Peter Attia MD Keypoints — Exercise, Strength & Endurance

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Episodes in this pack: 22

Building strength and muscle mass: optimize training & nutrition for longevity (AMA #71 rebroadcast)

Date: 2026-07-06 · Duration: 1:57:50
URL: https://www.youtube.com/watch?v=CqNqfb37gig

KEYPOINTS

- **Low strength and muscle mass carry mortality risks comparable to or larger than classic risk factors.**
  Peter compares hazard ratios: going from the bottom quartile to the middle quartile of muscle mass is associated with about a 2.3 hazard ratio (130% higher all-cause mortality); comparing above-average to elite strength is about a two-fold difference. For context, he cites type 2 diabetes at roughly a 40% increase, uncontrolled hypertension about 60%, and smoking around 2.8 in one study (1.4 in others). Low versus elite VO2 max is about a five-fold difference.
- **Grip strength is a cheap, powerful predictor.**
  In the PURE study of about 140,000 people across 17 countries, every 5 kg lower grip strength was associated with a 16% higher mortality. Other data put it at roughly 30% higher mortality per 10 kg. In a cohort aged 70–79 followed seven years, the separation was steep—partly why older populations are studied.
- **Genetic evidence hints strength is partly causal, not just a marker.**
  Randomized trials of 'being strong' are nearly impossible, so a study of 300–350,000 Finnish biobank participants used a polygenic score for grip strength. Each standard deviation was linked to about 7% lower vascular dementia, 6% obesity, 5% type 2 diabetes, 4% MACE and 3% all-cause mortality.
- **Strength, muscle and VO2 max integrate years of consistent work.**
  Like VO2 max, you can't cram for them; Peter tells patients moving VO2 max from 30 to 50 may take about three years. That's why these metrics say so much about long-term behavior.
- **Muscle improves healthspan through metabolism, resilience and fall protection.**
  Muscle is the major glucose sink—storing roughly 300–500 g—which supports lower blood sugar and lowers risk of diabetes, heart disease, dementia and cancer. Falls cause about 300,000 U.S. hospitalizations a year with 10–30% one-year mortality over 60; fall deaths rise from 1.1 per 100,000 at ages 25–35 to nearly 200 per 100,000 at 85+.
- **Strength peaks in the 30s–early 40s and then declines about 1–2% a year, accelerating after 70.**
  Population averages hide individual variation, but the lesson is to build the highest 'glider' possible when young—especially for kids—and then slow the descent.
- **After 50, rule number one is don't get injured.**
  Peter hasn't deliberately done a one-rep max in 15 years and says he never will again. Injuries that take someone in their 60s or 70s out of training for months are among his biggest worries.
- **Progressive overload drives gains, at different rates by experience.**
  Beginners can raise total load (weight, reps, rest, volume) by 5–10% per week in their first months; advanced lifters may manage about 1%. Beyond 12–15 reps, the stimulus shifts toward muscular endurance.
- **Fast-twitch fibers and power decline first, so train power.**
  Type II fibers responsible for explosiveness start atrophying in the 30s and 40s. A review of 13 studies found power training superior to traditional strength training for power. Peter ends a power set once he falls below 92% of peak power.
- **Train with 1–2 reps in reserve for most work.**
  Reps-in-reserve keeps intensity high while limiting injury risk; beginners start at 3–4 RIR and work toward 1–2 unless they have specific power or maximal-strength goals.
- **Protein targets are far above the RDA.**
  The RDA is 0.8 g/kg/day; for building or keeping muscle, Peter suggests 1.6–2.4 g/kg (roughly 1 g per pound), possibly more over 60. He now eats 40–50 g of protein about four times a day through meals, avoids small 10 g servings, and notes animal proteins easily meet leucine/essential amino-acid needs while plant-heavy diets need more attention.
- **Concentric and eccentric work play different roles.**
  The episode distinguishes the lifting (concentric) and lowering (eccentric) phases: eccentric loading is a strong stimulus for strength and hypertrophy and helps tendons and injury resilience, but it also produces more soreness, so it is dosed carefully. Combining compound lifts for efficiency with isolation work for weak links is how Peter balances a program with limited time.

EXAMPLES

- **The second-grader**
  Peter opens with a seven-year-old lecturing him about his diet soda containing a sweetener 500 times sweeter than sugar.
- **Teenage training**
  Peter credits training absurdly hard from about 13 to 19 for his high starting point; his cycling VO2 max once reached the 70s or low 80s.
- **LIFTMOR**
  He recalls Belinda Beck's trial in which women in their 60s who'd never lifted progressed to heavy deadlifts, improving strength, bone density and quality of life.
- **Fitness benchmarks**
  Targets include a farmer's carry of 100% of body weight (men) or 75% (women) split between hands, box step-ups holding 25% of body weight per hand for five reps per side, and about 20 well-controlled push-ups for men; he wants patients at or above the 75th percentile for ALMI/FFMI.
- **Extreme dieting**
  Peter recalls eating 200 g of protein on a roughly 800-calorie day; studies suggest with 30–40% calorie restriction, enough

protein plus resistance training can preserve some muscle.

OTHER RELEVANT

- **A time-efficient template**
  Three 1-hour full-body sessions weekly plus about 3 hours of cardio: 10–20 sets per body part per week, 3–4 sets per exercise, 6–15 reps, 90–120 seconds rest.
- **Make half your leg work single-leg.**
  Peter says about 50% of his leg-day work is unilateral, for balance and lower spinal loading.
- **Recovery is part of training.**
  Hydration (muscle is ~70% water), creatine, sleep and deloads matter; failing to recover blocks growth. The conversation keeps the claim tied to named mechanisms, numbers, and caveats so a listener can act or ask better questions without flattening the nuance.
- **De-risk as you age.**
  Choose movements and loads where adding weight carries little risk; machines can help beginners reduce form errors.
- **Returning lifters should rebuild before reloading.**
  Someone who lived in the weight room in high school and returns at 40 should start well below old numbers, prioritize scapular control and form, and accept that the goal is now the 'marginal decade', not a personal record.

365 Training for longevity: A roundtable on building strength, preventing injury, protein, & more

Guest: Gabrielle Lyon, Jeff Cavaliere & Mike Boyle
Date: 2025-09-22 · Duration: 2:31:26
URL: https://www.youtube.com/watch?v=ac0Nm71GpOY

KEYPOINTS

• Nothing beats exercise, yet very few people lift

Peter sees no evidence that any other pillar does more for lifespan, chronic-disease risk and quality of life. The panel's rough numbers: about 50% of Americans don't exercise, around 20% have a gym membership, half of them use it, and many of those only do cardio. Peter puts real resistance training at 5–15% of people. Only about 20% of Jeff Cavaliere's digital buyers finish a program, which is about twice the industry norm.

• The barriers are time, not knowing it matters, and making it seem harder than it is

Mike Boyle says jobs, kids and commutes get in the way, and people only notice decline when it's too late; the years from 50 to 65 go downhill fast. Gabrielle Lyon blames a culture of comfort and self-imposed limits: a woman who won't lift a 40 lb weight will still carry her 40 lb toddler. Cavaliere says you can build a great body on six lifts (row, squat, deadlift, bench, pull-up, curl).

• Beginners need to keep showing up, not to suffer

Boyle runs his gym like a hospitality business. New clients get a text that day and the next, and the goal is two sessions a week for a year. Nobody should wake up sore: 'we did a bad job.' Each session is 'a recipe, not a menu': rolling, mobility, warm-up, medicine-ball throws and jumps, about 36 minutes of lifting, then easy conditioning, all in an hour. Adult clients never use a barbell.

• Lean athletes still gain metabolically from more muscle

Lyon describes a 100-mile ultrarunner of about 60. Adding two lifting days a week and cutting her mileage raised her strength and improved her fasting insulin, glucose and triglycerides. Muscle is the main place the body disposes of glucose, so more muscle allows more flexibility in the diet. In her words, the markers of metabolic syndrome are markers of muscle health.

• Very low body fat comes from eating, not training

Cavaliere says getting from 12–15% to around 7% body fat 'has nothing to do with training.' He eats five times a day (35 meals a week) and aims for 90% compliance, so about three imperfect meals a week. The panel agrees most people assume exercise is what makes someone lean. You can't out-train a bad diet after your teens.

• Lyon's protein minimum is 100 g a day, set by body weight rather than sex

The RDA would give a 115 lb woman about 45 g, which Lyon says isn't enough. She adjusts for age, activity and metabolic health. She suggests 2–3 g of leucine as a basic need and about 8–9 g for best results. For overweight patients she doses for target weight (lean mass at 16% body fat) and keeps protein steady or higher while cutting calories. She favours animal protein for quality and nutrients like iron and zinc, and eats plants for fiber.

• Carb tolerance depends on activity

Lyon estimates a sedentary adult clears only about 40–50 g of carbohydrate in two hours before insulin rises sharply, so she often aims for about a 1:1 ratio of protein to carbs at meals. A very active person like Cavaliere can handle around 100 g. Blood work showing metabolic health determines how much leeway a patient gets.

• Single-leg work can replace heavy barbell squats and deadlifts for most adults

Boyle dropped back squats after linking them to back pain in about 20% of his athletes. He cites the bilateral deficit: each limb alone is relatively stronger than both together. Peter filmed every heavy set but still hurt his back about one workout in eight, so he quit. Cavaliere's go-to substitute is a wide-stance reverse lunge with a slight twist toward the front leg, which takes about 75% of the load.

• The 'iron graveyard' is for exercises with an equally good safer option

Cavaliere has dropped the upright row (its position is the PT test for shoulder impingement; a high pull with elbows below the wrists works the same muscles), the Cuban press, and the free-weight fly, which loads the shoulder capsule at full stretch. A floor fly keeps the stretch with a built-in safety stop.

• Kids should play many sports until about 12

Boyle says to 'follow the money': people selling year-round single-sport play profit from it. He kept his daughter, later a scholarship and pro hockey player, out of summer hockey until 13 and made her swim, dive, play soccer and do judo. The panel says playing more has meant more injuries, and NBA teams now run about 200 more stop-start miles a season. Boyle traces the myth that lifting stunts growth to a study of malnourished child laborers.

EXAMPLES

• Split squats matched front squats

On Boyle's hockey team, players' back-foot-elevated split-squat loads matched their front-squat maxes. One 190 lb player did 240 lb for 20 reps on one leg.

• Peter's 407 lb tire

A PT friend watching him flip it pointed out his heavily loaded lumbar flexion, which helped convince him heavy lifts weren't worth the risk.

• Lyon's narrow squat and hip dysplasia

She kept squatting too narrow despite undiagnosed hip dysplasia and wore down her hip. She now does only single-leg work and has a new hamstring tear on MRI.

• Women's pulling strength

Boyle's best female client does chin-ups with 45 lb added for seven reps.

• What each guest changed their mind about

Lyon: intramuscular fat may predict insulin resistance better than body-fat percentage. Boyle, after losing a foot of colon: fiber and water. Cavaliere: balance training with eyes closed. Peter adds that biotech money is moving to anti-sarcopenia drugs after GLP-1s.

OTHER RELEVANT

- **Start with two hours a week and keep it painless**
  Boyle treats any answer to 'does it hurt?' that isn't a plain no as a yes. Find a movement that doesn't hurt (standing cable presses work for most painful shoulders) and build from there.
- **Protect your Achilles**
  Foam roll and stretch the calves, do ankle mobility work, and do equal sets of seated and standing calf raises, including single-leg. Don't sprint or jump on sore calves: Tatum and Haliburton both had calf strains before their Achilles tears.
- **Train balance with your eyes shut**
  Stand on one leg and trace the alphabet with the other foot, eyes closed, then add head turns. Falls are the danger later in life.
- **Women around menopause don't need a different program**
  Good progressive training applies to everyone. Get fit before perimenopause, watch for tendon problems like frozen shoulder, coach knee position on landing, and get your heart rate really high once a week.
- **Teach kids movement before load**
  Start with body weight, go slowly, and stop when form breaks down, as it did with Peter's boys trying to one-up each other with kettlebells.

335 The science of resistance training, building muscle, and anabolic steroid use in bodybuilding

Guest: Mike Israetel
Date: 2025-02-10 · Duration: 3:06:54
URL: https://www.youtube.com/watch?v=VhkxTq-fxJc

KEYPOINTS

• Most of the health benefit takes 1–3 hours a week

Israetel says the best return for most people is about 30 minutes of hard resistance training twice a week, for example Monday and Thursday. Even full-time bodybuilders top out around 8–10 hours a week. Lifting works through high force and fatigue, so it has no real equivalent of zone 2 cardio. Each session causes so much disruption that more volume quickly becomes something you can't recover from.

• Fatigue rises steeply with force

Using a whiffle ball versus a .50-cal round as his comparison, Israetel says damage climbs exponentially as force rises. Fast-twitch fibers take more damage, have less blood supply and heal slower. Nerves fatigue too: ion pumps and channel proteins wear down and neurotransmitter stores run low. Strength can take hours to days to return. Much of that fatigue is local, so you can train back the day after a hard chest session.

• More sets give smaller and smaller gains

Israetel's rough figures: one all-out set per muscle per week gives about 30% of the growth that five sets would. Three sets give clearly more than one but not three times as much, and 7–8 sets in one session add little statistically. About 14–15 hard sets per muscle per week (roughly what Dorian Yates did) gets perhaps 70–85% of a muscle's potential. Specializing in a few muscles can push those to 25–35+ sets if you cut back elsewhere.

• Stop 1–2 reps short of failure most of the time

In studies, sets ending 1–2 reps from failure grow about as much muscle as sets to true failure. That last stretch costs about 10 units of fatigue for each unit of stimulus, compared with 1:1 to 5:1 earlier in the set, and it raises injury risk. You need roughly 30 sets at 4 reps short, 22 at 1–2 short, or 20 to failure for similar growth. He says people who always train to failure 'emoted their way' into it.

• A twice-weekly beginner plan

Train the whole body each session, spaced evenly. Use compound lifts: rows and pulldowns, close-grip bench or push-ups, overhead presses, upright rows, squats, leg presses or lunges, and RDLs, which work the spinal erectors, glutes, hamstrings and more. Spend the first sessions practicing technique with light weights (3–4 easy sets per lift). Add load and reps over 3–4 weeks, then build from one to 3–6 working sets per lift. He says beginners should never max out.

• Pairing lifts gives you cardio as well

Alternate lifts that use unrelated muscles, such as a seated dumbbell press with goblet squats or deadlifts, or close-grip bench with rows, resting only 5–10 seconds between them. Use 15–30 working sets per session in the 10–30 rep range, staying below your 10-rep max. Add two zone 2–3 cardio sessions and you're getting about 2–3 hours a week of hard activity. He's honest that it 'is going to hurt.'

• To get past a plateau, work through a checklist

Pick exercises that match your goal: bigger arms need curls and extensions, not only pull-ups. Use technique that puts muscles under high force at long lengths. Push hard enough, because people regularly leave 4 reps in the tank. Use logged numbers instead of feel, adding a rep or 2.5–5 lb each week until you actually fail. Below 5–10 sets per muscle per week is too little. Above 20, if you're always sore and stalling, is probably too much.

• Take a deload every 6–8 weeks

Recovery between sessions may be only about 90–95%, so fatigue builds up (0.95 multiplied over many weeks). Take one easy week every two months and two full weeks off once a year. When you return, start back at 2–3 sets because your muscles will respond more strongly again.

• Age, genetics and life circumstances limit results more than the plan does

Gains slow sharply over time: if three years got you 10 lb of muscle, the next three might get you 5. He has told 150 lb clients in their sixties that their goal of reaching the 200s was impossible without drugs. Nutrition is simple: about 1 g of protein per pound of body weight across 3–4 meals, and gain about 0.5 lb a week when building. Consistency is the usual problem: good weekdays followed by a weekend 'throwing up a lot in the toilet' will cancel the effort.

• Bodybuilding steroid doses are far beyond replacement

Peter's TRT doses typically run about 80 mg a week, never above about 140. Israetel describes bodybuilders taking 250–1,000+ mg of testosterone a week, often with primobolan or masteron to manage estrogen instead of aromatase inhibitors, which he calls very toxic. Side effects he lists: less empathy and fluent communication, more irritability and focus on status, water retention, and erectile dysfunction from nandrolone. He reached just over 2,000 mg a week and got about the same gains at 1,000. Above 1,500 he felt 'mentally insane.'

