

MOVE THE BODY, HEAL THE MIND

Overcome Anxiety, Depression, and
Dementia and Improve Focus,
Creativity, and Sleep

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EXPANDING YOUR ENJOYMENT FOR EXERCISE

It starts in a brain region called the **insula**. The insula stores a homeostatic map of the body. This gives us a sense of who we are, at least physically speaking. Throughout the body, special neurons act like sensors collecting information about the body's current status. This information is sent to the insula and compared to the homeostatic map. Any discrepancy between the two will activate the insula to trigger a stress response, giving rise to feelings of pain and unpleasantness. The insula activity correlates with our rating of perceived exertion (RPE),⁹ and therefore your RPE provides a window into how hard your brain thinks your body is working. The accumulation of lactate causes a breach in homeostasis and an RPE rating of 14, which roughly approximates your lactate threshold.¹⁰

Both RPE and lactate threshold can be used to predict how good or bad exercising will make you feel. This was demonstrated by a study that recruited a group of twelve sedentary men.¹¹ Liam was one of them. Prior to the actual study, Liam completed an exercise stress test to determine his lactate threshold, and the researchers used the results of that test to set the intensity of his workouts: above or below his lactate threshold. The workouts were completed on separate days, and on both days Liam walked for 20 minutes on a treadmill. The things that differed between the two workouts were the speed and incline of the treadmill, which were adjusted to achieve the target intensities. During each workout, Liam reported on two things:

1. How he felt, using the Feeling Scale from -5 (very bad) to +5 (very good).¹²
2. How hard he thought he was working using the RPE scale below.¹³

	6
7	Very, very light
8	
9	Very light
10	
11	Fairly light
12	
13	Somewhat hard
14	
15	Hard
16	
17	Very hard
18	
19	Very, very hard
20	Maximal exertion

While working out *below* his lactate threshold, Liam's RPE was 10 and he felt good. However, while working out *above* his lactate threshold, his mind and body took a turn for the worse. At the halfway mark, Liam's RPE was 14 and he felt fairly good. But by the end of the workout, his RPE had increased to 17 and he was feeling fairly bad. What happened to him? When exercising above our threshold, lactate accumulates faster than it can be cleared. And for poor Liam, it didn't take long for his lactate levels to soar, leaving him feeling terrible.

Fortunately, you can shift up your lactate threshold with training,¹⁴ which expands your comfort zone for exercising. Therefore, trained individuals have a much more expansive range where exercising feels good.^{15, 16} This is why my well-trained roommate was able to enjoy the fast-paced run that was far too stressful for my untrained body. The running pace was still well below her lactate threshold, even though it was well above mine.

If I had only known about the exercise stress response back then, I

might have tried a different approach. The real tragedy is that how we feel during the first few workouts of a new program predicts whether we will stick with it over the long term.¹⁷ Running made me feel bad, so I quit.

Born to run? Maybe. But one thing was for sure, I needed to take a slower and steadier approach to have a fighting chance at achieving my goal of becoming a runner.

The Fresh Start Workout

REFERENCE: Chapter 1

NEURO FIX: Tone the stress system

MINDSET: Slow and steady

LEVEL: Beginner

MON	TUES	WED	THURS	FRI	SAT	SUN
Wellness Walk	Opener	Wellness Walk		Wellness Walk	Opener	

WELLNESS WALK

Walk for 10 minutes at a comfortable, easy pace.

Ready to take the next step? Increase walk time by 2 minutes each week. After a few weeks, add intensity to one or two of your weekly walks. For example, 3 minutes of easy walking followed by 1 minute of brisk walking and repeat that four times.

OPENER

Warm up with a 5-minute Wellness Walk, then complete exercises 1 to 6 for the prescribed repetitions. Take a 2-minute rest break. Repeat.

ORDER	EXERCISE	REPETITIONS	PICTURED
1	Arm Swings (up and down)	10 reps	Page 168
2	Arm Swings (across the body)	10 reps	Page 168
3	Hip Twists	10 reps per side	Page 177
4	Knee Tucks	10 reps per side	Page 179
5	Butt Kicks	10 reps per side	Page 170
6	Crossovers	10 reps per side	Page 172
	Rest	2 minutes	

Ready to take the next step? Increase your repetitions to 15 reps. Repeat the exercises a third time.

The Fearless Workout

REFERENCE: Chapter 2

MINDSET: Get out of your head and into your body

NEURO FIX: Soothe an overactive amygdala

LEVEL: Beginner

MON	TUES	WED	THURS	FRI	SAT	SUN
Wellness Walk	Mindful Mover	Wellness Walk + Fear Buster		Wellness Walk + Fear Buster	Opener	

WELLNESS WALK

Walk for 20 minutes at a comfortable, easy pace. During your walk, pay attention to your breath.

THE MINDFUL MOVER

Warm up with a 5-minute Wellness Walk, then complete exercises 1 to 7 for the prescribed repetitions. Take a 2-minute mindful break. Focus on your breathing. Repeat.

ORDER	EXERCISE	REPETITIONS	PICTURED
1	Arm Circles (forward)	10 reps	Page 167
2	Arm Circles (backward)	10 reps	Page 167
3	Straight-Leg Kicks	10 reps per side	Page 196
4	Hip Openers	10 reps per side	Page 177
5	Lateral Step Gathers	10 reps per side	Page 183
6	Heel Walk	10 reps	Page 176
7	Toe Walk	10 reps	Page 200
	Mindful Break	2 minutes	

Ready to take the next step? Increase your repetitions to 15 reps. Repeat the exercises a third time. Or combine the Opener (below) and Mindful Mover into one awesome workout and repeat twice.

FEAR BUSTER

After your Wellness Walk, when you feel ready, set your mind to this: “Activating my stress response helps me adapt.” Then pick up the pace. Run as fast as you can for as long as you can. Try for 20 seconds. Then, walk to cool down.

Ready to take the next step? Add another Fear Buster and take as much time as you need between the two. Gradually add more Fear Busters until you are able to do ten.

OPENER

Warm up with a 5-minute Wellness Walk then complete exercises 1 to 6 for the prescribed repetitions, take a 2-minute mindful break. Repeat.

ORDER	EXERCISE	REPETITIONS	PICTURED
1	Arm Swings (up and down)	10 reps	Page 168
2	Arm Swings (across the body)	10 reps	Page 168
3	Hip Twists	10 reps per side	Page 177
4	Knee Tucks	10 reps per side	Page 179
5	Butt Kicks	10 reps per side	Page 170
6	Crossovers	10 reps per side	Page 172
	Mindful Break	2 minutes	

Ready to take the next step? Increase your repetitions to 15 reps. Repeat the exercises a third time.

The Healer Workout

REFERENCE: Chapter 3

MINDSET: Exercise is medicine

NEURO FIX: Heal your inflamed

brain

LEVEL: Intermediate

MON	TUES	WED	THURS	FRI	SAT	SUN
Wellness Walk	Uplifter	Blissful Brisk Walk		Soothing Cycle	The Remedy	

WELLNESS WALK

Walk for 30 minutes at a comfortable, easy pace. Pay attention to your breath. Walk outdoors for a healing boost from the sun.

Ready to take the next step? Add 5 minutes of easy walking each week.

UPLIFTER

Warm up with a 5-minute Wellness Walk, then complete exercises 1 to 8 for the prescribed repetitions. Take a 2-minute mindful break. Focus on your breathing. Repeat.

ORDER	EXERCISE	REPETITIONS	PICTURED
1	Front Plank (modified)	30 seconds	Page 175
2	Oblique Twists	10 reps per side	Page 184
3	Superman (alternating)	10 reps per side	Page 197
4	Kneeling Donkey Kicks	10 reps per side	Page 180
5	Sit Stands	10 reps	Page 192
6	Row (supported)	10 reps per side	Page 187
7	Lateral Raises	10 reps	Page 182
8	Single-Leg Balance	30 seconds per side	Page 191
	Mindful Break	2 minutes	

Ready to take the next step? Increase your repetitions to 15 reps and 40 seconds. Repeat the exercises a third time. *Advanced progressions:* 1. Front Plank (modified) to Front Plank; 3. Superman (alternating) to Superman and hold for 5 seconds; 8. Single Leg Balance to Single Leg Balance with eyes closed; add weight or resistance to exercises 4 to 7.

BLISSFUL BRISK WALK

Warm up with a 5-minute Wellness Walk. Then pick up the pace to a brisk walk that is comfortably challenging for you. Hold that pace for 8 minutes, then take a 2-minute Wellness Walk break. Repeat.

Ready to take the next step? Hold the brisk pace for an extra minute each week.

SOOTHING CYCLE

Warm up with 5 minutes of easy riding followed by 30 minutes of steady cycling at a moderate intensity.

Ready to take the next step? Add 5 minutes of steady cycling each week. Include a few hills on your route.

THE REMEDY

Warm up with a 5-minute Wellness Walk, then complete exercises 1 to 8 for the prescribed repetitions. Take a 2-minute mindful break. Focus on your breathing. Repeat.

ORDER	EXERCISE	REPETITIONS	PICTURED
1	Kickouts	10 reps per side	Page 178
2	Side Plank (modified)	30 seconds per side	Page 190
3	Bird Dogs	10 reps per side	Page 169
4	Supine Hip Hold	30 seconds	Page 198
5	Pushups (modified)	10 reps	Page 185
6	Cat Cow	10 reps per movement	Page 171
7	Side-Lying Hip Abduction	10 reps per side	Page 189
8	Side-Lying Hip Adduction	10 reps per side	Page 189
	Mindful Break	2 minutes	

Ready to take the next step? Increase your repetitions to 15 reps and 40 seconds. Repeat the exercises a third time. *Advanced progressions:* 2. Side Plank (modified) to Side Plank; 3. Bird Dog to Bird Dog Holds and hold for 5 seconds; 4. Supine Hip Hold to Single Leg Supine Hip Hold; 5. Pushups (modified) to Pushups; 7. Add weight or resistance; 8. Add weight or resistance.

The Rebuilder Workout

REFERENCE: Chapter 4

MINDSET: Structure and support

NEURO FIX: Give the brain the

reward it seeks

LEVEL: Intermediate

MON	TUES	WED	THURS	FRI	SAT	SUN
Wellness Walk	Brain Boot-camp	Craving Crusher	The Neuro Fix	Endorphin Elevator	Phoenix	

WELLNESS WALK

Walk for 30 minutes at a comfortable, easy pace. Listen to music and walk with friends for an extra neuro boost.

BRAIN BOOTCAMP

Warm up with a 5-minute Wellness Walk, then complete exercises 1 to 4 in Circuit #1 for the prescribed repetitions. Take a 2-minute mindful break. Focus on your breathing. Repeat. Then move on to Circuit #2. Repeat.

Circuit #1

ORDER	EXERCISE	REPETITIONS	PICTURED
1	Pushups	10 reps	Page 185
2	Row (single arm)	10 reps per side	Page 187
3	Bird Dogs (5-second holds)	10 reps per side	Page 169
4	Bicycles	10 reps per side	Page 169
	Mindful Break	2 minutes	

Circuit #2

ORDER	EXERCISE	REPETITIONS	PICTURED
1	Split Squats	10 reps per side	Page 194
2	Supine Hip Lifts	10 reps	Page 198
3	Mountain Climbers	10 reps per side	Page 184
4	Side Plank	30 seconds per side	Page 190
	Mindful Break	2 minutes	

Ready to take the next step? Increase your repetitions to 15 reps and 40 seconds. Repeat the exercises a third time.

CRAVING CRUSHER

Warm up with a 5-minute Wellness Walk, then pick up the pace until it is comfortably challenging for you (brisk walk or easy jog). Hold that pace for 60 seconds, then take a 2-minute Wellness Walk break. Repeat five times. Cool down with a 10-minute Wellness Walk.

Ready to take the next step? Repeat six times and add another repeat each week.

THE NEURO FIX

Do it anywhere anytime you need it: Warm up with a 5-minute Wellness Walk, then complete exercises 1 to 4. Work as hard as you can. Repeat.

ORDER	EXERCISE	REPETITIONS	PICTURED
1	Jumping Jacks	30 seconds	Page 178
2	Mountain Climbers	30 seconds	Page 184
3	Skaters	30 seconds	Page 193
4	High Knees	30 seconds	Page 176

ENDORPHIN ELEVATOR

Take the stairs! Warm up with a 10-minute Wellness Walk. Then climb a set of stairs for 60 seconds, walk down, rest for 30 seconds. Repeat five times. Cool down with a 10-minute Wellness Walk.

Ready to take the next step? Add an extra 60-second stair climb every week.

PHOENIX

Warm up with a 5-minute Wellness Walk, then complete exercises 1 to 4 in Circuit #1 for the prescribed repetitions. Take a 2-minute mindful break. Focus on your breathing. Repeat. Then move on to Circuit #2. Repeat.

Circuit #1

ORDER	EXERCISE	REPETITIONS	PICTURED
1	Shoulder Presses (with Bicep Curl)	10 reps	Page 188
2	Reverse Flies	10 reps	Page 186
3	Kneeling Woodchoppers	10 reps per side	Page 181
4	Dead Bugs	10 reps per side	Page 173
	Mindful Break	2 minutes	

Circuit #2

ORDER	EXERCISE	REPETITIONS	PICTURED
1	Sumo Squats	10 reps	Page 197
2	Side-Lying Hip Abduction	10 reps per side	Page 189
3	Side-Lying Hip Adduction	10 reps per side	Page 189
4	Front Plank	30 seconds per side	Page 175
	Mindful Break	2 minutes	

Ready to take the next step? Increase your repetitions to 15 reps and 40 seconds. Repeat the exercises a third time.

The Extender Workout

REFERENCE: Chapter 5

MINDSET: Fit for life

NEURO FIX: Nourish the brain with

vital nutrients

LEVEL: Intermediate

MON	TUES	WED	THURS	FRI	SAT	SUN
Wellness Walk	Vitality Pump	Wellness Walk Plus		Memory Booster	Elixir for Life	

WELLNESS WALK

Walk for 30 minutes at a comfortable, easy pace. Pay attention to your breathing.

VITALITY PUMP

Warm up with a 5-minute Wellness Walk, then complete exercises 1 to 6 for the prescribed repetitions. Take a 30-second mindful break. Focus on your breathing. Repeat.

ORDER	EXERCISE	REPETITIONS	PICTURED
1	Kickouts	10 reps per side	Page 178
2	Supine Hip Lifts	10 reps	Page 198
3	Superman (alternating)	10 reps per side	Page 197
4	Sit Stands	10 reps	Page 192
5	Pushups (modified, wall)	10 reps	Page 185
6	Single-Leg Balance	10 reps per side	Page 191
	Mindful Break	30 seconds	

Ready to take the next step? Increase your repetitions to 15 reps and 40 seconds. Repeat the exercises a third time. *Advanced progressions:* 3. Superman (alternating) to Superman, hold each repetition for 5 seconds; 5. Pushups (modified, wall) to Pushups (modified); 6. Single Leg Balance to Single Leg Balance with eyes closed.

