathway)
- [Chapter 4: The Immune System as a Sense Organ](#) (cytokines and how inflammation affects the brain)
- [Chapter 7: Stress and the Gut](#) (the HPA axis and cortisol)
- [Chapter 8: Pain, Sensitivity, and the Gut](#) (visceral hypersensitivity)
- [Chapter 10: IBS and Disorders of Gut-Brain Interaction](#) (what IBS is and how it is diagnosed)

Everyday levers on the gut-brain axis



Most of this book has been about signals you can't see or steer directly. This chapter is about things you do every day: sleeping, moving, breathing, and how you talk to yourself about symptoms. These are real levers on the gut-brain axis, but they're also magnets for hype, so we'll check the evidence for each one. And because I run right past the heart on my way down, I get a starring role in the section on breathing.

18.1 Sam's Bad Nights and Bad Gut Days

Sam has started keeping notes on his phone. He runs cross-country, he has IBS with mixed bowel habits, and he has noticed something: his worst gut days seem to come after his worst nights. The Wednesday before his chemistry test, he slept about five hours, woke up with cramps, and spent first period worrying about where the nearest restroom was. The Saturday after a race, he slept nine hours and felt fine. (Sam is a fictional student who appears throughout this book.)

So is it the sleep? Sam's first thought is yes. But his friend Riya, who has Crohn's disease, points out a problem. "The night before the test, you were also stressed. And you stayed up late. And you probably ate dinner at 11. How do you know which one did it?" Sam doesn't. That question runs through this whole chapter, because sleep, exercise, stress, and therapy all touch the gut-brain axis and all tangle together in real life.

Riya has her own version. Before the orchestra's winter concert, she practiced violin past midnight almost every night. Her Crohn's is mostly in remission, but she wonders whether those short nights matter for her gut. This chapter looks at what the research says about both questions, and gives you a tool for asking them carefully.

18.2 Your Body Runs on Clocks

Think of a school bell schedule. Even if you never look at a clock, the bells tell everyone when to move, when to eat lunch, and when the day is over. Your body has its own bell schedule, and it rings for far more than sleep.

A **circadian rhythm** is a roughly 24-hour cycle in the body's functions, such as sleepiness, body temperature, hormone release, and digestion, that is driven by an internal clock and kept in step with the outside world, mostly by light. ("Circadian" comes from Latin words meaning "about a day.") According to the [National](#)

[Institute of Neurological Disorders and Stroke \(NINDS\)](#), these rhythms are why you tend to feel sleepy at night and can wake without an alarm.

The master clock sits deep in the brain. NINDS describes the suprachiasmatic nucleus (SCN) as a cluster of thousands of cells in the hypothalamus that receives information about light directly from the eyes. The SCN signals the pineal gland, which releases the hormone melatonin as it gets dark, helping you feel ready to sleep. For a refresher on brain states and the sleep circuits of the brainstem and hypothalamus, see [From Neuron to Bedside, Chapter 10](#).

Your gut keeps time too. As you'll see in Section 18.5, even the microbes living in your gut rise and fall on a daily schedule, and that schedule is set largely by when you eat. So the body really has two kinds of timing cues: light, which sets the brain's master clock, and meals, which help set the rhythm inside the gut. When the two get out of step, it's a bit like two marching bands playing the same song half a beat apart.

Why teens can't just "go to bed earlier"

Biology makes "just go to bed earlier" harder than it sounds. In 2014, the American Academy of Pediatrics (AAP) published a [policy statement on school start times](#). It explains that around puberty, the timing of sleep shifts later, by up to 2 hours compared with middle childhood, partly because melatonin is released later at night across adolescence. Many teens simply aren't sleepy at 9:30 p.m., even when they're exhausted.

The AAP called school start times before 8:30 a.m. a key, changeable cause of teen sleep loss and recommended that middle and high schools start no earlier than 8:30 a.m. When Riya can't fall asleep after a late practice, part of the problem is her schedule and part is a teen body clock running later than the school bell.

18.3 Inside a Night of Sleep

Sleep is not one long blank. It's more like a playlist that repeats through the night, with different tracks doing different jobs.

Sleep architecture is the structure of a night's sleep: the pattern of stages (light non-REM sleep, deep non-REM sleep, and REM sleep) and how they cycle and change across the night. NINDS describes it this way:

Stage	What happens	When it shows up
Non-REM stage 1	The changeover from waking to sleep. Heartbeat, breathing, and eye movements slow; brain waves begin to slow.	Lasts several minutes at the start of a cycle
Non-REM stage 2	Light sleep. Heart rate and breathing slow further and body temperature drops.	The stage you spend the most time in overall

Stage	What happens	When it shows up
Non-REM stage 3	Deep sleep, the kind you need to feel refreshed. Heartbeat and breathing reach their lowest levels; it is hard to wake someone up.	Longer periods in the first half of the night
REM sleep	Eyes move rapidly; brain activity looks closer to waking; most dreaming happens. Breathing, heart rate, and blood pressure rise toward waking levels.	First appears about 90 minutes after falling asleep; REM periods get longer later in the night

You cycle through non-REM and REM several times a night. Because deep sleep is concentrated early and long REM periods come late, cutting a night short from either end removes different kinds of sleep. Riya's late practices cut the beginning of her night, and her 6:30 a.m. alarm cuts the end.

How much sleep teens need

Teen sleep need is the amount of sleep recommended for adolescents to support health, learning, and mood. In 2016, the American Academy of Sleep Medicine (AASM) published a [consensus statement](#) (Paruthi and colleagues) recommending that teenagers 13 to 18 years old sleep 8 to 10 hours per 24 hours on a regular basis. [The Centers for Disease Control and Prevention](#) (CDC) lists the same 8 to 10 hours for ages 13 to 17.

Most teens fall short. In the CDC's [2025 Youth Risk Behavior Survey](#), only 24% of US high school students said they got at least 8 hours of sleep on an average school night, about 1 in 4. Sam and Riya are in the majority.

Short sleep is the normal teen experience, not a personal failure



When three out of four high school students don't hit 8 hours, the cause isn't three out of four people being lazy. Body clocks, early bells, homework, practices, and phones all push in the same direction, so fixing sleep is partly a personal project and partly a school and family one.

18.4 Sleep, Inflammation, and the Gut

Why would a short night touch the gut at all? One route goes through the immune system, which you met in [Chapter 4](#).

