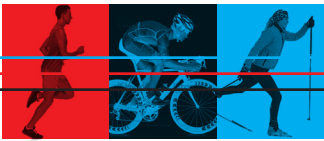
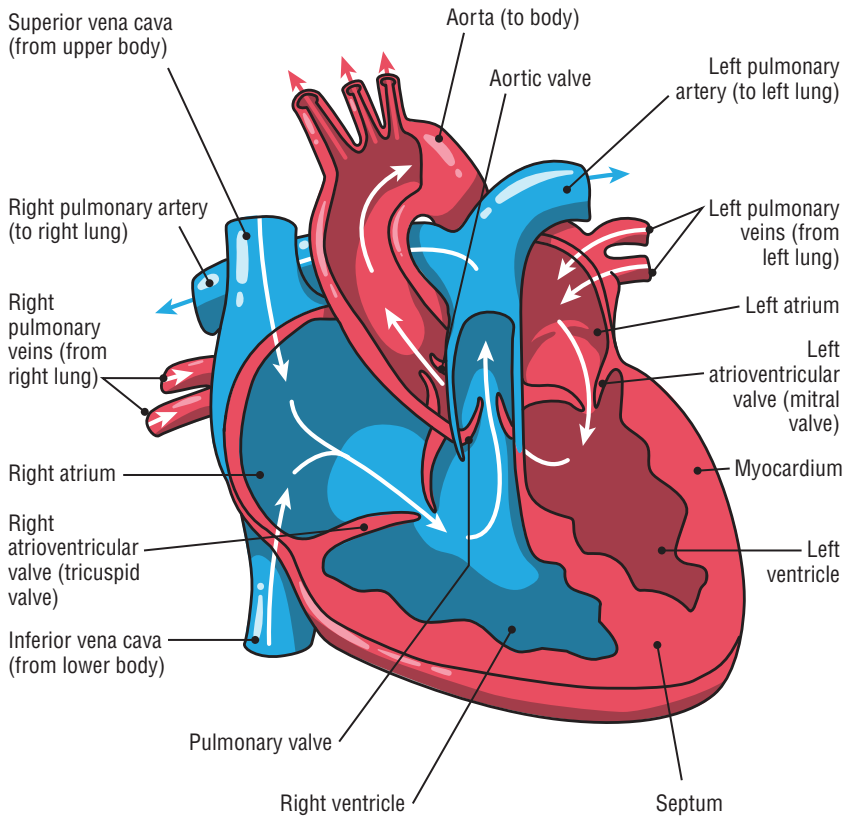


