Fitness, Strength & Endurance

Huberman Lab Keypoints

Episodes in this pack: 15

The Most Effective Weight Training, Cardio & Nutrition for Women | Dr. Lauren Colenso-Semple

Guest: Dr. Lauren Colenso-Semple
Date: 2026-02-16 · Duration: 2:31:58
URL: https://www.youtube.com/watch?v=_Q4XT82yd-Q

KEYPOINTS

1. Muscle responds to training the same way in women and men
Colenso-Semple, an exercise scientist, says muscle protein synthesis and growth after training or protein are very similar in both sexes. Men start with more muscle because of the testosterone surge at puberty, but untrained men and women gain similar relative size once they start lifting.

2. Natural testosterone differences within the normal range don't predict gains
A man at 400 ng/dL doesn't build noticeably more muscle than one at 600 if both are within the roughly 300–900 ng/dL range, and the same holds for women. Only well-above-normal doses from steroids change the picture. Post-workout spikes in testosterone and growth hormone were once thought to drive growth, but they don't predict long-term gains, so programs built to maximize those spikes miss the point.

3. Lifting heavy won't make women bulky by accident
She credits the bikini category in bodybuilding, group fitness and CrossFit with making lifting feel feminine. Yet 'where are all of these bulky women?' Very muscular physiques take years of hard work and often drugs. Keeping teenage girls out of weight rooms is a cultural habit, not a safety issue.

4. A good beginner program trains the whole body two or three times a week
Treat lifting as a way to grow muscle, not shrink. Train all major muscle groups two or three times a week (upper/lower splits make sense at four days, more detailed splits at five or six). After warm-ups, do at least 2 hard sets per exercise, ideally 3, and up to 4, since more is probably overkill. Mix squat-type and hip-hinge movements, and progress load or reps month to month.

5. Any rep range builds muscle if you train close to failure
Stopping one or two reps short of failure is enough. Growth is similar with heavy, low-rep sets and lighter, high-rep sets, but heavy sets need many more sets to match total volume. To maximize a one-rep max, you need some very heavy, low-rep training. She is skeptical of partial reps and tempo tricks because they're hard to repeat consistently.

6. Rest about two minutes, or pair pushes with pulls
Two minutes works for most exercises and three for squats and deadlifts. Heavy one-rep-max work may need 4–5 minutes. To save time, alternate a press with a row or pull-down, which doesn't seem to hurt results.

7. Cardio rarely interferes with muscle gains
Cardio blunts muscle growth mainly with very high volume done right before lifting, so avoid sprints before leg day. If strength is the priority, lift first and separate the two by several hours. Enjoyable outdoor activity counts, and high intensity mainly saves time. Walking needn't be obsessively tracked, and the 10,000-steps figure was more or less arbitrary.

8. No need to train by menstrual cycle phase
The data don't support changing training by phase. Train hard and consistently, and adjust or skip a session if symptoms hit, but you aren't less capable during your period. Studies of combined oral contraceptives, which make up most of the research, show no effect on strength, muscle growth or power. Hormonal IUDs and patches are less studied.

9. Train the same way through perimenopause and menopause
The goals don't change: build muscle and strength, maintain bone density and reduce the risk of falls and fractures. Maintaining nerve-to-muscle connections matters too, not just hormones. A gym's circuit of machines is a good starting point for women who are nervous about the weight room.

EXAMPLES

1. Fasted training makes no difference
Long-term studies find the same muscle and fat-loss results whether people train fed or fasted. The 2012-era fasted-cardio craze didn't hold up, because extra fat burned during the workout doesn't change daily totals. The opposite fear, that fasted lifting costs muscle, also lacks support, since most lifting sessions don't drain stored carbohydrate. She trains fasted in the morning, always with caffeine, and never after 2 p.m. to protect her sleep.

2. The 'anabolic window' and the 30-gram limit
Muscle protein synthesis stays elevated for up to 24 hours after lifting, so eating protein 30 minutes or 3 hours later makes no difference. Huberman cites a study suggesting people can use up to 100 g in one sitting. She says consistent daily and weekly protein intake matters more than per-meal timing or dosing.