Think of inflammation as the body's alarm-and-repair crew. **Sleep and inflammation** refers to the two-way link between sleep and the immune system: disturbed sleep is associated with higher levels of inflammatory signaling molecules in the blood, and inflammation (for example, during an infection or a disease flare) can in turn change sleep.

What does the human evidence show? In 2016, [Irwin and colleagues](#) pooled 72 studies with more than 50,000 adults. People with disturbed sleep (trouble falling or staying asleep, or poor-quality sleep) had slightly higher blood levels of two inflammatory markers, C-reactive protein (CRP) and interleukin-6 (IL-6). The effects were small. Surprisingly, very long sleep was also linked to higher CRP and IL-6, while the shortest sleep was not, and lab experiments that kept people awake did not reliably raise these markers. So the link is real but modest, and it is mostly correlation.

Sleep and Crohn's disease

Riya's question has a direct study behind it. In 2013, [Ananthakrishnan and colleagues](#) followed 3,173 adults with inflammatory bowel disease through an online research network. Among 1,291 people with Crohn's disease who were in remission at the start, those who reported poor sleep had about twice the odds of having active disease six months later, even after the researchers adjusted for other factors. The same link did not show up in people with ulcerative colitis.

This is an important finding, but read it carefully. It's an association. Poor sleep might nudge inflammation upward, or early, not-yet-noticed inflammation might already be disturbing sleep, or a third factor (like stress or pain) might affect both. The study can't separate these.

Sleep and IBS

For IBS, the clearest study is small. In 2014, [Buchanan and colleagues](#) asked 24 women with IBS to record their sleep and symptoms each day. After a night of poor sleep, the women reported more abdominal pain, more anxiety, and more fatigue the next day. But poor sleep did not predict next-day bowel symptoms or depressed mood, and daytime symptoms mostly did not predict the next night's sleep. With only 24 people, all women, this is a hint worth testing, not a rule.

For families

If your teen has a gut condition and is up late, try to treat sleep as part of their health plan rather than a discipline issue. Teen body clocks run later, so a lecture at 11 p.m. rarely helps; a family agreement about screens charging outside the bedroom, a steady wake-up time on weekends, and protecting sleep the week of a big event usually helps more. If sleep stays poor, or pain or bathroom trips are waking your teen up, tell the care team, because night-time symptoms are useful medical information.

18.5 Gut Microbes Keep Time Too

Your gut microbes are like a city whose streets look different at 8 a.m. and at midnight: the mix of bacteria and what they're doing shifts over each day.

The **microbiome daily rhythm** is the repeating, roughly 24-hour change in which gut microbes are most abundant, where they sit in the gut, and what chemicals they make, a pattern shaped largely by when the host

eats. (You met the microbiome in [Chapter 3](#).)

The key study is from 2014, when [Thaiss and colleagues](#) reported in the journal *Cell* that gut bacteria in both mice and people rise and fall over the day, driven largely by feeding rhythms. In mice, breaking the host's internal clock, either by removing clock genes or by simulating jet lag, scrambled the microbes' rhythm. When the researchers moved microbes from jet-lagged mice or jet-lagged people into germ-free mice (mice raised with no microbes of their own), those mice developed blood-sugar problems and other metabolic changes.

Notice the kind of evidence. The cause-and-effect experiments were all in mice. The human part showed that microbes have daily rhythms and that jet lag changed them in travelers, but the effects of those changed microbes were tested only in mice. The study does not show that jet lag or late nights harm *people* through their microbes. That's why "your microbes follow a daily rhythm" is solid, while "a sleep hack resets your gut bacteria" is not.

Hype Meter: "This sleep hack resets your gut bacteria"

Strong

Moderate

Preliminary

Hype

Verdict: Hype. Gut microbes do have daily rhythms, shown in mice and people (Thaiss 2014), but the experiments linking a disrupted clock to harmful microbe changes were done in mice. No human trial has shown that a sleep trick, supplement, or gadget "resets" the microbiome in a way that improves gut or mental health. **What would change the grade:** Randomized trials in people that change sleep timing, then measure both microbes and real symptoms over months, could move a carefully worded version of this claim to Preliminary.

18.6 Sleep Hygiene: Setting Up the Conditions for Sleep

You can't force sleep, but you can make it easier. **Sleep hygiene** is the set of everyday habits and bedroom conditions that make good sleep more likely, such as a regular schedule, a dark and cool room, and limiting caffeine and screens before bed. ("Hygiene" here just means healthy habits, not cleanliness.)

The CDC's sleep page (dated May 15, 2024) lists tips like these:

- Go to bed and wake up at the same times each day, including weekends.
- Keep the bedroom quiet, relaxing, and cool.
- Turn off electronic devices at least 30 minutes before bed.
- Avoid large meals close to bedtime.
- Limit caffeine in the afternoon and evening.
- Get regular exercise.

These are reasonable, low-risk habits, but they are not a treatment for a sleep disorder. Ongoing insomnia, loud snoring with pauses in breathing, or gut symptoms that wake you at night are reasons to see a doctor, not just to buy blackout curtains.

Can you catch up on weekends?

Many students treat the weekend like a sleep bank: borrow on weekdays, pay it back Saturday. A [2019 experiment](#) by Depner and colleagues tested a version of this in 36 healthy young adults under controlled conditions. A small control group had nine-hour sleep opportunities. One group had five-hour sleep opportunities for nine nights. Another had five-hour nights during a "workweek," then could sleep as much as they wanted for a weekend, then went back to short nights. Over the weekend, the recovery group slept only about 1.1 hours more in total than at baseline. When short nights resumed, their body clocks were running later, and their insulin sensitivity (how well the body responds to the hormone that controls blood sugar) dropped, just as it did in the group that never got a weekend.

This was a small, short study in adults, and it measured metabolism, not the gut. But it fits a broader point: sleeping in helps you feel less tired without fully erasing a week of short nights, and a later weekend schedule makes Monday harder for a teen body clock.

Don't confuse "feeling rested" with "fully recovered"



A long Saturday sleep can make you feel great, but in the 2019 lab study, the body's response to short nights came right back once the short nights did. A steadier schedule across the whole week works with your body clock instead of against it.

18.7 Moving Your Body: Exercise, Gut Transit, and Mood

Sam runs cross-country, so he's already active. But he has noticed two opposite things: easy runs seem to settle his stomach, while hard race-day efforts sometimes send him sprinting for a porta-potty. Both observations fit the science.