WELLNESS WALK PLUS

Warm up with a 5-minute Wellness Walk, then pick up the pace until you can no longer talk comfortably (brisk walk or easy jog). Maintain

that pace for 3 minutes. Then take a 3-minute Wellness Walk break. Alternate between faster and slower paces five times. Cool down with a 5-minute Wellness Walk.

Ready to take the next step? Add an extra repeat each week. Swap your regular Wellness Walk for a Wellness Walk Plus. Add more days.

MEMORY BOOSTER

Warm up with a 5-minute Wellness Walk. Walk up a gradual hill for 4 minutes and then walk down the hill. Repeat hill walk four times. Cool down with a 5-minute Wellness Walk.

Ready to take the next step? Add an extra repeat each week. Try a steeper hill.

ELIXIR FOR LIFE

Warm up with a 5-minute Wellness Walk, then complete exercises 1 to 6 for the prescribed repetitions. Take a 30-second mindful break. Focus on your breathing. Repeat.

ORDER	EXERCISE	REPETITIONS	PICTURED
1	Front Plank (modified)	30 seconds	Page 175
2	Bird Dogs	10 reps per side	Page 169
3	Squats (supported)	10 reps	Page 195
4	Side-Lying Hip Abduction	10 reps per side	Page 189
5	Lateral Raises (bent over)	10 reps	Page 182
6	Cat Cow	10 reps per movement	Page 171
	Mindful Break	30 seconds	

Ready to take the next step? Increase your repetitions to 15 reps and 40 seconds. Repeat the exercises a third time. *Advanced progressions:* 1. Front Plank (modified) to Front Plank; 3. Squats (supported) to Squats.

The Good Night's Sleep Workout

REFERENCE: Chapter 6

NEURO FIX: Reset the brain's clock

MINDSET: Consistent effort

LEVEL: Advanced

MON	TUES	WED	THURS	FRI	SAT	SUN
Wellness Run	Rise and Shine	Wellness Run	Sprints for Shut-Eye	Wellness Run	Sound Sleeper	

WELLNESS WALK-TO-RUN

Warm up with a 5-minute Wellness Walk. Walk or run for 30 minutes at a comfortably challenging pace at the same time every day. Morning is best if you're struggling to fall asleep at night.

Ready to take the next step? Run 5 minutes longer every week.

RISE AND SHINE

Warm up with a 5-minute Wellness Walk, then complete exercises 1 to 8 for the prescribed repetitions. Take a 30-second mindful break. Focus on your breathing. Repeat.

ORDER	EXERCISE	REPETITIONS	PICTURED
1	Front Plank	30 seconds	Page 175
2	Supine Hip Lifts (single leg)	10 reps per side	Page 198
3	Split Squats	10 reps per side	Page 194
4	Pushups	10 reps	Page 185
5	Bicycles	10 reps per side	Page 169
6	Kneeling Donkey Kicks	10 reps per side	Page 180
7	Lateral Raises	10 reps	Page 182
8	Jumping Jacks	30 seconds	Page 178
	Mindful Break	30 seconds	

Ready to take the next step? Increase your repetitions to 15 reps and 40 seconds. Repeat the exercises a third time.

SPRINTS FOR SHUT-EYE

Warm up with a 10-minute Soothing Cycle (page 66), then go as fast as you can go for as long as you can. Try for 20 seconds. Take a 2-minute Soothing Cycle break, then repeat six times. Cool down with a 10-minute Wellness Walk. Complete at least 1 hour before bed so that your heart rate has time to recover.

Ready to take the next step? Add another repeat each week.

THE SOUND SLEEPER

Warm up with a 5-minute Wellness Walk, then complete exercises 1 to 8 for the prescribed repetitions. Take a 30-second mindful break. Focus on your breathing. Repeat.

ORDER	EXERCISE	REPETITIONS	PICTURED
1	Side Plank	30 seconds	Page 190
2	Superman (alternating)	10 reps per side	Page 197
3	Squats	10 reps per side	Page 195
4	Pushups	10 reps	Page 185
5	Row (single arm)	10 reps per side	Page 187
6	Hip Openers	10 reps per side	Page 177
7	Dead Bugs	10 reps per side	Page 173
8	Skaters	30 seconds	Page 193
	Mindful Break	30 seconds	

Ready to take the next step? Increase your repetitions to 15 reps and 40 seconds. Repeat the exercises a third time.

The Achiever Workout

REFERENCE: Chapter 7

MINDSET: Focused and creative

NEURO FIX: Energize and engage

the brain's networks

LEVEL: Advanced

MON	TUES	WED	THURS	FRI	SAT	SUN
Wellness Run	Tenacious Lift	HIIT for Grit	The Neuro Fix	Go Team Go!	Accelerator	

WELLNESS WALK-TO-RUN

Warm up with a 5-minute Wellness Walk. Run for 20 minutes at a comfortably challenging pace. Pay attention to your breath. Cool down with a 5-minute Wellness Walk.

Ready to take the next step? Run 5 minutes longer every week.

TENACIOUS LIFT

Warm up with a 5-minute Wellness Walk, then complete exercises 1 to 5 in Circuit #1 for the prescribed repetitions. Take a 30-second mindful break. Focus on your breathing. Repeat. Then move on to Circuit #2. Repeat.

Circuit #1

ORDER	EXERCISE	REPETITIONS	PICTURED
1	Front Plank	30 seconds	Page 175
2	Kneeling Woodchoppers	10 reps per side	Page 181
3	Sumo Squats	10 reps	Page 197
4	Three-Way Leg Raises	10 reps per way	Page 199
5	High Knees	30 seconds	Page 176
	Mindful Break	30 seconds	

Circuit #2

ORDER	EXERCISE	REPETITIONS	PICTURED
1	Bicycles	10 reps per side	Page 169
2	Deadlifts	10 reps	Page 174
3	Pushups	10 reps	Page 185
4	Reverse Flies	10 reps	Page 186
5	Mountain Climbers	30 seconds	Page 184
	Mindful Break	30 seconds	

Ready to take the next step? Increase your repetitions to 15 reps and 40 seconds. Repeat the exercises a third time. *Advanced progressions:* Circuit #1: 1. Front Plank to Single Leg Front Plank, add reaches or do on unstable surface; 2. Add weight; 3. Add weight; 4. Add resistance band. Circuit #2: 2. Add weight; 3. Do on a decline or unstable surface and change the tempo; 4. Add weight.

HIIT FOR GRIT

Warm up for 5 minutes, then HIIT it. Do 1 minute with hard effort followed by 1 minute with easy effort; repeat ten times. Can be done while running, cycling, or stair-climbing, indoors or outdoors. Feel free to mix it up for maximum grit.

Ready to take the next step? Add an incline or resistance to your hard effort.

THE NEURO FIX

(Do it anywhere, anytime you need it): Warm up with a 5-minute Wellness Walk, then complete exercises 1 to 4. Work as hard as you can. Repeat.

ORDER	EXERCISE	REPETITIONS	PICTURED
1	Jumping Jacks	30 seconds	Page 178
2	Mountain Climbers	30 seconds	Page 184
3	Skaters	30 seconds	Page 193
4	High Knees	30 seconds	Page 176

THE ACCELERATOR

Warm up with a 5-minute Wellness Walk, then complete exercises 1 to 5 in Circuit #1 for the prescribed repetitions. Take a 30-second mindful break. Focus on your breathing. Repeat. Then move on to Circuit #2. Repeat.

Circuit #1

ORDER	EXERCISE	REPETITIONS	PICTURED
1	Dead Bugs	10 reps per side	Page 173
2	Side Plank	30 seconds	Page 190
3	Squats	10 reps	Page 195
4	Supine Hip Lifts	10 reps	Page 198
5	Skaters	30 seconds	Page 193
	Mindful Break	30 seconds	

Circuit #2

ORDER	EXERCISE	REPETITIONS	PICTURED
1	V Sit	30 seconds	Page 200
2	Split Squats	10 reps per side	Page 194
3	Row	10 reps	Page 187
4	Shoulder Presses	10 reps	Page 188
5	Jumping Jacks	30 seconds	Page 178
	Mindful Break	30 seconds	

Ready to take the next step? Increase your repetitions to 15 reps and 40 seconds. Repeat the exercises a third time. Advanced progressions: Circuit #1: 2. Do on unstable surface; 3. Add weight; 4. Add weight, marches, or do with single leg. Circuit #2: 1. Arms raised overhead; Add weight to workouts 2 to 4.

GO TEAM GO!

Play your favorite sport. Have fun!

APPENDIX: EXERCISES

Note: No weights? No problem. You can substitute weighted household items like cans, laundry detergent, or rocks in a bag or anything with a handle.



Arm Circles (backward): Stand tall with your feet shoulder-width apart and arms by your sides. Straighten and extend each arm. Rotate each arm backward to make a circle. Move arms in synchrony.

Arm Circles (forward): Stand tall with your feet shoulder-width apart and arms by your sides. Straighten and extend each arm. Rotate each arm forward to make a circle. Move arms in synchrony.



Arm Swings (across the body): Stand tall with your feet shoulder-width apart. Straighten and extend your arms out in front of you at shoulder height. Hold this position while you open your arms away from each other and then bring them back together, crossing them in front.

Arm Swings (up and down): Stand tall with your feet shoulder-width apart and arms by your sides. Straighten and extend your arms up overhead. Reach for the sky. Then bring them back down to your sides.



Bicycles: Lie down on your back with your hands behind your head and knees bent with shins parallel to the ceiling. Engage your core and lift your chest off the ground as you bring your left elbow toward your right knee while extending your left leg out in front of you. Lower yourself back to the starting position and then switch sides.



Bird Dogs: Get on your hands and knees with your hands directly underneath your shoulders and your knees directly underneath your hips. Engage your core. Stretch and reach your right arm and left leg away from your body. Keep right thumb pointed up toward the ceiling. Bring your arm and leg back to the starting position and then switch sides. Keep your hips level throughout the movement. *Bird Dog Holds* involve the same movement, but you hold your arm and leg up and away from your body for the prescribed duration and then switch sides.



Butt Kicks: Stand tall with your feet shoulder-width apart, knees slightly bent, and your arms by your side. Kick your right foot back toward your right glute and then return to starting position. Repeat with your left foot.



Cat Cow: Get on your hands and knees with your hands directly underneath your shoulders and your knees directly underneath your hips. Engage your core. For cat pose, tuck your tailbone in while you arch your upper back and tuck your head with eyes looking at knees. For cow pose, tilt your tailbone back while pushing your shoulder blades back and lifting your head with eyes forward. Alternate between cat and cow poses.



Crossovers: Stand tall with your feet shoulder-width apart and your arms outstretched. Step to the right with your right foot. Swing your left foot behind your right foot and then in front of it, touching down with your toe for balance when needed. End the sequence by stepping your left foot back to the starting position. Complete all reps before switching sides.



Dead Bugs: Lie on your back. Point your arms and legs straight up in the air, positioning your arms over shoulders and your legs over hips. Engage your core. Slowly extend and lower your right arm backward (behind your head) and your left leg forward (in front of your body). Stop just before your arm touches the ground. Now, bring that arm and leg back to their starting positions. Repeat the movement with your left arm and right leg.



Deadlifts: Stand tall with your feet shoulder-width apart and arms in front of you with a weight in each hand and palms facing your body. Engage your core. Bring your hips back as you lower the weights in front of your body to the tops of your shins. Keep your back flat and knees slightly bent. Bring your hips forward and straighten your legs to return to the starting position. Keep your arms straight and your shoulders strong throughout the movement.



Front Plank: Lie down facing the ground. Lift your body up with your forearms (elbows underneath your shoulders) and toes (so that your back is parallel to the ground). Hold this position while engaging your core. *Single Leg Front Plank* involves the same position but with one leg lifted. Hold this position while engaging your core. Switch legs and repeat.



Front Plank (modified): Lie down facing the ground. Lift your body up with your forearms (elbows underneath your shoulders) and position knees on the ground so that your back is parallel to the ground. Hold this position while engaging your core.



Heel Walk: Stand tall with your feet shoulder-width apart and your arms in a comfortable position. Walk forward on your heels.

High Knees: Stand tall with your feet shoulder-width apart. Arms stretched out in front of you. While running in place, lift knees up high to your waist, keeping your body tall and feet flexed toward your shins.



Hip Openers: Stand tall with your feet shoulder-width apart and your arms in a comfortable position. Raise your right knee up and out in front of your body to hip height and rotate it to the right side of your body. Touch down your right foot behind your body. Then raise it up again to hip height before rotating it back to the starting position. Complete all reps before switching sides.

Hip Twists: Stand tall with your feet shoulder-width apart and your hands on your hips. Keep your lower body facing forward, engage your core, and rotate your upper body to the right and then to the left. Move in a slow and controlled manner.



Jumping Jacks: Stand tall with your feet shoulder-width apart. Jump up, kicking both feet out while you extend your arms up overhead toward each other. On your way back down, return your legs together and arms to your sides.



Kickouts: Lie on your back with arms by your side. Bend your hips and knees so that knees are directly above your hips with shins parallel to the ground. Engage your core. Slowly extend your right leg while keeping your back flat. Bring your right leg back to the starting position. Repeat the movement with your left leg.



Knee Tucks: Stand tall with your feet shoulder-width apart. Bend your left leg to your waist, grab it with both hands, and give it a tug. Then lower. Repeat with your right leg.



Kneeling Donkey Kicks: Get on your hands and knees with your hands directly underneath your shoulders and your knees directly underneath your hips. Engage your core. Extend and lift your left leg out behind you and then bring it back to the starting position. Keep hips level throughout the movement. Complete all the repetitions for one leg and then switch legs.



Kneeling Woodchoppers: Get down on your right knee. Position your left leg forward with knee bent at a 90-degree angle and foot flat on the ground. Engage your core and hold a weight with both hands. Extend your arms as you move the weight diagonally across your body from below your right hip to above your left shoulder. Complete all reps for one side. Switch leg positions and repeat.



Lateral Raises: Stand tall with your feet about shoulder-width apart, arms by your sides, holding dumbbells with palms facing your body. Lift the weights by extending your arms straight out from the side of your body up until you reach shoulder height and then lower back down. Keep your elbows soft throughout the movement. This movement can also be performed in a *bent-over* position with upper body parallel to the floor.



Lateral Step Gathers: Stand tall with your feet shoulder-width apart and your arms outstretched. Step to the right with your right foot and bring your left foot to meet it. Then, step to the left with your left foot and bring your right foot to meet it.



Mountain Climbers: Do a plank. Bend your right knee and bring it directly under your body as far as you can. Then as you return your right leg to its starting position, repeat the movement with your left leg.



Oblique Twists: Lie down on your back with your hands behind your head and your knees bent with feet flat on the ground. Engage your core and lift your chest off the ground as you bring your left elbow toward your right knee. Keep your lower body still. Return to the starting position and switch sides.



Pushups: Lie facing the ground with your hands and toes on the ground. The rest of your body should be off the ground. Your hands should be greater than shoulder-width apart with your elbows in line with your chest. Your toes should be far enough away from your hands so that your whole body is in a straight line. Lower your body as far as you can without touching the ground and then push yourself back up to the starting position.