Chris Case
John Mandrola, MD
Lennard Zinn

THE HAMMIRE HEART

How too much
exercise can kill you,
and what you
can do to protect
your heart





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CONTENTS

List of Illustrations vii

Preface ix

Introduction 1

1 How the heart works 9
CASE STUDY Gene Kay 30

2 The athlete's heart 35
CASE STUDY Jenni Lutze 45

**3 Heart attacks, arrhythmias, and
endurance athletes 51**
CASE STUDY Micah True 66

4 The evidence 71
CASE STUDY Mike Endicott 113

5 What to look for in yourself 125
CASE STUDY Genevieve Halvorsen 152

6 Getting the news 159
CASE STUDY Mark Taylor 170

7 **Addicted to exertion 175**
CASE STUDY Dave Scott 187

8 **Treatment options for athlete arrhythmia 195**
CASE STUDY Paul Ernst 221

9 **The takeaway 231**
CASE STUDY Jason Agosta 258

Epilogue 263

Acknowledgments 269

Notes 273

Glossary 283

Index 295

About the Authors 305

ILLUSTRATIONS

- Figure I.1 Does more exercise mean greater health? 7
- Figure 1.1 Cross-section of the heart 10
- Figure 1.2 Cardiac diastole 11
- Figure 1.3 Atrial systole, ventricular diastole 12
- Figure 1.4 Atrial diastole, ventricular systole 13
- Figure 1.5 The heart's electrical circuitry 16
- Figure 1.6 Electrical signals travel in a wave through the heart 19
- Figure 1.7 Action potential in a cardiac cell 24
- Figure 1.8 Action potential in a pacemaker cell 26
- Figure 2.1 Structural differences in the normal heart, the athlete's heart, and a diseased heart suffering from hypertrophic cardiomyopathy 37
- Figure 5.1 Alcohol consumption and the risk of arrhythmia 130
- Figure 5.2 An ECG trace of one cardiac cycle 139
- Figure 8.1 The QT interval on a normal ECG trace 210
- Figure 8.2 Pulmonary vein ablation 213

PREFACE

CHRIS CASE

The sun shone bright on the upturned Flatirons rock formations above Boulder, Colorado. It was another perfect day in a cycling paradise. Leonard Zinn, a world-renowned technical cycling guru, founder of Zinn Cycles, author of *Zinn and the Art of Road Bike Maintenance*, longtime member of the *VeloNews* magazine staff, and former member of the US national cycling team, was riding hard up his beloved Flagstaff Mountain, a popular road that snakes over 4 miles and almost 2,000 feet above the city. It was a ride he had done a thousand times before. But on this day, in July 2013, his life would change forever.

Fifteen minutes into his attempt to set a new Strava “king of the mountain” (KOM) time for the climb in the 55-plus age group, he felt his heart “skip” a beat. It was something he had felt before, but only at rest. He looked down at the Garmin computer on his handlebars and noticed

that his heart rate had jumped from 155 to 218 beats per minute (bpm) and stayed elevated. He tapped the Garmin's screen. Was the connection bad? He felt fine but eventually pulled the plug on the attempt, knowing that the distraction had disrupted any chance at a record.

His heart rate immediately dropped, so he headed down the mountain to establish a different Strava segment KOM. His training plan called for a very hard ride, so he went to another climb and did a set of intervals. His ride completed, he headed home.

Later that day, he called his physician as a precaution. Much to his surprise, after describing the incident, he was told to head to the emergency room immediately. Then things took an even more serious turn: After a series of tests, the ER physician recommended that he be taken via ambulance to the main cardiac unit of the Boulder hospital for an overnight evaluation.

Despite the initial alarm, his doctors simply prescribed rest. That seemed easy enough. So easy, in fact, that even though he trusted the cardiologists and the ER doctor, he ignored the true depth of their warnings. While he obeyed their calls for rest for a short time, he eventually returned to his usual training plan. His only concession was that he did not resist when he was asked to wear a portable telemetric electrocardiogram (ECG) unit that dangled around his neck (a device known as a Holter monitor); it didn't disrupt his routine.

What did disturb life and training were the annoying episodes that started to become more frequent during his intense rides. Now when his heart rate spiked, he experienced what felt like a flopping fish in his chest.

More upsetting was the phone call in the middle of the night from a faraway nurse who had been monitoring the ECG readings from his

Holter monitor. She had some shocking news: His heart had stopped for a few seconds. He had to finally admit that something was definitely wrong.

By October, Zinn could do nothing to eliminate the episodes. He made every attempt to reduce the stress in his life, but intense riding and racing always triggered an episode of elevated heart rate and that fish-out-of-water feeling. After further visits to his cardiac electrophysiologist, he received an official diagnosis: multifocal atrial tachycardia.

That's when Zinn ultimately decided to heed the warning he'd been given and quit racing. He also backed off from riding with intensity or duration. In doing so, he felt instantaneously downgraded from thoroughbred to invalid. He altered the very nature of his life, in more ways than one. He was made to face the reality that he could never do what he used to do in the same way that he used to do it. He now became interested in maintaining an activity level to sustain his longevity rather than his fitness or speed.

Life had changed. Forever.

Zinn quickly realized he was not alone. When he began the psychologically arduous process of coming to terms with his life-changing condition, he reached out to friends who had been fabulous athletes in their day and who continued to push themselves well into their 40s and 50s.