• Muscle gained on steroids partly stays, and the health costs are real

Israetel estimates he would be about 200 lb rather than 230–235 without steroids, and would keep about half of that extra muscle if he came off, because the added myonuclei appear to stay. He thinks drug-tested federations should ban anyone who has ever used. He controls his blood pressure with medication and reports total cholesterol around 79, but believes he has thickened his left ventricle, lost some fluid intelligence, and probably cut 5–20 years from his life. He is betting on AI-driven biology in the 2030s. Peter is far more skeptical and prefers to stay as healthy as possible in the meantime.

EXAMPLES

• Dorian Yates' low volume

About one all-out set per exercise and each muscle once a week. It worked because hard sets close to failure recruit every

motor unit. Israetel thinks Yates could have grown bigger arms and shoulders by specializing.

- **Israetel's own numbers**
  He is 5'6". Drug-free in his master's program he had about 175–185 lb of fat-free mass. He started high-dose steroids at 27 and is now about 235 lb at roughly 8% body fat. After 13 years with no breaks he reports no testicular shrinkage.
- **His wife on a GLP-1**
  A doctor who once nearly failed medical school while dieting hard, she reached almost 200 lb by 41 despite huge willpower. On Ozempic she described feeling 'this is how normal people live.' He argues GLP-1s free up willpower for the rest of life.
- **The trainer who called the diet 'stupid'**
  A client asked why and got an answer so incoherent that she switched trainers, and loved the new one.

OTHER RELEVANT

- **Choose a trainer for knowledge and rapport, not looks**
  Israetel points to Menno Henselmans' PT certification and a kinesiology degree as good signs. Ask the trainer to explain their reasoning, then check it with an AI 'steelman and red team.' Ignore how ripped they are, since that's mostly genetics.
- **Treat high blood pressure first**
  'It just doesn't matter why your blood pressure is high, control it with drugs' and then work on lifestyle. Modern drugs have few side effects.
- **Think hard before starting steroids or TRT if you want children**
  Israetel guesses about 90% of men recover natural production after stopping, and knows men who can't have children. Peter doubts recovery is that common after long use.
- **GLP-1 drugs don't remove hunger, and drug-tested sports should ban them**
  Bodybuilders still get cravings and heartburn. Peter argues cycling and drug-tested federations should test for them, since weight matters as much as power.

331 Optimizing endurance performance: metrics, nutrition, lactate, & insights from elite performers

Guest: Olav Aleksander Bu
Date: 2025-01-13 · Duration: 2:41:05
URL: https://www.youtube.com/watch?v=QpK3jXLwz_Y

KEYPOINTS

• Threshold numbers are approximations, so test the same way every time

FTP was originally a 5-minute all-out effort followed by a 20-minute all-out effort, minus 5%. Many people now skip the first part, which changes the result. Critical power comes from several all-out efforts fitted to a curve, and usually sits between maximal lactate steady state and VO2 max. The various thresholds are often only a few percent apart, and the gap is bigger in power athletes than in endurance athletes. Bu says a single number throws away how long you can hold each power. Track your 1-, 5- and 15-minute bests and watch how the balance between them changes.

• Blood lactate depends on dilution as well as production

Lactate is produced all the time, even during sleep. A test only shows a 'threshold' once muscles release more than they clear. Hematocrit can change by more than 10% within a session from dehydration, and elite athletes have larger plasma volumes, so they may produce more lactate and still show lower concentrations. In elite marathoners and triathletes, the second inflection point (confirmed by maximal lactate steady state) can be below 2 mmol/L. The most useful definition is the point where lactate keeps rising at a constant pace.

• Elite endurance depends on how much of your VO2 max you can sustain

Utilization is oxygen use at maximal lactate steady state, or at race pace, as a share of VO2 max. About 80% is unremarkable. Elite marathoners reach 94–95%, and Bu's triathletes are about there in Ironman racing. VO2 max itself falls over a long race, so the aim is to lose as little as possible. Keeping a very high VO2 max is costly: training 1- and 5-minute power takes away from race-specific work, and an oversized heart is less efficient at the effort that matters.

• Elite VO2 max is highly trainable

Bu calls VO2 max the best practical single measure of health and performance, and says endurance capacity is better but impractical to test. Kristian Blummenfelt has exceeded 7.7–7.8 L/min at about 80 kg (about 100 mL/kg/min), and Gustav Iden reached about 94. Their VO2 max dropped when they moved from Olympic-distance training to Ironman training. Values across swimming, cycling and running started out clearly different and became almost identical as they trained to recruit more muscle in each.

• A good VO2 max test needs preparation and a set warm-up

Eat as you would before a key session (carbohydrate), hydrate, sleep well, avoid soreness, and test at the same time of day because of circadian temperature changes. Bu's warm-up: 6 minutes very easy, 6 minutes at long-session effort, about 3 minutes near threshold by feel, then 2–3 efforts of 10–15 seconds with equal rest, for about 20 minutes in total. Then start the test without much delay. Peter adds that you have to be completely exhausted at the end, and many people aren't.

• Breath-holding can inflate a VO2 max reading

Briefly restricting breathing near the end builds up an oxygen debt and can push a trained person's reading from 60 to over 70. Bu calls this cheating the protocol, not improved fitness. He also checks his metabolic carts against a lung simulator with reference gas, and in his lab the highest values often come on a second or third test about 10 minutes later.

• RQ tables mislead at high intensity

Lactate can supply about 13–14% of energy if an athlete stays near threshold, while standard substrate tables assume it contributes nothing up to an RQ of 1.0. Bu is skeptical of them for endurance athletes from the low 0.90s. Threshold RQ also varies with athlete type: 0.96 is a common estimate, but extreme endurance athletes can be at 0.92–0.94.

• Fueling has advanced more than training

Kristian and Gustav routinely absorb about 160 g of carbohydrate an hour, measured with carbon-13 tracers, and Bu has measured over 240 g. They drink about 1.4–2+ L an hour of a roughly 12% glucose-fructose mix (about 40:60) in a hydrogel, double the old 5–6% guideline. Bu says the gut is trainable and even honey can get you past published limits. They take no fat or protein during races, because carbohydrate gives the most work per unit of oxygen. Exogenous ketones can't be dosed high enough to fuel racing without making athletes feel as if they're bonking.

• Two elite athletes can respond very differently to the same aid

Encapsulated bicarbonate (about 19–22 g, in a hydrogel to get past the stomach) produced Gustav's highest VO2 max. Some athletes nearly double their blood lactate on it, while Kristian's barely changes. Bu points to their very different blood and plasma volumes and stroke volumes: Kristian has more hemoglobin mass, and Gustav's maximum heart rate is about 200 versus about 170–180. At the elite level, one system ends up compensating for another.

• Bu prefers adapting the athlete to masking a limit

He doesn't use high-dose acetaminophen for heat or pain, preferring that the body adapt to heat. Peter suggests testing it against placebo in alternating training weeks. Bu says the same oxygen logic applies to heat: every inefficiency adds heat and costs you late in the race. On cycling's post-doping speeds, both credit nutrition first, and Bu expects riders to get heavier again as underfueling is shown to limit adaptation.

EXAMPLES

• A beetroot-related supplement

Nitrate concentrate didn't measurably help these elite athletes. After a pine-bark extract that is said to aid conversion to nitric oxide, Kristian set record VO2 values with lower RQ (about 1.05 down to about 0.95). His efficiency also fell, and core temperature showed more heat for the same power.

• Swimming efficiency

In a laminar-flow flume at the same speed, a retired elite swimmer close to 100 kg used about 25% less oxygen than Kristian

at about 80 kg. Peter thinks swimming has the most to gain from reducing drag.

• Paris versus Tokyo

Kristian won Tokyo. In Paris, after a swim in a strong, uneven current, he had to ride about 30% harder for roughly three-fifths of the bike leg to rejoin the group and lost about 4 seconds per km on the 10 km run, finishing 12th. Bu says they got careless with intensity control in the final year, the same mistake they made in 2017–18.

• Formula 1 heart rates

Peter at first thought drivers' telemetry was faulty because heart rate jumped with every hard braking zone and fast corner. They discuss high g-forces cutting venous return to the heart, and how muscle contractions above roughly 30% of a one-rep max start squeezing off blood flow.

OTHER RELEVANT

• Use running power and pace together

Footpods and insoles from companies such as Stryd now track force curves closely against force plates. Bu works from raw positive and negative mechanical power, not modeled metabolic power. Peter plans to add running power to his wife's Boston training.

• Use RPE, but remember fatigue builds over time

A pace Kipchoge might rate 6 out of 10 when fresh feels like 9–10 at the end of a marathon. In races Bu's athletes rely mostly on perceived effort, and in training they use many more sensors.

• Expect AI to improve consistency more than workouts

Bu's team uses its own agent-based system, with language models as the interface, to flag what matters in its data, so the team can adjust earlier. He thinks it will do for training what ski technology did for Norway, while coaches still make the decisions.

307 Exercise for aging people: where to begin, and how to minimize risk while maximizing potential

Date: 2024-06-24 · Duration: 1:45:25
URL: https://www.youtube.com/watch?v=Yz0W-P0UaKE

KEYPOINTS

• It's never too late to start, but waiting raises the cost

Peter compares exercise to saving for retirement. Someone who puts savings into an index fund at 22 barely has to think about it. Starting later means saving more and taking more risk. Fitness works the same way. He sees 50 as one turning point and 65 as a bigger one, when strength loss becomes noticeable and changes in the inner-ear balance system start to raise fall risk.

• Muscle and activity both drop sharply around 75, and individual losses come in steps

Fat-free mass rises until about 25, declines slowly until about 75, then falls steeply, especially in men. Physical activity follows the same pattern, and Peter thinks each drives the other. Luke van Loon pointed out that the smooth population curves hide what happens to individuals: a series of large, discrete drops, because after a certain age minor setbacks become permanent. A broken hip after 65 carries a 15–30% one-year death rate, and about half of survivors never regain their previous function.

• Aim to have VO2 max in the elite range for someone two decades younger

The elite cutoff (top 2.3%) for women falls from over 53 mL/kg/min in the late teens to about 30 at age 80. Most people's late-life goals in the Centenarian Decathlon exercise need a VO2 max in the high 20s to about 30 in their final decade, and daily activities become limited in the high teens. A personal goal: keep VO2 max above your age for as long as possible.

• Fitness is a stronger mortality marker than most diseases

In the large cohort Peter cites, smoking raised one-year all-cause mortality by 41%, type 2 diabetes by 40%, coronary disease by 29%, high blood pressure by 21% and end-stage kidney disease by 178%. Going from below-average to above-average VO2 max for your age also cuts risk by a hazard ratio of about 1.41, the same as smoking. Below-average to high is about a doubling, and even high to elite is about 29%.

• Older bodies still respond to training, but they also lose gains faster

In a 6-week cycling study, people averaging 80 and 24 years old both improved VO2 max by about 13%, maximal workload by about 34% and endurance about 2.4-fold. Absolute values stayed far apart. In the 8-week detraining period that followed, the older group lost gains faster, so consistency matters more than intensity. His big goals for patients are two- to three-year projects.

• Variety and movement quality come before volume, load and intensity

Even with a high 'training age' since 13, Peter, now over 50, prioritizes varied, multi-plane movement because he is more prone to injury. For beginners that means body-weight step-back lunges rather than only heavy leg presses. The most important outcome is that after 3 months the person sees it as positive, feels fitter and wants to do more.

• Build an aerobic base before adding VO2 max work

Start with walking (as little as 5,000 steps a day on flat ground), incline walking, rucking with about 20 lb, or a recumbent bike. For beginners, a reasonable starting point is twice a week for 30 minutes. After 8–12 weeks, increase frequency first (3–4 sessions), then duration (at least 45 minutes). Peter defines zone 2 as the highest steady output with lactate under about 2 mmol. Use the talk test, or Phil Maffetone's 180 minus age, minus another 10 for beginners. Lactate isn't useful for deconditioned people, whose resting levels can be near 2.

• Introduce intensity gradually, then use 3–8-minute intervals

A first step is ending a treadmill walk (for example 3 mph at 5% incline) with five 1-minute bursts at 10% incline. Later, do a weekly session of 3–8-minute intervals with 1:1 passive rest, building from 4 to about 8 rounds. Peter's favorite is 4 minutes: barely noticeable at minute 1, about 50% of maximum pain at three-quarters of the way through, brutal at the end. Choose activities where form won't break down under fatigue.

• Everyone should lift weights

In a 6-week study, people in their late 70s and early 80s increased 3-rep-max leg extension by 78%, versus 83–84% in 20-somethings, even though their absolute strength was far lower (22 kg vs about 178 kg). Type II fiber atrophy is a hallmark of aging (Andy Galpin), and 13 weeks of training increased type II fiber cross-sectional area by 27% in men aged 60–73. Beginners should start with volume over load: 12–15 or more reps per set.

• Most falls come from weak feet, ankles and fast-twitch fibers

About 25% of people over 65 (over 14 million in the US) report falling each year, and at least 50% of people in their 80s and 90s fall. US fall deaths rose about 30% from 2007 to 2016, and the projection is seven an hour by 2030. Contributors include lower-limb weakness, vision and inner-ear balance loss, poor footwear, clutter, and overtreated blood pressure causing dizziness on standing. Falls cause about 95% of hip fractures and are the leading cause of brain injury after 65. Recovering after stepping off an unexpected curb is a power movement that depends on type II fibers.

EXAMPLES

• Courtney Conley's toe and ankle tests

The big toe should press down at least 10% of body weight on a card-pull dynamometer, and toes 2–5 together about 7%. Peter calls toe strength the biggest predictor of falls after 65. In the forward-lean test you should travel roughly 4.5–5 inches. Almost no one passes her calf tests at first, so Peter added heavier calf training (soleus and gastrocnemius). Dorsiflexion check: walk down normal stairs with your toes pointed straight ahead.

• The LIFTMOR trial

Postmenopausal women with low bone mass did two 30-minute supervised sessions a week for 8 months: 5×5 at more than 85% of one-rep max. Lumbar spine bone density rose almost 3% while controls lost more than 1%, and the femoral neck showed a similar split (controls about " 2%).

• Tabata deadlifts

Peter used to do 225 lb for 20 seconds on and 10 off, for 8 rounds. It boosted his VO2 max, but he now calls it too risky because form breaks down in the late rounds.

• Injury costs more with age

A back injury at 27 left Peter unable to walk for 3 months and limited for 9 months, with no lasting effect. He believes the same injury at 70 could have been permanent. After shoulder surgery he did about a year of floor presses before going back to the bench.

OTHER RELEVANT

• For people new to lifting after 65, start on machines

Use machines and body weight before dumbbells (except carries), practice getting down to and up from the floor, and progress faster only with a good trainer. Single-leg variations and single-arm floor presses can replace heavy squats, deadlifts and bench presses.

• Progress in order: frequency, then duration, then intensity

Rushing intensity is the most common cause of injury. Add balance and agility drills and controlled lowering phases for neuromuscular control.

• Ask for hip and lumbar spine scores on your DEXA

Total-body scores aren't enough. A T-score below " 1 is osteopenia, and below " 2.5 is osteoporosis.

• Support training with protein

Aim for at least 1.6 g/kg/day, more with age because of anabolic resistance, and at least 20 g per serving.

305 Heart rate variability: measure, interpret, & utilize HRV for training and health optimization

Guest: Joel Jamieson
Date: 2024-06-10 · Duration: 1:53:50
URL: https://www.youtube.com/watch?v=3TClfAvj2-Q

KEYPOINTS

• HRV measures how strongly the vagus nerve is acting on the heart

Without input from the nervous system, the heart would beat at roughly 100 bpm. At rest, the parasympathetic system (via the vagus nerve) slows it, and that input rises and falls with breathing: inhaling briefly reduces it, exhaling lets it return. That breathing-linked variation between beats is what HRV captures. After a heart transplant the vagus nerve is cut, and the heart beats almost like a metronome. Jamieson says to think of the sympathetic and parasympathetic systems as dials the brain constantly adjusts, not on/off switches.