Pushups (modified): Get down on your hands and knees. Your hands should be greater than shoulder-width apart with your elbows in line with your chest. Your knees should be far enough away from your hands so that there is a straight line from your knees to your shoulders. Lower your body as far as you can without touching the ground and then push yourself back up to the starting position. Modified pushups can also be done against a wall. Stand an arm's length away from the wall with your back straight, hips square, and hands on wall. Bend your elbows and lean into the wall as far as you can without touching it and then push yourself back to the starting position.



Reverse Flies: Bend forward with knees slightly bent, back straight, and chest facing the ground at a 45-degree angle. With straight arms positioned underneath your chest, hold a dumbbell in each hand with palms facing each other. Lift the weights away from each other to shoulder height, making a “T,” and then lower to starting position.



Row: Bend forward with knees slightly bent, back straight, and chest facing the ground at a 45-degree angle. With straight arms positioned underneath your chest, hold a dumbbell in each hand with palms facing each other. Keeping your elbows close to your body, bend your elbows back to lift the weights behind your body. Then return to starting position. The same movement can be performed one arm at a time (i.e., *single arm*). Complete all reps for one arm before switching sides.

Row (supported): Bend forward with knees slightly bent, back straight, and chest facing the ground. Support yourself by holding on or kneeling on a sturdy support like a chair or bench. With your other arm straight and positioned underneath your chest, hold a dumbbell in your hand with palm facing you. Keeping your elbows close to your body, bend your elbow back to lift the weight behind your body. Then return to starting position. Complete all reps for one arm before switching sides.



Shoulder Presses: Stand tall with your feet about shoulder-width apart and a dumbbell in each hand. Bend your elbows and lift them to shoulder height. Start with the dumbbells in line with the bottom of your ears, palms facing forward. Extend your arms up, bring the dumbbells together overhead, and then return to starting position. Add a *Bicep Curl* by starting with the dumbbells by your sides, palms facing forward. Curl the dumbbells up toward your shoulders, twist your wrists so your palms are facing forward, and extend your arms up to execute the shoulder press. Return to the starting position by first lowering the dumbbells to your shoulders, twisting your wrists so your palms are facing you, and lowering to starting position.



Side-Lying Hip Abduction: Lie down on your side so that your hips are stacked on top of each other and your head is supported by your arm or hand. Engage your core. Keeping your top leg straight and foot flexed, lift it up until it's just past your shoulder while positioning your top foot parallel to the ground. Lower it back down until it's just above the bottom leg. Complete all reps before switching sides.



Side-Lying Hip Adduction: Lie down on left side so that your hips are stacked on top of each other and your head is supported by your arm or hand. Engage your core and place your right arm in front of you for support. Bend your right leg and place it behind your left knee so that your right foot is firmly planted on the ground. Now, keeping your left leg straight and foot flexed, lift it up toward shoulder level while positioning your foot parallel to the ground. Lower it back down until it's just above the ground. Complete all reps before switching sides.



Side Plank: Lie down on your left side with feet stacked on top of each other. Lift your body up with your bottom forearm (elbow underneath your shoulder) and feet (so that your back is flat). Hold this position while engaging your core. Hold for the prescribed duration before switching sides.



Side Plank (modified): Lie down on your left side with knees bent and feet and knees stacked. Lift your body up with your bottom forearm (elbow underneath your shoulder) and knee (past your hips so that your back is flat). Hold this position while engaging your core. Hold for the prescribed duration before switching sides.



Single-Leg Balance: Stand tall with your hands on your hips and slowly lift one leg off the ground while balancing on the other. Keep your core engaged and hips level. Close your eyes for added difficulty. Repeat with other leg.



Sit Stands: Sit tall on a chair with your feet shoulder-width apart and your arms by your sides or resting on your knees. Without leaning forward, press off with your feet and stand up tall. Sit back down with control.



Skaters: Stand tall with your feet shoulder-width apart. Bend your knees. Hop to the left with your left foot while you transfer your body weight to your left leg and bring your right foot behind your left foot, just past it, and not touching the ground. Push off from your left foot and hop to the right with your right foot as you transfer your body weight to your right leg and swing your left foot behind your right foot without touching the ground.



Split Squats: Stand with your feet about shoulder-width apart and with one foot about 3 feet in front of the other. While leaning forward slightly from the waist, lower your body down to the ground while bending your knees so that your front foot remains flat and your back foot is on its toes. Then press into the ground with your feet and stand back up to the starting position. Switch the front and back leg once all of the repetitions have been completed.



Squats: Stand tall with your feet about shoulder-width apart and your arms stretched out in front of you. As if you were going to sit in a chair, bend your knees and lower your body down while keeping your chest up. Lower down as much as you can with control and then press into the ground with your feet and stand back up. For a *supported squat*, hold a sturdy support like a chair or countertop while performing the squat.



Straight-Leg Kicks: Stand tall with your feet shoulder-width apart. Stretch out your right arm in front of you at shoulder height. Kick up your right leg in front of your body, keeping your leg straight and body tall. Repeat with your left arm and leg.



Sumo Squats: Stand tall with your feet wider than shoulder-width and your toes pointed out to the side. Hold the top of a dumbbell in front of you below your waist with your arms fully extended. As if you were going to sit in a chair, bend your knees and lower your body down while keeping your chest up. Lower down as much as you can with control and then press into the ground with your feet and stand back up.



Superman (alternating): Lie on your stomach with legs and arms fully extended, thumbs up and toes pointed. Engage your core and gently lift and extend your right arm and left leg and then bring them back down to the ground. Repeat the same movement with your left arm and right leg. Alternate between sides for the prescribed repetitions. Superman involves the same movement, but you raise both arms and legs at the same time and hold for the prescribed duration.



Supine Hip Hold: Lie on your back with your arms by your side and your legs bent and hip-width apart. Make sure that your feet are flat on the ground past your knees and away from your body. Push into the ground with your feet to lift your hips. Keep your body flat from your knees to your shoulders and hold.



Supine Hip Lifts: Same as Supine Hip Hold but instead of holding, lift and lower your hips. For the *single-leg* modification, instead of placing two feet flat on the ground, place only one foot on the ground at a time. Keep your other leg straight and hovering above the ground. Complete all reps before switching sides.



Three-Way Leg Raises: Stand tall with your feet hip-width apart and core engaged. Lift your right leg out in front of your body and back to the starting position. Now lift that same leg out to the side of your body and back to the starting position. And finally, lift that same leg directly behind you (don't lean forward) and back to the starting position. Keep your leg straight and foot flexed through the entire movement. Complete all the repetitions on one side before switching sides.



Toe Walk: Stand tall with your feet shoulder-width apart and your arms in a comfortable position. Walk forward on your toes.



V Sit: Sit down on the ground. Lean back onto your tailbone. Lift your legs off the ground while keeping your back and legs straight. Stretch your arms out in front of you. Hold this position for the prescribed amount of time.

REFERENCES

1. The Reasons It's Hard to Exercise

1. Blundell, J., Gibbons, C., Caudwell, P., Finlayson, G. & Hopkins, M. Appetite control and energy balance: Impact of exercise. *Obesity Reviews* **16**, 67–76 (2015).
2. Liebenberg, L. Persistence hunting by modern hunter-gatherers. *Current Anthropology* **47**, 1017–1026 (2006).
3. Selinger, J.C., O'Connor, S.M., Wong, J.D. & Donelan, J.M. Humans can continuously optimize energetic cost during walking. *Current Biology* **25**, 2452–2456 (2015).
4. Englert, C. & Rummel, J. I want to keep on exercising but I don't: The negative impact of momentary lacks of self-control on exercise adherence. *Psychology of Sport and Exercise* **26**, 24–31 (2016).
5. Harris, S. & Bray, S.R. Effects of mental fatigue on exercise decision-making. *Psychology of Sport and Exercise* **44**, 1–8 (2019).
6. Cheval, B., et al. Avoiding sedentary behaviors requires more cortical resources than avoiding physical activity: An EEG study. *Neuropsychologia* **119**, 68–80 (2018).
7. Arbour, K.P. & Martin Ginis, K.A. A randomised controlled trial of the effects of implementation intentions on women's walking behaviour. *Psychology and Health* **24**, 49–65 (2009).
8. Reed, J.L. & Pipe, A.L. The talk test: A useful tool for prescribing and monitoring exercise intensity. *Current Opinion in Cardiology* **29**, 475–480 (2014).
9. Williamson, J., McColl, R., Mathews, D., Ginsburg, M. & Mitchell, J. Activation of the insular cortex is affected by the intensity of exercise. *Journal of Applied Physiology* **87**, 1213–1219 (1999).
10. Scherr, J., et al. Associations between Borg's rating of perceived exertion

- and physiological measures of exercise intensity. *European Journal of Applied Physiology* **113**, 147–155 (2013).
11. Parfitt, G., Rose, E.A. & Burgess, W.M. The psychological and physiological responses of sedentary individuals to prescribed and preferred intensity exercise. *British Journal of Health Psychology* **11**, 39–53 (2006).
 12. Hardy, C.J. & Rejeski, W.J. Not what, but how one feels: The measurement of affect during exercise. *Journal of Sport and Exercise Psychology* **11**, 304–317 (1989).
 13. Borg, G.A. Psychophysical bases of perceived exertion. *Medicine & Science in Sports & Exercise* (1982).
 14. Messonnier, L.A., et al. Lactate kinetics at the lactate threshold in trained and untrained men. *Journal of Applied Physiology* **114**, 1593–1602 (2013).
 15. Ekkekakis, P., Hall, E.E. & Petruzzello, S.J. The relationship between exercise intensity and affective responses demystified: To crack the 40-year-old nut, replace the 40-year-old nutcracker! *Annals of Behavioral Medicine* **35**, 136–149 (2008).
 16. Acevedo, E., Kraemer, R., Haltom, R. & Tryniecki, J. Perceptual responses proximal to the onset. *Journal of Sports Medicine & Physical Fitness* **43**, 267–273 (2003).
 17. Williams, D.M., et al. Acute affective response to a moderate-intensity exercise stimulus predicts physical activity participation 6 and 12 months later. *Psychology of Sport and Exercise* **9**, 231–245 (2008).
 18. Seiler, S. What is best practice for training intensity and duration distribution in endurance athletes? *International Journal of Sports Physiology and Performance* **5**, 276–291 (2010).
 19. Bargai, N., Ben-Shakhar, G. & Shalev, A.Y. Posttraumatic stress disorder and depression in battered women: The mediating role of learned helplessness. *Journal of Family Violence* **22**, 267–275 (2007).
 20. Maier, S.F. & Seligman, M.E. Learned helplessness at fifty: Insights from neuroscience. *Psychological Review* **123**, 349 (2016).
 21. Silverman, M.N. & Deuster, P.A. Biological mechanisms underlying the role of physical fitness in health and resilience. *Interface Focus* **4**, 20140040 (2014).
 22. Greenwood, B.N. & Fleshner, M. Exercise, stress resistance, and central serotonergic systems. *Exercise and Sport Sciences Reviews* **39**, 140 (2011).
 23. Rimmele, U., et al. Trained men show lower cortisol, heart rate and psychological responses to psychosocial stress compared with untrained men. *Psychoneuroendocrinology* **32**, 627–635 (2007).
 24. von Haaren, B., Haertel, S., Stumpp, J., Hey, S. & Ebner-Priemer, U. Reduced emotional stress reactivity to a real-life academic examination stressor in students participating in a 20-week aerobic exercise training: A randomised controlled trial using Ambulatory Assessment. *Psychology of Sport and Exercise* **20**, 67–75 (2015).

25. Silverman, M.N. & Deuster, P.A. Biological mechanisms underlying the role of physical fitness in health and resilience. *Interface Focus* **4**, 20140040 (2014).
26. Kitraki, E., Karandrea, D. & Kittas, C. Long-lasting effects of stress on glucocorticoid receptor gene expression in the rat brain. *Neuroendocrinology* **69**, 331–338 (1999).
27. Labonte, B., et al. Differential glucocorticoid receptor exon 1B, 1C, and 1H expression and methylation in suicide completers with a history of childhood abuse. *Biological Psychiatry* **72**, 41–48 (2012).
28. Cohen, S., et al. Chronic stress, glucocorticoid receptor resistance, inflammation, and disease risk. *Proceedings of the National Academy of Sciences* **109**, 5995–5999 (2012).
29. Lupien, S.J., McEwen, B.S., Gunnar, M.R. & Heim, C. Effects of stress throughout the lifespan on the brain, behaviour and cognition. *Nature Reviews Neuroscience* **10**, 434–445 (2009).
30. Adlard, P. & Cotman, C. Voluntary exercise protects against stress-induced decreases in brain-derived neurotrophic factor protein expression. *Neuroscience* **124**, 985–992 (2004).
31. Marais, L., Stein, D.J. & Daniels, W.M. Exercise increases BDNF levels in the striatum and decreases depressive-like behavior in chronically stressed rats. *Metabolic Brain Disease* **24**, 587–597 (2009).
32. Zschucke, E., Renneberg, B., Dimeo, F., Wüstenberg, T. & Ströhle, A. The stress-buffering effect of acute exercise: Evidence for HPA axis negative feedback. *Psychoneuroendocrinology* **51**, 414–425 (2015).
33. Stults-Kolehmainen, M.A., Bartholomew, J.B. & Sinha, R. Chronic psychological stress impairs recovery of muscular function and somatic sensations over a 96-hour period. *The Journal of Strength & Conditioning Research* **28**, 2007–2017 (2014).
34. Perna, F.M. & McDowell, S.L. Role of psychological stress in cortisol recovery from exhaustive exercise among elite athletes. *International Journal of Behavioral Medicine* **2**, 13 (1995).
35. Lucibello, K.M., Paolucci, E.M., Graham, J.D. & Heisz, J.J. A randomized control trial investigating high-intensity interval training and mental health: A novel non-responder phenotype related to anxiety in young adults. *Mental Health and Physical Activity*, **18**, 100327 (2020).
36. Soya, H., et al. BDNF induction with mild exercise in the rat hippocampus. *Biochemical and Biophysical Research Communications* **358**, 961–967 (2007).
37. Bood, R.J., Nijssen, M., Van Der Kamp, J. & Roerdink, M. The power of auditory-motor synchronization in sports: Enhancing running performance by coupling cadence with the right beats. *PLOS ONE* **8** (2013).
38. De Ataide e Silva, T., et al. Can carbohydrate mouth rinse improve performance during exercise? A systematic review. *Nutrients* **6**, 1–10 (2014).