The number of friends, colleagues, and former teammates who had had similar or more severe heart issues was alarming. Far from being an outlier, Zinn was one among many.

That's when I, as the managing editor of *VeloNews* and a friend and colleague of Zinn, couldn't help but think there was more to this issue than an isolated incident on an iconic climb in a cycling-crazed town. Once I

heard the various stories of heart arrhythmias in masters endurance athletes and read the research literature on the subject, it was obvious that this would make for a compelling and important article in the magazine. (An arrhythmia is an irregular heart rhythm caused by a malfunction in the heart's electrical system. Zinn's tachycardia is but one example.)

With the help of many, particularly Dr. John Mandrola, we published "Cycling to Extremes: Are Endurance Athletes Hurting Their Hearts by Repeatedly Pushing Beyond What Is Normal?" in our August 2015 issue. Mandrola's assistance was critical, as he is a cardiac electrophysiologist from Louisville, Kentucky, who frequently writes and lectures on the very subject of endurance athletes and heart health. He has also been a competitive athlete much of his life and has an arrhythmia himself (atrial fibrillation, which is defined as a rapid and irregular heartbeat above 300 beats per minute).

The response from readers and members of the media was staggering. Zinn, in particular, was inundated by letters, e-mails, and phone calls from friends, colleagues, and strangers. The overwhelming majority of the attention came from individuals for whom the article was extremely moving or meaningful, something they could relate to, a story that touched them unlike anything they had read before. In more than one case, the article changed a life.

There were also some naysayers, to be sure, those who doubted the connection or took offense at the representation of their cherished pastime and of exercise in general. It is true that the scientific community is not fully in agreement on the numerous complex issues involved in heart arrhythmias and the potential causal connection to lifelong endurance exercise.

Therein lies the very reason for this book. The topic is broad, multifaceted, complicated, and, in so many ways, extremely important to investigate further. Another magazine article wouldn't move the needle very far. We needed a more thorough exploration. Why now? The explosion in popularity of endurance sports has coincided with the ability and desire of an active populace to strive for elite athletic achievements deep into their lives.

Of course, that begs the question: Is exercise good for your heart? Undoubtedly, it is. In fact, it is undeniably the best medicine there is for preventing a host of cardiovascular diseases, as well as a multitude of other diseases. Its documented beneficial results would qualify it as a miracle drug if a pharmaceutical company could figure out how to bottle it. But even miracle drugs have a recommended dosage, and vastly exceeding it is not generally prudent.

Can there be too much of a good thing? Quite possibly—as you'll soon learn. Are endurance athletes hurting their hearts by repeatedly pushing beyond what is normal? Just maybe, and there is a sad and tragic irony to the paradox that those at the highest level of performance could be beset by similar types of heart disease that afflict those who are sedentary or obese, or who smoke. But our hope is that such side effects of an active lifestyle can be prevented with a better understanding of exercise and heart health.

After reading this book, you'll have that understanding of how and why endurance sports could damage your heart. We'll review the evidence, which has been aided in recent years by advancements in research techniques such as magnetic resonance imaging and a more robust

understanding of genetics, all of which has helped inform researchers as to the mechanisms that cause damage. If you're an athlete (or have one in your family), you will acquire the necessary tools to make more informed decisions about what is an appropriate amount of training. For those who suspect they may have an arrhythmia or are feeling cardiac symptoms, we will guide you on what to do next. You'll read real-life case studies of exercise-induced disease.

In short, you'll understand a problem that until now has often included more lore than fact. And for those of you who have already developed an arrhythmia, perhaps this book can bring you comfort in knowing that you're not alone, and that life does not have to end. There can be a rich and rewarding life on the other side of your diagnosis, if you are patient, well-informed, and persistent.