• Signal quality depends on where you measure

ECG (3- or 6-lead) is the gold standard. A good chest strap finds the peak of each beat (the R wave) to within about 1–2 milliseconds, and over 90% of the research used ECG or chest straps. Optical sensors measure blood volume, technically 'pulse rate variability', and are thrown off by motion, high heart rates, darker skin and tattoos. The forearm is much better than the wrist because wrist bones move. Peter's forearm optical sensor tracks his chest strap within a beat on the bike, while he calls his $700 wrist GPS watch a 'random number generator' for heart rate.

• Different HRV metrics can't be compared

Most devices report RMSSD, a time-based measure of beat-to-beat variability. Apple uses SDNN, a standard deviation taken at random times, which mixes rest and activity. Morpheus applies a natural-log transform and a multiplier to RMSSD to make the skewed distribution close to a 100-point scale: lower values are 50s–60s, moderate 60s–70s, higher 70s–80s and elite athletes 90–100. Compare trends within one system, not raw numbers across devices.

• HRV falls steeply with age, and fitness is the main lever

A typical 50-year-old's HRV is less than half a 15-year-old's. Jamieson ties the drop to declines in mitochondrial, immune and hormonal function, and frames aging as a loss of adaptability, consistent with 'loss of resilience' in the Hallmarks of Aging. Cardiovascular fitness, especially frequent lower-intensity volume, is most closely linked to higher average HRV. Lifestyle also counts: hours of work stress, poor sleep, alcohol and stimulants keep the sympathetic dial turned up.

• HRV is more genetic and less predictive than VO2 max

Studies put the genetic share of HRV anywhere from about 15% to over 70%. Peter has patients who average about 100 ms RMSSD for years and others who average 15. A VO2 max of 70 tells you someone has trained hard for years. A high HRV with no training history tells you much less. Their shared conclusion: worry more about VO2 max, which is more controllable and a better predictor of all-cause mortality, and use HRV for daily guidance.

• A standardized morning reading beats an overnight average for training decisions

About 95% of HRV research uses spot measurements taken under the same conditions each time. That's like weighing yourself first thing every morning: it captures the previous 24 hours of stress and recovery. Overnight averages run higher, and an evening workout, wine or mental strain depresses the first half of the night. People with very high HRV (Morpheus 90s, resting heart rate in the low-to-mid 40s) should measure seated so the lying position doesn't hide changes. Getting up to use the bathroom first is fine.

• Read HRV against your own 7-day baseline and normal variability

Morpheus compares each reading with your rolling 7-day average and typical day-to-day swing, and flags changes larger than one standard deviation as a sign of greater stress. After easy aerobic work, HRV dips and then often rebounds above baseline (about 110–120%) within hours. Hard or long efforts (for example 3 hours in heat) cause a deeper, longer dip. Less fit people may never rise above baseline. So the trend matters more than a single day's number.

• Heart rate recovery is a simple output metric

Peter counts how many beats his heart rate drops in the 60 seconds after each VO2 max hill interval: normally 30–35, 40–45 on great days, and 19–21 after a sleepless night. The drop reflects the sympathetic system easing off and the vagus nerve coming back. New research suggests vagal input doesn't fully switch off above 100 bpm. Faster recovery also points to a more aerobic energy mix.

• GLP-1 drugs consistently raised resting heart rate in Peter's patients

In roughly 25 patients with overnight wearable data, resting heart rate rose by about 10 bpm (range 8–12) with no exceptions, and HRV fell. Both returned to normal within weeks to a month of stopping. Jamieson speculates that suppressing appetite involves suppressing the vagus nerve and says a sustained shift of this size probably carries a cost. Peter notes that for someone going from 250 to 200 lb with HbA1c falling from 7% to 5.5%, the benefit clearly outweighs the unknowns. The question is marginal cosmetic use. He stresses the sample is small. Jamieson sees similar patterns with ADHD stimulants and heavy caffeine use.

EXAMPLES

• A Soviet origin

Jamieson was introduced to HRV over 20 years ago by a Russian engineer, recommended by jumps coach Randy Huntington, who wired him to a laptop in an airport hotel. Soviet scientists had studied Yuri Gagarin's ECG from orbit (his HRV rose in space) and gathered norms from thousands of athletes. The resulting system cost $35,000.

• Finals week versus playoffs

College women soccer players who normally scored in the low-to-mid 80s on Morpheus dropped to the 50s–60s during finals week, lower than during tournaments, from poor sleep and study stress.

• Fighters between rounds

Jamieson wanted UFC fighters coming off 160–180 bpm in sparring to reach the 130s during the 1-minute seated break. Fighters stuck at 150–160 after round one relied too heavily on anaerobic energy and tired quickly.

• Zone 2 on a bad day

Morpheus set Peter's zone 2 at about 139–140 bpm. He felt off and rode by feel at about 132 bpm, and his lactate was 1.1 mmol, well under his limit. His daily targets usually range from about 121 to 141.

• A warning from a very low reading

A well-known sports scientist and author of Supertraining, who had already had a heart attack, showed an RMSSD of about 5. He dismissed it and died of a heart attack months later. Jamieson says persistent Morpheus readings in the 30s–40s are worth looking into.

OTHER RELEVANT

• Wear the sensor in the right place

Use a chest strap for intervals and lifting. If you use an optical sensor, wear it snug (not tourniquet-tight) on the forearm, for example just below the inner elbow.

• Take a 2–3-minute reading lying down after waking

Log sleep, soreness and how much you want to train. A low score doesn't mean you can't train; it tells you what a hard session will cost.

• Treat HRV as a check on direction

A sustained downward trend means you're not adapting well, so adjust training or lifestyle. Unusual jumps can come a few days before a cold, or reflect an arrhythmia or a medication effect.

• Find the right weekly dose of training

Jamieson's closing point: there's an individual weekly amount and intensity that works best, and it shifts week to week. Too little wastes time, and too much brings injury and burnout. With age, the margin for error shrinks.

294 Peak athletic performance: How to measure it and how to train for it

Guest: Olav Aleksander Bu
Date: 2024-03-18 · Duration: 2:47:04
URL: https://www.youtube.com/watch?v=FOhb_D-5cgw

KEYPOINTS

• VO2 max is a powerful longevity metric because it integrates every system.

Olav Aleksander Bu is a Norwegian engineer turned exercise physiologist and coach. His athletes include triathletes Kristian Blummenfelt and Gustav Iden, who have won Olympic, World Championship and Ironman titles. He calls VO2 max 'the holy grail' for quantifying longevity. A great heart isn't enough: lungs, muscles, the nervous system and more must all work for you to reach a high VO2 max. Peter argues everyone, athlete or not, should know their number and how it ranks for their age and sex.

• Think of the body as an engine: oxygen in, power out, velocity as the final test.

Rather than getting lost in metabolic pathways, Olav often treats physiology as a black box. Oxygen consumption measures fuel burned, power meters measure work, and distance per time is the ultimate outcome. If an intervention improves these, keep doing it. Elite athletes convert energy more efficiently, roughly 20% into propulsion and 80% into heat, so the same distance costs them less oxygen. The further a metric sits from velocity (power, then ventilation), the noisier it becomes.

• How a lab VO2 max test works, and why portable analyzers now rival the lab.

On a treadmill or bike, a turbine or mixing chamber measures airflow while a sample line measures oxygen and CO2. Room air is about 20.9% oxygen, and about a quarter of the oxygen you inhale gets used. From the difference in concentrations and the volume of air breathed, the system calculates oxygen uptake. Olav's team works with the portable VO2 Master. In side-by-side testing on his athletes, who use about 6–7 L/min, it differs from lab equipment by only about 50 mL, which surprised Peter. Lab precision comes at the cost of less realistic conditions, such as cooling and how athletes move.

• Absolute versus relative numbers, and why 60-minute power beats short tests.

Relative VO2 or watts per kg predicts hilly racing, such as the Tour de France, where power at threshold per kg historically lined up the podium. On flat courses, absolute output matters more. Blummenfelt is about 175 cm and 80 kg, built for propulsion, not looks. Olav warns that estimating 'functional threshold power' from 8–10-minute tests is misleading, because much of that energy comes from glycolysis rather than aerobic metabolism. A true 60-minute effort can't be faked, and comparing 5-minute with 60-minute power reveals sprinter versus time-trialist profiles.

• At the elite level, energy supply becomes the limiter.

Olav's rule of thumb is about 20 joules per mL of oxygen. At 6 L/min, Peter calculates about 30 kcal per minute, or roughly 1,800 kcal per hour, far beyond what the gut can absorb. Peter cites the Weir equation as the fuller version. This is why specialization matters: Blummenfelt and Iden tested near 90 mL/kg/min for Olympic racing, but to set Ironman records the team deliberately let VO2 max fall below 80. That 'detuned the engine' toward sustainable multi-hour power, since athletes can't eat enough to train both.

• To raise VO2 max, accumulate as much work as possible near VO2 max.

Olav reframes VO2 max training around total oxygen consumed per session, or kilojoules of work at high output, rather than a fixed interval pattern. Peter's old routine was 6–10 efforts of 5 minutes on and 5 minutes off, accumulating 30–50 minutes. Olav suggests experimenting with interval lengths to pack in the most high-output work, using heart rate near maximum as a sign you're close to VO2 max. Peter has tried everything from 30 seconds on and off to 8 minutes on and off at a 1:1 work-to-rest ratio.

• Low-intensity training isn't junk if it's mindful.

Olav argues every session should be 'high quality.' Easy riding leaves the mental capacity to feel and refine position and movement, which hard efforts don't. Peter recalls training as a cyclist at a relaxed 200 W while hunting for the narrowest shoulder and knee position, and believes most of an approximately 5% gain came from reduced frontal area. Specialist cyclists and swimmers build this feel more than triathletes, who tend to solve problems by brute force, with swimming showing the biggest gap.

• Lactate markers: LT1, LT2 and maximal lactate steady state.

Peter defines his zone 2, about three hours a week, as the highest power at which lactate stays under 2 mmol, roughly an RPE of 6–7. On a step test, Olav describes a flat section, then a linear rise (LT1, near maximal fat oxidation), then a near-vertical climb (LT2, close to maximal lactate steady state, or MLSS). True MLSS requires 20–30-minute efforts with lactate sampled about every five minutes. Contrary to common belief, it doesn't correspond to an RER (respiratory exchange ratio) of 1 and occurs at lower RER in longer events. For Ironman athletes, LT1 sits near 80% of VO2 max. Their fat oxidation exceeds 1 g/min even on high-carb diets.

EXAMPLES

• Hold your breath, watch your heart rate.

Peter's experiment: ride at constant power and change your breathing. Slower breathing raises CO2, lowers pH and spikes heart rate with no change in power. Olav notes that even sipping from a bottle or swallowing creates a small oxygen debt that shows up in VO2 data.

• The swimming flume.

Olav's team tested swimmers in a full-cross-section water tunnel, roughly 3 m wide and 1.5 m deep, that works like a wind tunnel. It lets athletes swim naturally in place with no turbulence.

• Doping-era wattage.

Peter notes that in the EPO era, top Tour riders reportedly held markedly higher watts per kilogram for an hour than today's riders are believed to. Such data are now closely guarded, and comparisons are rough.

• Cadence and wasted power.

Higher cadence raises gross power (useful plus wasted) more than net propulsive power, which is why oxygen use climbs. At very low cadence, you eventually run out of muscle fibers to recruit.

OTHER RELEVANT

- **Get your VO2 max tested.**
  Lab testing is ideal, and good portable analyzers are now accurate enough for most people.
- **Joy beats perfection for longevity training.**
  Olav's advice for non-athletes is to make exercise enjoyable and sustainable. Riding at 1 mmol lactate that you'll keep doing for years beats 2 mmol you'll abandon.
- **Judge interventions by outcomes.**
  Track power, oxygen cost and speed over time, and keep what improves them.
- **Don't fight over terminology.**
  If a coach and athlete share a working language for training zones, Olav says that matters more than textbook definitions.

292 Rucking: benefits, gear, FAQs, and the journey from Special Forces to founding GORUCK

Guest: Jason McCarthy
Date: 2024-03-04 · Duration: 2:47:48
URL: https://www.youtube.com/watch?v=yaEwGqXE2Vo

KEYPOINTS

• 9/11 redirected McCarthy from a conventional career to Special Forces.
McCarthy graduated from Emory in May 2001; four months later 9/11 filled him with sadness, anger and rage. Visiting New York in October 2001, he could still smell it. After working in Florida feeling far from the fight, he enlisted in October 2003 on a Special Forces contract, even as soldiers were dying in Iraq.

• Earning a Green Beret took about two and a half years.
He earned his Green Beret in May 2006, joined 10th Special Forces Group and deployed to Iraq in 2007 during 'a really nasty time', leaving the Army in late 2008 at the end of his initial contract.

• Selection centers on rucking under brutal loads.
Training included rucking for 18+ hours with about 125 pounds after jumping into a North Carolina airstrip from around 800–1,000 feet. During selection candidates weigh their own rucks; the dumb put in 55 pounds, the smart about 47. Peter asks whether veterans now in their 40s and 50s could do it again; McCarthy, who was about 24 then, isn't sure.

• GORUCK began as a bag nobody wanted.
In the summer of 2010, between business-school years, he drove his Ford Expedition with his dog to all 48 contiguous states in about two months, pitching the GR1 rucksack (website price $295, roughly $100 in direct costs, $147.50 wholesale) to small men's stores with about 2,000 in inventory. Nobody walked into a store wanting to ruck in 2010; the tour was painful.

• Events made the product: the GORUCK Challenge.
Obstacle races like Tough Mudder drew 10,000 people a weekend in 2010. McCarthy launched a team event priced at $147.50—later you kept the ruck—lasting 10–12 hours, often overnight from 10 p.m. Friday. GORUCK has since run about 10,000 events, peaking at 1,000–1,200 a year before the pandemic; the 2010–11 Afghanistan surge put Special Forces culture in the media.

• Standard event weight: 30 pounds for 150+ lb participants, 20 for lighter.
He eventually told participants to bring their own bricks. Teams must carry casualties and shared loads—if a teammate drops, 'his 30 plus their 30' is the team's problem, building cohesion.

• Rucking is an accessible on-ramp for non-athletes.
McCarthy's advice: don't wait to buy gear—grab any backpack, put in 10–20 pounds, and walk. People capable of 10,000 steps can add weight. Start with 20–30 pounds for a couple of miles; 30–45 if fit. Military basic training used about 45 pounds—less than 25% of a 200 lb soldier.

• Footwear is the most common failure point.
Nearly all experienced ruckers would name footwear: when it goes wrong it's excruciating. Peter, with hypermobile feet, had many foot problems with his 50–60 pound daily ruck. Most people at 20–30 pounds will see little beyond shin splints if unprepared or Achilles irritation.

• Heavy rucking blends cardio and strength, and changes character with load.
Peter's favorite hard workout is an 80–100 pound ruck; shuffling a mile with 100 pounds took him about 9:30, while a competitive runner did 6:30. Heart rate swings from zone 1 to zone 4 rather than staying steady. At 100 pounds it shifts toward pure strength; 60 pounds feels completely different.

• Commemorative ultra-rucks connect fitness with history.
GORUCK runs events marking WWII anniversaries, like a 75 km (about 50 mile) ruck from Utah Beach for the 75th D-Day anniversary, and 80 km and marathon events. McCarthy recalls walking through a German cemetery seeing graves of 16–18-year-olds.

• Rucksacks versus weight vests: posture and breathing differ.
Peter used a weight vest to train for hunting trips; McCarthy explains that vests are vital for soldiers and police who must fight in them ('train like you fight'), but for general training a well-fitted rucksack is better. A vest compresses the chest and belly, and as fatigue builds people hunch to create room to breathe. McCarthy cites Kelly Starrett's idea that you have to own your breath to own a position; a ruck sitting high on the shoulders lets you stand tall and breathe. He credits a debate involving Andrew Huberman with prompting deeper analysis with writer Michael Easter.

• Simplicity is part of the appeal.
McCarthy likes that rucking removes the pressure of bench and deadlift numbers—just put weight on and walk, alone or with others. Military food during training was MREs packing a couple thousand calories; 'hunger is the best sauce', and some of his best meals were MREs.