2. Move Away from Anxiety and Pain

1. Bandelow, B. & Michaelis, S. Epidemiology of anxiety disorders in the 21st century. *Dialogues in Clinical Neuroscience* **17**, 327 (2015).
2. Watson, J.B. & Rayner, R. Conditioned emotional reactions. *Journal of Experimental Psychology* **3**, 1 (1920).
3. El Khoury-Malhamé, M., et al. Amygdala activity correlates with attentional bias in PTSD. *Neuropsychologia* **49**, 1969–1973 (2011).
4. Zhou, Z., et al. Genetic variation in human NPY expression affects stress response and emotion. *Nature* **452**, 997–1001 (2008).
5. Zhou, Z., et al. Genetic variation in human NPY expression affects stress response and emotion. *Nature* **452**, 997–1001 (2008).
6. Fendt, M., et al. Fear-reducing effects of intra-amamygdala neuropeptide Y infusion in animal models of conditioned fear: An NPY Y1 receptor independent effect. *Psychopharmacology* **206**, 291–301 (2009).
7. Sah, R., et al. Low cerebrospinal fluid neuropeptide Y concentrations in post-traumatic stress disorder. *Biological Psychiatry* **66**, 705–707 (2009).
8. Rämson, R., Jürimäe, J., Jürimäe, T. & Mäestu, J. The effect of 4-week training period on plasma neuropeptide Y, leptin and ghrelin responses in male rowers. *European Journal of Applied Physiology* **112**, 1873–1880 (2012).
9. Lucibello, K., Parker, J. & Heisz, J. Examining a training effect on the state anxiety response to an acute bout of exercise in low and high anxious individuals. *Journal of Affective Disorders* **247**, 29–35 (2019).
10. Stubbs, B., et al. An examination of the anxiolytic effects of exercise for people with anxiety and stress-related disorders: A meta-analysis. *Psychiatry Research* **249**, 102–108 (2017).
11. Ensari, I., Greenlee, T.A., Motl, R.W. & Petruzzello, S.J. Meta-analysis of acute exercise effects on state anxiety: An update of randomized controlled trials over the past 25 years. *Depression and Anxiety* **32**, 624–634 (2015).
12. Stubbs, B., et al. An examination of the anxiolytic effects of exercise for people with anxiety and stress-related disorders: A meta-analysis. *Psychiatry Research* **249**, 102–108 (2017).
13. Gordon, B.R., McDowell, C.P., Lyons, M. & Herring, M.P. The effects of resistance exercise training on anxiety: A meta-analysis and meta-regression analysis of randomized controlled trials. *Sports Medicine* **47**, 2521–2532 (2017).
14. Cramer, H., et al. Yoga for anxiety: A systematic review and meta-analysis of randomized controlled trials. *Depression and Anxiety* **35**, 830–843 (2018).
15. Wang, F., et al. The effects of tai chi on depression, anxiety, and psychological well-being: A systematic review and meta-analysis. *International Journal of Behavioral Medicine* **21**, 605–617 (2014).
16. Raeder, F., Merz, C.J., Margraf, J. & Zlomuzica, A. The association between fear extinction, the ability to accomplish exposure and exposure therapy outcome in specific phobia. *Scientific Reports* **10**, 1–11 (2020).

17. Keyan, D. & Bryant, R.A. Acute exercise-induced enhancement of fear inhibition is moderated by BDNF Val66Met polymorphism. *Translational Psychiatry* **9**, 1–10 (2019).
18. Tanner, M.K., Hake, H.S., Bouchet, C.A. & Greenwood, B.N. Running from fear: Exercise modulation of fear extinction. *Neurobiology of Learning and Memory* **151**, 28–34 (2018).
19. Asmundson, G.J., et al. Let's get physical: A contemporary review of the anxiolytic effects of exercise for anxiety and its disorders. *Depression and Anxiety* **30**, 362–373 (2013).
20. Smits, J.A., et al. Reducing anxiety sensitivity with exercise. *Depression and Anxiety* **25**, 689–699 (2008).
21. Sabourin, B.C., Hilchey, C.A., Lefavre, M.-J., Watt, M.C. & Stewart, S.H. Why do they exercise less? Barriers to exercise in high-anxiety-sensitive women. *Cognitive Behaviour Therapy* **40**, 206–215 (2011).
22. Moshier, S.J., et al. Clarifying the link between distress intolerance and exercise: Elevated anxiety sensitivity predicts less vigorous exercise. *Cognitive Therapy and Research* **37**, 476–482 (2013).
23. Esquivel, G., et al. Acute exercise reduces the effects of a 35% CO₂ challenge in patients with panic disorder. *Journal of Affective Disorders* **107**, 217–220 (2008).
24. Plag, J., Ergec, D.L., Fydrich, T. & Ströhle, A. High-intensity interval training in panic disorder patients: A pilot study. *The Journal of Nervous and Mental Disease* **207**, 184–187 (2019).
25. Spindler, H. & Pedersen, S.S. Posttraumatic stress disorder in the wake of heart disease: Prevalence, risk factors, and future research directions. *Psychosomatic Medicine* **67**, 715–723 (2005).
26. Edmondson, D., et al. Prevalence of PTSD in survivors of stroke and transient ischemic attack: A meta-analytic review. *PLOS ONE* **8**, e66435 (2013).
27. Fang, J., Ayala, C., Luncheon, C., Ritchey, M. & Loustalot, F. Use of outpatient cardiac rehabilitation among heart attack survivors—20 states and the District of Columbia, 2013 and four states, 2015. *Morbidity and Mortality Weekly Report* **66**, 869 (2017).
28. Ter Hoeve, N., et al. Does cardiac rehabilitation after an acute cardiac syndrome lead to changes in physical activity habits? Systematic review. *Physical Therapy* **95**, 167–179 (2015).
29. Farris, S.G., Bond, D.S., Wu, W.C., Stabile, L.M. & Abrantes, A.M. Anxiety sensitivity and fear of exercise in patients attending cardiac rehabilitation. *Mental Health and Physical Activity* **15**, 22–26 (2018).
30. Edmondson, D., et al. Posttraumatic stress due to an acute coronary syndrome increases risk of 42-month major adverse cardiac events and all-cause mortality. *Journal of Psychiatric Research* **45**, 1621–1626 (2011).
31. Dahlhamer, J., et al. Prevalence of chronic pain and high-impact chronic pain among adults—United States, 2016. *Morbidity and Mortality Weekly Report* **67**, 1001 (2018).

32. Slade, S.C., Patel, S., Underwood, M. & Keating, J.L. What are patient beliefs and perceptions about exercise for nonspecific chronic low back pain? A systematic review of qualitative studies. *The Clinical Journal of Pain* **30**, 995–1005 (2014).
33. Pfingsten, M., et al. Fear-avoidance behavior and anticipation of pain in patients with chronic low back pain: A randomized controlled study. *Pain Medicine* **2**, 259–266 (2001).
34. Boudreau, M., et al. Impact of panic attacks on bronchoconstriction and subjective distress in asthma patients with and without panic disorder. *Psychosomatic Medicine* **79**, 576–584 (2017).
35. Witcraft, S.M., Dixon, L.J., Leukel, P. & Lee, A.A. Anxiety sensitivity and respiratory disease outcomes among individuals with chronic obstructive pulmonary disease. *General Hospital Psychiatry* **69**, 1–6 (2021).
36. van Tilburg, M.A., Palsson, O.S. & Whitehead, W.E. Which psychological factors exacerbate irritable bowel syndrome? Development of a comprehensive model. *Journal of Psychosomatic Research* **74**, 486–492 (2013).
37. Yoshino, A., et al. Sadness enhances the experience of pain via neural activation in the anterior cingulate cortex and amygdala: An fMRI study. *Neuroimage* **50**, 1194–1201 (2010).
38. Gray, K. & Wegner, D.M. The sting of intentional pain. *Psychological Science* **19**, 1260–1262 (2008).
39. Pfingsten, M., et al. Fear-avoidance behavior and anticipation of pain in patients with chronic low back pain: A randomized controlled study. *Pain Medicine* **2**, 259–266 (2001).
40. Pfingsten, M., et al. Fear-avoidance behavior and anticipation of pain in patients with chronic low back pain: A randomized controlled study. *Pain Medicine* **2**, 259–266 (2001).
41. Jamieson, J.P., Nock, M.K. & Mendes, W.B. Mind over matter: Reappraising arousal improves cardiovascular and cognitive responses to stress. *Journal of Experimental Psychology: General* **141**, 417 (2012).
42. Wood, J.V., Elaine Perunovic, W. & Lee, J.W. Positive self-statements: Power for some, peril for others. *Psychological Science* **20**, 860–866 (2009).
43. Symons, C.M., O'Sullivan, G.A. & Polman, R. The impacts of discriminatory experiences on lesbian, gay and bisexual people in sport. *Annals of Leisure Research* **20**, 467–489 (2017).
44. Caceres, B.A., et al. Assessing and addressing cardiovascular health in LGBTQ adults: A scientific statement from the American Heart Association. *Circulation* **142**, e321–e332 (2020).
45. Herrick, S.S. & Duncan, L.R. A systematic scoping review of engagement in physical activity among LGBTQ+ adults. *Journal of Physical Activity and Health* **15**, 226–232 (2018).
46. Meyer, M.L., Williams, K.D. & Eisenberger, N.I. Why social pain can live on: Different neural mechanisms are associated with reliving social and physical pain. *PLOS ONE* **10**, e0128294 (2015).

47. Eisenberger, N.I., Lieberman, M.D. & Williams, K.D. Does rejection hurt? An fMRI study of social exclusion. *Science* **302**, 290–292 (2003).
48. Meyer, M.L., Williams, K.D. & Eisenberger, N.I. Why social pain can live on: Different neural mechanisms are associated with reliving social and physical pain. *PLOS ONE* **10**, e0128294 (2015).
49. Danziger, N. & Willer, J.C. Tension-type headache as the unique pain experience of a patient with congenital insensitivity to pain. *Pain* **117**, 478–483 (2005).
50. Csupak, B., Sommer, J.L., Jacobsohn, E. & El-Gabalawy, R. A population-based examination of the co-occurrence and functional correlates of chronic pain and generalized anxiety disorder. *Journal of Anxiety Disorders* **56**, 74–80 (2018).
51. Doll, A., et al. Mindful attention to breath regulates emotions via increased amygdala–prefrontal cortex connectivity. *Neuroimage* **134**, 305–313 (2016).
52. Wells, R.E., et al. Attention to breath sensations does not engage endogenous opioids to reduce pain. *Pain* **161**, 1884–1893 (2020).
53. Shelov, D.V., Suchday, S. & Friedberg, J.P. A pilot study measuring the impact of yoga on the trait of mindfulness. *Behavioural and Cognitive Psychotherapy* **37**, 595 (2009).
54. Zhang, J., et al. A randomized controlled trial of mindfulness-based tai chi chuan for subthreshold depression adolescents. *Neuropsychiatric Disease and Treatment* **14**, 2313 (2018).
55. Caldwell, K., Adams, M., Quin, R., Harrison, M. & Greeson, J. Pilates, mindfulness and somatic education. *Journal of Dance & Somatic Practices* **5**, 141–153 (2013).
56. Mothes, H., Klaperski, S., Seelig, H., Schmidt, S. & Fuchs, R. Regular aerobic exercise increases dispositional mindfulness in men: A randomized controlled trial. *Mental Health and Physical Activity* **7**, 111–119 (2014).
57. Ulmer, C.S., Stetson, B.A. & Salmon, P.G. Mindfulness and acceptance are associated with exercise maintenance in YMCA exercisers. *Behaviour Research and Therapy* **48**, 805–809 (2010).

3. Mental Health Is Physical Health

1. Mojtabai, R. & Olfson, M. Proportion of antidepressants prescribed without a psychiatric diagnosis is growing. *Health Affairs* **30**, 1434–1442 (2011).
2. Spielmans, G.I., Spence-Sing, T. & Parry, P. Duty to warn: Antidepressant black box suicidality warning is empirically justified. *Frontiers in Psychiatry* **11**, 18 (2020).
3. Andrews, P.W. & Thomson Jr, J.A. The bright side of being blue: Depression as an adaptation for analyzing complex problems. *Psychological Review* **116**, 620 (2009).
4. Fava, M. & Davidson, K.G. Definition and epidemiology of treatment-resistant depression. *Psychiatric Clinics of North America* **19**, 179–200 (1996).

5. James, S.L., et al. Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990–2017: A systematic analysis for the Global Burden of Disease Study 2017. *The Lancet* **392**, 1789–1858 (2018).
6. Santosh, P.J. & Malhotra, S. Varied psychiatric manifestations of acute intermittent porphyria. *Biological Psychiatry* **36**, 744–747 (1994).
7. Dienberg Love, G., Seeman, T.E., Weinstein, M. & Ryff, C.D. Bioindicators in the MIDUS national study: Protocol, measures, sample, and comparative context. *Journal of Aging and Health* **22**, 1059–1080 (2010).
8. Sin, N.L., Graham-Engeland, J.E., Ong, A.D. & Almeida, D.M. Affective reactivity to daily stressors is associated with elevated inflammation. *Health Psychology* **34**, 1154 (2015).
9. Charles, S.T., Piazza, J.R., Mogle, J., Sliwinski, M.J. & Almeida, D.M. The wear and tear of daily stressors on mental health. *Psychological Science* **24**, 733–741 (2013).
10. Chiang, J.J., Turiano, N.A., Mroczek, D.K. & Miller, G.E. Affective reactivity to daily stress and 20-year mortality risk in adults with chronic illness: Findings from the National Study of Daily Experiences. *Health Psychology* **37**, 170 (2018).
11. Caballero, B. The global epidemic of obesity: An overview. *Epidemiologic Reviews* **29**, 1–5 (2007).
12. Van Cauter, E., Spiegel, K., Tasali, E. & Leproult, R. Metabolic consequences of sleep and sleep loss. *Sleep Medicine* **9**, S23–S28 (2008).
13. Piercy, K.L., et al. The physical activity guidelines for Americans. *The Journal of the American Medical Association* **320**, 2020–2028 (2018).
14. Booth, F.W., Gordon, S.E., Carlson, C.J. & Hamilton, M.T. Waging war on modern chronic diseases: Primary prevention through exercise biology. *Journal of Applied Physiology* (2000).
15. World Health Organization. *Global Status Report on Noncommunicable Diseases 2014*. https://apps.who.int/iris/bitstream/handle/10665/148114/9789241564854_eng.pdf (2014).
16. Chen, G.Y. & Nuñez, G. Sterile inflammation: Sensing and reacting to damage. *Nature Reviews Immunology* **10**, 826–837 (2010).
17. Buret, A.G. How stress induces intestinal hypersensitivity. *The American Journal of Pathology* **168**, 3 (2006).
18. Yang, J., et al. Lactose intolerance in irritable bowel syndrome patients with diarrhoea: The roles of anxiety, activation of the innate mucosal immune system and visceral sensitivity. *Alimentary Pharmacology & Therapeutics* **39**, 302–311 (2014).
19. Chida, Y., Hamer, M. & Steptoe, A. A bidirectional relationship between psychosocial factors and atopic disorders: A systematic review and meta-analysis. *Psychosomatic Medicine* **70**, 102–116 (2008).
20. Pedersen, A., Zachariae, R. & Bovbjerg, D.H. Influence of psychological stress