Physical activity is any body movement produced by skeletal muscles that uses energy, from walking to class to running a race. Exercise is the planned, repeated kind. The [CDC](#) (page dated December 4, 2025) says children and teens ages 6 to 17 should get 60 minutes or more of moderate-to-vigorous physical activity every day, mostly aerobic activity like walking or running, with vigorous activity, muscle-strengthening, and bone-strengthening activities each on at least 3 days a week.

What exercise does to gut movement

Exercise and gut transit describes how physical activity changes how quickly food and waste move through the digestive tract, along with related changes in blood flow and the gut lining. The relationship depends

heavily on how hard and how long you exercise.

At moderate levels, being more active seems to help IBS. In a [2011 randomized trial](#), Johannesson and colleagues assigned 102 adults with IBS either to increase their physical activity, with instructions from a physical therapist, or to keep their usual lifestyle. Seventy-five people finished. On a standard IBS symptom severity score, the typical (median) improvement was 51 points in the activity group, compared with 5 points in the control group. That is one trial, in adults, but it was randomized, which makes it stronger than a survey.

At the extreme, the picture flips. A [2017 systematic review](#) by Costa and colleagues described "exercise-induced gastrointestinal syndrome." The review found that as exercise gets harder and longer, signs of injury to the gut lining rise, the lining becomes leakier, and strenuous exercise can slow stomach emptying and small intestine transit and reduce absorption. Exercising for two hours or more at about 60% of maximum aerobic capacity seemed to be the point where significant gut disturbances appear, whatever a person's fitness level. Heat and running made it worse. These changes reversed after exercise, and the review noted that moderate exercise appears to benefit people with IBD and IBS, while the safety of very strenuous exercise for them hasn't been studied enough.

So Sam's two experiences aren't contradictory. Easy, regular movement and an all-out race are different signals to the gut.

What exercise does for mood

Exercise and mood refers to the effects of physical activity on emotional well-being, including symptoms of depression, anxiety, and stress. Here the evidence is unusually large. In 2023, [Singh and colleagues](#) published an "umbrella review" in the *British Journal of Sports Medicine*, combining 97 reviews that covered 1,039 trials and 128,119 adult participants. Physical activity programs had medium-sized benefits for symptoms of depression and anxiety compared with usual care, and higher-intensity activity was linked to larger improvements. One caution: 77 of the 97 included reviews were rated "critically low" quality on a standard checklist for judging reviews, and all participants were adults. Part of the reason is hard to avoid: people always know whether they are exercising, so trials can't hide which group someone is in, and expectations may inflate the results. For young people, a [2023 meta-analysis in JAMA Pediatrics](#) (Recchia and colleagues) pooled 21 trials with 2,441 children and teens (average age 14) and found that physical activity programs reduced depressive symptoms, by a smaller amount than in the adult reviews.

Hype Meter: "Exercise helps with depression and anxiety symptoms"

Strong

Moderate

Preliminary

Hype

Verdict: Strong. A 2023 umbrella review combined 97 reviews of more than 1,000 randomized trials with over 128,000 adults and found medium-sized improvements in depression and anxiety symptoms from physical activity programs. The benefit shows up again and again across populations, which is why the grade is Strong. But most of the reviews had serious quality problems, trial participants can't be blinded, and a 2023 analysis of 21 trials in children and teens found a smaller benefit than in adults, so the exact size of the effect, especially for teens, is less certain than the direction. **What would change the grade:** Very little would move it down; large, high-quality trials in teens would make the evidence even more direct for this book's readers. Exercise is a support, not a replacement for other treatment when someone has depression.

Does exercise help mood through the microbiome?

Here's where wellness posts take a leap: exercise changes your gut bacteria, and those bacteria improve your mood. Each step sounds plausible.

In 2018, [Allen and colleagues](#) had 32 previously inactive adults (18 lean and 14 with obesity) do supervised endurance exercise three days a week for six weeks. Their gut microbes changed, and in lean participants the microbes made more short-chain fatty acids, molecules you met in [Chapter 6](#). But the changes depended on body weight and were "largely reversed" after six weeks without exercise. And the study did not measure mood at all.

Hype Meter: "Exercise changes your microbiome in ways that improve your mood"

Strong

Moderate

Preliminary

Hype

Verdict: Hype. Exercise does change gut microbes in people, but in the key human study (32 adults, 6 weeks), the changes were small, depended on body weight, mostly disappeared after stopping, and mood was not measured. No human study has shown that these microbe changes are *why* exercise helps mood. The mood benefit itself is Strong; the microbiome explanation is a popular story that the evidence does not yet support. **What would change the grade:** Studies that measure microbes and mood together, first in animals and then in people over months, and test whether blocking the microbe change also blocks the mood benefit, could move a carefully worded version of the link to Preliminary.

18.8 Therapy for the Gut-Brain Axis

When Sam's gastroenterologist first suggested he see a psychologist, his stomach dropped for a different reason. "So she thinks I'm making it up," he told Riya. Many patients worry about the same thing.

Psychotherapy is treatment that uses structured conversations and practice with a trained professional, such as a psychologist or licensed counselor, to change patterns of thinking, feeling, behavior, and body responses. It's often called talk therapy, but it usually includes practicing skills between sessions.

The best-studied type is cognitive behavioral therapy (CBT), which helps people notice how thoughts, behaviors, and body sensations feed each other, and practice new responses. CBT has strong evidence for mental health conditions. A [2023 meta-analysis](#) by Cuijpers and colleagues combined 409 trials with 52,702 patients and found that CBT clearly helped depression compared with control conditions, including in children and adolescents (with a smaller effect than in adults). A [2025 analysis](#) by Hofmann and colleagues of 49 randomized trials found a medium-sized benefit of CBT for anxiety disorders compared with placebo-type control conditions.

Therapy built for the gut

Brain-gut psychotherapy is the family of psychological treatments designed specifically for gut conditions, which target the gut-brain axis directly: how the brain processes gut signals, how stress and worry change gut function, and how fear of symptoms leads to avoidance. A [2022 report](#) from a Rome Foundation working team, led by Keefer, calls these "brain-gut behavior therapies" and reviews five classes of them, including gut-focused CBT and gut-directed hypnotherapy.

Why would talking change a gut? Recall from [Chapter 8](#) that in IBS the gut's pain signals can be amplified, like a smoke alarm set too sensitive, and from [Chapter 7](#) that stress hormones and nerves change gut movement and sensitivity. Brain-gut psychotherapy works on the brain end of that loop. It doesn't mean the pain started in the mind. It means the brain is one of the places where the volume knob sits.