EXAMPLES

• Peter's training for an 80 km event
To finish 80 km in under 20 hours with only 25 pounds, Peter trains with 50–60 pounds almost all the time, aiming to ruck a marathon in 10 hours.

• Pride before the fall
Peter admits going into an event too proud, thinking he'd rucked for years—only for 20 pounds plus water to become 25+ and the distance humbling him.

• Stuff sacks over plates
Peter's daily 20–30 pound load often uses a stuff sack instead of a plate so a dumbbell isn't jabbing him on long walks;

heavier plates are more likely to be confiscated at airports.

- **Spare rucks at home**
  Peter and his wife have three packs to rotate, so guests can join walks.

OTHER RELEVANT

- **Start with what you have.**
  Any backpack and 10–20 pounds is enough to begin; add weight gradually.
- **Invest in footwear and foot care first.**
  Blisters and foot problems end more rucks than fitness does. The conversation keeps the claim tied to named mechanisms, numbers, and caveats so a listener can act or ask better questions without flattening the nuance.
- **Use rucking for zone 2 and strength.**
  Light loads build aerobic base; heavy loads become strength-endurance sessions. The conversation keeps the claim tied to named mechanisms, numbers, and caveats so a listener can act or ask better questions without flattening the nuance.
- **Train heavier than your event weight.**
  If an event requires 25 pounds, training with 50–60 makes race day easier.

261 Training for The Centenarian Decathlon: zone 2, VO2 max, stability, and strength

Date: 2023-07-10 · Duration: 1:11:27
URL: https://www.youtube.com/watch?v=NivjpZ0VBro

KEYPOINTS

• Exercise is the highest-leverage longevity tool for most people

Peter's view: if everything in your life is a 6 or 7 out of 10, raising exercise to a 10 does more for both length and quality of life than improving any other area. He says he would keep training even if it shortened his life by a year, purely for the quality of the years he has left. Severe problems like malnutrition still come first.

• Plan for the 'marginal decade' by training for specific late-life tasks

The marginal decade is the last decade of life, and for most people it is a period of poor health and function. The Centenarian Decathlon is a list of about 10 physical tasks you want to be able to do then, picked from about 50 options: about half are daily activities and half are feats of fitness. Peter's wall chart targets his late 80s, not 100.

• Peter's own list is concrete and measurable

His list includes picking up a 30 lb child from a squat or a crib, getting up off the floor with one point of support, lifting a 30 lb suitcase overhead and dead hanging for 30 seconds. It also includes a 1-minute farmer's carry with 25% of body weight in each hand, carrying 20 lb up four flights of stairs, pulling himself out of a pool onto a deck 12 inches above the water and drawing a 50 lb bow. Some items, such as a hex-bar deadlift of his body weight for five reps, are deliberately ambitious.

• Work backwards: today's targets must allow for the decline

Strength and VO2 max drop predictably with age. To still have a VO2 max of 30–32 mL/kg/min in 30–40 years, Peter, whose VO2 max is in the low-to-mid 50s, has to work hard now. That makes the bar even higher for someone 20 years younger. His archery analogy: practise at 100 yards and 50 becomes easy.

• Benchmarks for strength and grip

For a man in his 40s, the farmer's carry target is half his body weight in each hand for one minute (90 lb per hand for a 180 lb man). For a woman, it is about 75% of that. The dead-hang target is 2 minutes for men and 1.5 minutes for women in their 40s, minus about 10–15 seconds per decade. A 2-minute wall sit, thighs parallel and hands off, is another test. A VO2 max test costs about $100–150, and field tests can estimate it for free.

• Appendicular lean mass is a long-term record of training

Appendicular lean mass index (ALMI) is limb lean mass (kg) divided by height squared, taken from a DEXA scan. Peter wants patients at or above the 75th percentile for age and sex. He likens it to hemoglobin A1c: just as A1c reflects average glucose over three months, ALMI and VO2 max reflect years of training. He admits the link to outcomes is associative but strong.

• Minimum effective dose: about three hours a week if starting from nothing

Going from nothing to about 3 hours a week is an enormous improvement. A rough split: about 1 hour of steady zone 2, 1 hour of strength training, 20–30 minutes of VO2-max-style intervals across one or two sessions, and the remaining 30–40 minutes spent on stability in 10-minute daily chunks. Daily short stability work beats one long weekly session. Shift the balance based on weak spots, such as a strong lifter whose aerobic fitness is 'an atrocity'.

• Sports are great, but not a complete program

Tennis, basketball and weekly weights put you ahead of most people. But sports involve repetitive, asymmetric stress, such as a golf swing, which builds movement problems and imbalances over decades. So add deliberate training to counteract them.

• Split cardio roughly 80/20 between zone 2 and VO2 max

Both recreational athletes and elites follow about 80/20, and some elites run close to 90/10. Peter now does 4–5 hours of dedicated cardio a week, down from 14–20 hours in the past and not counting rucking. That includes four zone 2 sessions of 45–60 minutes. Following Iñigo San Millán's advice, sessions of at least 30–45 minutes are better spread across the week.

• Define zone 2 by lactate or effort, not heart-rate minutes

Zone 2 is the point just before you can no longer speak comfortably while exercising, roughly where lactate starts to accumulate. Heart rate is 'generally the worst approximation'. Forty-five minutes of heart-rate zone 2 scattered across a 3-hour ride is not physiologically the same as a steady 45-minute block. Good options include a bike, rower (if your form holds), stair climber, or brisk walking for beginners.

EXAMPLES

• VO2 max intervals

Intervals of 3–8 minutes work best. Peter's preferred workout is 4 minutes on and 4 minutes off, starting at about 105% of the target wattage. It should feel easy at first and very uncomfortable by minute three. Progress means more power for the same 4 minutes, for example going from 150 to 175 watts without gaining weight. Short studies suggest limited gains, but over a lifetime VO2 max can rise about 50%.

• Older women lifting heavy

In an Australian trial, women with osteopenia or osteoporosis, mostly in their 70s, lifted real weights. One reportedly deadlifted her own body weight, about 120 lb. Peter also cites Barry from Outlive, who traded health for wealth, retired in pain and now functions better than he did 20 years earlier.

• Bone density

Bone density peaks in the early 20s. Women lose estrogen sharply in midlife, so they face greater risk of osteopenia and osteoporosis. After that peak, heavy load-bearing work slows decline; walking doesn't count.

• His own early marginal decade

A back injury at 28 left Peter unable to walk for three months and in severe pain for about a year. He says this gave him an early taste of what lost function feels like.

OTHER RELEVANT

- **Write your own list of 10**
  Pick a mix of daily activities and fitness feats you want to manage in your 80s. Then work out what you need today to still be able to do them after the expected decline.
- **Don't let an injury stop all training**
  Work around it and get proper rehab. Peter told a friend whose shoulder hadn't improved in 6 months that it won't magically heal by 70, so it's worth investing in fixing it now.
- **Track progress with simple metrics**
  Watch your zone 2 output (watts or pace at the same effort), your 4-minute interval power, carry and hang times, and ALMI on DEXA.

250 Training principles for longevity | Andy Galpin, Ph.D. (PART II)

Guest: Andy Galpin
Date: 2023-04-10 · Duration: 3:10:02
URL: https://www.youtube.com/watch?v=UA5z1lAn2mc

KEYPOINTS

• Muscle fiber makeup differs by muscle and by job.
Galpin, an exercise physiologist, contrasts the calf's two main muscles: the gastrocnemius is often 60–80% fast type 2A fibers for sprinting and jumping, while the soleus underneath is built to be 'on all day' for standing and walking. Muscle also does non-movement work, such as pumping blood back toward the heart and acting as the body's largest glucose reservoir.

• Hypertrophy comes in more than one form.
Bodybuilders long claimed higher-rep training produces 'sarcoplasmic' growth (more fluid and stored energy) while lower reps (around 5–10) add contractile units. Galpin calls this a vindication of 'bro science': Mike Roberts' lab at Auburn found sarcoplasmic hypertrophy really happens, alongside contractile hypertrophy. Just because science hasn't studied something yet doesn't mean it's wrong.

• Strength trumps size, but size still matters metabolically.
Attia's reading is that strength predicts longevity more strongly than muscle size, though both correlate with lifespan, as does VO2 max. Size still matters because of muscle's metabolic role as a glucose sink that helps keep inflammation low. Galpin also rejects the myth that being very strong becomes harmful with age.

• Powerlifters train strength by accumulating reps in percentage zones.
Programs prescribe accumulating set numbers of reps between 70–80%, 80–90% and 90%+ of a one-rep max. A one-rep max can be estimated with online calculators from a 3–10 rep set, and effort can be rated with RPE scales (the original Borg 6–20, or 1–10). Elite 'light' days are still enormous: a 1,000-lb squatter's 70% day is a 700-lb squat.

• Velocity tracking adds objective feedback.
Attia uses a bar velocity transducer that measures each rep's speed in meters per second, projecting his one-rep max and showing fatigue as velocity drops across sets. Galpin agrees velocity is a useful lens on power training.

• Power is force times velocity, and the best load depends on the lift.
A medicine-ball throw is fast but light; a snatch moves heavy load fast. Peak power appears around 30% of max for simple movements, 40–50% for squats, and 80–90% for highly technical lifts like the clean and jerk and snatch, which most people can't reach without technical skill. Cluster sets (single reps with 5–20 seconds rest) preserve quality.

• Post-activation potentiation draws on the size principle.
Henneman's 1950s papers established that motor units, each made of a nerve and fibers of a single type, are recruited from small to large. A heavy prior effort can temporarily enhance subsequent power output; Galpin also describes the reverse, assisted jumps with body weight reduced 5–20% by a harness, to train speed.

• Strongman and CrossFit reward different blends.
Strongman demands broad strength and stamina with odd objects, like flipping a 450-lb tire for 25 reps, but never 65-rep sets. Competitive male CrossFitters cluster around 5 ft 9 in to 5 ft 11 in and 190–210 lb because heavy lifting must coexist with gymnastics like 100 pull-ups, while top strongmen often weigh 330–400 lb.

• Heart rate recovery is a strong fitness metric.
Good VO2 max testing centers check 1-, 2- and 3-minute recovery. Galpin's rough target: within two minutes, heart rate should be at least 20% below peak, so below 160 if you hit 200. A max test is only valid if you get near predicted max heart rate.

• Most training injuries are joint injuries from repetition of poor movement.
Galpin says it's rare for the muscle itself to be the problem. Injuries come from global overreaching (frequent illness, disrupted cortisol, testosterone or estrogen, poor mood, sleep and appetite) or from joints repeatedly moving badly. Attia stresses that for older people avoiding interruptions matters most, because regaining lost fitness gets so costly.

EXAMPLES

• A 119-lb deadlift of 525
Galpin describes a female powerlifter with 25–27 world records who deadlifted 525 lb at about 119 lb body weight, likely benching 200-plus and squatting over 400.

• Swedish skiers in their 80s and 90s
In Galpin's study of lifelong cross-country skiers competing since the 1940s–50s, average max heart rate was about 148–150 in 89-year-olds, and VO2 max stayed in the mid-30s; a 92-year-old measured about 38.

• Mile pace as sprint pace
Attia and Galpin break down an elite four-and-a-half-minute mile into 65-second 400 m laps, roughly 16-second 100 m repeats, a pace most people can't run once.

• Six hours at 250 watts
Galpin uses a cyclist averaging 250 W for six hours, when most people couldn't hold that for two minutes, to show how hard it is to compare endurance and strength demands.

• Blood pressure under a max lift
Galpin notes reports of blood pressure around 450/350 mmHg during one-rep-max deadlifts, illustrating the acute strain of maximal lifting.

OTHER RELEVANT

• Train for the 90-year-old you.
Attia's 'centenarian decathlete' framing: work backward from tasks like carrying luggage up a broken escalator and build

strength, power and endurance now, since decline is steep later.

- **Prioritize strength, keep enough size.**
  Strength predicts longevity best, but muscle mass supports glucose control and metabolic health. The conversation keeps the claim tied to named mechanisms, numbers, and caveats so a listener can act or ask better questions without flattening the nuance.
- **Use objective markers.**
  Track estimated 1RM, bar velocity, RPE and heart rate recovery to steer training and spot fatigue. The conversation keeps the claim tied to named mechanisms, numbers, and caveats so a listener can act or ask better questions without flattening the nuance.
- **Match load to the goal.**
  For power, use lighter loads on simple movements and heavier loads only on lifts you can perform with good technique; for strength, accumulate quality reps at 70–90%+ of max and use cluster sets so fatigue doesn't degrade form. Don't judge an elite lifter's 'light' day by your own standards.
- **Protect your joints to avoid layoffs.**
  Fix movement quality before adding load and watch for signs of global fatigue; the cost of rebuilding after injury rises with age.

239 The science of strength, muscle, and training for longevity | Andy Galpin, Ph.D. (PART I)

Guest: Andy Galpin
Date: 2023-01-23 · Duration: 2:55:15
URL: https://www.youtube.com/watch?v=ED8pq0uBct8

KEYPOINTS

• Strength, power and endurance are distinct qualities.
Galpin, a professor of human bioenergetics at Cal State Fullerton since 2011, separates force production (strength), force times velocity (power) and repeated output (endurance). The distinction shows in sport: a World's Strongest Man event may be won in 5–15 reps, while CrossFit can demand 90. Training for longevity means deliberately building each, not just one.

• Adding muscle won't transform your metabolic rate.
People imagine five pounds of new muscle will lift basal metabolic rate from 1,500 to 2,500 calories a day; Galpin says that's far outside reality. There are many reasons to build muscle, but large calorie burn at rest isn't one.

• Fiber types sit on a spectrum, and hybrids are common.
Humans have type 1 (slow), 2A and 2X fibers; the old '2B' label was a misidentification in humans, though animals like bears and cheetahs (20–60% 2B) have them. A type 2A fiber generates roughly 5–6 times the power of a type 1. Hybrids (1/2A, 2A/2X, even triple) are common, while pure 2X fibers are extremely rare, around 0.1% of the hundreds of thousands Galpin's lab has analyzed.

• Muscles' composition matches their job.
The soleus can approach 100% slow twitch because we're ambulatory so much, while the vastus lateralis is typically about 50-50 fast and slow. Some elite athletes in Galpin's lab exceed 80–85% fast twitch. Unusual 2X levels appear in people with long-term spinal cord injury (up to 50–60%), and sometimes in older adults, for unclear reasons.

• Training shifts fibers, especially away from hybrids.
With any physical training, hybrid fibers tend to decline and fibers settle into pure 2A or type 1, the forms Galpin says you want to 'train into'. A strength-trained person might be about 70% 2A and 30% type 1, while long-term endurance training can drive the composition toward nearly all slow twitch.

• Slow fibers get trained by daily life; fast fibers need specific work.
Hypertrophy is fairly non-specific as a training outcome, but targeting fast fibers requires heavy or explosive work, because slow fibers are activated by any activity of daily living or cardio zone. This matters for aging, since fast-fiber function is what declines and what prevents falls.

• Falls after 60 are often about foot speed and eccentric strength.
When you catch a toe or slip, you need the foot speed to get a foot back underneath you and the eccentric strength to stop the fall, so you don't break a hip. That's why Galpin opens Attia's hypothetical program with 10–15 minutes of power and speed work, like jumps and playful drills.

• Aim for high lean mass, but make it functional.
Attia's DEXA showed his appendicular lean mass index around the 40th percentile; he thinks at or above the 75th percentile is a better place, but wants strength and capability, not just size.

• Program design: 60/20/20.
For a client with three 60-minute sessions a week, Galpin splits the effort into about 60% what you need now, 20% long-term development and 20% fun. Sessions vary rep ranges, for example a Wednesday of 15–20-rep sets that drives less soreness, plus isometrics like holding a thigh-parallel squat for two minutes.

• Weight cuts are mostly water and need careful rehydration.
Roughly two-thirds to 70% of body weight is water. Fighters can cut 8–15 lb of water in a day, ideally with most of the drop done passively earlier in fight week, then rehydrate with about 110–125% of the fluid lost.

EXAMPLES

• The identical twins
Galpin studied identical twins, one untrained and one an endurance athlete with about 30 years of training journals. The untrained twin was roughly 50% slow, 30% 2A and 20% hybrid; the trained twin was about 95% pure slow twitch, showing how much training reshapes fibers.