- on upper respiratory infection — a meta-analysis of prospective studies. *Psychosomatic Medicine* **72**, 823–832 (2010).
- 21. Kivimäki, M. & Kawachi, I. Work stress as a risk factor for cardiovascular disease. *Current Cardiology Reports* **17**, 1–9 (2015).
 - 22. Sisó, S., Jeffrey, M. & González, L. Sensory circumventricular organs in health and disease. *Acta Neuropathologica* **120**, 689–705 (2010).
 - 23. Savitz, J., et al. Putative neuroprotective and neurotoxic kynurenone pathway metabolites are associated with hippocampal and amygdalar volumes in subjects with major depressive disorder. *Neuropsychopharmacology* **40**, 463–471 (2015).
 - 24. Couch, Y., et al. Microglial activation, increased TNF and SERT expression in the prefrontal cortex define stress-altered behaviour in mice susceptible to anhedonia. *Brain, Behavior, and Immunity* **29**, 136–146 (2013).
 - 25. Lanquillon, S., Krieg, J.C., Bening-Abu-Shach, U. & Vedder, H. Cytokine production and treatment response in major depressive disorder. *Neuropsychopharmacology* **22**, 370–379 (2000).
 - 26. Strawbridge, R., et al. Inflammation and clinical response to treatment in depression: A meta-analysis. *European Neuropsychopharmacology* **25**, 1532–1543 (2015).
 - 27. Haroon, E., et al. Antidepressant treatment resistance is associated with increased inflammatory markers in patients with major depressive disorder. *Psychoneuroendocrinology* **95**, 43–49 (2018).
 - 28. Svensson, T., et al. The association between complete and partial non-response to psychosocial questions and suicide: The JPHC Study. *The European Journal of Public Health* **25**, 424–430 (2015).
 - 29. Rethorst, C.D., et al. Pro-inflammatory cytokines as predictors of antidepressant effects of exercise in major depressive disorder. *Molecular Psychiatry* **18**, 1119 (2013).
 - 30. Corruble, E., Legrand, J., Duret, C., Charles, G. & Guelfi, J. IDS-C and IDS-sr: Psychometric properties in depressed in-patients. *Journal of Affective Disorders* **56**, 95–101 (1999).
 - 31. Kvam, S., Kleppe, C.L., Nordhus, I.H. & Hovland, A. Exercise as a treatment for depression: A meta-analysis. *Journal of Affective Disorders* **202**, 67–86 (2016).
 - 32. Schuch, F.B., et al. Exercise as a treatment for depression: A meta-analysis adjusting for publication bias. *Journal of Psychiatric Research* **77**, 42–51 (2016).
 - 33. Netz, Y. Is the comparison between exercise and pharmacologic treatment of depression in the clinical practice guideline of the American College of Physicians evidence-based? *Frontiers in Pharmacology* **8**, 257 (2017).
 - 34. Babyak, M., et al. Exercise treatment for major depression: Maintenance of therapeutic benefit at 10 months. *Psychosomatic Medicine* **62**, 633–638 (2000).
 - 35. Das, A., et al. Comparison of treatment options for depression in heart

- failure: A network meta-analysis. *Journal of Psychiatric Research* **108**, 7–23 (2019).
- 36. Thombs, B.D., et al. Does evidence support the American Heart Association's recommendation to screen patients for depression in cardiovascular care? An updated systematic review. *PLOS ONE* **8**, e52654 (2013).
 - 37. Blumenthal, J.A., et al. Exercise and pharmacological treatment of depressive symptoms in patients with coronary heart disease: Results from the UPBEAT (Understanding the Prognostic Benefits of Exercise and Antidepressant Therapy) study. *Journal of the American College of Cardiology* **60**, 1053–1063 (2012).
 - 38. Gleeson, M., et al. The anti-inflammatory effects of exercise: Mechanisms and implications for the prevention and treatment of disease. *Nature Reviews Immunology* **11**, 607–615 (2011).
 - 39. Brandt, C. & Pedersen, B.K. The role of exercise-induced myokines in muscle homeostasis and the defense against chronic diseases. *Journal of Biomedicine and Biotechnology* **2010**, 1–6 (2010).
 - 40. Severinsen, M.C.K. & Pedersen, B.K. Muscle–organ crosstalk: The emerging roles of myokines. *Endocrine Reviews* **41**, 594–609 (2020).
 - 41. Champaneri, S., Wand, G.S., Malhotra, S.S., Casagrande, S.S. & Golden, S.H. Biological basis of depression in adults with diabetes. *Current Diabetes Reports* **10**, 396–405 (2010).
 - 42. Nerurkar, L., Siebert, S., McInnes, I.B. & Cavanagh, J. Rheumatoid arthritis and depression: An inflammatory perspective. *The Lancet Psychiatry* **6**, 164–173 (2019).
 - 43. Sforzini, L., Nettis, M.A., Mondelli, V. & Pariante, C.M. Inflammation in cancer and depression: A starring role for the kynurenone pathway. *Psychopharmacology*, 1–15 (2019).
 - 44. Paolucci, E.M., Loukov, D., Bowdish, D.M. & Heisz, J.J. Exercise reduces depression and inflammation but intensity matters. *Biological Psychology* **133**, 79–84 (2018).
 - 45. Gerritsen, R.J. & Band, G.P. Breath of life: The respiratory vagal stimulation model of contemplative activity. *Frontiers in Human Neuroscience* **12**, 397 (2018).
 - 46. Buchheit, M., et al. Monitoring endurance running performance using cardiac parasympathetic function. *European Journal of Applied Physiology* **108**, 1153–1167 (2010).
 - 47. Machhada, A., et al. Vagal determinants of exercise capacity. *Nature Communications* **8**, 1–7 (2017).
 - 48. von Haaren, B., Haertel, S., Stumpp, J., Hey, S. & Ebner-Priemer, U. Reduced emotional stress reactivity to a real-life academic examination stressor in students participating in a 20-week aerobic exercise training: A randomised controlled trial using Ambulatory Assessment. *Psychology of Sport and Exercise* **20**, 67–75 (2015).

49. Netz, Y. Is the comparison between exercise and pharmacologic treatment of depression in the clinical practice guideline of the American College of Physicians evidence-based? *Frontiers in Pharmacology* **8**, 257 (2017).
50. Nebiker, L., et al. Moderating effects of exercise duration and intensity in neuromuscular vs. endurance exercise interventions for the treatment of depression: A meta-analytical review. *Frontiers in Psychiatry* **9**, 305 (2018).
51. Sabir, M.S., et al. Optimal vitamin D spurs serotonin: 1, 25-dihydroxyvitamin D represses serotonin reuptake transport (SERT) and degradation (MAO-A) gene expression in cultured rat serotonergic neuronal cell lines. *Genes & Nutrition* **13**, 19 (2018).
52. Parker, G.B., Brotchie, H. & Graham, R.K. Vitamin D and depression. *Journal of Affective Disorders* **208**, 56–61 (2017).
53. Harvey, S.B., et al. Exercise and the prevention of depression: Results of the HUNT cohort study. *American Journal of Psychiatry* **175**, 28–36 (2018).
54. Rector, N.A., Richter, M.A., Lerman, B. & Regev, R. A pilot test of the additive benefits of physical exercise to CBT for OCD. *Cognitive Behaviour Therapy* **44**, 328–340 (2015).

4. Free Yourself from Addiction

1. Mónok, K., et al. Psychometric properties and concurrent validity of two exercise addiction measures: A population wide study. *Psychology of Sport and Exercise* **13**, 739–746 (2012).
2. Sussman, S., Lisha, N. & Griffiths, M. Prevalence of the addictions: A problem of the majority or the minority? *Evaluation & the Health Professions* **34**, 3–56 (2011).
3. Trott, M., et al. Exercise addiction prevalence and correlates in the absence of eating disorder symptomatology: A systematic review and meta-analysis. *Journal of Addiction Medicine* **14**, e321–e329 (2020).
4. Lichtenstein, M.B. & Jensen, T.T. Exercise addiction in CrossFit: Prevalence and psychometric properties of the Exercise Addiction Inventory. *Addictive Behaviors Reports* **3**, 33–37 (2016).
5. Herie, M., Godden, T., Shenfeld, J. & Kelly, C. *Addiction: An Information Guide*. Centre for Addiction and Mental Health. <https://www.camh.ca/-/media/files/guides-and-publications/addiction-guide-en.pdf> (2010).
6. Szabo, A., Griffiths, M.D., Marcos, R.d.L.V., Mervó, B. & Demetrovics, Z. Focus: Addiction: Methodological and conceptual limitations in exercise addiction research. *The Yale Journal of Biology and Medicine* **88**, 303 (2015).
7. Sutoo, D. & Akiyama, K. The mechanism by which exercise modifies brain function. *Physiology & Behavior* **60**, 177–181 (1996).
8. Hernandez, L. & Hoebel, B.G. Food reward and cocaine increase extracellular dopamine in the nucleus accumbens as measured by microdialysis. *Life Sciences* **42**, 1705–1712 (1988).
9. Fiorino, D.F. & Phillips, A.G. Facilitation of sexual behavior and enhanced

- dopamine efflux in the nucleus accumbens of male rats after D-amphetamine-induced behavioral sensitization. *Journal of Neuroscience* **19**, 456–463 (1999).
- 10. Di Chiara, G. & Imperato, A. Drugs abused by humans preferentially increase synaptic dopamine concentrations in the mesolimbic system of freely moving rats. *Proceedings of the National Academy of Sciences* **85**, 5274–5278 (1988).
 - 11. Volkow, N.D., Fowler, J.S., Wang, G.-J. & Swanson, J.M. Dopamine in drug abuse and addiction: Results from imaging studies and treatment implications. *Molecular Psychiatry* **9**, 557–569 (2004).
 - 12. Krasnova, I.N., et al. Methamphetamine self-administration is associated with persistent biochemical alterations in striatal and cortical dopaminergic terminals in the rat. *PLOS ONE* **5**, e8790 (2010).
 - 13. Ballard, M.E., et al. Low dopamine D2/D3 receptor availability is associated with steep discounting of delayed rewards in methamphetamine dependence. *International Journal of Neuropsychopharmacology* **18** (2015).
 - 14. Cass, W.A. & Manning, M.W. Recovery of presynaptic dopaminergic functioning in rats treated with neurotoxic doses of methamphetamine. *Journal of Neuroscience* **19**, 7653–7660 (1999).
 - 15. Woolverton, W.L., Ricaurte, G.A., Forno, L.S. & Seiden, L.S. Long-term effects of chronic methamphetamine administration in rhesus monkeys. *Brain Research* **486**, 73–78 (1989).
 - 16. Wang, G., et al. Decreased dopamine activity predicts relapse in methamphetamine abusers. *Molecular Psychiatry* **17**, 918–925 (2012).
 - 17. Sutoo, D. & Akiyama, K. The mechanism by which exercise modifies brain function. *Physiology & Behavior* **60**, 177–181 (1996).
 - 18. Robertson, C.L., et al. Effect of exercise training on striatal dopamine D2/D3 receptors in methamphetamine users during behavioral treatment. *Neuropsychopharmacology* **41**, 1629–1636 (2016).
 - 19. Goldfarb, A.H., Hatfield, B., Armstrong, D. & Potts, J. Plasma beta-endorphin concentration: Response to intensity and duration of exercise. *Medicine and Science in Sports and Exercise* **22**, 241–244 (1990).
 - 20. Dietrich, A. & McDaniel, W.F. Endocannabinoids and exercise. *British Journal of Sports Medicine* **38**, 536–541 (2004).
 - 21. Boecker, H., et al. The runner's high: Opioidergic mechanisms in the human brain. *Cerebral Cortex* **18**, 2523–2531 (2008).
 - 22. Fuss, J., et al. A runner's high depends on cannabinoid receptors in mice. *Proceedings of the National Academy of Sciences* **112**, 13105–13108 (2015).
 - 23. Raichlen, D.A., Foster, A.D., Seillier, A., Giuffrida, A. & Gerdeman, G.L. Exercise-induced endocannabinoid signaling is modulated by intensity. *European Journal of Applied Physiology* **113**, 869–875 (2013).
 - 24. Dietrich, A. & McDaniel, W.F. Endocannabinoids and exercise. *British Journal of Sports Medicine* **38**, 536–541 (2004).

25. Mitchell, M.R., Berridge, K.C. & Mahler, S.V. Endocannabinoid-enhanced “liking” in nucleus accumbens shell hedonic hotspot requires endogenous opioid signals. *Cannabis and Cannabinoid Research* **3**, 166–170 (2018).
26. Schwarz, L. & Kindermann, W. β -Endorphin, catecholamines, and cortisol during exhaustive endurance exercise. *International Journal of Sports Medicine* **10**, 324–328 (1989).
27. Cohen, E.E., Ejsmond-Frey, R., Knight, N. & Dunbar, R.I. Rowers’ high: Behavioural synchrony is correlated with elevated pain thresholds. *Biology Letters* **6**, 106–108 (2010).
28. Tarr, B., Launay, J., Cohen, E. & Dunbar, R. Synchrony and exertion during dance independently raise pain threshold and encourage social bonding. *Biology Letters* **11**, 2015.0767 (2015).
29. Sullivan, P. & Rickers, K. The effect of behavioral synchrony in groups of teammates and strangers. *International Journal of Sport and Exercise Psychology* **11**, 286–291 (2013).
30. Whiteman-Sandland, J., Hawkins, J. & Clayton, D. The role of social capital and community belongingness for exercise adherence: An exploratory study of the CrossFit gym model. *Journal of Health Psychology* **23**, 1545–1556 (2018).
31. Wise, R.A. Dopamine and reward: The anhedonia hypothesis 30 years on. *Neurotoxicity Research* **14**, 169–183 (2008).
32. Ferreri, L., et al. Dopamine modulates the reward experiences elicited by music. *Proceedings of the National Academy of Sciences* **116**, 3793–3798 (2019).
33. Wang, D., Wang, Y., Wang, Y., Li, R. & Zhou, C. Impact of physical exercise on substance use disorders: A meta-analysis. *PLOS ONE* **9**, e110728 (2014).
34. Mooney, L.J., et al. Exercise for methamphetamine dependence: Rationale, design, and methodology. *Contemporary Clinical Trials* **37**, 139–147 (2014).
35. Robertson, C.L., et al. Effect of exercise training on striatal dopamine D2/D3 receptors in methamphetamine users during behavioral treatment. *Neuropharmacology* **41**, 1629–1636 (2016).
36. Rawson, R.A., et al. The impact of exercise on depression and anxiety symptoms among abstinent methamphetamine-dependent individuals in a residential treatment setting. *Journal of Substance Abuse Treatment* **57**, 36–40 (2015).
37. Rawson, R.A., et al. Impact of an exercise intervention on methamphetamine use outcomes post-residential treatment care. *Drug and Alcohol Dependence* **156**, 21–28 (2015).
38. Abrantes, A.M., et al. Exercise preferences of patients in substance abuse treatment. *Mental Health and Physical Activity* **4**, 79–87 (2011).
39. Beiter, R., Peterson, A., Abel, J. & Lynch, W. Exercise during early, but not late abstinence, attenuates subsequent relapse vulnerability in a rat model. *Translational Psychiatry* **6**, e792 (2016).