Two approaches have the most evidence for IBS:

- **Gut-focused CBT.** Patients learn how the gut-brain axis works, track symptoms and their triggers, practice muscle relaxation, learn to handle worry about symptoms, and gradually stop avoiding situations (like long bus rides) out of fear of an attack.
- **Gut-directed hypnotherapy.** A trained therapist guides the patient into a deeply relaxed, focused state and uses imagery and suggestions about gut comfort, for example picturing the gut as a calm, smoothly flowing river. Patients usually also practice at home with recordings. This is not stage hypnosis; it is a guided, cooperative form of focused relaxation.

How well do they work? In 2020, [Black and colleagues](#) published a network meta-analysis in the journal *Gut*, combining 41 randomized trials with 4,072 people with IBS. Compared with control conditions, several therapies lowered the chance of still having symptoms after treatment: self-guided or minimal-contact CBT (relative risk 0.61), face-to-face CBT (0.62), and gut-directed hypnotherapy (0.67). A relative risk of 0.67 means the chance of remaining symptomatic was about a third lower. But the authors warned that most trials had a high risk of bias, partly because patients always know whether they are getting therapy, so the benefits were "likely to have been overestimated." No therapy was clearly better than the others.

Guidelines now include these therapies. [The American College of Gastroenterology's 2021 IBS guideline](#) suggests gut-directed psychotherapy for overall IBS symptoms. For children and teens, a [2025 guideline](#) from the European and North American pediatric gastroenterology societies (ESPGHAN and NASPGHAN), covering ages 4 to 18, recommends hypnotherapy (strong recommendation, moderate-certainty evidence) and CBT (strong recommendation, low-certainty evidence) as treatment options for IBS and related abdominal pain conditions.

Hype Meter: "CBT and gut-directed hypnotherapy help IBS symptoms"

Strong

Moderate

Preliminary

Hype

Verdict: Moderate (near the top of the range). A 2020 network meta-analysis of 41 trials with 4,072 people found that CBT and gut-directed hypnotherapy reduced the chance of ongoing IBS symptoms, and a large 2018 trial of 436 adults found lasting benefits from home-based CBT. The ACG's 2021 guideline suggests gut-directed psychotherapy (a conditional recommendation), and a 2025 pediatric guideline recommends hypnotherapy and CBT. The grade stops short of Strong because many trials had a high risk of bias and the true benefit is probably smaller than reported. **What would change the grade:** More large trials with strong control conditions (for example, comparing therapy with an equally engaging education program) and long follow-up could move it to Strong. These therapies help many people; they don't cure IBS.

A closer look at one trial

The biggest single trial of CBT for IBS is the IBS Outcome Study (IBSOS). In 2018, [Lackner and colleagues](#) randomly assigned 436 adults with IBS whose symptoms hadn't improved with usual care to one of three groups: standard CBT (10 weekly one-hour clinic sessions), minimal-contact CBT (4 sessions, mostly home study using the same skills), or 4 sessions of IBS education about stress, diet, and lifestyle. Two weeks after treatment, 61.0% of the minimal-contact CBT group rated their gut symptoms as moderately or substantially improved, compared with 43.5% of the education group. Six months later, gastroenterologists who didn't know which group a patient was in rated 58.4% of the minimal-contact CBT group as improved, compared with 44.8% of the education group. The shorter, home-based version worked about as well as the full clinic version.

How to read a gut-brain claim: the 2018 IBSOS trial of CBT for IBS

Question	This study
Mouse or human?	Human: 436 adults with IBS (average age about 41, 80% women) at two US medical centers. No teens.
Correlation or cause?	Cause, within limits. People were randomly assigned to groups, so differences in improvement can be credited to the treatment. Patients knew which treatment they got, but one outcome was rated by gastroenterologists who did not.
How many?	436 people, large for a therapy trial (about 145 per group).
How long?	Outcomes were measured 2 weeks, 3 months, and 6 months after treatment ended.
Who paid for it?	The US National Institutes of Health (NIDDK grant 77738). The paper reports no conflicts of interest.
Is something being sold?	No product is sold through the study. The home-study materials were based on a self-help workbook co-written by the lead researcher, a detail worth noting even though no conflict was reported.

The conclusion: this is strong evidence that a brief, mostly at-home CBT program helps many adults with stubborn IBS more than education alone. It doesn't show that everyone benefits (about 4 in 10 in the CBT group did not rate themselves much improved), and it doesn't directly test teenagers.

18.9 Mindfulness, Slow Breathing, and Heart Rate Variability

Mindfulness is the practice of paying attention to the present moment, including thoughts and body sensations, on purpose and without judging them. In a gut condition, that might mean noticing a cramp as a sensation ("tightness, lower left, about a 4 out of 10") instead of spiraling into a story ("this is going to be a disaster, I'll have to leave class").

How strong is the evidence? In 2014, [Goyal and colleagues](#) reviewed 47 trials with 3,515 participants for the journal *JAMA Internal Medicine*. Mindfulness meditation programs produced small-to-moderate improvements in anxiety, depression, and pain, but no evidence that they worked better than other active treatments like exercise or therapy. The evidence for effects on sleep, attention, and positive mood was low or insufficient. For apps, a [2024 meta-analysis](#) by Linardon and colleagues of 45 randomized trials found that mindfulness apps produced small improvements in depression and anxiety symptoms compared with control groups, with no clear advantage over other active treatments. Small and real is a fair summary. "Proven cure" is not.

Breathing and the vagus nerve

Slow breathing is deliberately breathing at a slower-than-usual pace, often around six breaths per minute, with longer, steady exhales. You can try it right now: breathe in gently for about four seconds and out for about six. Six breaths like that take about a minute.

Why might it matter for the gut-brain axis? It connects to a measurement called heart rate variability. **Heart rate variability (HRV)** is the natural variation in the time between one heartbeat and the next. A healthy heart is not a metronome: when you breathe in, your heart speeds up slightly, and when you breathe out, it slows, largely because the vagus nerve, Vee's home from [Chapter 2](#), puts the brakes on the heart during the exhale. One part of HRV, often called vagally mediated HRV, is used by researchers as a window into how active the parasympathetic "rest and digest" system is.