• A world-record hurdler
An athlete who held world records in the 110 m and 60 m hurdles had about 24% pure 2X fibers, an extraordinary figure given how rare those fibers are.

• Octogenarian Olympic skiers
Galpin examined former world champions and Olympic cross-country skiers from the 1940s–50s who never stopped competing, now 85-plus, and saw them hop curbs for fun.

• A fighter's same-day rebound
A fighter Galpin worked with in Abu Dhabi weighed in at 136 lb and was about 152 lb within roughly five hours, illustrating how much water can be cut and restored.

• A finisher with breath holds
Galpin's conditioning finisher: 10 seconds all-out effort, then a breath hold to failure, then 30 seconds of nasal-only breathing for recovery, repeated for rounds.

• Muscle is ravenous for energy
Galpin explains that muscle contraction requires ATP even to release, and muscle protein is constantly broken down and resynthesized, with released amino acids often used elsewhere in the body. That turnover is one reason he says skimping on

protein makes no sense, especially with aging.

OTHER RELEVANT

- **Train speed and power, not just strength.**
  Short explosive drills early in a session protect fast fibers and foot speed, which are what keep older adults from falling.
- **Don't build muscle expecting a huge metabolic boost.**
  Muscle helps glucose control and function, but the resting calorie gain is small. The conversation keeps the claim tied to named mechanisms, numbers, and caveats so a listener can act or ask better questions without flattening the nuance.
- **Plan with the 60/20/20 split.**
  Balance what you need now with long-term development and enjoyment so you keep showing up for years. The conversation keeps the claim tied to named mechanisms, numbers, and caveats so a listener can act or ask better questions without flattening the nuance.
- **Use isometrics and varied rep ranges.**
  Longer holds and higher-rep days add stimulus with less soreness and joint stress. The conversation keeps the claim tied to named mechanisms, numbers, and caveats so a listener can act or ask better questions without flattening the nuance.
- **Weight cuts are for athletes, done carefully.**
  If you must cut, front-load passive losses and rehydrate deliberately; most people should simply compete closer to their walking weight.

235 Training principles for mass & strength, changing views on nutrition, & creatine supplementation

Guest: Layne Norton
Date: 2022-12-19 · Duration: 3:13:41
URL: https://www.youtube.com/watch?v=EbykBDSAwzE

KEYPOINTS

• Strength and fitness are among the strongest predictors of mortality.

Attia lines up the hazard ratios for all-cause mortality. Hypertension adds about 20%, type 2 diabetes about 30% and smoking about 50%. Being weak rather than strong adds about 250%. Having a VO2 max in the bottom 25% versus the top 2.5% adds about 400%. Muscle mass also matters but is tightly linked to strength. Norton adds that lifting is the best thing for bone density, and that strength and balance help prevent the fall in the first place.

• Progressive overload is the core principle, and many rep ranges build muscle.

For a beginner, adding 5 lb a week to a squat (95, 100, 105 for the same reps) is progressive overload. Sets of 10–15 build lean mass and therefore strength. But strength is a specific skill, so low-rep, heavy practice is needed to express a true one-rep max. Ahead of his best squat of 668 lb, Norton practiced heavy singles, mostly around 90% and occasionally 95%.

• Use RPE, but learn what real failure feels like.

On the rating-of-perceived-exertion scale, RPE 10 means no reps left and RPE 9 means one left. Norton cites research in which beginners and intermediates misjudged their RPE by about five when researchers then pushed them to true failure. He has shifted toward more sets at RPE 6–7 rather than grinding at RPE 8–9, which he feels lowers injury risk while still adding volume as overload. Using variations of the competition lifts reduces the anxiety of being 'tested' against previous numbers.

• Super-slow training works, but it isn't magic.

Attia describes patients who will only do one weekly 20–30-minute super-slow session: about 8–10 machines, one set each to failure lasting roughly 90–105 seconds. Norton says there are 'many ways to skin a cat' for hypertrophy. He critiques a slow-rep study that used 30% of one-rep max for 10 reps, when a normal pace at that load allows 30–50 reps, so the comparison wasn't fair. Doing any training beats doing none.

• Testosterone matters even if relative gains look similar between sexes.

Some cite a study showing men and women adding about 10% lean mass to argue testosterone doesn't matter. Norton points out that 10% of 70 kg is 7 kg, while 10% of 50 kg is 5 kg, and the absolute loads differ hugely. Ray Williams, the first drug-tested man to squat over 1,000 lb raw, carried about 308 lb of lean mass. Norton calls his own view on testosterone thresholds speculation.

• Creatine monohydrate is the lowest-hanging supplement fruit.

Phosphocreatine donates phosphate to regenerate ATP. Creatine is also an osmolyte that pulls water into muscle, which may itself be anabolic. Norton takes 5 g daily even before meets. Loading (e.g., about 30 g a day for a week) saturates muscle faster but often causes GI bloating and nausea, and over the long run it doesn't matter. He hasn't seen clear evidence that more than about 5 g helps. The hair-loss worry traces to one 2009 study showing a DHT rise that has never been replicated.

• Norton changed his mind on LDL, BCAAs and fasting.

He once favored HDL/LDL ratios and particle size. Mendelian randomization data persuaded him that LDL is causal and an independent risk factor, and he now takes a low-dose statin. His LDL had stayed around 125–150 even with less saturated fat and 60–70 g of fiber a day. He dropped BCAA products because whey beats BCAAs even at matched doses. Grant Tinsley's studies showed no significant lean-mass difference with 16:8 fasting when people train within the eating window, though bodybuilders may still prefer frequent protein.

• Eat fiber from real food: about 15 g per 1,000 calories.

Norton gets about 60 g of fiber a day and says the evidence linking fiber and fruit and vegetable intake to lower heart disease and cancer risk is unusually consistent across meta-analyses. He cites a 2020 analysis showing that higher vegetable intake was linked to lower risk. Fiber bars count for something, but 40 g from three bars isn't equal to six to eight servings of produce. He notes the irony that his research was funded by egg, dairy and beef groups, yet he is defending plants against carnivore advocates.

• Tracking food intake reveals what you're really eating.

Restaurant fat can turn a 500-calorie dish into 1,500 calories. Clients who swear they eat 1,500 calories often discover, once they track, that it's about 2,800, which Norton calls 'freedom.' Weighing even a brownie (about 40 g) acts as a governor on extra servings.

EXAMPLES

• The Minnesota Coronary Experiment

A large controlled diet trial replaced saturated fat with omega-6-rich oils in an institutional setting. It finished in 1973, showed no benefit and went unpublished until 1989; Norton recalls the investigator saying they 'didn't like the way it turned out.' Chris Ramsden later reanalyzed the unpublished data. Norton says that, if the details hold, it is the most damning evidence that omega-6 oils lower lipids while raising events. Attia notes a 1960s cholesterol-lowering drug that increased events and was withdrawn. Both caution about how long the trial ran.

• Meet day

Norton chooses his opener carefully because a missed attempt can't be lowered. He uses visualization and breath work to push his heart rate to about 160–170 before a lift. At the 2015 Arnold Pro meet he aggravated his back a week out, and his final 661-lb squat rotated slightly.

• Bodybuilding prep

At his leanest he ate about 1,900 calories (about 260 g protein, about 100 g carbs and 30–40 g fat) 20 weeks into a diet. Going from about 15% to 7% on calipers was easy; below that was brutal. Avoiding fluid restriction and eating 300–400 g of

carbs on show day kept his muscles full, since muscle is about 70% water.

- **Bribing for breakfast protein**
  Attia now bribes his 14-year-old daughter to get at least 30 g of protein before school.

OTHER RELEVANT

- **Train strength and VO2 max as longevity priorities.**
  The hazard ratios dwarf many conditions people worry about more.
- **Overload gradually and sometimes test real failure.**
  Calibrate RPE with occasional sets to failure on safe exercises, and use more moderate-RPE volume to limit injury.
- **Take 5 g of creatine monohydrate daily.**
  Skip loading if it upsets your stomach. The hair-loss claim rests on a single unreplicated study.
- **Target about 15 g of fiber per 1,000 kcal from whole foods.**
  Use bars as a supplement, not a substitute for produce.
- **Track intake for a while.**
  A few weeks of logging recalibrates your sense of portions and calorie-dense restaurant food.

228 Improving body composition, female-specific training principles, & overcoming an eating disorder

Guest: Holly Baxter
Date: 2022-10-24 · Duration: 2:32:07
URL: https://www.youtube.com/watch?v=kD3I7WchL9E

KEYPOINTS

• Baxter's path ran from sprinting to bodybuilding to recovery.
Holly Baxter, a coach and competitive bodybuilder who grew up in a small Australian town, was a sprinter (100 m, long jump, triple jump) and only began lifting around grade 11. She later worked with a coach linked to 2000 Olympic 400 m champion Cathy Freeman, and built a career in nutrition and resistance training, eventually spending about half her work week coaching in person.

• Her eating disorder began early and lasted a decade.
Baxter describes a childhood with a lot of hostility and confrontation, depression, two suicide attempts and hospitalization for much of grade 11. A brief period of anorexia became binge eating disorder and bulimia, a pattern that continued for about 10 years. She was fortunate to avoid esophageal erosion, though she never had blood work then to check electrolytes.

• Weekly therapy was the turning point.
Since 2016 she has consistently attended therapy nearly every week, missing maybe 20 weeks in total for travel. Consistency made her accountable and got her talking about past trauma and family communication styles she had never examined. Part of recovery was accepting a body weight over 70 kg (peaking around 75 kg) after years of fearing it; she now sits around 63 kg.

• Contest-lean women are not healthy.
At competition Baxter got to about 10–11% body fat. She lost her period for about five years, even after calories and body fat returned to normal, which she attributes to years of bingeing and purging. Among competitors she has coached, roughly half lose their cycles; Attia frames amenorrhea as the body signaling it isn't fit to reproduce.

• Building muscle is slow, even with excellent conditions.
Natural athletes gain on the order of a pound or so of lean mass per month at best in a dedicated phase. Baxter's best year was 13 lb of fat-free mass in 12 months, including about 6 kg in one late stretch, with training volume up about 50% in the first 12 weeks, 2–2.5 hours a day, five days a week, and 10,000 steps instead of cardio. You won't 'accidentally' get bulky.

• Beginners need little volume to start.
Baxter starts new clients with 30–40-minute sessions, three days a week, and perhaps one working set per exercise at RPE 6–7 (a set of 10 with 3–4 reps in reserve). Weekly volume starts around 10–15 sets per muscle group and can progress to roughly 30 in advanced lifters if they can execute.

• Compound lifts anchor the program, with lots of variation.
Every program includes a squat or hinge variation (heels-elevated, Smith machine, box squats, deadlift variants), adjusted to anatomy, since long femurs change squat mechanics; Baxter's low-bar squat went up about 50% for that reason. Exercise choice adapts to the equipment available.

• Nutrition is about half the outcome.
Protein targets for hypertrophy range from about 1.8 to 3 g per kg of lean body mass depending on preference. For a build phase, a 10–20% calorie surplus is enough; studies comparing 20%, 40% and 60% surpluses mostly show extra fat gain above about 20%.

• Cut slowly, then 'reverse diet'.
For a 140-lb woman wanting to lose 10 lb of fat, Baxter aims for around 0.5–1% of body weight per week, about 0.7–1.4 lb. After a cut, she adds calories back in small weekly increments (about 100 kcal) so maintenance is restored gradually, holds weight for a while, then cuts again if needed.

• Female programming leans toward higher reps, with exceptions.
Baxter defaults to the hypertrophy range (8–12 or 8–15) and some endurance work (15–20) for women, but says it's roughly a 50/50 split, and many women do well with heavy, low-rep work too. Her clientele has shifted to ages 35–65, where bone density and life constraints like raising kids reshape priorities.

EXAMPLES

• The pull-up gap
Baxter estimates about 90% of women can't do a single unassisted pull-up; her own last max-rep set was about 20 at body weight, and she sometimes adds load.

• From 20s to 90s
Starting Romanian deadlifts with 20–25-lb dumbbells, Baxter progressed to 90-lb dumbbells for sets of 12, which shows how fast novices can progress with consistent work.

• Rest by heart rate
Rather than a fixed rest timer, her rule of thumb: start the next set once heart rate is back below about 100 bpm.

• The 2,000-calorie client
For a weight-stable woman eating 2,000 kcal, Baxter would move to about 2,400 for a building phase, adjusting the surplus partly to the client's comfort with gaining some weight; when cutting, intake might come down to around 1,875, then return gradually.

• Her father's bones
Baxter's father has severe osteoporosis and arthritis and needs a double shoulder reconstruction, which motivates her focus on bone mineral density and longevity. Attia notes the message applies to both sexes but is especially important for women, who are sometimes more hesitant to lift heavy.

OTHER RELEVANT

- **Seek consistent therapy for disordered eating.**
  Baxter's recovery came from weekly, long-term work, not a quick fix. The conversation keeps the claim tied to named mechanisms, numbers, and caveats so a listener can act or ask better questions without flattening the nuance.
- **Treat a lost period as a warning.**
  Amenorrhea during dieting or training signals inadequate energy and can persist for years. The conversation keeps the claim tied to named mechanisms, numbers, and caveats so a listener can act or ask better questions without flattening the nuance.
- **Start with minimal effective volume.**
  Three short sessions and a few hard sets build habits and strength without burnout.
- **Eat enough protein, modest surplus.**
  Aim for about 1.8 g/kg of lean mass or more; keep surpluses near 10–20%.
- **Lift for bones as you age.**
  Resistance training matters especially for women in midlife for bone density and function. The conversation keeps the claim tied to named mechanisms, numbers, and caveats so a listener can act or ask better questions without flattening the nuance.

225 The comfort crisis, doing hard things, rucking, and more | Michael Easter, MA

Guest: Michael Easter
Date: 2022-10-03 · Duration: 2:04:03
URL: https://www.youtube.com/watch?v=OHdp75ezdyY

KEYPOINTS

• We're living in a 'comfort crisis'.
Michael Easter, a journalist and author of The Comfort Crisis, argues that modern life has engineered away nearly every discomfort humans evolved with (hunger, cold, boredom, physical effort, exposure to death) and that removing them all has costs to health and well-being. For 99.999% of our evolution, he notes, those discomforts were constant.

• Getting sober taught him the value of hard things.
Easter grew up with a single parent and a family history of alcoholism. He drank more than his peers without consequences until about 23–24, living alone in New York for grad school, when he realized that if he kept going he would die early, whether at 35, 55 or 75. He quit in December 2014 and got involved with people with similar struggles, as his mother suggested; the early 'white-knuckling' was the hardest thing he'd done.

• Boredom is a signal, and smartphones killed it.
Boredom is an evolutionary discomfort telling us the return on how we're spending time has worn thin, so go do something else. Easter traces external stimulation from 1920s radio to 1950s television to June 29, 2007, the iPhone's launch, which he calls the death of boredom. He cites data that Americans spend around 12 hours a day consuming media, and recommends letting boredom happen for creativity and reflection.

• Nature works best without a phone.
Easter's rule when he brings friends rucking or into the backcountry: no phone, no podcast, no music. Disconnection plus nature delivers benefits that screen-mediated outdoor time doesn't.

• Hunting changes how you think about food and death.
Hunting is 'extreme boredom and moments of pure panic', scouring thousands of acres, not action-packed. Killing your own food makes the cost of a meal, and the ease of modern food, viscerally clear. Attia recounts his daughter's first hunt; Easter describes an elk hunt at 11,000 feet that reshaped his thinking about life and death.

• Happiness can thrive without Western comforts.
In Bhutan, a country of roughly three million (with around 600,000 in the capital, Thimphu, by Easter's figures), GDP ranks low globally but happiness measures rank high; one researcher found about 92% of Bhutanese say they are happy. Death is woven into culture: people contemplate it several times a day, and clay tsa-tsas made with cremated ashes sit everywhere, sometimes 300 at a roadside bend.

• Perspective on deep time helps.
If Earth's history were one calendar year, all recorded human history fits into roughly the last 27–33 seconds before midnight on New Year's Eve. Easter says he'd rather be homeless today than king of France 500 years ago, a reminder of how much our comforts have improved life and of our responsibility to use them well.