Introduction

CHRIS CASE AND JOHN MANDROLA

FOR THE PAST FEW YEARS, a debate about whether too much exercise can be bad for your health has been playing out in popular media. Maybe you've seen some of the articles—they've appeared in the *New York Times*, *Sports Illustrated*, the *Wall Street Journal*, *U.S. News and World Report*, and many other places. With titles like “The Great Fitness Debate: Is It True That You Can Exercise Too Much?” and “Can Too Much Exercise Harm the Heart?” they instantly grab the attention of many readers. After all, we've been told for decades that exercise is the best medicine for your heart. Now there's a chance it's harmful? What is a person to believe?

Sometimes the authors of these articles pit one camp against another, stating things like “the too-much-exercise advocates believe. . .,” as if this were a political debate, with one side being right and the other side being misinformed at best and dangerous at worst. Occasionally the authors

suggest that those who believe there can be too much exercise are verging on alarmism. (Let us emphasize that the authors of this book are anything but alarmists. In fact, all three are lifelong endurance athletes with a penchant for riding hard and suffering often. That is, until two of them were made to slow down after developing heart arrhythmias, which you'll soon learn more about.)

Some authors may cite studies that look at Olympians or professional cyclists who've competed in the Tour de France and find no lasting negative effects on the heart. Are you an Olympian? Have you ever raced in the Tour de France? Could it be that the athletes who have reached such heights in sports are genetically different from you and me? Maybe they're not the best examples for understanding what is happening in the hearts of the general population. (There's also the fact that Olympians and professional cyclists tend to relax after they've retired, more often than not. It's just the middle-aged people who *think* they're training to race the Tour who can't seem to stop themselves from pushing so hard for so long.)

As you can see by holding this book in your hands, this is a topic massive in scope and complexity, without simple answers. Almost nothing about this subject is black and white. There's a good chance the aforementioned articles suffer from oversimplification. That's not to say this book has all the answers, either. Far from it. Much more research is needed to settle the issue of just how much exercise is safe, and to better understand the links between exercise dosage and heart health. Scientific research in this area not only is relatively new but is hard to conduct given the limited number of people who fall into the mold of the longtime endurance athlete.

It cannot be stated enough: Exercise is extremely beneficial for heart health. Dozens of large epidemiological studies have found that people who exercise in any amount, whether five minutes a day or two hours a day, are much less likely to develop or die from heart disease than people who are inactive. (That being said, exercise does not make you immune to every heart problem that exists, especially if you have a history of unhealthy living, eating poorly, or smoking or are genetically predisposed to conditions that affect the heart.) These benefits are especially important in this era. The Western world now suffers from a near epidemic of chronic diseases wrought by the toxic combination of too much food and too little exercise.

No one in the health field doubts that regular exercise promotes and maintains physical, mental, and emotional health. Structured exercise can even be used to treat disease. Examples include cardiac rehabilitation in patients with coronary artery disease and heart failure, and pulmonary rehabilitation for patients with emphysema.

Recently, a group of researchers from Adelaide, Australia, showed that overweight and sedentary patients with a heart arrhythmia called atrial fibrillation who exercised enough to gain fitness ended up with less arrhythmia burden. (Their hearts no longer had as many periods of abnormal heart rhythm.)¹ Exercise in this study behaved like an anti-arrhythmic drug.

As we've already observed, if exercise were a marketable pill or procedure, it would be a blockbuster. That's why it's difficult for us to write about the possibility that exercise can be harmful. But there are many studies suggesting just that.

The limits of exercise science

Although the evidence confirming the health benefits of low- to moderate-dose exercise is strong, the science that explores high-dose exercise is much more speculative and controversial.

An important reason is the type of studies used in exercise science. The strongest evidence in all of medicine comes from the blinded randomized controlled trial. In this type of study, one group of individuals is randomly selected to have treatment X and another group gets treatment Y. Randomization is used to even out any differences in the two groups for things like age, gender, and socioeconomic status. In the experiment, researchers strive to make the two treatments the only difference between the two groups in the study. Blinding makes it impossible for anyone to know which treatment was received. That way, if there is a difference in a subject's outcome, it can only be attributed to the treatment.