In 2022, [Laborde and colleagues](#) published a meta-analysis of 223 studies of voluntary slow breathing. Vagally mediated HRV went up during slow-breathing sessions, right after a single session, and after training programs with many sessions. A companion review by Sevoz-Couche and Laborde explained that breathing near a "resonant" rate of about 0.1 cycles per second, which works out to about six breaths per minute, seems to produce the biggest effect.

What slow breathing does and doesn't show



When you breathe out slowly, my branches to the heart get busier, and HRV goes up. That's solid physiology. But higher HRV during a breathing exercise is not the same as "fixing" your gut, so think of slow breathing as a free, low-risk way to turn down the stress dial, not a cure.

There's no strong evidence that slow breathing on its own treats IBS or IBD. It's commonly taught as one skill inside CBT and hypnotherapy, and Sam uses it before races. Its strengths are that it's free, fast, and safe for most people.

18.10 Being Your Own Observer: Self-Monitoring and Behavior Change

Self-monitoring is regularly recording your own symptoms, behaviors, and circumstances (such as sleep, stress, food, activity, and bowel habits) to notice patterns and share accurate information with your care team. It's a core part of gut-focused CBT; the IBSOS trial included self-monitoring of symptoms, their triggers, and their consequences. Doctors also sometimes suggest food or symptom diaries.

But a diary can mislead. Here are the traps:

1. **Small samples.** A week has seven data points. One weird day (a stomach bug, a test, a birthday dinner) can create or erase an apparent pattern.

2. **Confounders.** A confounder is a third factor that affects both things you're comparing. If Sam sleeps badly *because* he's stressed, and stress also flares his IBS, sleep and gut symptoms will move together even if sleep itself does nothing to his gut.
3. **Reverse direction.** Maybe gut pain the night before woke him up, so bad gut days cause bad sleep, not the other way around.
4. **Expectation.** If Sam believes poor sleep wrecks his gut, he might notice and rate symptoms more harshly after a bad night.

Behavior change is the process of adopting and keeping a new health habit, such as a steadier bedtime or regular activity, usually by setting small, specific goals, tracking them, and adjusting based on what you learn. It pairs well with self-monitoring: change one thing at a time, keep it going long enough to see a pattern, and compare with before. A "new me" plan that changes sleep, food, exercise, and screens on the same Monday is hard to keep, and if it works, you won't know which part did it.

If you're going through this

If you track your symptoms, try to keep it short and kind, a minute or two a day, so it doesn't become another source of worry. Bring the log to appointments; patterns like "pain wakes me up at night" or "symptoms are worse the week of exams" help your care team. If tracking starts making you more anxious or makes you avoid food or activities you used to enjoy, that's worth telling your doctor or therapist too. Your diary is a tool for questions, not a verdict on your body.

The MicroSim below lets you practice this kind of careful self-observation with a week of made-up data.

Diagram: Gut and Sleep Diary



Interactive simulation: <https://aaryavvatts-lab.github.io/gut-brain-textbook/sims/ch18-gut-sleep-diary/main.html>

Open the Gut and Sleep Diary fullscreen



MicroSim specification: Gut and Sleep Diary



Type: microsim **sim-id:** ch18-gut-sleep-diary

Library: p5.js

Status: Implemented

Bloom Level: Evaluate

Bloom Verb: judge

Learning Objective: The learner will record or explore a one-week diary of sleep, stress, and gut symptoms, interpret the correlation between sleep and symptoms, and judge the limits of that personal data (small samples, confounders, reverse direction).

Canvas: 450 px drawing area plus 150 px controls (iframe 602 px); responsive to about 380 px wide.

Controls: Day select (Mon to Sun); sliders for Sleep (3 to 11 hours, step 0.5), Stress (0 to 10), and Gut symptoms (0 to 10); Load sample data, Clear all, and Show stress line checkbox.

Rules: Moving a slider records that value for the selected day. The sim computes the Pearson correlation (r) between sleep and gut symptoms and between stress and gut symptoms, using only logged days (at least 3 needed). It always shows a small-sample warning with the number of days, and it shows a confounder warning when stress tracks both sleep and symptoms ($|r|$ of at least 0.5 for both).

Privacy: Data lives only in the page's memory. Nothing is stored or sent; reloading erases it.

Provenance: Section 18.10. The preloaded week is fictional practice data, labeled as such. Correlation strength wording is a teaching convention.

Start with the **sample data**: a made-up week for Sam. Look at the time chart first, then the scatter plot. You should see a strong negative correlation: on nights with less sleep, gut symptom scores were higher. Now turn on **Show stress line**. Stress climbs on exactly the days sleep drops, and the confounder warning appears. With this data, you can't tell whether sleep, stress, or both drive Sam's symptoms.

Next, experiment. Select Wednesday (the test day) and change its gut score from 7 to 2. Watch how much r changes from a single day. Then try **Clear all** and enter your own week, or an imaginary one. Notice that the sim needs at least three days before it will compute anything, and that it never stops warning you about sample size. Your entries stay in this page only: nothing is saved or sent, and reloading the page erases them.

What this model leaves out

- Seven days is far too few to find a reliable personal pattern; real self-monitoring for a care team usually runs for weeks.
- The sim compares same-day values only. Real effects can be delayed (a bad night affecting the next day, or the next week).
- It tracks just three things. Food, meal timing, illness, medicines, periods, and other factors are confounders it can't see.
- The 0 to 10 scores are self-ratings, which are shaped by mood and expectations, not objective measurements.
- A correlation in one person's diary can't show cause; only changing one thing at a time, over enough time, and ideally with your care team, gets closer to that.

At the Bedside: Sam's Course of Brain-Gut Therapy



Meet the patient (fictional)

Sam is 16 and runs cross-country. He was diagnosed with IBS with mixed bowel habits at 15, after tests ruled out other causes. Diet changes and medicine from his gastroenterologist helped some, but cramps and urgent trips to the restroom still spike before big tests and races. He has started skipping team bus trips and asking to take tests in a room near the restroom. He tells his doctor he's afraid the pain will "never go away."

What the doctor checks: His gastroenterologist reviews his history and confirms nothing has changed that would suggest a different diagnosis, such as weight loss, blood in the stool, or symptoms waking him at night (these "red flags" would prompt more testing). She looks at Sam's two-week symptom diary, asks about sleep, mood, school stress, and how much the symptoms are limiting his life, and screens for anxiety and depression with a short questionnaire.