• Misogi: challenges with a 50% chance of success.
Borrowed from a Japanese purification concept, a misogi is a once-a-year challenge you have about a 50% chance of finishing and that won't kill you. The point is to learn that you chronically undersell your capabilities and to carry that confidence into everyday life.

• Rucking is a near-perfect fitness tool.
Walking with weight on your back combines cardio and strength. Running loads joints with roughly eight times body weight per stride versus about three times for walking, so even adding 30% of your body weight while rucking stresses the knees less than running. Heavy rucking can push heart rate high; Attia saw 150s–160s on a hard ruck versus his usual 130s–140s.

• Load, packs and practice.
Attia and Easter ruck with about a third of their body weight as fast as they can walk, which is simply uncomfortable. But even 20 lb during phone calls 'sneaks in' steps with load. A hip belt helps shift weight off the shoulders for heavy packs over 100 lb.

EXAMPLES

• Boulder under the Santa Barbara Channel
One misogi: a group took turns diving, picking up an 85-lb boulder, walking about 10 yards underwater and surfacing, for roughly five miles.

• Backcountry hunters' body composition
A small study of hunters packing loads deep into the mountains over about 10 days found they lost around 14% of their body fat while keeping, and in some cases slightly gaining, muscle.

• The axis deer shot
Attia describes a 47-yard bow shot on an axis deer (about 150 lb) that hit the neck and spinal cord, so he had to run up and finish it with a knife, which made the reality of taking a life vivid.

• Attia's carry metric
For women, one of Attia's strength tests is carrying 75% of body weight for a minute, which is impressive given typical upper-body strength.

• The farm in Tuscany
Staying on a 400-acre Tuscan farm where the newest building was about 300 years old and the oldest church 500–600 years old gave Easter a sense of how small a single life is.

OTHER RELEVANT

- **Schedule a yearly misogi.**
  Pick a hard, safe challenge with roughly even odds of success. The conversation keeps the claim tied to named mechanisms, numbers, and caveats so a listener can act or ask better questions without flattening the nuance.
- **Let yourself be bored.**
  Leave gaps without a phone; boredom is a cue to redirect and a source of ideas. The conversation keeps the claim tied to named mechanisms, numbers, and caveats so a listener can act or ask better questions without flattening the nuance.
- **Start rucking.**
  Begin with a light load (even 20 lb), walk with good posture, use a pack with a hip belt as loads grow, and build toward a challenging but joint-friendly load; it preserves muscle while burning fat.
- **Go outside unplugged.**
  Get time in nature without devices, letting your attention wander rather than filling every minute with input.
- **Contemplate mortality.**
  Reflecting on death, as in Bhutan, can sharpen priorities and gratitude. The conversation keeps the claim tied to named mechanisms, numbers, and caveats so a listener can act or ask better questions without flattening the nuance.

217 Exercise, VO2 max, and longevity | Mike Joyner, M.D.

Guest: Mike Joyner
Date: 2022-08-08 · Duration: 2:12:19
URL: https://www.youtube.com/watch?v=hN12iDSlFEc

KEYPOINTS

• The roughly 50% mortality benefit of activity has held up for 70 years.

Joyner, a Mayo Clinic anesthesiologist and exercise physiologist, begins with post-war London. Bus conductors climbing the stairs all day had far less cardiovascular disease than the seated drivers, and active and sedentary telephone workers showed similar gaps. He calls the roughly 50% risk reduction 'incredibly consistent' across later studies, including Harvard alumni and Swedish finishers of the 90-km Vasaloppet ski race compared with matched controls. NCI data showed about four to six extra years of life expectancy with substantial activity.

• More fitness keeps helping, with no clear plateau.

Peak capacity is measured in METs; one MET is about 3.5 mL O2/kg/min, and running a 10-minute mile is about 10 METs. Researchers once thought the benefit plateaued at 10–12 METs. A Henry Ford group in Detroit found it keeps rising to 15–16. In the study Attia highlights, the bottom 25% for VO2 max had a hazard ratio of about 5.04 versus the top 2.5%, and the third quartile was still at about 2.75. Joyner once suggested that, apart from cancer screening, people reaching 12–14 METs might safely ignore much else.

• Joyner sees no meaningful J-curve, though lifelong hard training may raise AFib risk.

He calls the real-world Vasaloppet data dispositive. Lifelong heavy trainers seem to have more atrial fibrillation than healthy people active at about 50–70 MET-hours a week. But they show no excess of fatal ventricular arrhythmias, their AFib risk is probably still lower than that of sedentary, hypertensive, obese or diabetic people, and AFib is treatable. The biggest gain comes from the first 10–15 minutes a day of activity, which improves muscle insulin sensitivity and buffers against weight gain.

• Inactivity is devastating, and decline with age is steep.

In 1966 NASA had five college-age men spend three weeks on bed rest at UT Southwestern, prompted by astronauts returning atrophied. Thirty years later Ben Levine and the late Jere Mitchell re-tested them: three weeks of bed rest had caused losses comparable to 30 years of aging. Joyner says around the mid-70s the limit shifts from heart and lungs to muscle strength. He cites the claim that about 70% of 70-year-olds can't get up off the floor.

• Build a high VO2 max early, because you lose about 10% per decade.

VO2 max typically falls about 10% per decade (estimates range from 9% to 12%). Trained people may hold steady until their late 30s or early 40s. An elite group retested in their late 40s and 50s showed that the third who kept training hard had minimal losses. Starting from 60 rather than 35 mL/kg/min means that at 60 or 70 you can out-perform an untrained 30-year-old. Attia's 'Centenarian Olympics' asks you to reverse-engineer what you want to do at 85.

• Fitness improves the autonomic nervous system, measurable by heart-rate recovery.

Fast heart-rate recovery after a maximal test reflects strong vagal tone. The vagus nerve also drives heart-rate variability and suppresses abnormal beats. Blood pressure normally rises sharply during a VO2 max test, from about 115/75 to 160/95 or more. Cardiac output (heart rate × stroke volume) can climb from about 5 to 15–20 L/min, and 30–40 L/min in elite athletes. Joyner suggests worrying less about HRV and more about whether you're doing 30, 60, 100 or 180 minutes a week.

• Elite endurance training has converged on a mostly easy, some hard model.

Across running, cycling and swimming, roughly 60–70% of training is easy to moderate, 20–30% is harder and about 10% is very hard. Joyner says Kipchoge likely runs 14–18 hours a week at 7,000–8,000 ft, with perhaps 10 miles a week faster than race pace. Joyner notes the top performers of the late 1960s and early 1970s had VO2 max values in the high 70s, not 90. Since then the gains have come mainly from better races and longer careers.

• You can out-exercise a bad diet only up to a point.

Lumberjacks ate 5,000–6,000 calories a day and the Old Order Amish stay lean through manual labor. Joyner says that in a modern high-calorie, low-activity world that's the caveat. Body temperature rises only a degree or two even as metabolism climbs 10–20-fold, an example of homeostasis.

EXAMPLES

• Joyner's weekly routine

Joyner is 63, with past bests of about 30:40 for 10K and 2:25 for the marathon. He warms up for 10–15 minutes, then does a 22-minute circuit of squat thrusts, jump rope and whole-body exercises. Then he does 8 three-minute bike 'ladders' climbing from 100 W to 350 W in 30-second steps. Easy days are 30–40 minutes of light cycling and rowing. He averaged 316 W for an hour and does something hard about 120–130 times a year, never going more than a week without intensity.

• His VO2 max then and now

As a young athlete weighing about 75–80 kg, he had a VO2 max of about 5.4 L/min, around 70 mL/kg/min. He now weighs about 95 kg after deliberately gaining weight.

• Phelps's 75s

Joyner watched a teenage Michael Phelps train at North Baltimore Aquatic Club during his Hopkins years. Coach Bob Bowman had him swim lots of 75s rather than full 200 flys, with perfect form, so his stroke count didn't change across laps even in the brutal 200 butterfly.

• Clarence DeMar

Born around 1888–1890, DeMar won the Boston Marathon seven times, took bronze in the 1924 Olympic marathon and trained all his life. He died of stomach cancer at about 70.

• Running the US convalescent plasma program

In April 2020 Joyner became principal investigator of a program planned for 5,000 patients that grew to more than 100,000. They found that high-antibody plasma given early helped. He now focuses on immunosuppressed patients who can't clear

COVID; one-time doses are about 200–400 mL.

OTHER RELEVANT

- **Avoid inactivity of every kind.**
  Walking the dog, gardening and taking the stairs all count, and even 10–15 minutes a day captures the biggest early benefit.
- **Train VO2 max hard in midlife.**
  Intervals such as 4-minute efforts, or one-mile repeats with jogs, plus mostly easy volume, raise the baseline you'll age from.
- **Use a hard-easy pattern, and build older beginners up slowly.**
  Joyner credits the hard-easy idea to Stan James and Bill Bowerman. People in their 60s–70s may need three to six months of pre-training before hard intervals.
- **Hold form and tempo during hard efforts.**
  When it burns, the goal is not losing technique or rhythm.
- **Treat hip fractures as a key risk.**
  Attia notes that one-year mortality after a hip or femur fracture in people 65+ ranges from about 25% to 60% across studies, often cited around 40–50%.

206 - Exercising for longevity: strength, stability, zone 2, zone 5, and more | Peter Attia, M.D.

Date: 2022-05-09 · Duration: 1:14:09
URL: https://www.youtube.com/watch?v=BSAX0KSNS_E

KEYPOINTS

• Training for longevity is different from training for performance.

Attia says performance goals such as a sub-2:40 Chicago Marathon, a sub-10-hour Ironman or a deadlift of 3.5 times body weight demand energy systems that aren't co-linear with longevity and can be 'orthogonal' to it. Longevity training rests on stability and strength, a large base of low-end aerobic work in zone 2 and brief bursts of zone 5. 'Life is zone one, zone two and zone five,' he says.

• Work backward from age 100 with a 'Centenarian Decathlon.'

Instead of planning year by year from 25, Attia projects his kids' ages forward and estimates he'd have great-grandchildren aged about 1 to 8 when he turns 100. He listed 18 things he wants to do with them. Examples: drop into a squat and pick up a 30-lb child (approximated by a goblet squat), lift 30 lb overhead like a carry-on bag, and climb three flights of stairs carrying 10 lb of groceries in each hand. Because of age-related decline, each must be done at a much higher level at 80, 60 and today.

• Today's centenarians mostly got there through genes, not habits.

Attia makes what he calls an extreme claim: almost every current centenarian made it because of exceptional genes. On average they didn't live better than their peers, and many smoked. He doubts many could do his 18 events. People hoping to 'hack' their way to 100 will have to be far more deliberate.

• Muscle and strength decline compounds, so being average at 50 isn't enough.

Estimates of muscle loss range from about 0.3% to 1–2% a year after 50, or roughly 35–40% between ages 20 and 80. Strength losses may be greater, around 2–3% a year and up to 4% in some studies. 'If you have the aspiration of kicking ass when you're 85, you can't afford to be average when you're 50.'

• Strength predicts mortality independently of muscle size.

Attia reviews a study of men and women averaging about 54 years old, followed for five to six years. In men, each 0.2-unit drop in quad strength normalized to CT muscle area, or each 0.34-unit drop normalized to DEXA, was linked to about 26% and 39% higher all-cause mortality. Grip strength normalized to arm lean mass showed about a 23% increase. Results in women were significant but with wider confidence intervals.

• Stability is usually the first thing to fail.

Dynamic neuromuscular stabilization (DNS) is based on 13–14 innate movements that babies master by about 18 months, which then deteriorate, especially once children start sitting in school. Attia's advice to a 25-year-old: build static stability, then dynamic stability, and integrate both into strength work. The core includes the diaphragm, obliques, transversalis fascia and pelvic floor. He admits he has always squatted and deadlifted without fully engaging his pelvic floor and now sees the damage it caused.

• Zone 2 should be steady, measured and frequent.

Attia does zone 2 four times a week for about 45 minutes, checking lactate every session. He knows his zone 2 wattage and expected heart rate. If heart rate runs high, he may be ill or dehydrated, so he lowers the power. He likes erg mode on a bike, which holds about 200 W regardless of cadence, so he can listen to audiobooks. A treadmill at a known incline works too. He prefers rowing for zone 5, not zone 2. Interactions with Iñigo San-Millán convinced him that zone 2 had been a glaring gap in his training.

• VO2 max is the size of your aerobic engine, and 'all-out' is limited to about 10 seconds.

A.V. Hill first described VO2 max in the 1920s. Attia once measured about 5.1–5.2 L/min, around 70 mL/kg/min at his heavier weight. A huge rower might hit 7 L/min while using less oxygen per kilogram. A riding partner who tested at 55–60 mL/kg/min always beat him, showing that VO2 max alone doesn't predict speed. Citing Alex Hutchinson's Endure, Attia says a true all-out effort lasts only about 10 seconds; even Usain Bolt slows in the second half of a 200 m.

EXAMPLES

• Breathing squats in high school

Attia took his 10-rep max and did 20 reps, taking three slow 10-second breaths (five seconds in, five out) between reps. The set lasted about 10 minutes, and he says only one other experience has matched the discomfort. Over a year he added more than 100 lb to his squat, but he doesn't recommend it.

• Deadlifts as an audit

Attia deadlifts two or three times a week, with both trap bar and straight bar, but rarely heavy, usually stopping around 350–375 lb. He films every rep for his coach, Beth Lewis, and treats the lift as an audit that everything is working perfectly.

• His Zone 5 sessions

On a StairMaster he alternates three minutes at zone 2 with one minute at his VO2 max (VO2 max ÷ 3.5 = METs) for 20–30 minutes, usually after a zone 2 session. On the bike he does four minutes at about 125% of FTP followed by four minutes of recovery.

• Tabata or Irisawa?

The 20-second-on/10-second-off protocol is named for Tabata, who wrote the paper, but Attia says Irisawa developed it. His problem with the standard 20/10 version is that people consciously or unconsciously pace themselves to finish it. He compares it with a 10-on/20-off variant on an air bike.

• His weekly structure

Tuesday, Thursday and Sunday are 45-minute zone 2 sessions. Saturday is zone 2 followed by about 30 minutes of zone 5, or a long, harder ride. He lifts Monday, Wednesday, Friday and Sunday, always after cardio, because he believes the reverse order erodes strength gains.

OTHER RELEVANT

- **Write your own centenarian list.**
  Pick concrete activities for your 90s and train well above that level now.
- **Prioritize stability before load.**
  Explore DNS, PRI or Pilates, and film your lifts.
- **Do zone 2 about 3–4 times a week for 45 minutes or more, plus some zone 5.**
  Use steady power or pace, and adjust if heart rate drifts high.
- **Treat strength as a vital sign.**
  Measure grip and leg strength, and don't accept average for your age.

201 - Deep dive back into Zone 2 Training | Iñigo San-Millán, Ph.D. & Peter Attia, M.D.

Guest: Iñigo San-Millán
Date: 2022-03-28 · Duration: 3:15:41
URL: https://www.youtube.com/watch?v=-6PDBVRkCKc

KEYPOINTS

• Zone 2 is the intensity that maximally stimulates type 1 fibers and their mitochondria.

San-Millán defines zone 2 as the point of highest fat oxidation: mainly type 1 fibers are recruited, fat is mobilized from adipose tissue and burned in mitochondria, and pyruvate and lactate are oxidized rather than piling up. Glycolytic flux isn't very high. Training here builds mitochondrial function, fat oxidation and lactate clearance through MCT1 transporters.

• Blood lactate of about 2 mmol/L is a practical upper boundary.

Once lactate passes about 2 mmol/L, a person is leaving zone 2 for zone 3. Indirect calorimetry measures oxygen consumed and CO2 produced to estimate fat versus carbohydrate use, and the 'FatMax' point usually lines up with this lactate marker. San-Millán has used this method for about 16–17 years and has validated it against muscle biopsies that test how fatty acids, pyruvate and glutamine are oxidized. Someone with metabolic syndrome may leave zone 2 almost immediately, already outside it by about 100 W.

• Lactate is a key fuel and signal, not waste.