These sorts of trials are impossible in sports medicine. It's easy to see how a randomized controlled study would never be able to answer the too-much-exercise question. First, athletes cannot be blinded to their exercise exposure. Second, there are many variables that affect the occurrence of heart disease. Things like exercise duration and intensity, other stressors in life (divorce, illness, job), family history, and diet all factor into the development of heart disease.

The lack of controlled trials weakens the evidence base in sports medicine. It means we must rely on less rigorous types of studies. These include observational, mechanistic, and animal studies.

Observational trials are problematic because without randomizing the groups and controlling all the trial's factors, one cannot determine

cause and effect. For instance, an observational study could suggest long-term endurance exercise *associates* with heart problems, but it cannot easily say long-term endurance exercise *causes* heart problems.

The reason for this important difference is that when you observe nonrandomized groups, you cannot exclude confounding factors and biases. A common bias is that only athletes with problems seek medical attention; the majority of people who compete could be doing well. This is called selection bias.

Mechanistic studies pose problems because they merely provide a plausible way in which endurance exercise could damage the heart. For instance, we describe studies that show modest increases in the cardiac enzyme troponin in athletes right after finishing a major long-distance race. Troponin is typically released during heart injury (e.g., heart attack). This type of study, therefore, supports the hypothesis that repeated bouts of exercise that are intense enough to release an enzyme associated with heart damage could, over time, lead to heart disease. But it's just a hypothesis—a plausible one, but a hypothesis nonetheless.

Animal studies are limited for obvious reasons: Animals are not people. That doesn't mean animal studies are useless; in fact, they can be quite helpful. But it does mean that they are largely speculative.

As you can see, exercise science faces a few challenges. That doesn't mean the results of the emerging research should be ignored or marginalized as inaccurate or inconsequential. It does mean that it's much harder to prove conclusively that one thing causes another—that high-dose exercise causes heart arrhythmias, for example. Thus, the debates will continue to stir in popular media. And researchers will continue to seek answers.

Exercise dosage

Even the best of things can be overdone: Water and oxygen can be lethal in high enough doses. Too much water leads to hyponatremia (low sodium in the blood), and prolonged exposure to high levels of oxygen can damage lung tissue. The old saying holds true: “everything in moderation.” Sometimes, there truly can be too much of a good thing.

As you’ll soon see, there is also a growing body of evidence to suggest that long-term endurance exercise can have negative consequences for your heart. Let’s be very clear about what we mean by that: We’re talking about a highly elevated level of exercise that is not only extremely intense but often competitive and is performed for years, if not decades.

There is little that is “normal” or “regular” about the exercise dosages that we will review. But if you’re reading this book, you may very well be one of those “abnormal” folks who partakes in this kind of activity, and may have for decades. You’re not alone.

The dose of exercise that promotes health is surprisingly small. A study of more than 13,000 men and women who were followed for eight years showed that although death rates decreased with greater levels of fitness, the largest reduction occurred between the sedentary group and those with low levels of fitness.² How low? Mortality benefit in this study plateaued at levels of fitness that represent half of what is expected from a trained athlete.

A larger, more recent study confirmed the plateau effect of exercise. In a 12-year study of Taiwanese subjects, researchers also found lower death rates (both from heart disease and cancer) with increasing levels of daily physical activity, but the degree of benefit lessened after 30–60 minutes of exercise per day.³

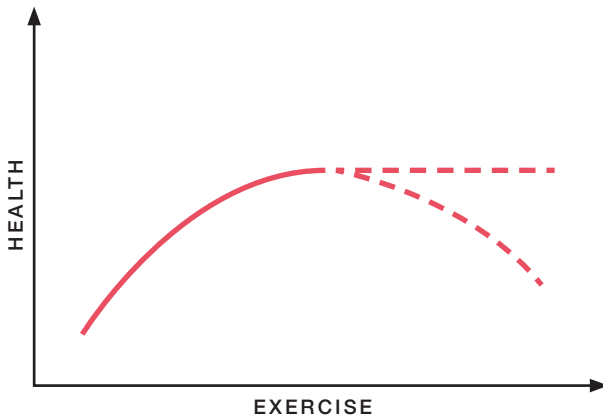


FIGURE I.1. Does more exercise mean greater health? Or is there a point at which too much exercise becomes detrimental?