3. Creatine gummies often contain little creatine
When top-selling creatine gummies on Amazon were tested, some contained almost none, because the creatine is sometimes just sprayed on. She recommends 5 g a day of creatine monohydrate powder. It's safe and well studied, and the dose is the same for women. The benefit is modest: an extra rep or two, or a second off a sprint.

4. 'Cortisol belly' is mostly marketing
Real Cushing syndrome is uncommon and is usually a side effect of heavy steroid use. Its symptoms have been twisted into claims that any stress or belly fat 'must be cortisol' and that zone 2 or high-intensity training are harmful, mainly to sell

supplements that don't work. Huberman adds that stress-related eating is the overlooked factor.

OTHER RELEVANT

1. Menopause hormone therapy aims to relieve symptoms

Estrogen-based therapy aims to ease hot flashes, night sweats and poor sleep, not to restore premenopausal hormone levels. Feeling better can help women stick with training and diet. Testosterone for women is mainly proven for low libido, at low doses aiming for the low end of normal. Higher doses risk a deeper voice and unwanted hair, and there's no evidence low doses build muscle.

2. Add balance work to your strength sessions

Instead of walking in a weighted vest (no substitute for lifting) or testing grip strength, she builds balance into lifting with single-leg Romanian deadlifts, walking lunges and full-range, multi-direction movements.

3. Keep caffeine consistent

Most of caffeine's performance boost goes to people who don't normally drink it. Habitual users like her mainly notice the alertness.

Build Your Ideal Physique | Dr. Bret Contreras

Guest: Dr. Bret Contreras
Date: 2025-09-22 · Duration: 3:03:56
URL: https://www.youtube.com/watch?v=7SIjcX5B1Vs

KEYPOINTS

1. Twice a week per muscle is the safe default; three times works if you manage recovery
Contreras sets the minimum for a beginner at two full-body sessions a week. One brutal, well-coached full-body day can still bring gains for a year or two. Hitting each muscle three times a week may be slightly better but risks spinning your wheels. His preferred structure is a Monday-to-Friday lower–upper–lower–upper–lower split. About 74% of his followers are women, and they usually want three lower days, while men often prefer the reverse.

2. Progressive overload matters more than set counts
Much of the result comes from the first working set, and adding volume doesn't add results in a straight line. He sees many lifters repeating the same weights every week and going through the motions. He prescribes three sets in his online programs and usually two when coaching in person because he pushes clients harder. What matters is logging lifts and gaining strength over time without cutting range of motion or letting form slip.

3. Strength can't rise in a straight line, so rotate lifts
If you added 5 lb a month forever, everyone would be lifting 600+ lb after a decade. Expecting endless PRs leads to contorted form, joint pain and nagging injuries. Borrowing from Louie Simmons, he picks a focus lift each month (a squat-and-bench month, then a deadlift-and-chin-up month) while keeping every movement pattern in the program. Progress should look like a sawtooth that trends up and to the right.

4. Maximum recoverable volume (MRV) depends on exercise choice
MRV is the most volume you can do and still recover. Exercises that load a muscle in its stretched position, such as walking lunges, deep RDLs, Bulgarian split squats and touch-and-go deadlifts, cause the most damage. Hip thrusts, 45-degree hypers, band and cable work load the squeezed position and are easier to recover from. Walking lunges may be the best glute exercise, he says, but they're 'too good' to train frequently, so he often uses step-ups instead.

5. Four lower-body patterns each session: squat/lunge, hinge, thrust/bridge, abduction
He programs one exercise from each pattern, about three sets each, three times a week. That's 36 weekly sets, of which roughly 12 target glute medius and minimus rather than glute max. Alternate bilateral and unilateral squat patterns, and vertical with angled hinges, because single-leg and vertical work cause more soreness. If clients feel beat up, he cuts sets, backs off from failure or swaps exercises.