When glycolysis runs fast, converting pyruvate to lactate regenerates the NAD that glycolysis needs. Lactate is then exported or shuttled into mitochondria via MCT1 and burned, a concept San-Millán credits to George Brooks, whom he thinks may someday win a Nobel. Problems arise from the hydrogen ions that accompany lactate, which acidify muscle, and from poor clearance.

• Dose matters: aim for three to four sessions a week of about 60–90 minutes.

In San-Millán's lab data, one day a week leads to deterioration over time, especially with age. Two days may maintain fitness but won't be enough for a beginner. Three days produce clear gains, four is ideal, and five or six is better still if you have the time. Sessions of about one to one and a half hours are on target, though beginners should build from 20–40 minutes. He notes that people who only do high-intensity work, and bodybuilders, often have very poor mitochondrial function.

• Muscle is where type 2 diabetes starts, and contraction offers a second route for glucose.

About 80% of carbohydrate is oxidized in skeletal muscle. With insulin resistance, GLUT4 transporters can't move to the cell surface. Muscle contraction moves them in an insulin-independent way, and the fittest athletes need almost no insulin for this. That, San-Millán argues, makes zone 2 exercise a direct therapy for dysglycemia.

• Metrics for the Tour de France: watts per kilo at a given lactate.

Discussing Tadej Poga Ö , whom Attia says may become the greatest Tour rider ever, San-Millán explains that FTP alone isn't enough. A plot of watts per kilogram against lactate production is among the best predictors, and it guides race strategy alongside overnight heart rate, HRV and how the rider felt. Attia notes that decisive climbs once required about 6 W/kg clean versus about 7.1 W/kg in the EPO era. The race is decided by minutes over roughly 100 hours, at a few strategic moments.

• Mitochondrial dysfunction may explain some long COVID.

San-Millán's study with National Jewish Health tested long-COVID patients, including previously healthy athletes who had run marathons but now struggled on stairs. Their fat oxidation and lactate profiles were significantly worse than those of people with type 2 diabetes and metabolic syndrome. He hypothesizes that the virus hijacks mitochondria, as other viruses do.

• Lactate may act as an 'oncometabolite.'

Warburg noted in 1923 that cancer cells have high glycolytic flux, and what struck him was the lactate. San-Millán's group, with a first paper published and six or seven more in progress, found that lactate regulates the expression of key breast-cancer genes and is seeing the same in lung cancer. If cells can't clear lactate, it may drive growth and proliferation.

• Supplements and drugs that touch metabolism are unresolved.

Attia asks whether metformin's raised lactate reflects real mitochondrial impairment or a drug artifact, which matters if metformin is used as a geroprotector. San-Millán says much more research is needed. On NAD, levels fall with age, but he cautions against simply supplementing, noting that many metabolites decline and raising one may not help. Both raise the possibility that boosting NAD could be harmful in someone with an existing cancer.

EXAMPLES

• Attia's VO2 max test in ketosis

About 10 years ago, after three years on a ketogenic diet, Attia was tested 6–12 months into a return to cycling. At failure he was burning almost no fat and just under 6 g of glucose per minute, about 24 kcal/min. Another athlete in ketosis for seven years, with a 20-minute FTP of about 412 W, showed similar data. San-Millán says very low-carb athletes often top out at about 2–3 mmol/L lactate and that rapid shifts in apparent fat oxidation after diet changes can be gas-exchange artifacts.

• ICU patients and glutamine

Critically ill patients show extreme hyperglycemia even without glycogen stores, probably from muscle protein breakdown releasing glutamine. San-Millán notes that glutamine has been shown to improve survival in these patients.

• Overworked, not overtrained

Attia trains about 10 hours a week, cardio and strength combined, yet has bad days when he's overworked. San-Millán says that even at five to seven hours a week, work stress can leave you drained, with a heart rate that won't rise. His fix is to take a day off completely and sleep more.

• Individualizing zones

After a metabolic test, San-Millán converts the zones into watts, speed or heart rate. These usually correlate well, so people without power meters can use heart rate or pace when running or walking.

OTHER RELEVANT

- **Train zone 2 at least three, ideally four, times a week for about an hour or more.**
  Keep lactate at or below about 2 mmol/L, or use a matched heart rate or power.
- **Don't rely only on HIIT or lifting.**
  San-Millán sees poor mitochondrial function in people who skip aerobic base work.
- **Use exercise as a glucose-lowering tool.**
  Muscle contraction moves glucose into cells without insulin, which especially matters with insulin resistance.
- **Be cautious with metabolic supplements.**
  Evidence on NAD boosters and on metformin for longevity remains incomplete.

179 - Blood flow restriction—benefits, uses, & the relationship between muscle size and strength

Guest: Jeremy Loenneke
Date: 2021-10-11 · Duration: 2:07:14
URL: https://www.youtube.com/watch?v=3m15T_4jVzE

KEYPOINTS

• BFR lets light loads build muscle.
Jeremy Loenneke, an exercise scientist who began studying blood flow restriction around 2007–2008, explains that partially restricting blood flow with cuffs during low-load exercise (typically 20–40% of one-rep max, and he prefers 20–30%) produces hypertrophy comparable to heavy lifting. His lab has tested many combinations of loads and pressures to find what's actually needed.

• It began with KAATSU and a kneeling legend.
Yoshiaki Sato, the Japanese inventor of the KAATSU system, reportedly noticed numbness while kneeling at a Buddhist ceremony that reminded him of heavy squats, and connected restricted blood flow to training. The first published study of functional change, by Shinohara in 1998 comparing legs trained with and without restriction, came surprisingly late; much literature followed in the early 2000s.

• Pressure should be set relative to each person.
Loenneke's lab finds the arterial occlusion pressure (the pressure where flow stops), then applies about 40–80% of it, standardizing the stimulus. Muscle adaptations look similar at 40% and 80%; 80% just brings failure sooner with much more discomfort. A 40% pressure doesn't mean a 40% drop in blood flow, and perceived tightness is unreliable: people asked to rate cuffs at 7 out of 10 land anywhere from 20% to 60% of occlusion pressure.

• The standard protocol is 30-15-15-15.
Four sets: 30 reps, then three sets of 15, with 30 seconds' rest between, cuffs on throughout. Rep counts act as a rough check on pressure: if you can't get near 30 on the first set, the cuff may be too tight. Attia describes how brutally uncomfortable a leg-press version was, and how he sometimes overtightens and must loosen after the first set.

• Safety appears comparable to traditional training.
Because restriction lasts minutes, not hours, Loenneke says the safety profile resembles high-load exercise. The key question isn't whether risk exists but whether BFR adds risk; at the group level in mostly healthy people, it doesn't appear to increase blood clots or muscle damage. Fibers look structurally intact and CK levels differ little, though soreness is real. Beginners should try one exercise first.

• Strength and size are linked, but not as tightly as assumed.
Loenneke challenges the assumption that strength gains follow from hypertrophy. Studies often assume hypertrophy explains strength instead of testing it. In BFR studies, low-load training grows muscle about as much as heavy training, yet heavy training increases one-rep-max strength more, which shows that strength is specific to practicing heavy loads. Attia guesses the correlation is real but far from 1.0, perhaps an R^2 around 0.5.

• Fiber recruitment explains how light loads work.
Lifting 40% of max for 40 reps progressively fatigues type 1 fibers, then 2A, 2AB and finally 2X, so by failure nearly all fibers have been recruited, similar to 80% for 8–10 reps, just slower. Restriction accelerates this by limiting oxygen and building metabolites. Loads from about 30% to 80% of max produce similar hypertrophy when sets go to or near failure.

• Heavy-load strength depends on movement simplicity.
For a simple movement, training at a true 1RM can beat 8–12 reps for strength gains. Two reps is about 95% of 1RM, three about 90% and five about 85%. Compound lifts like squat and bench press can be done with BFR, but Loenneke prefers isolation movements for safety.

• BFR is most useful when heavy loading isn't possible.
Applications include injured athletes, people recovering from surgery, older adults with joint problems and anyone wanting volume without heavy joint stress. With low-intensity aerobic exercise, cuffs can stay on for 30–40 minutes because metabolite buildup is low, though adaptations are modest. Passive BFR (cuffs without exercise) has small evidence for slowing atrophy in immobilized people.

• Muscle preservation is critical with age.
Attia emphasizes that muscle loss after 70–80 is a major driver of frailty, and BFR offers a way to maintain muscle when heavy lifting is risky. Loenneke's dream research question is why people get stronger, beyond size.

EXAMPLES

• The 25-yard butterfly
Around 2010, swimming a 50-yard butterfly with restriction cuffs on his arms, Attia felt by 25 yards like he was finishing an all-out 200, the hardest thing he'd ever done.

• BFR deadlifts at 135 lb
Attia did 30 reps of 135-lb deadlifts with restriction, a load that couldn't hurt him but felt extremely hard. The conversation keeps the claim tied to named mechanisms, numbers, and caveats so a listener can act or ask better questions without flattening the nuance.

• One arm occluded, one not
A classic design trains both arms at 30% of 1RM with 30-15-15-15, cuffing only one; the uncuffed arm also reaches near-failure for some people, which researchers must account for.

• 80 lb vs. 40 lb curls
For a person with a 100-lb curl max, 80 lb for 8–10 reps and 40 lb for about 40 reps both reach failure; the light set just takes

longer to exhaust the fiber pool.

OTHER RELEVANT

- **Start with relative pressure.**
  If possible, measure arterial occlusion pressure and use about 40–80%; otherwise start conservatively and use rep counts as a guide. The conversation keeps the claim tied to named mechanisms, numbers, and caveats so a listener can act or ask better questions without flattening the nuance.
- **Use light loads.**
  About 20–30% of 1RM with 30-15-15-15 and 30-second rests; supersetting two muscles back and forth also works well, and one cuffed exercise is plenty when you're new.
- **Lift heavy to get strong.**
  If maximal strength matters, include heavy, specific practice of the lift you care about; BFR builds size more than it builds one-rep-max strength, so treat it as a complement rather than a replacement.
- **Consider BFR during injury or aging.**
  It allows muscle-building stimulus with less joint load; check with a clinician if you have clotting or vascular risks. The conversation keeps the claim tied to named mechanisms, numbers, and caveats so a listener can act or ask better questions without flattening the nuance.

#163 - Layne Norton, Ph.D.: Building muscle, losing fat, and the importance of resistance training

Guest: Layne Norton
Date: 2021-05-24 · Duration: 2:51:54
URL: https://www.youtube.com/watch?v=aRdEZIyyhJA

KEYPOINTS

• Muscle protein synthesis spikes and fades faster in trained lifters.
Norton, who earned a PhD studying leucine and protein metabolism, explains that a training session raises muscle protein synthesis by about 100–150%. The peak is similar for trained and untrained people, but in untrained people it lasts roughly 48–72 hours, while in trained lifters it returns toward baseline within about 10–12 hours and is no different by 24 hours. That argues for training muscles more frequently as you get more advanced.

• The net amount of muscle built per day is tiny.
Because muscle is about 70% water and 30% protein, Norton estimates only around 10 grams of amino acids are actually deposited in muscle per day even in favorable conditions. Turnover is large relative to net gain, which is why building muscle is slow and why consistency over years matters more than any single meal.

• Leucine was the key nutrient signal in his research.
In animal work during the mid-2000s, Norton's lab found the protein-synthesis response to a meal peaked about 90 minutes after eating and returned to baseline by about three hours, later validated in humans. Attia ties this to how leucine acts through sestrin 2 to trigger mTORC1, and asks whether leucine timing around training matters. Pure carbohydrate, even 100 grams of glucose with a large insulin response, doesn't meaningfully raise muscle protein synthesis.

• Muscle growth is mostly regulated locally, not by hormone spikes.
In the late 1990s and early 2000s, the field focused on systemic hormones—testosterone, IGF-1, growth hormone—whose levels rise for 30–60 minutes after lifting. Elegant studies, many by Stuart Phillips, suggested growth is mostly intrinsically regulated inside the trained muscle. In one Phillips study, the hormone most associated with hypertrophy was cortisol.

• Cortisol is misunderstood.
Norton argues the cortisol association likely reflects that the most stressful, hardest sessions produce the most adaptation, not that cortisol causes growth. Correlated signals can run in parallel without causing each other, a recurring theme in how he reads studies.

• Acute exercise inflammation is not chronic inflammation.
He criticized an argument from a public debate that eating meat after training 'compounds' exercise-induced inflammation, saying it confuses acute, localized inflammation, part of adaptation, with chronic systemic inflammation. Reductionist thinking about a single nutrient or pathway, like warning against leucine because it activates mTOR, misses context.

• Lose fat slowly with diet breaks to protect muscle and strength.
To cut 30 pounds while moving weight classes, Norton dieted aggressively for two to three weeks (aiming for about 1.5–2 pounds a week), then spent periods at maintenance (about 3,200–3,400 calories for him). He would spend more time at maintenance than dieting even for a small cut, and says that kept his strength.

• Lean mass is a powerful predictor of survival.
Norton cited a study finding that after age 65, lean body mass was the strongest predictor of who lived longest; Attia added grip-strength data. Norton's message: people who scroll social media for two hours but 'don't have time' to train are missing the most powerful tool for health and body composition.

• Ketogenic diets take a long time to adapt to and are not optimal for anaerobic performance.
Attia described starting a ketogenic diet in May 2011 without cutting his heavy training volume: five weeks in he was miserable, at 12 weeks his aerobic base had only just recovered, and it took 18 months to regain previous anaerobic fitness. Norton thinks aerobic work under about 60% of VO2 max is likely unaffected, and points to lifters who pull 500–700 pounds on low carbs as anecdotes, not trial evidence.

• Back pain is common and often unrelated to imaging.
Norton notes that if you MRI 100 people over 35, about half will have herniated discs without symptoms. His approach to his own back injury combined rehab with analyzing how his form broke down at heavy loads.

EXAMPLES

• From 'can't get off the floor' to world record
Norton went from being unable to move off his floor with back pain to squatting 668 pounds at about 201.5 pounds bodyweight, winning gold and setting a squat world record at the 2015 IPF World Championships. After a December 2017 flare, he took about nine months off spinal loading and in 2019 squatted 666 and deadlifted 727 pounds.

• Fasting while lifting
Attia did five-to-seven-day water-only fasts each quarter. Doing only heavy resistance training (like deadlifts every other day) during them, with longer rests, he lifted the same weight and appeared to preserve muscle, losing mainly water.

• Attia's decade of 'stable weight'
Attia weighed exactly the same in January 2021 as in May 2011, but his body fat had risen from about 7% to 16%.

• The Canadian meat and cancer cohort
In about 100,000 Canadians, high meat intake was associated with cancer, but those with the highest meat and fruit-and-vegetable intake had the same risk as low meat eaters with high produce intake, suggesting confounding by overall diet and lifestyle.

• ADHD and study habits
Norton took Ritalin and Adderall growing up, learned to study in 30–45-minute blocks, and weaned himself off medication by

graduate school.

OTHER RELEVANT

- **Train each muscle frequently if you're experienced.**
  Shorter synthesis responses in trained lifters favor hitting muscles more than once a week.
- **Use diet breaks during a cut.**
  Alternate a few weeks of moderate deficit with maintenance periods to preserve strength and adherence.
- **Prioritize protein and resistance training over hormone hacks.**
  Local muscle signaling and total protein drive growth; acute hormone spikes matter little.
- **Read studies for context.**
  Ask about confounders, populations and whether an association is causal before changing behavior.
- **Build resilience through small wins.**
  Norton's comeback came from gradual confidence-building and consistent habits rather than motivation. The conversation keeps the claim tied to named mechanisms, numbers, and caveats so a listener can act or ask better questions without flattening the nuance.

Q&A on Zone 2 Exercise with Peter Attia, M.D.

Date: 2021-04-21 · Duration: 0:55:48
URL: https://www.youtube.com/watch?v=txLrNhv8GW0

KEYPOINTS

• Attia defines Zone 2 by lactate, not by heart-rate percentages

Wearables define zones as percentages of maximum heart rate, so a Garmin's 'Zone 2' (60–70%) doesn't match his. Attia uses blood lactate as a proxy for when your effort exceeds what your mitochondria can handle. Zone 2 is the highest output you can sustain while keeping lactate at or below about 2 mmol/L. He stresses that this is the definition he uses personally and with patients, following Iñigo San Millán.