40. Robertson, C.L., et al. Effect of exercise training on striatal dopamine D2/D3 receptors in methamphetamine users during behavioral treatment. *Neuropharmacology* **41**, 1629–1636 (2016).
41. Rawson, R.A., et al. Impact of an exercise intervention on methamphetamine use outcomes post-residential treatment care. *Drug and Alcohol Dependence* **156**, 21–28 (2015).
42. Goldstein, R.Z. & Volkow, N.D. Dysfunction of the prefrontal cortex in addiction: Neuroimaging findings and clinical implications. *Nature Reviews Neuroscience* **12**, 652–669 (2011).
43. Brecht, M.L. & Herbeck, D. Time to relapse following treatment for methamphetamine use: A long-term perspective on patterns and predictors. *Drug and Alcohol Dependence* **139**, 18–25 (2014).
44. Shin, C.B., et al. Incubation of cocaine-craving relates to glutamate over-flow within ventromedial prefrontal cortex. *Neuropharmacology* **102**, 103–110 (2016).
45. Parvaz, M.A., Moeller, S.J. & Goldstein, R.Z. Incubation of cue-induced craving in adults addicted to cocaine measured by electroencephalography. *The Journal of the American Medical Association Psychiatry* **73**, 1127–1134 (2016).
46. Abel, J.M., Nesil, T., Bakhti-Suroosh, A., Grant, P.A. & Lynch, W.J. Mechanisms underlying the efficacy of exercise as an intervention for cocaine relapse: A focus on mGlu5 in the dorsal medial prefrontal cortex. *Psychopharmacology*, 1–17 (2019).
47. Wang, D., Zhou, C., Zhao, M., Wu, X. & Chang, Y.-K. Dose–response relationships between exercise intensity, cravings, and inhibitory control in methamphetamine dependence: An ERPs study. *Drug and Alcohol Dependence* **161**, 331–339 (2016).
48. Wang, D., Zhu, T., Zhou, C. & Chang, Y.-K. Aerobic exercise training ameliorates craving and inhibitory control in methamphetamine dependencies: A randomized controlled trial and event-related potential study. *Psychology of Sport and Exercise* **30**, 82–90 (2017).
49. Lautner, S.C., Patterson, M.S., Ramirez, M. & Heinrich, K. Can CrossFit aid in addiction recovery? An exploratory media analysis of popular press. *Mental Health and Social Inclusion* **24** (2020).
50. Bava, S. & Tapert, S.F. Adolescent brain development and the risk for alcohol and other drug problems. *Neuropsychology Review* **20**, 398–413 (2010).
51. Galvan, A. Adolescent development of the reward system. *Frontiers in Human Neuroscience* **4**, 6 (2010).
52. Hill, S.Y., et al. Dopaminergic mutations: Within-family association and linkage in multiplex alcohol dependence families. *American Journal of Medical Genetics Part B: Neuropsychiatric Genetics* **147**, 517–526 (2008).
53. Giacometti, L. & Barker, J. Sex differences in the glutamate system: Implications for addiction. *Neuroscience & Biobehavioral Reviews* **113**, 157–168 (2020).

54. Bobzean, S.A., DeNobrega, A.K. & Perrotti, L.I. Sex differences in the neurobiology of drug addiction. *Experimental Neurology* **259**, 64–74 (2014).
55. Velicer, W.F., et al. Multiple behavior interventions to prevent substance abuse and increase energy balance behaviors in middle school students. *Translational Behavioral Medicine* **3**, 82–93 (2013).
56. Korhonen, T., Kujala, U.M., Rose, R.J. & Kaprio, J. Physical activity in adolescence as a predictor of alcohol and illicit drug use in early adulthood: A longitudinal population-based twin study. *Twin Research and Human Genetics* **12**, 261–268 (2009).
57. Cooper, A.R., et al. Objectively measured physical activity and sedentary time in youth: The International Children's Accelerometry Database (ICAD). *International Journal of Behavioral Nutrition and Physical Activity* **12**, 1–10 (2015).
58. García-Rodríguez, O., et al. Probability and predictors of relapse to smoking: Results of the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC). *Drug and Alcohol Dependence* **132**, 479–485 (2013).
59. Campana, B., Brasiel, P.G., de Aguiar, A.S. & Dutra, S.C.P.L. Obesity and food addiction: Similarities to drug addiction. *Obesity Medicine* **16**, 100136 (2019).
60. Mantsch, J.R., Baker, D.A., Funk, D., Lê, A.D. & Shaham, Y. Stress-induced reinstatement of drug seeking: 20 years of progress. *Neuropsychopharmacology* **41**, 335 (2016).

5. Keep Your Brain Young

1. Mendonça, J., Marques, S. & Abrams, D. Children's attitudes toward older people: Current and future directions. *Contemporary Perspectives on Ageism*, 517–548 (2018).
2. Mendonça, J., Marques, S. & Abrams, D. Children's attitudes toward older people: Current and future directions. *Contemporary Perspectives on Ageism*, 517–548 (2018).
3. Levy, B.R. Mind matters: Cognitive and physical effects of aging self-stereotypes. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences* **58**, P203–P211 (2003).
4. Hess, T.M., Hinson, J.T. & Hodges, E.A. Moderators of and mechanisms underlying stereotype threat effects on older adults' memory performance. *Experimental Aging Research* **35**, 153–177 (2009).
5. Hausdorff, J.M., Levy, B.R. & Wei, J.Y. The power of ageism on physical function of older persons: Reversibility of age-related gait changes. *Journal of the American Geriatrics Society* **47**, 1346–1349 (1999).
6. Fenesi, B., et al. Physical exercise moderates the relationship of apolipoprotein E (APOE) genotype and dementia risk: A population-based study. *Journal of Alzheimer's Disease* **56**, 297–303 (2017).

7. Edwardson, C.L., et al. Association of sedentary behaviour with metabolic syndrome: A meta-analysis. *PLOS ONE* **7**, e34916 (2012).
8. Verhaaren, B.F., et al. High blood pressure and cerebral white matter lesion progression in the general population. *Hypertension* **61**, 1354–1359 (2013).
9. Vermeer, S.E., et al. Silent brain infarcts and white matter lesions increase stroke risk in the general population: The Rotterdam Scan Study. *Stroke* **34**, 1126–1129 (2003).
10. Debette, S. & Markus, H. The clinical importance of white matter hyperintensities on brain magnetic resonance imaging: Systematic review and meta-analysis. *The British Medical Journal* **341** (2010).
11. Gorelick, P.B., et al. Vascular contributions to cognitive impairment and dementia: A statement for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke* **42**, 2672–2713 (2011).
12. Emrani, S., et al. Alzheimer's/vascular spectrum dementia: Classification in addition to diagnosis. *Journal of Alzheimer's Disease* **73**, 63–71 (2020).
13. Perosa, V., et al. Hippocampal vascular reserve associated with cognitive performance and hippocampal volume. *Brain* **143**, 622–634 (2020).
14. de La Torre, J.C. Alzheimer's disease is a vasocognopathy: A new term to describe its nature. *Neurological Research* **26**, 517–524 (2004).
15. Yan, S., et al. Association between sedentary behavior and the risk of dementia: A systematic review and meta-analysis. *Translational Psychiatry* **10**, 1–8 (2020).
16. van Alphen, H.J., et al. Older adults with dementia are sedentary for most of the day. *PLOS ONE* **11**, e0152457 (2016).
17. Carter, S.E., et al. Regular walking breaks prevent the decline in cerebral blood flow associated with prolonged sitting. *Journal of Applied Physiology* **125**, 790–798 (2018).
18. Loh, R., Stamatakis, E., Folkerts, D., Allgrove, J.E. & Moir, H.J. Effects of interrupting prolonged sitting with physical activity breaks on blood glucose, insulin and triacylglycerol measures: A systematic review and meta-analysis. *Sports Medicine* **50**, 295–330 (2020).
19. Ekelund, U., et al. Does physical activity attenuate, or even eliminate, the detrimental association of sitting time with mortality? A harmonised meta-analysis of data from more than 1 million men and women. *The Lancet* **388**, 1302–1310 (2016).
20. Mckendry, J., Breen, L., Shad, B.J. & Greig, C.A. Muscle morphology and performance in master athletes: A systematic review and meta-analyses. *Ageing Research Reviews* **45**, 62–82 (2018).
21. Kontro, T.K., Sarna, S., Kaprio, J. & Kujala, U.M. Mortality and health-related habits in 900 Finnish former elite athletes and their brothers. *British Journal of Sports Medicine* **52**, 89–95 (2018).
22. Rogers, M.A., Hagberg, J.M., Martin 3rd, W., Ehsani, A. & Holloszy, J.O. De-

- cline in VO₂ max with aging in master athletes and sedentary men. *Journal of Applied Physiology* **68**, 2195–2199 (1990).
- 23. Kurl, S., Laukkanen, J., Lonnroos, E., Remes, A. & Soininen, H. Cardiorespiratory fitness and risk of dementia: A prospective population-based cohort study. *Age and Ageing* **47**, 611–614 (2018).
 - 24. Hölder, H., et al. Midlife cardiovascular fitness and dementia: A 44-year longitudinal population study in women. *Neurology* **90**, e1298–e1305 (2018).
 - 25. Lalande, S., et al. Effects of interval walking on physical fitness in middle-aged individuals. *Journal of Primary Care & Community Health* **1**, 104–110 (2010).
 - 26. Morikawa, M., et al. Physical fitness and indices of lifestyle-related diseases before and after interval walking training in middle-aged and older males and females. *British Journal of Sports Medicine* **45**, 216–224 (2011).
 - 27. Karstoft, K., et al. The effects of free-living interval-walking training on glycemic control, body composition, and physical fitness in type 2 diabetic patients: A randomized, controlled trial. *Diabetes Care* **36**, 228–236 (2013).
 - 28. Lachman, M.E. Development in midlife. *The Annual Review of Psychology* **55**, 305–331 (2004).
 - 29. Reed, J.L. & Pipe, A.L. The talk test: A useful tool for prescribing and monitoring exercise intensity. *Current Opinion in Cardiology* **29**, 475–480 (2014).
 - 30. Stienen, M.N., et al. Reliability of the 6-minute walking test smartphone application. *Journal of Neurosurgery: Spine* **31**, 786–793 (2019).
 - 31. Burr, J.F., Bredin, S.S., Faktor, M.D. & Warburton, D.E. The 6-minute walk test as a predictor of objectively measured aerobic fitness in healthy working-aged adults. *The Physician and Sports Medicine* **39**, 133–139 (2011).
 - 32. Kurl, S., Laukkanen, J., Lonnroos, E., Remes, A. & Soininen, H. Cardiorespiratory fitness and risk of dementia: A prospective population-based cohort study. *Age and Ageing* **47**, 611–614 (2018).
 - 33. Ainslie, P.N., et al. Elevation in cerebral blood flow velocity with aerobic fitness throughout healthy human ageing. *The Journal of Physiology* **586**, 4005–4010 (2008).
 - 34. Morland, C., et al. Exercise induces cerebral VEGF and angiogenesis via the lactate receptor HCAR1. *Nature Communications* **8**, 15557 (2017).
 - 35. El Hayek, L., et al. Lactate mediates the effects of exercise on learning and memory through SIRT1-dependent activation of hippocampal brain-derived neurotrophic factor (BDNF). *Journal of Neuroscience* **39**, 2369–2382 (2019).
 - 36. Phillips, H.S., et al. BDNF mRNA is decreased in the hippocampus of individuals with Alzheimer's disease. *Neuron* **7**, 695–702 (1991).
 - 37. Altman, J. & Das, G.D. Autoradiographic and histological evidence of postnatal hippocampal neurogenesis in rats. *Journal of Comparative Neurology* **124**, 319–335 (1965).
 - 38. Van Praag, H., Kempermann, G. & Gage, F.H. Running increases cell proliferation and neurogenesis in the adult mouse dentate gyrus. *Nature Neuroscience* **2**, 266 (1999).

39. Van Praag, H., Christie, B.R., Sejnowski, T.J. & Gage, F.H. Running enhances neurogenesis, learning, and long-term potentiation in mice. *Proceedings of the National Academy of Sciences* **96**, 13427–13431 (1999).
40. Van Praag, H., Kempermann, G. & Gage, F.H. Running increases cell proliferation and neurogenesis in the adult mouse dentate gyrus. *Nature Neuroscience* **2**, 266 (1999).
41. Van Praag, H., Christie, B.R., Sejnowski, T.J. & Gage, F.H. Running enhances neurogenesis, learning, and long-term potentiation in mice. *Proceedings of the National Academy of Sciences* **96**, 13427–13431 (1999).
42. Van Praag, H., Shubert, T., Zhao, C. & Gage, F.H. Exercise enhances learning and hippocampal neurogenesis in aged mice. *Journal of Neuroscience* **25**, 8680–8685 (2005).
43. Boldrini, M., et al. Human hippocampal neurogenesis persists throughout aging. *Cell Stem Cell* **22**, 589–599.e585 (2018).
44. Sorrells, S.F., et al. Human hippocampal neurogenesis drops sharply in children to undetectable levels in adults. *Nature* **555**, 377 (2018).
45. Jack, C., et al. Rate of medial temporal lobe atrophy in typical aging and Alzheimer's disease. *Neurology* **51**, 993–999 (1998).
46. Erickson, K.I., et al. Exercise training increases size of hippocampus and improves memory. *Proceedings of the National Academy of Sciences* **108**, 3017–3022 (2011).
47. Maass, A., et al. Vascular hippocampal plasticity after aerobic exercise in older adults. *Molecular Psychiatry* **20**, 585–593 (2015).
48. Gorbach, T., et al. Longitudinal association between hippocampus atrophy and episodic-memory decline. *Neurobiology of Aging* **51**, 167–176 (2017).
49. Tromp, D., Dufour, A., Lithfous, S., Pebayle, T. & Després, O. Episodic memory in normal aging and Alzheimer disease: Insights from imaging and behavioral studies. *Ageing Research Reviews* **24**, 232–262 (2015).
50. Kovacevic, A., Fenesi, B., Paolucci, E. & Heiss, J.J. The effects of aerobic exercise intensity on memory in older adults. *Applied Physiology, Nutrition, and Metabolism* (2019).
51. Lourenco, M.V., et al. Cerebrospinal fluid irisin correlates with amyloid- β , BDNF, and cognition in Alzheimer's disease. *Alzheimer's & Dementia: Diagnosis, Assessment & Disease Monitoring* **12**, e12034 (2020).
52. Lourenco, M.V., et al. Exercise-linked FNDC5/irisin rescues synaptic plasticity and memory defects in Alzheimer's models. *Nature Medicine* **25**, 165 (2019).
53. Lourenco, M.V., et al. Cerebrospinal fluid irisin correlates with amyloid- β , BDNF, and cognition in Alzheimer's disease. *Alzheimer's & Dementia: Diagnosis, Assessment & Disease Monitoring* **12**, e12034 (2020).
54. de Freitas, G.B., Lourenco, M.V. & De Felice, F.G. Protective actions of exercise-related FNDC5/Irisin in memory and Alzheimer's disease. *Journal of Neurochemistry* **155**, 602–611 (2020).