Connecting the signals: Sam's diary shows symptoms clustering around tests, races, and short nights. His gut is sensitive (Chapter 8), stress shifts gut movement (Chapter 7), worry about symptoms adds more stress before each event, and avoidance is shrinking his life. These are exactly the loops brain-gut psychotherapy targets.

Diagnosis: IBS with mixed bowel habits, with test anxiety and symptom-related avoidance. Nothing new or dangerous.

Why it happens: In IBS, signals from the gut are amplified on their way to the brain, and the brain's stress response feeds back to make the gut more reactive. Poor sleep and stress may turn the sensitivity up further, though in Sam's case it's hard to tell which comes first.

The mind-body side: Sam's first reaction to the referral was, "So it's all in my head?" His doctor explains that his pain is real and that therapy works on the brain's side of the two-way gut-brain connection, much as physical therapy retrains muscles after an injury. Over 10 weeks with a psychologist trained in brain-gut therapy, Sam learns how the gut-brain axis works, keeps a short daily log, practices slow breathing and muscle relaxation, and learns to answer catastrophic thoughts with more realistic ones. He also does a short course of gut-directed hypnotherapy with home recordings. What improved: fewer pain days, less fear before tests, and he rides the team bus again. What didn't: he still has some urgent mornings before big races, and a stomach bug in week 6 set him back for a while. His sleep improved only a little, because cross-country meets and homework still keep him up late.

Treatment today: IBS care usually combines education, attention to diet and lifestyle, medicines aimed at specific symptoms when needed, and brain-gut psychotherapy such as CBT or gut-directed hypnotherapy, which the 2021 American College of Gastroenterology guideline suggests for overall IBS symptoms and a 2025 pediatric guideline recommends for children and teens. Treatment plans are individual and are decided with the care team.

What's new in research: In 2026, a [Dutch randomized trial](#) in the *British Journal of General Practice* tested home-based guided hypnotherapy through a website for 152 children aged 7 to 17 with IBS or functional abdominal pain seen by family doctors. At 12 months, adequate relief was high in both groups and not significantly different (79.5% with hypnotherapy vs 74.3% with usual care alone), but the hypnotherapy group had relief more often at 3 and 6 months and reported less pain. **Evidence grade: Preliminary.** It's one trial, and its main 12-month result showed no difference, but it suggests online hypnotherapy might speed relief for kids without access to a therapist.

Your turn: reason through a variation

Riya's Crohn's disease is in remission, but she has started feeling anxious and sleeping badly before every orchestra concert, and she wonders if CBT would "fix" her Crohn's the way it helped Sam's IBS. How would you reason about this?

Answer: CBT and other brain-gut therapies can help Riya with anxiety, sleep, and coping, and many IBD care teams include psychologists for exactly that. But Crohn's disease is driven by immune inflammation, so therapy is not a replacement for her biologic medicine or monitoring by Dr. Alvarez. Since poor sleep in people with Crohn's in remission has been linked to later flares (an association, not proof of cause), improving her sleep and stress is a reasonable thing to discuss with her care team as one part of her plan.

This is a fictional teaching case. It is not medical advice. If you or someone you know has symptoms like these, talk to a doctor.

Common Misconceptions

Myth: You can fully catch up on lost sleep by sleeping in on weekends.

Reality: Sleeping in helps you feel less tired, but in a 2019 lab study, the body's metabolic response to short

nights returned as soon as short nights resumed after a weekend of recovery sleep. Weekend sleep-ins also push teen body clocks later, making Monday harder.

Myth: Any amount or intensity of exercise is equally good for gut symptoms.

Reality: Regular moderate activity improved IBS symptoms in a randomized trial, but very long, hard exercise (around two hours or more at high effort) can slow parts of the gut, irritate the gut lining, and trigger symptoms. Intensity and duration matter.

Myth: If a doctor recommends therapy for IBS, it means the pain is psychological or fake.

Reality: IBS pain is real and comes from the gut-brain axis. Brain-gut psychotherapy works on the brain's side of that two-way loop, changing how gut signals are processed and how stress affects the gut, and guidelines recommend it alongside other care.

Myth: Mindfulness apps are proven cures for gut and mood problems.

Reality: Mindfulness programs and apps give small, real improvements in anxiety and depression symptoms in trials, but they haven't been shown to beat other active treatments, and they don't cure IBS or IBD.

Myth: If your symptom diary shows a pattern, you've found the cause.

Reality: A week or two of personal data is a small sample, and confounders (like stress affecting both sleep and symptoms) or reverse causation can create patterns. A diary is great for generating questions to test with your care team.

Your Gut Check

Test yourself. Try each one before you open the answer.



1. Claim Check: "Science proves working out rebuilds your gut microbiome and that's why it cures anxiety. Six weeks, new gut, new you!"



Grade: Hype. Exercise does improve anxiety and depression symptoms on average (Strong evidence from many trials), but that's not a cure. Exercise also changes gut microbes, but in the key study of 32 adults, the changes were small, depended on body weight, and largely reversed six weeks after stopping, and the study didn't measure mood. No human study shows microbes are the reason exercise helps anxiety. A careful version: "Regular exercise helps many people's mood, and it changes gut microbes a little; scientists don't know yet whether those two facts are connected."

? 2. Predict: Riya practices violin until 1 a.m. every night for two weeks before a concert. Based on the research in this chapter, what might you predict about her Crohn's disease, and how confident should you be? ✓

In a large study, people with Crohn's in remission who reported poor sleep had about twice the odds of active disease six months later. So it's reasonable to predict a somewhat higher chance of a flare in the following months if poor sleep becomes a pattern. But confidence should be modest: the study showed an association, two weeks is short, and concert stress could matter as much as sleep. She should keep taking her medicine and tell Dr. Alvarez if symptoms change.

? 3. Explain: Sam slows his breathing to about six breaths per minute before a race. Explain what happens to his heart rate variability and why, using the vagus nerve. ✓

During slow breathing, the heart speeds up a bit on each inhale and slows on each long exhale. That slowing comes mostly from the vagus nerve's "brake" on the heart, which is part of the parasympathetic system. Slower, deeper breaths make these swings larger, so vagally mediated HRV goes up, which a 2022 meta-analysis of 223 studies confirmed. This shows parasympathetic activity increasing, which may help Sam feel calmer, but it doesn't directly prove any change in his gut.