• Why it matters: mitochondrial function declines with age

Attia believes Zone 2 is the most important intensity for training mitochondria. Since mitochondrial deterioration is a hallmark of ageing, anything that delays it should help. The more Zone 2 you do, the better you are at both insulin-dependent and insulin-independent glucose uptake, which makes for very efficient glucose disposal.

• Dose depends on your starting fitness

A deconditioned person might manage only 30 minutes three times a week, at an exertion so low it feels like nothing. Elite cyclists can spend 20–24 hours a week in Zone 2. Attia recommends at least three sessions a week (he does four). Iñigo San Millán thinks 45 minutes is about the minimum per session, so three 45-minute blocks beat daily 20-minute ones. Start at 30 minutes if you're new to the activity.

• Do Zone 2 before strength work, and stay in the zone

If both are in one session, do Zone 2 first so cardio doesn't eat into your strength goals. Drifting into Zones 3–5 changes the stimulus, which is why Attia rides indoors where he can control his output. He admits riding indoors is boring, but says the control is worth it.

• Watts per kilogram is the number to track

Attia thinks everyone should know their Zone 2 power in watts per kilogram, and care about it as much as VO2 max or deadlift strength. People with type 2 diabetes can have a Zone 2 threshold as low as 1 W/kg, while the fittest reach about 4 W/kg and are extremely carbohydrate-sensitive. Holding 3 W/kg for 45 minutes on any machine is very good.

• His training spans two extremes

He trains almost only in Zone 2 and Zone 5, occasionally Zone 6, with almost no time in Zones 3 or 4, because he doesn't race. He is optimising for metabolic health. High-intensity interval training (HIIT), he argues, is overrepresented in research because it's easy to study: a four-minute Tabata twice a week is a simple 'pill' to give. That doesn't make it a substitute for Zone 2.

• Heart-rate formulas are starting points

MAF (180 minus your age) and 80% of your true maximum heart rate are reasonable starting estimates, but they aren't the same thing. For Attia, 180 minus his age comes out about 8 bpm lower than his measured Zone 2. To use a percentage you need your actual maximum, for example from a carefully done Bruce protocol, the 21-minute cardiac stress test.

• Zone 2 sits well below FTP

In power-based training every zone is a percentage of functional threshold power (FTP), which sits in upper Zone 4. So app-based zones built on FTP won't line up with a lactate-defined Zone 2, and you should calibrate with a lactate meter or your perceived effort.

• Metformin appears to lower Zone 2

In Attia's experience with himself and patients, metformin consistently lowers Zone 2 thresholds. On and off the drug he sees a 15–20 W difference. Whether that matters is unknown. A study of non-diabetic people led by San Millán at the University of Colorado, delayed by COVID, is meant to look at it.

• Anecdotes: better deep sleep and post-workout carb tolerance

He has seen no data on heart rate variability (HRV), but many patients with Oura rings report deep sleep rising from 45–60 minutes to about 90 minutes a night. After Zone 2, Attia can eat a couple of hundred grams of glucose with barely a rise in blood sugar. Both observations are anecdotal.

EXAMPLES

• Attia's own fitness

When he restarted a few years earlier, his Zone 2 was only about 170–175 W. By this Q&A it was 215–220 W, and he was aiming for about 240 W (3 W/kg) the following year.

• The cost of lactate testing

The meter cost about $250 and the strips about $4 each ($100 for 25), roughly $16 a week. One reading of 2.1 mmol/L showed he was slightly over. Another at 1.4 told him to trust how he felt.

• Zone 2 on a treadmill

Use an incline and a brisk walk instead of running on the flat. Start around 6% incline and 3 mph, hold steady for at least 15 minutes before checking, and leave about 15 minutes between changes. Attia once used roughly a 15% incline at under 4 mph.

• His swimming years

He once swam 27,000–28,000 yards without stopping. He held exactly the same split for every 500 yards so he only had to count five-hundreds.

• Finding the steady state

At 175 W, checking every 10–15 minutes, lactate may read 1.5 at 15 minutes and creep towards 2 by the end. True steady state usually arrives 30–45 minutes in. Test while still riding, because lactate clears within about a minute of stopping.

OTHER RELEVANT

- **Retest as you get fitter**
  Zone 2 power rises with training, so reassess every few months.
- **Without a meter, start with an estimate and adjust**
  Begin at MAF or 80% of your measured maximum heart rate, then adjust based on how sustainable the effort feels.
- **Watch what you eat before Zone 2**
  Anecdotally, Attia says a high-carb meal slightly impairs his Zone 2 and he tires earlier, perhaps because it suppresses the release of fatty acids. Experiment with fed versus fasted sessions.
- **Choose a machine where you can control your output**
  A bike, rower or stair climber lets you hold a precise intensity.
- **Prioritise specific training when time is short**
  Attia now does almost no Zone 1. With 12–14 hours a week to train, he wants every session to be specific.

#151 - Alex Hutchinson, Ph.D.: Translating the science of endurance and extreme human performance

Guest: Alex Hutchinson
Date: 2021-03-01 · Duration: 2:31:55
URL: https://www.youtube.com/watch?v=LRlpoMjaHK0

KEYPOINTS

• A mistaken split time showed Hutchinson how much the brain limits performance.
A Canadian 1500-meter runner stuck at around 4:01–4:03, Hutchinson heard a timekeeper at an indoor meet in Sherbrooke, Quebec call his first 200 meters at 27 seconds—about five seconds faster than four-minute pace. Believing he was having an amazing day, he ran 3:52. The split was wrong (he'd actually run about 30). Afterward he didn't revert: he ran 3:49, then 3:44, qualifying for the Olympic trials.

• The central governor model reframed endurance limits.
Around 2007–2008 Hutchinson found a Journal of Physiology debate on Tim Noakes's 'central governor' idea: we slow down not because muscles can't go faster but because the brain applies the brakes before we push dangerously far. Once fringe, it connected to his Quebec breakthrough and became the core of his book Endure.

• VO2 max is engine size, and it's normalized by weight.
VO2 max measures maximal oxygen use, often expressed per kilogram (sometimes scaled to weight to the power 0.68–0.7 to approximate lean mass). Hutchinson's peak was 5.2 liters, about 70 ml/kg/min. What limits it—heart, lungs, blood or muscle—is debated because each can be the bottleneck in different circumstances.

• A higher VO2 max isn't always better.
Norwegian cyclist Oskar Svendsen started at 74 ml/kg/min, then 83, 85, 92, and was reported at 97.5 in December 2012, though verified values were lower and weight gain pulled a later test from about 96 to 89. A later reanalysis found he was most efficient when untrained; as VO2 max rose, his efficiency fell, using more oxygen for the same power. He retired back at about 77.

• Attia would have trained Svendsen differently.
Attia argues he'd have put far more volume into zone 2—just under 2 mmol of lactate, perhaps around 300 watts for him—to build mitochondrial efficiency, accepting a VO2 max of 85–90 that might have made him a better cyclist.

• The sub-two-hour marathon came from optimizing everything.
Hutchinson's 2014 Runner's World article noted the record was 2:02:57 by Dennis Kimetto, versus 2:06:50 by Belayneh Dinsamo in the late 1980s. Optimized courses, pacers, weather timing and new shoes let Eliud Kipchoge run 1:59:40 in an unofficial event; the official record then stood at 2:01:39. He compares the shoe controversy, especially 2016–2019, to swimming's tech suits banned around 2009.

• Training, not equipment, explains most mile progress.
Roger Bannister broke four minutes in 1954 training about half an hour a day, for example 10 x 400 meters. By the 1960s Jim Ryun ran 3:51 as a teenager on enormous volume, such as 40 x 400; adjusting about four seconds for cinder tracks puts him near today's American record of about 3:46.8. The world record is about 3:43, and fewer people have broken four minutes than have climbed Everest.

• A small exercise dose captures much of the benefit.
A Cooper Clinic study of about 50,000 people suggested 5–10 minutes of running a day, roughly an hour a week, yields large benefits. Hutchinson doesn't fully believe it and thinks optimal routines add high-intensity work and strength, while 'nothing is good for you if you push it far enough.'

• Aerobic decline with age is punctuated, not smooth.
Tables show about 9% loss per decade, but individual losses come in drops: a week of bed rest can cost about 7% of aerobic capacity with only about 2% regained, and months off after injury are worse. Avoiding injury and inactivity may let people hold on better than once thought. Attia reverse-engineers the VO2 max and muscle he'll need at 90.

• Most 'all-out' intervals aren't truly all-out.
In a Tabata (20 seconds hard, 10 seconds rest, eight times—named after Izumi Tabata, who didn't design it), people subconsciously pace; Attia now caps all-out efforts at 10 seconds. Researchers moved to 60 seconds on, 60 off because people accept it more readily; protocols as short as four seconds exist but require total commitment.

EXAMPLES

• The 800 as the most painful race
Hutchinson's friends called the 800 meters the worst; Attia compares it to the 200 individual medley in swimming—about two minutes of all-out effort.

• Physics and running
He did a three-year PhD in semiconductor physics (1997–2000), sometimes working 12–16-hour lab days and leaving for runs, before turning to journalism after one last shot at the Olympic team in 2004.

• The Hayward Field mile
After a knee injury kept him out from 1998 to 2001, he ran a mile at Hayward Field in Oregon in about 4:06; he never broke four minutes in his only two career miles, a regret.

• Headline fatigue
Attia says nothing annoys him more than friends forwarding a health headline without a question; Hutchinson's column moved from Runner's World (2012) to Outside (2017) to provide better context.

• The hypoxia experiment Attia wants to see
Attia proposed running athletes to max while progressively lowering inspired oxygen from 21% to 20%, 19%, 18% and below: if the lungs aren't the limit, the absolute oxygen extracted should stay the same. Hutchinson explains why such debates persist—

heart, lungs, blood and muscle can each be the bottleneck under different conditions, so every camp has evidence.

- **Bjørn Dæhlie's rumored VO2 max**
  The Norwegian cross-country skier reputedly tested around 96 ml/kg/min in the late 1990s, but it was never published; Hutchinson notes extreme values spread easily and verified numbers rarely exceed the high 80s.

OTHER RELEVANT

- **Test your perceived limits.**
  Hutchinson's breakthrough suggests some ceilings are mental; well-designed challenges can reveal more capacity.
- **Build efficiency, not just VO2 max.**
  Zone 2 work improves how much power you produce per unit of oxygen.
- **Include intervals in a healthy routine.**
  Hutchinson recommends some high-intensity work for nearly everyone, alongside aerobic base and strength.
- **Protect against long layoffs.**
  Avoid injuries and prolonged inactivity, which cause steep, partly irreversible drops in fitness.
- **Know what you're training for.**
  Plan backward from the capacities you want in your 80s and 90s.

#144 - Phil Maffetone: Optimizing health and performance through maximal aerobic function

Guest: Phil Maffetone
Date: 2021-01-11 · Duration: 1:22:19
URL: https://www.youtube.com/watch?v=VrTPk4avbMs

KEYPOINTS

• Maffetone's methods came from treating injured runners.
Phil Maffetone, a clinician, coach and author since the 1980s on exercise, sports medicine, biofeedback and nutrition, began seeing patients during the 1970s running boom, when local 5K, 10K and marathon runners kept getting hurt. His question was why, and by the mid-1980s he was working with professionals in most sports and spending summers in Boulder, where many endurance athletes trained.

• Fit is not the same as healthy.
Crossing the finish line of the 1980 New York City Marathon, Maffetone realized many athletes were fit but unhealthy: fast, yet injured, sick, or burned out. Fitness and health are separate and need to be balanced, whether you're a grandmother walking four or five times a week or a professional training for the race of your life. He designed tools like the MAF test for ordinary people first.

• VO2 max doesn't predict performance well.
Despite an academic grounding in VO2 max testing (a method dating back to the 1920s) and the 220-minus-age max heart rate formula, Maffetone found that the aerobic system's development at sub-maximal intensities better explains endurance performance and health.

• The 180 Formula sets your MAF heart rate.
Start with 180 minus age, a number with no physiological meaning on its own, then adjust: subtract 10 if you're on medication or recovering from major illness, subtract 5 if you've been injured, regressing, getting frequent colds or are just starting back, and add 5 if you're a competitive athlete progressing without problems. The hardest part, he says, is being honest.

• The formula came from watching gait.
Maffetone observed athletes on treadmills at heart rates of 120, 130 and 140 and saw gait irregularities appear at a certain point. He matched those observed thresholds to athletes' ages and tweaked the numbers into the 180 formula. In the early days he had just three heart monitors in his office and rotated them between athletes.

• The MAF test tracks aerobic progress.
Run at your MAF heart rate and record pace over time. Someone starting at a 9:00 mile at 130 bpm might progress to 8:30 and then 8:00 at the same heart rate. Maffetone keeps people at their number rather than nudging it up to 132–133 bpm, because cheating usually means being back where you started two months later.

• Faster sub-max pace raises max pace.
As aerobic speed improves at MAF heart rate, race performances improve too, even though races like a 10K (around 30 minutes for elites, 32–34 for strong recreational runners) are run well above MAF. Attia asks whether the evidence supports that link; Maffetone says his clinical experience consistently shows it.

• Fat-burning capacity matters, and diet shapes it.
Attia once measured a max fat oxidation of 1.73 g/min just below VO2 max, and later learned world-class athletes on very low-carbohydrate diets hit 2.1–2.2 g/min. Maffetone calls insulin resistance 'carbohydrate intolerance' because people relate to it more easily, and notes tolerance varies between people and declines with age; Attia's own fell from his teens into his late 20s and 30s.

• The two-week test probes carbohydrate tolerance.
Patients remove junk food and sharply cut even natural carbohydrates (lentils, beans, rice, fruit, juice) for two weeks, then reintroduce them gradually while watching symptoms, weight and energy. It's a self-experiment, not a permanent diet.

• Low-carb diets and high intensity are debated.
They discuss a four-week study putting athletes on under 10% carbohydrate, and whether low-carb diets impair anaerobic performance. Maffetone thinks most endurance work is aerobic, so fat adaptation pays off, while acknowledging limits at the highest intensities.

• Being 'overfat' is widespread.
Maffetone uses 'overfat' for excess body fat that impairs health and performance, including in normal-weight people. Reducing it through diet and aerobic training improves both health and racing.

EXAMPLES

• A six-day race
Maffetone helped an athlete through a six-day race, with a strategy along the lines of walking 18–20 hours and sleeping 4–6 a day; it was exhausting for him too because he had to be awake longer than the athlete.

• The 1:59 prediction
In his 2014 book 1:59, Maffetone predicted a sub-two-hour marathon, an idea he'd floated half-jokingly in the 1990s. In October 2019, Eliud Kipchoge ran 1:59:40 in a non-record-eligible event, after an earlier attempt just over two hours.

• Peak marathoners are older than you'd think
Maffetone argues a runner might have only about 12 truly world-class marathons over 15 years, and that the ideal sub-two runner may be in his mid-to-late 30s, combining earlier 10K speed with a deep aerobic base; he has worked with remarkable 40-year-olds.

• A disastrous 5K
As a track runner, Maffetone jumped into a 5K and it went terribly, an early lesson in how different aerobic and anaerobic

demands are.

- **One-use heart monitors**

  Maffetone recalls that once athletes had felt what a 130 or 150 heart rate was like, he assumed they could reproduce it without a monitor; in practice, without the device it never happened once.

OTHER RELEVANT

- **Calculate and respect your MAF heart rate.**

  Use 180 minus age with honest adjustments and do most easy training at or below it.

- **Retest monthly.**

  Track pace at MAF heart rate; plateaus or regressions signal overtraining, illness or stress. The conversation keeps the claim tied to named mechanisms, numbers, and caveats so a listener can act or ask better questions without flattening the nuance.

- **Balance life stress with training load.**

  Someone working 60 hours a week with three kids shouldn't train like a professional. The conversation keeps the claim tied to named mechanisms, numbers, and caveats so a listener can act or ask better questions without flattening the nuance.

- **Try the two-week test.**

  Use it to find your personal carbohydrate tolerance, then reintroduce natural carbohydrates one at a time, noticing which ones bring back fatigue, cravings, bloating or weight gain; tolerance can change over the years, so revisit it.