55. Okwumabua, T.M., Meyers, A.W. & Santille, L. A demographic and cognitive profile of master runners. *Journal of Sport Behavior* **10**, 212 (1987).
56. Frisoni, G.B., et al. Mild cognitive impairment in the population and physical health: Data on 1,435 individuals aged 75 to 95. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences* **55**, M322–M328 (2000).
57. Sachdev, P.S., et al. Factors predicting reversion from mild cognitive impairment to normal cognitive functioning: A population-based study. *PLOS ONE* **8**, e59649 (2013).
58. Singh, M.A.F., et al. The Study of Mental and Resistance Training (SMART) study—resistance training and/or cognitive training in mild cognitive impairment: A randomized, double-blind, double-sham controlled trial. *Journal of the American Medical Directors Association* **15**, 873–880 (2014).
59. Tak, E.C., van Uffelen, J.G., Paw, M.J.C.A., van Mechelen, W. & Hopman-Rock, M. Adherence to exercise programs and determinants of maintenance in older adults with mild cognitive impairment. *Journal of Aging and Physical Activity* **20**, 32–46 (2012).
60. Penninkilampi, R., Casey, A.-N., Singh, M.F. & Brodaty, H. The association between social engagement, loneliness, and risk of dementia: A systematic review and meta-analysis. *Journal of Alzheimer's Disease* **66**, 1619–1633 (2018).
61. Sundström, A., Adolfsson, A.N., Nordin, M. & Adolfsson, R. Loneliness increases the risk of all-cause dementia and Alzheimer's disease. *The Journals of Gerontology: Series B* **75**, 919–926 (2020).
62. Dunlop, W.L. & Beauchamp, M.R. Birds of a feather stay active together: A case study of an all-male older adult exercise program. *Journal of Aging and Physical Activity* **21**, 222–232 (2013).
63. Farrance, C., Tsoufliou, F. & Clark, C. Adherence to community based group exercise interventions for older people: A mixed-methods systematic review. *Preventive Medicine* **87**, 155–166 (2016).
64. Kanamori, S., et al. Exercising alone versus with others and associations with subjective health status in older Japanese: The JAGES Cohort Study. *Scientific Reports* **6**, 1–7 (2016).
65. Brady, S., et al. Reducing isolation and loneliness through membership in a fitness program for older adults: Implications for health. *Journal of Applied Gerontology* **39**, 301–310 (2020).
66. Hawkley, L.C. & Cacioppo, J.T. Loneliness matters: A theoretical and empirical review of consequences and mechanisms. *Annals of Behavioral Medicine* **40**, 218–227 (2010).
67. Hawkley, L.C., Thisted, R.A. & Cacioppo, J.T. Loneliness predicts reduced physical activity: Cross-sectional & longitudinal analyses. *Health Psychology* **28**, 354 (2009).
68. Devereux-Fitzgerald, A., Powell, R., Dewhurst, A. & French, D.P. The accept-

- ability of physical activity interventions to older adults: A systematic review and meta-synthesis. *Social Science & Medicine* **158**, 14–23 (2016).
- 69. Stubbs, B., et al. Risk of hospitalized falls and hip fractures in 22,103 older adults receiving mental health care vs 161,603 controls: A large cohort study. *Journal of the American Medical Directors Association* **21**, 1893–1899 (2020).
 - 70. Karssemeijer, E.G., et al. Exergaming as a physical exercise strategy reduces frailty in people with dementia: A randomized controlled trial. *Journal of the American Medical Directors Association* **20**, 1502–1508. e1501 (2019).
 - 71. Northey, J.M., Cherbuin, N., Pumpa, K.L., Smee, D.J. & Rattray, B. Exercise interventions for cognitive function in adults older than 50: A systematic review with meta-analysis. *British Journal of Sports Medicine* **52**, 154–160 (2018).

6. Move More to Sleep, Think, and Feel Better

- 1. Roth, T. Insomnia: Definition, prevalence, etiology, and consequences. *Journal of Clinical Sleep Medicine* **3**, S7–S10 (2007).
- 2. Timpano, K.R., Carbonella, J.Y., Bernert, R.A. & Schmidt, N.B. Obsessive compulsive symptoms and sleep difficulties: Exploring the unique relationship between insomnia and obsessions. *Journal of Psychiatric Research* **57**, 101–107 (2014).
- 3. Morin, C.M., et al. Insomnia disorder. *Nature Reviews Disease Primers* **1**, 1–18 (2015).
- 4. Hirshkowitz, M., et al. National Sleep Foundation's sleep time duration recommendations: Methodology and results summary. *Sleep Health* **1**, 40–43 (2015).
- 5. Olds, T., Blunden, S., Petkov, J. & Forchino, F. The relationships between sex, age, geography and time in bed in adolescents: A meta-analysis of data from 23 countries. *Sleep Medicine Reviews* **14**, 371–378 (2010).
- 6. Dregan, A. & Armstrong, D. Adolescence sleep disturbances as predictors of adulthood sleep disturbances—a cohort study. *Journal of Adolescent Health* **46**, 482–487 (2010).
- 7. Cohen, D.A., et al. Uncovering residual effects of chronic sleep loss on human performance. *Science Translational Medicine* **2**, 14ra13 (2010).
- 8. Taylor, D.J., Lichstein, K.L., Durrence, H.H., Reidel, B.W. & Bush, A.J. Epidemiology of insomnia, depression, and anxiety. *Sleep* **28**, 1457–1464 (2005).
- 9. Shao, Y., et al. Altered resting-state amygdala functional connectivity after 36 hours of total sleep deprivation. *PLOS ONE* **9**, e112222 (2014).
- 10. Jamieson, D., Broadhouse, K.M., Lagopoulos, J. & Hermens, D.F. Investigating the links between adolescent sleep deprivation, fronto-limbic connectivity and the onset of mental disorders: A review of the literature. *Sleep Medicine* **66**, 61–67 (2020).
- 11. Baum, K.T., et al. Sleep restriction worsens mood and emotion regulation in adolescents. *Journal of Child Psychology and Psychiatry* **55**, 180–190 (2014).

12. Wong, M.M., Brower, K.J. & Zucker, R.A. Sleep problems, suicidal ideation, and self-harm behaviors in adolescence. *Journal of Psychiatric Research* **45**, 505–511 (2011).
13. <https://www.nimh.nih.gov/health/statistics/suicide>.
14. Krause, A.J., et al. The sleep-deprived human brain. *Nature Reviews Neuroscience* **18**, 404 (2017).
15. Poudel, G.R., Innes, C.R., Bones, P.J., Watts, R. & Jones, R.D. Losing the struggle to stay awake: Divergent thalamic and cortical activity during microsleeps. *Human Brain Mapping* **35**, 257–269 (2014).
16. Lo, J.C., Ong, J.L., Leong, R.L., Gooley, J.J. & Chee, M.W. Cognitive performance, sleepiness, and mood in partially sleep deprived adolescents: The Need for Sleep Study. *Sleep* **39**, 687–698 (2016).
17. Tefft, B.C. Asleep at the wheel: The prevalence and impact of drowsy driving. <https://aaafoundation.org/wp-content/uploads/2018/02/2010DrowsyDrivingReport.pdf> (2010).
18. Williamson, A.M. & Feyer, A.-M. Moderate sleep deprivation produces impairments in cognitive and motor performance equivalent to legally prescribed levels of alcohol intoxication. *Occupational and Environmental Medicine* **57**, 649–655 (2000).
19. Landrigan, C.P., et al. Effect of reducing interns' work hours on serious medical errors in intensive care units. *New England Journal of Medicine* **351**, 1838–1848 (2004).
20. Bromley, L.E., Booth III, J.N., Kilkus, J.M., Imperial, J.G. & Penev, P.D. Sleep restriction decreases the physical activity of adults at risk for type 2 diabetes. *Sleep* **35**, 977–984 (2012).
21. Taheri, S. The link between short sleep duration and obesity: We should recommend more sleep to prevent obesity. *Archives of Disease in Childhood* **91**, 881–884 (2006).
22. Knutson, K.L., Spiegel, K., Penev, P. & Van Cauter, E. The metabolic consequences of sleep deprivation. *Sleep Medicine Reviews* **11**, 163–178 (2007).
23. Kovacevic, A., Mavros, Y., Heisz, J.J. & Singh, M.A.F. The effect of resistance exercise on sleep: A systematic review of randomized controlled trials. *Sleep Medicine Reviews* **39**, 52–68 (2018).
24. Wang, W.L., Chen, K.H., Pan, Y.C., Yang, S.N. & Chan, Y.Y. The effect of yoga on sleep quality and insomnia in women with sleep problems: A systematic review and meta-analysis. *The British Medical Journal Psychiatry* **20**, 1–19 (2020).
25. Raman, G., Zhang, Y., Minichiello, V.J., D'Ambrosio, C.M. & Wang, C. Tai chi improves sleep quality in healthy adults and patients with chronic conditions: A systematic review and meta-analysis. *Journal of Sleep Disorders & Therapy* **2** (2013).
26. Kredlow, M.A., Capozzoli, M.C., Hearon, B.A., Calkins, A.W. & Otto, M.W.

- The effects of physical activity on sleep: A meta-analytic review. *Journal of Behavioral Medicine* **38**, 427–449 (2015).
- 27. Czeisler, C.A., et al. Stability, precision, and near-24-hour period of the human circadian pacemaker. *Science* **284**, 2177–2181 (1999).
 - 28. Daan, S. & Gwinner, E. Jürgen Aschoff (1913–98). *Nature* **396**, 418–418 (1998).
 - 29. Aschoff, J. Circadian rhythms in man. *Science* **148**, 1427–1432 (1965).
 - 30. Grivas, T.B. & Savvidou, O.D. Melatonin the “light of night” in human biology and adolescent idiopathic scoliosis. *Scoliosis* **2**, 6 (2007).
 - 31. Haim, A. & Zubidat, A.E. Artificial light at night: Melatonin as a mediator between the environment and epigenome. *Philosophical Transactions of the Royal Society B: Biological Sciences* **370**, 20140121 (2015).
 - 32. Lanfumey, L., Mongeau, R. & Hamon, M. Biological rhythms and melatonin in mood disorders and their treatments. *Pharmacology & Therapeutics* **138**, 176–184 (2013).
 - 33. Youngstedt, S.D., et al. Circadian phase-shifting effects of bright light, exercise, and bright light + exercise. *Journal of Circadian Rhythms* **14** (2016).
 - 34. Fischer, D., Lombardi, D.A., Marucci-Wellman, H. & Roenneberg, T. Chronotypes in the US— influence of age and sex. *PLOS ONE* **12**, e0178782 (2017).
 - 35. Youngstedt, S.D., Elliott, J.A. & Kripke, D.F. Human circadian phase-response curves for exercise. *The Journal of Physiology* **597**, 2253–2268 (2019).
 - 36. Kalak, N., et al. Daily morning running for 3 weeks improved sleep and psychological functioning in healthy adolescents compared with controls. *Journal of Adolescent Health* **51**, 615–622 (2012).
 - 37. Stutz, J., Eiholzer, R. & Spengler, C.M. Effects of evening exercise on sleep in healthy participants: A systematic review and meta-analysis. *Sports Medicine* **49**, 269–287 (2019).
 - 38. Oda, S. & Shirakawa, K. Sleep onset is disrupted following pre-sleep exercise that causes large physiological excitement at bedtime. *European Journal of Applied Physiology* **114**, 1789–1799 (2014).
 - 39. Vogel, C., Wolpert, C. & Wehling, M. How to measure heart rate? *European Journal of Clinical Pharmacology* **60**, 461–466 (2004).
 - 40. Nanchen, D. Resting heart rate: What is normal? *Heart* **104**, 1048–1049 (2018).
 - 41. Lader, M. & Mathews, A. Physiological changes during spontaneous panic attacks. *Journal of Psychosomatic Research* **14**, 377–382 (1970).
 - 42. Horváth, A., et al. Effects of state and trait anxiety on sleep structure: A polysomnographic study in 1083 subjects. *Psychiatry Research* **244**, 279–283 (2016).
 - 43. Erlacher, D., Ehrlenspiel, F., Adegbesan, O.A. & Galal El-Din, H. Sleep habits in German athletes before important competitions or games. *Journal of Sports Sciences* **29**, 859–866 (2011).
 - 44. Lowe, H., et al. Does exercise improve sleep for adults with insomnia? A

- systematic review with quality appraisal. *Clinical Psychology Review* **68**, 1–12 (2019).
- 45. Baron, K.G., Reid, K.J. & Zee, P.C. Exercise to improve sleep in insomnia: Exploration of the bidirectional effects. *Journal of Clinical Sleep Medicine* **9**, 819–824 (2013).
 - 46. Bastien, C.H., Vallières, A. & Morin, C.M. Validation of the Insomnia Severity Index as an outcome measure for insomnia research. *Sleep Medicine* **2**, 297–307 (2001).
 - 47. Hartescu I., Morgan K. & Stevinson C.D. Increased physical activity improves sleep and mood outcomes in inactive people with insomnia: A randomized controlled trial. *Journal of Sleep Research* **24**, 526–534 (2015).
 - 48. Kredlow, M.A., Capozzoli, M.C., Hearon, B.A., Calkins, A.W. & Otto, M.W. The effects of physical activity on sleep: A meta-analytic review. *Journal of Behavioral Medicine* **38**, 427–449 (2015).
 - 49. Porkka-Heiskanen, T. & Kalinchuk, A.V. Adenosine, energy metabolism and sleep homeostasis. *Sleep Medicine Reviews* **15**, 123–135 (2011).
 - 50. Dworak, M., Diel, P., Voss, S., Hollmann, W. & Strüder, H. Intense exercise increases adenosine concentrations in rat brain: Implications for a homeostatic sleep drive. *Neuroscience* **150**, 789–795 (2007).
 - 51. Peng, W., et al. Regulation of sleep homeostasis mediator adenosine by basal forebrain glutamatergic neurons. *Science* **369** (2020).
 - 52. Aschoff, J. Circadian rhythms in man. *Science* **148**, 1427–1432 (1965).
 - 53. NASA. *Apollo 11 Mission Report*. https://www.nasa.gov/specials/apollo50th/pdf/A11_MissionReport.pdf
 - 54. Cheng, W.J. & Cheng, Y. Night shift and rotating shift in association with sleep problems, burnout and minor mental disorder in male and female employees. *Occupational and Environmental Medicine* **74**, 483–488 (2017).
 - 55. Porkka-Heiskanen, T. & Kalinchuk, A.V. Adenosine, energy metabolism and sleep homeostasis. *Sleep Medicine Reviews* **15**, 123–135 (2011).
 - 56. Roehrs, T. & Roth, T. Caffeine: Sleep and daytime sleepiness. *Sleep Medicine Reviews* **12**, 153–162 (2008).
 - 57. Van Dongen, H.P., Rogers, N.L. & Dinges, D.F. Sleep debt: Theoretical and empirical issues. *Sleep and Biological Rhythms* **1**, 5–13 (2003).
 - 58. Spiegel, K., Leproult, R. & Van Cauter, E. Impact of sleep debt on metabolic and endocrine function. *The Lancet* **354**, 1435–1439 (1999).
 - 59. Montagna, P. Fatal familial insomnia: A model disease in sleep physiopathology. *Sleep Medicine Reviews* **9**, 339–353 (2005).
 - 60. Carskadon, M.A. & Dement, W.C. Normal human sleep: An overview. *Principles and Practice of Sleep Medicine* **4**, 13–23 (2005).
 - 61. Montagna, P. Fatal familial insomnia: A model disease in sleep physiopathology. *Sleep Medicine Reviews* **9**, 339–353 (2005).
 - 62. Fultz, N.E., et al. Coupled electrophysiological, hemodynamic, and cerebrospinal fluid oscillations in human sleep. *Science* **366**, 628–631 (2019).