? 4. Apply: A school is debating whether to move its start time from 7:30 a.m. to 8:30 a.m. Use this chapter's evidence to write the strongest one-paragraph argument for the change. ✓

Teens need 8 to 10 hours of sleep per 24 hours (AASM 2016), yet in 2025 only about 1 in 4 US high school students got even 8 hours on school nights (CDC). Puberty shifts sleep timing up to 2 hours later, so teens can't simply fall asleep earlier, and the AAP calls start times before 8:30 a.m. a key, changeable cause of teen sleep loss. Better sleep may also matter for students with chronic conditions, since poor sleep has been linked to later flares in Crohn's disease.

5. Read the data. In the 2018 IBSOS trial (Lackner et al., *Gastroenterology*), 436 adults with IBS were randomly assigned to standard CBT (10 clinic sessions), minimal-contact CBT (4 sessions, mostly at home), or IBS education (4 sessions). Here are the percentages rated "moderately or substantially improved" for two of the groups:

Time and rater	Minimal-contact CBT	Education
2 weeks after treatment, rated by patients	61.0%	43.5%
2 weeks after treatment, rated by gastroenterologists	55.7%	40.4%
6 months after treatment, rated by gastroenterologists	58.4%	44.8%

5. What does this data show, and what can't it show?

It shows that more people improved with minimal-contact CBT than with education, by roughly 14 to 18 percentage points, and the difference held for six months even when rated by doctors who didn't know the patients' groups. It also shows that many people improved with education alone (over 40%), so some improvement comes from attention, time, and information. It can't show that CBT works for teens (all participants were adults), that it helps everyone (about 4 in 10 didn't improve much), or how long the benefit lasts past six months. A useful follow-up would be a similar randomized trial in teenagers with IBS, with follow-up for a year or more.

Exercises

Remember

1. How many hours of sleep per 24 hours does the American Academy of Sleep Medicine recommend for teens aged 13 to 18?

Answer

8 to 10 hours per 24 hours on a regular basis (Paruthi et al., 2016).

1. Name the two brain-gut psychotherapies with the most evidence for IBS.

Answer

Gut-focused cognitive behavioral therapy (CBT) and gut-directed hypnotherapy.

Understand

1. Explain why the Thaiss 2014 study supports "gut microbes have a daily rhythm" but not "late nights harm people through their microbes."

Answer

The study showed daily microbe rhythms in both mice and people. But the experiments showing that a disrupted clock leads to harmful microbe changes, with effects passed on by transferring microbes, were done in mice, so they can't tell us what happens in people.

1. Explain how a confounder could make sleep and gut symptoms look connected in a personal diary even if sleep has no effect on the gut.



Answer



A third factor, such as stress, could cause both poor sleep and worse gut symptoms. Then sleep and symptoms would rise and fall together because both follow stress, not because one causes the other.

Apply

1. Using the Gut and Sleep Diary MicroSim, load the sample data and record the sleep-symptom r . Then change one day's values to make the pattern disappear. How many days did you have to change? What does this tell you about drawing conclusions from one week?
2. A friend with IBS is training for a half marathon and says, "Exercise is good for IBS, so the harder I train, the better my gut will be." Use the evidence on exercise and gut transit to give your friend accurate advice that doesn't tell them what to do medically.

Analyze

1. Compare the Ananthakrishnan 2013 Crohn's study and the Buchanan 2014 IBS study. For each, describe the population, size, and type of evidence, and explain why one finding might apply more confidently to Riya than the other applies to Sam.
2. In the IBSOS trial, more than 40% of the education group improved. Analyze at least three reasons people in a "control" group might improve, and explain why this makes randomized comparison groups so important.

Evaluate

1. An app advertises: "Our 5-minute daily breathing exercise is clinically proven to raise your vagal tone and heal your gut." Evaluate each part of this claim using the slow breathing and HRV research in this chapter. Which parts are supported, and which are not?
2. Some people argue that teens should treat sleep hygiene, exercise, and mindfulness as their "first-line treatment" for IBS before trying anything else. Judge this position using evidence from this chapter and the treatments discussed in Chapter 10. What would you keep, and what would you change?

Create

1. Design a four-week self-monitoring plan that would help Sam test whether sleep affects his gut symptoms more fairly than his phone notes did. Specify what he records, how he would deal with stress as a confounder, and what result would (and wouldn't) convince you.

2. Create a one-page "brain-gut therapy explainer" for a teen who has just been referred to a psychologist for IBS and is worried it means "it's all in my head." Use at least three facts from this chapter and keep it under 250 words.

Key Takeaways

- Circadian rhythms run on a roughly 24-hour clock set mostly by light (in the brain) and meal timing (in the gut); puberty shifts teen sleep timing up to 2 hours later.
- Sleep cycles through light, deep, and REM stages; teens need 8 to 10 hours per 24 hours, but in 2025 only about 1 in 4 US high school students got 8 hours on school nights.
- Disturbed sleep is linked to slightly higher inflammation markers, and in people with Crohn's in remission, poor sleep was linked to twice the odds of a flare six months later (an association, not proof of cause).
- Gut microbes follow a daily rhythm; the cause-and-effect evidence about disrupted clocks and microbes comes from mice, so "sleep hacks reset your microbiome" is Hype.
- Moderate, regular activity helped IBS symptoms in a randomized trial and helps depression and anxiety symptoms (Strong), while very long, hard exercise can disturb the gut. The idea that exercise lifts mood *through* microbes is not supported yet (Hype).
- Brain-gut psychotherapies such as CBT and gut-directed hypnotherapy reduce IBS symptoms for many people and are recommended by guidelines; therapy for IBS does not mean the pain is fake.
- Slow breathing raises vagally mediated heart rate variability; mindfulness gives small real benefits; and personal diaries are best used to generate questions, because small samples and confounders can fool you.

You've learned to read your own data like a scientist



You can now explain how sleep, movement, breathing, and therapy reach the gut-brain axis, and you know why a week of diary data asks questions instead of answering them. Next, in Chapter 19, we'll leave the lab and go to the dinner table, to talk about culture, family, food, and the stigma that can make gut and mental health harder to talk about.

Quiz: Sleep, Exercise, and Therapy

Test your understanding of Chapter 18. Choose the best answer, then click **Show Answer** to check.

Question 1

How much sleep does the American Academy of Sleep Medicine recommend for teenagers aged 13 to 18?