The take-home message from these findings is that if health is your goal, you need not exercise more than 30–60 minutes each day. Of course, most who participate or compete in endurance sports far exceed these levels of exercise.

The question is, does exercise have an upper-dose benefit limit? Does the health benefit of exercise reverse at higher doses of exercise? Is there a U-shaped curve (Figure I.1)?

These questions and many more will be addressed in Chapter 4, where we'll review the evidence supporting an association between certain types of heart arrhythmias and endurance exercise. Before that, however, let's take a brief look at how the heart works and assess the increased demands placed on the athlete's heart.

ABOUT THE AUTHORS

Chris Case is the managing editor of *VeloNews* and author of the groundbreaking article “Cycling to Extremes” that brought the problem of the athlete’s heart to national attention. A neuroscience graduate of Colgate University, Case conducted clinical research at the National Institute of Mental Health in Bethesda, Maryland, and at the University of Colorado Health Sciences Center before earning his master’s degree in journalism from the University of Texas at Austin. A competitive runner from the age of 12, Case rediscovered cycling in graduate school. He is a silver medalist at the US National Cyclocross Championships and Masters World Championships.

John Mandrola, MD, is a cardiac electrophysiologist as well as a runner, cyclist, and bicycle commuter. His medical practice encompasses

catheter ablation, including two decades of experience with AF ablation and cardiac device implantation. He is the chief cardiology correspondent for Medscape, contributing a weekly column, journal review podcast, and interviews with academic leaders. He has been an invited speaker on multiple continents. In recent years, Mandrola has coauthored academic journal articles in the fields of electrophysiology, sports cardiology, palliative care, and outcomes research. He maintains a health, fitness, and medicine blog at www.drjohnm.org. He completed his medical training in internal medicine, cardiology, and electrophysiology at Indiana University.

Lennard Zinn is a lifelong endurance athlete and a former member of the US national cycling team whose personal story of multifocal atrial tachycardia inspired this book. He holds a degree in physics from Colorado College and has held research positions at Los Alamos National Laboratory. Zinn is the senior technical writer for *VeloNews* and has reported on major stories for the magazine for more than 30 years. Since 1982, Zinn has owned the custom bicycle-building business Zinn Cycles, Inc. He is the best-selling author of *Zinn and the Art of Road Bike Maintenance* and *Zinn and the Art of Mountain Bike Maintenance*, among other cycling titles.

Heart conditions strike athletes, too. Despite their lean looks and healthy glow, athletes entering their 50s and 60s are seeing a dramatic rise in abnormal heart rhythms, known as arrhythmias. These older athletes are pushing their bodies harder than ever in the hope that exercise will keep them healthy and strong into their senior years. But is it too much?

The Haywire Heart shares the latest research on a set of conditions dubbed “athlete’s heart.” Starting with a wide-ranging look at the telltale symptoms, *The Haywire Heart* explores the prevention and treatment of arrhythmias in endurance athletes and explains how you can recognize and reduce your potential risk.

Gripping case studies of exercise-induced disease illustrate how endurance athletes like you are confronting the problem. A frank discussion of exercise addiction will help you understand if your drive and determination go too far. And practical advice will guide those who suspect they have an arrhythmia on how to talk with a doctor about the condition and its proven treatments.

The Haywire Heart is a groundbreaking and critically important guide to heart care for athletes. The information contained in these pages will help you protect your heart now so that you can enjoy the healthy, active lifestyle that excites you and inspires your friends and family for decades to come.