63. Shapiro, C.M., Bortz, R., Mitchell, D., Bartel, P. & Jooste, P. Slow-wave sleep: A recovery period after exercise. *Science* **214**, 1253–1254 (1981).
64. Shapiro, C.M., Griesel, R.D., Bartel, P.R. & Jooste, P.L. Sleep patterns after graded exercise. *Journal of Applied Physiology* **39**, 187–190 (1975).
65. Martin, J.M., et al. Structural differences between REM and non-REM dream reports assessed by graph analysis. *PLOS ONE* **15**, e0228903 (2020).
66. Ohayon, M.M., Carskadon, M.A., Guilleminault, C. & Vitiello, M.V. Meta-analysis of quantitative sleep parameters from childhood to old age in healthy individuals: Developing normative sleep values across the human lifespan. *Sleep* **27**, 1255–1273 (2004).
67. Lee, Y.F., Gerashchenko, D., Timofeev, I., Bacskai, B.J. & Kastanenka, K.V. Slow wave sleep is a promising intervention target for Alzheimer's disease. *Frontiers in Neuroscience* **14** (2020).
68. Ju, Y.E.S., Lucey, B.P. & Holtzman, D.M. Sleep and Alzheimer disease pathology—a bidirectional relationship. *Nature Reviews Neurology* **10**, 115–119 (2014).
69. Yang, P.Y., Ho, K.H., Chen, H.C. & Chien, M.Y. Exercise training improves sleep quality in middle-aged and older adults with sleep problems: A systematic review. *Journal of Physiotherapy* **58**, 157–163 (2012).
70. Rupp, T.L., Wesensten, N.J., Bliese, P.D. & Balkin, T.J. Banking sleep: Realization of benefits during subsequent sleep restriction and recovery. *Sleep* **32**, 311–321 (2009).
71. Ebrahim, I.O., Shapiro, C.M., Williams, A.J. & Fenwick, P.B. Alcohol and sleep I: Effects on normal sleep. *Alcoholism: Clinical and Experimental Research* **37**, 539–549 (2013).
72. Wassing, R., et al. Restless REM sleep impedes overnight amygdala adaptation. *Current Biology* **29**, 2351–2358.e2354 (2019).
73. Wassing, R., et al. Haunted by the past: Old emotions remain salient in insomnia disorder. *Brain* **142**, 1783–1796 (2019).
74. Habukawa, M., et al. Differences in rapid eye movement (REM) sleep abnormalities between posttraumatic stress disorder (PTSD) and major depressive disorder patients: REM interruption correlated with nightmare complaints in PTSD. *Sleep Medicine* **43**, 34–39 (2018).
75. Schuckit, M.A. & Hesselbrock, V. Alcohol dependence and anxiety disorders: What is the relationship? *The American Journal of Psychiatry* **151**, 1723–1734 (1994).
76. Ebrahim, I.O., Shapiro, C.M., Williams, A.J. & Fenwick, P.B. Alcohol and sleep I: Effects on normal sleep. *Alcoholism: Clinical and Experimental Research* **37**, 539–549 (2013).
77. Pietilä, J., et al. Acute effect of alcohol intake on cardiovascular autonomic regulation during the first hours of sleep in a large real-world sample of Finnish employees: Observational study. *The Journal of Medical Internet Research Mental Health* **5**, e9519 (2018).

7. Staying Focused, Being Creative, and Sticking to It

1. Pattabiraman, K., Muchnik, S.K. & Sestan, N. The evolution of the human brain and disease susceptibility. *Current Opinion in Genetics & Development* **65**, 91–97 (2020).
2. Zbozinek, T.D., et al. Diagnostic overlap of generalized anxiety disorder and major depressive disorder in a primary care sample. *Depression and Anxiety* **29**, 1065–1071 (2012).
3. Bechara, A. Decision making, impulse control and loss of willpower to resist drugs: A neurocognitive perspective. *Nature Neuroscience* **8**, 1458–1463 (2005).
4. Chadick, J.Z., Zanto, T.P. & Gazzaley, A. Structural and functional differences in medial prefrontal cortex underlie distractibility and suppression deficits in ageing. *Nature Communications* **5**, 1–12 (2014).
5. Christoff, K., Irving, Z.C., Fox, K.C., Spreng, R.N. & Andrews-Hanna, J.R. Mind-wandering as spontaneous thought: A dynamic framework. *Nature Reviews Neuroscience* **17**, 718–731 (2016).
6. McVay, J.C. & Kane, M.J. Does mind wandering reflect executive function or executive failure? Comment on Smallwood and Schooler (2006) and Watkins (2008). *Psychological Bulletin* **136**, 188–197 (2010).
7. Diamond, A. Executive functions. *Annual Review of Psychology* **64**, 135–168 (2013).
8. Miyake, A. & Friedman, N.P. The nature and organization of individual differences in executive functions: Four general conclusions. *Current Directions in Psychological Science* **21**, 8–14 (2012).
9. Chang, Y.K., Labban, J.D., Gapin, J.I. & Etnier, J.L. The effects of acute exercise on cognitive performance: A meta-analysis. *Brain Research* **1453**, 87–101 (2012).
10. Fenesi, B., Lucibello, K., Kim, J.A. & Heisz, J.J. Sweat so you don't forget: Exercise breaks during a university lecture increase on-task attention and learning. *Journal of Applied Research in Memory and Cognition* **7**, 261–269 (2018).
11. Giles, G.E., et al. Acute exercise increases oxygenated and deoxygenated hemoglobin in the prefrontal cortex. *Neuroreport* **25**, 1320–1325 (2014).
12. Basso, J.C. & Suzuki, W.A. The effects of acute exercise on mood, cognition, neurophysiology, and neurochemical pathways: A review. *Brain Plasticity* **2**, 127–152 (2017).
13. Bedard, C., St John, L., Bremer, E., Graham, J.D. & Cairney, J. A systematic review and meta-analysis on the effects of physically active classrooms on educational and enjoyment outcomes in school age children. *PLOS ONE* **14**, e0218633 (2019).
14. Donnelly, J.E., et al. Physical activity, fitness, cognitive function, and academic achievement in children: A systematic review. *Medicine and Science in Sports and Exercise* **48**, 1197 (2016).

15. Bull, F.C., et al. World Health Organization 2020 guidelines on physical activity and sedentary behaviour. *British Journal of Sports Medicine* **54**, 1451–1462 (2020).
16. Ogrodnik, M., Halladay, J., Fenesi, B., Heisz, J. & Georgiades, K. Examining associations between physical activity and academic performance in a large sample of Ontario students: The role of inattention and hyperactivity. *Journal of Physical Activity and Health* **17**, 1231–1239 (2020).
17. Ng, Q.X., Ho, C.Y.X., Chan, H.W., Yong, B.Z.J. & Yeo, W.S. Managing childhood and adolescent attention-deficit/hyperactivity disorder (ADHD) with exercise: A systematic review. *Complementary Therapies in Medicine* **34**, 123–128 (2017).
18. Weyandt, L., Swentosky, A. & Gudmundsdottir, B.G. Neuroimaging and ADHD: fMRI, PET, DTI findings, and methodological limitations. *Developmental Neuropsychology* **38**, 211–225 (2013).
19. Wigal, S.B., Emmerson, N., Gehricke, J.-G. & Galassetti, P. Exercise: Applications to childhood ADHD. *Journal of Attention Disorders* **17**, 279–290 (2013).
20. Yu, C.L., et al. The effects of acute aerobic exercise on inhibitory control and resting state heart rate variability in children with ADHD. *Scientific Reports* **10**, 1–15 (2020).
21. Pontifex, M.B., Saliba, B.J., Raine, L.B., Picchietti, D.L. & Hillman, C.H. Exercise improves behavioral, neurocognitive, and scholastic performance in children with attention-deficit/hyperactivity disorder. *The Journal of Pediatrics* **162**, 543–551 (2013).
22. Erickson, K.I., et al. Physical activity, cognition, and brain outcomes: A review of the 2018 physical activity guidelines. *Medicine & Science in Sports & Exercise* **51**, 1242–1251 (2019).
23. Ludyga, S., Gerber, M., Brand, S., Holsboer-Trachsler, E. & Pühse, U. Acute effects of moderate aerobic exercise on specific aspects of executive function in different age and fitness groups: A meta-analysis. *Psychophysiology* **53**, 1611–1626 (2016).
24. Verburgh, L., Königs, M., Scherder, E.J. & Oosterlaan, J. Physical exercise and executive functions in preadolescent children, adolescents and young adults: A meta-analysis. *British Journal of Sports Medicine* **48**, 973–979 (2014).
25. Hill, E.L. Executive dysfunction in autism. *Trends in Cognitive Sciences* **8**, 26–32 (2004).
26. Bremer, E., Graham, J.D., Heisz, J.J. & Cairney, J. Effect of acute exercise on prefrontal oxygenation and inhibitory control among male children with autism spectrum disorder: An exploratory study. *Frontiers in Behavioral Neuroscience* **14**, 84 (2020).
27. Pan, C.Y., et al. The impacts of physical activity intervention on physical and cognitive outcomes in children with autism spectrum disorder. *Autism* **21**, 190–202 (2017).
28. Tse, C.Y.A., et al. Examining the impact of physical activity on sleep quality

- and executive functions in children with autism spectrum disorder: A randomized controlled trial. *Autism* **23**, 1699–1710 (2019).
- 29. Kudrowitz, B. & Dippo, C. Getting to the novel ideas: Exploring the alternative uses test of divergent thinking. *ASME 2013 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference* (American Society of Mechanical Engineers Digital Collection, 2013).
 - 30. Feist, G.J. A meta-analysis of personality in scientific and artistic creativity. *Personality and Social Psychology Review* **2**, 290–309 (1998).
 - 31. Richard, V., Abdulla, A.M. & Runco, M.A. Influence of skill level, experience, hours of training, and other sport participation on the creativity of elite athletes. *Journal of Genius and Eminence* **2**, 65–76 (2017).
 - 32. Oppezzo, M. & Schwartz, D.L. Give your ideas some legs: The positive effect of walking on creative thinking. *Journal of Experimental Psychology: Learning, Memory, and Cognition* **40**, 1142 (2014).
 - 33. Bollimbala, A., James, P. & Ganguli, S. The effect of Hatha yoga intervention on students' creative ability. *Acta Psychologica* **209**, 103121 (2020).
 - 34. Blanchette, D.M., Ramocki, S.P., O'del, J.N. & Casey, M.S. Aerobic exercise and creative potential: Immediate and residual effects. *Creativity Research Journal* **17**, 257–264 (2005).
 - 35. Richard, V., Abdulla, A.M. & Runco, M.A. Influence of skill level, experience, hours of training, and other sport participation on the creativity of elite athletes. *Journal of Genius and Eminence* **2**, 65–76 (2017).
 - 36. Simons, D.J. & Chabris, C.F. Gorillas in our midst: Sustained inattentional blindness for dynamic events. *Perception* **28**, 1059–1074 (1999).
 - 37. Memmert, D. & Furley, P. "I spy with my little eye!": Breadth of attention, inattentional blindness, and tactical decision making in team sports. *Journal of Sport and Exercise Psychology* **29**, 365–381 (2007).
 - 38. Bowers, M.T., Green, B.C., Hemme, F. & Chalip, L. Assessing the relationship between youth sport participation settings and creativity in adulthood. *Creativity Research Journal* **26**, 314–327 (2014).
 - 39. Dietrich, A. Neurocognitive mechanisms underlying the experience of flow. *Consciousness and Cognition* **13**, 746–761 (2004).
 - 40. Beatty, R.E., Benedek, M., Kaufman, S.B. & Silvia, P.J. Default and executive network coupling supports creative idea production. *Scientific Reports* **5**, 1–14 (2015).
 - 41. Arnsten, A.F. Catecholamine modulation of prefrontal cortical cognitive function. *Trends in Cognitive Sciences* **2**, 436–447 (1998).
 - 42. Dang, L.C., O'Neil, J.P. & Jagust, W.J. Dopamine supports coupling of attention-related networks. *Journal of Neuroscience* **32**, 9582–9587 (2012).
 - 43. Beatty, R.E., Benedek, M., Silvia, P.J. & Schacter, D.L. Creative cognition and brain network dynamics. *Trends in Cognitive Sciences* **20**, 87–95 (2016).
 - 44. Duckworth, A.L., Peterson, C., Matthews, M.D. & Kelly, D.R. Grit: Persever-

- ance and passion for long-term goals. *Journal of Personality and Social Psychology* **92**, 1087 (2007).
45. Young, B.W. & Salmela, J.H. Examination of practice activities related to the acquisition of elite performance in Canadian middle distance running. *International Journal of Sport Psychology* **41**, 73 (2010).
 46. Ericsson, K.A. Towards a science of the acquisition of expert performance in sports: Clarifying the differences between deliberate practice and other types of practice. *Journal of Sports Sciences* **38**, 159–176 (2020).
 47. Will Crescioni, A., et al. High trait self-control predicts positive health behaviors and success in weight loss. *Journal of Health Psychology* **16**, 750–759 (2011).
 48. Liu-Ambrose, T., et al. Resistance training and executive functions: A 12-month randomized controlled trial. *Archives of Internal Medicine* **170**, 170–178 (2010).
 49. Best, J.R., Nagamatsu, L.S. & Liu-Ambrose, T. Improvements to executive function during exercise training predict maintenance of physical activity over the following year. *Frontiers in Human Neuroscience* **8**, 353 (2014).
 50. Antoniewicz, F. & Brand, R. Dropping out or keeping up? Early-dropouts, late-dropouts, and maintainers differ in their automatic evaluations of exercise already before a 14-week exercise course. *Frontiers in Psychology* **7**, 838 (2016).
 51. Fishbach, A. & Choi, J. When thinking about goals undermines goal pursuit. *Organizational Behavior and Human Decision Processes* **118**, 99–107 (2012).
 52. Wilson, K. & Brookfield, D. Effect of goal setting on motivation and adherence in a six-week exercise program. *International Journal of Sport and Exercise Psychology* **7**, 89–100 (2009).
 53. Di Domenico, S.I. and Ryan, R.M. The emerging neuroscience of intrinsic motivation: A new frontier in self-determination research. *Frontiers in Human Neuroscience* **11**, 145 (2017).
 54. Marashi, M.Y., et al. A mental health paradox: Mental health was both a motivator and barrier to physical activity during the COVID-19 pandemic. *PLOS ONE* **16(4)**, e0239244 (2021).