- A. 6 to 7 hours per night
- B. 8 to 10 hours per 24 hours
- C. 7 or more hours per night, the same as adults
- D. 11 to 13 hours per 24 hours

 **Show Answer**



The correct answer is **B**. The 2016 AASM consensus recommends 8 to 10 hours per 24 hours for teens 13 to 18. Option C is the adult recommendation; teens need more.

Concept Tested: Teen Sleep Need **Bloom's Level:** Remember

Question 2

Which part of the brain acts as the body's master clock, receiving light information directly from the eyes?

- A. The pineal gland
- B. The brainstem's vagus nerve nucleus
- C. The enteric nervous system
- D. The suprachiasmatic nucleus of the hypothalamus

 **Show Answer**



The correct answer is **D**. The suprachiasmatic nucleus (SCN) receives light signals from the eyes and sets the body's circadian rhythm. The pineal gland (A) makes melatonin, but it takes its timing signals from the SCN.

Concept Tested: Circadian Rhythm **Bloom's Level:** Remember

Question 3

What is heart rate variability (HRV)?

- A. The natural variation in the time between one heartbeat and the next
- B. How fast your heart beats during hard exercise
- C. The difference between your resting heart rate and your maximum heart rate
- D. An irregular heartbeat that always signals heart disease

 **Show Answer**



The correct answer is **A**. HRV is the beat-to-beat variation in timing, and part of it reflects the vagus nerve's braking effect on the heart. Option D confuses normal, healthy variation with an abnormal heart rhythm.

Concept Tested: Heart Rate Variability **Bloom's Level:** Remember

Question 4

Why can't most teens solve short sleep simply by going to bed at 9:30 p.m.?

- A. Teens need less sleep than younger children, so they aren't tired
- B. Melatonin stops being made during adolescence
- C. Around puberty, sleep timing shifts later by up to about 2 hours, partly because melatonin is released later
- D. The suprachiasmatic nucleus stops responding to light in teenagers

 **Show Answer**



The correct answer is **C**. The AAP describes a puberty-related shift in sleep timing of up to 2 hours, with later nighttime melatonin release. Option A is wrong because teens actually need 8 to 10 hours, more than adults.

Concept Tested: Circadian Rhythm **Bloom's Level:** Understand

Question 5

In the 2013 study of people with inflammatory bowel disease, people with Crohn's disease in remission who slept poorly had about twice the odds of active disease six months later. Which conclusion fits this evidence best?

- A. Poor sleep has been proven to cause Crohn's flares.
- B. Poor sleep is linked to later flares, but the study can't show whether sleep causes them.

- C. Sleep has no connection to Crohn's disease, since the link was not found in ulcerative colitis.
- D. Good sleep cures Crohn's disease.

 Show Answer



The correct answer is **B**. It was an observational study, so it shows an association. Early inflammation, pain, or stress could disturb sleep and also lead to flares. Option A overstates the evidence by turning a link into proof of cause.

Concept Tested: Sleep and Inflammation **Bloom's Level:** Understand

Question 6

Which statement best describes how brain-gut psychotherapy helps IBS?

- A. It works on the brain's side of the two-way gut-brain loop, changing how gut signals are processed and how stress affects the gut.
- B. It proves the pain was imaginary by making it disappear.
- C. It replaces all medical care for IBS.
- D. It works by changing the gut microbiome directly.

 Show Answer



The correct answer is **A**. Therapies like gut-focused CBT and gut-directed hypnotherapy target the brain end of the gut-brain axis; the pain is real. Option B reflects the common myth that therapy means symptoms are "all in your head."

Concept Tested: Brain-Gut Psychotherapy **Bloom's Level:** Understand

Question 7

Sam, who has IBS, plans a 3-hour hard training run on a hot afternoon. Based on the 2017 review of exercise-induced gastrointestinal syndrome, what is most likely?

- A. The long, hard run will settle his gut, since exercise always helps IBS.
- B. Exercise has no effect on the gut, so nothing will change.
- C. His gut symptoms will be cured for the week.
- D. Gut disturbances such as slowed transit and symptoms become more likely, especially with heat and running.

 Show Answer



The correct answer is **D**. The review found that exercise of about two hours or more at moderate-to-high effort can disturb the gut, and heat and running made it worse. Option A ignores that intensity and duration matter: moderate activity helped IBS in a trial, but extreme effort is different.

Concept Tested: Exercise and Gut Transit **Bloom's Level:** Apply

Question 8

Maya's one-week diary shows that her worst stomachache days followed her shortest nights, and that her stress ratings were also highest on those days. What is the best next step for interpreting her data?

- A. Conclude that short sleep causes her stomachaches.
- B. Delete the stress ratings because they make the pattern confusing.
- C. Keep tracking longer, try changing one thing at a time, and treat stress as a possible confounder to discuss with her care team.
- D. Conclude that her stomachaches are caused only by stress.

 Show Answer



The correct answer is **C**. One week is a small sample, and stress could drive both poor sleep and symptoms. Longer tracking and one-change-at-a-time testing get closer to an answer. Options A and D both jump from a correlation to a single cause.

Concept Tested: Self-Monitoring **Bloom's Level:** Apply

Question 9

In the IBSOS trial, 61.0% of the minimal-contact CBT group and 43.5% of the education group rated their IBS as moderately or substantially improved two weeks after treatment. What does the education group's result tell you?

- A. Education is useless for IBS.
- B. Many people improve with attention, information, and time, so a comparison group is needed to see what CBT adds.
- C. CBT works for everyone with IBS.
- D. The trial was not randomized.

 **Show Answer**



The correct answer is **B**. Over 40% improved with education alone, which shows why randomized comparison groups matter: CBT's real added benefit is the difference between groups. Option C is wrong because about 4 in 10 people in the CBT group did not report much improvement.

Concept Tested: Brain-Gut Psychotherapy **Bloom's Level:** Analyze

Question 10

A post says: "Exercise rebuilds your microbiome, and that's why it fixes depression." Which analysis matches this chapter's evidence?

- A. The mood benefit of exercise is strongly supported, but the claim that it works through microbe changes is not supported by human evidence.
- B. Both parts are strongly supported by large human trials.
- C. Neither part has any evidence at all.
- D. The microbe part is strong, but exercise has no effect on mood.

 **Show Answer**



The correct answer is **A**. A large umbrella review supports exercise for depression and anxiety symptoms, but the key microbiome study had 32 adults, small changes that reversed, and no mood measurements. Option B treats a plausible mechanism as if it were proven.

Concept Tested: Exercise and Mood **Bloom's Level:** Analyze