6. The 'rule of thirds' for glute exercise selection
A third of exercises should be vertical (squats, deadlifts, lunges, step-ups, good mornings). These are the hardest to recover from but work the most muscle. A third horizontal (hip thrusts, bridges, back extensions, reverse hypers). A third lateral or rotary (hip abduction variations), which barely beat you up. He invented the hip thrust by asking why glute-activation moves weren't being loaded heavily.

7. Tempo matters little for growth, but control protects joints
Repetitions lasting 1 second and 8 seconds build similar muscle, which surprises people coming from yoga or Pilates. Exploding up on a hip thrust is fine. He sees tempo mainly as injury prevention, and prescribing slow tempos for quick lifts like shrugs, or 72-second sets with one-minute rests, signals poor coaching.

8. Muscle is hard to build but easy to keep
In Bickel's study, young adults did 27 sets a week for quads for about four months. Cutting to one-ninth of that volume (one set each of squats, leg press and leg extensions once a week) maintained most size and strength. Contreras credits muscle memory, including extra myonuclei from satellite cells, though he notes this is debated. Five studies suggest that more than 30 weekly sets keep adding growth for short specialization blocks, but that isn't sustainable.

9. Muscle grows across a wide rep range
He cites a Schoenfeld paper in which 3×10 squats grew more muscle than 3×3. Broadly, anything from about 6 to 30 reps builds similar muscle if sets are hard. High reps may cause more damage, so lower reps can suit muscles trained frequently. Calves respond to stretch: use full-range or bottom-half standing raises, adding 3–5 lengthened partials at the end; seated raises and top squeezes help less.

EXAMPLES

1. Strong lifting during the 2020 lockdown
His clients trained 2–3 hours a day, six days a week, with spreadsheets and about 55 awards across six lifts: squat, bench, deadlift, military press, chin-up and hip thrust. One client weighing about 130 lb deadlifted 315 for 18 touch-and-go reps but was wrecked for a week and a half. Afterward they dropped music and hype, used reset reps and stricter, lower-rep sets.

2. No-load flexing grows muscle
In a study by Brittany Counts, one arm curled a dumbbell and the other did 4×20 concentrated flexing with no load. The unloaded arm still grew, including the triceps that resisted the movement. Contreras and Huberman suggest a mirror test: if you can't contract a muscle without weight, you'll struggle to train it.

3. One set to failure, twice a week
A client in his Phoenix condo days, trained Monday and Thursday, roughly doubled her glute size in six months and did best on single sets. His most underrated tip is two full-body sessions a week, one set to failure on 6–10 exercises, about 45

minutes each. He thinks that gets around 80% of the gains in a third of the time, as long as you rotate lifts.

4. A one-week break

A study with Brad Schoenfeld as an author found a week off brought no extra gains but little loss. Periodic layoffs cost some strength and size that returns quickly, and breaks help most when they restore motivation or ease nagging pain.

OTHER RELEVANT

1. Lower glutes: reverse lunges or glute-dominant step-ups

Reverse lunges are his top choice if you train glutes once a week, but they can make the adductor magnus very sore. For three sessions a week, use step-ups with a forward lean and the working thigh parallel to the floor. On hip thrusts, the classic mistake is going too heavy to reach full hip extension. Hyperextension should come from the hip (about 10° with bent knees), not the lower back.

2. Start at any age and keep lifting through pregnancy if you already lift

People can build muscle when they start late, even into their 80s or 90s, though gains are blunted. Experienced lifters should keep training while pregnant: sumo squats are well tolerated, and hip thrusts work with the bar on the upper thighs and shallower depth. He doesn't advise starting to lift for the first time during pregnancy.

3. Hip dips and spot reduction

Hip dips are a gap between glute medius and glute max where no muscle exists, so 'hip dip workouts' can't fill them; being lean makes them show. Spot fat loss has been disproven since the 1990s, and abs look best when you're leanest.

4. Plan a schedule you can repeat and revisit it every five years

Huberman passes on advice from neurologist Bob Knight: find the weekly workload you can sustain and update it every five years. Contreras adds that nagging injuries cut daily movement (NEAT), which compounds the cost.

How to Increase Your Speed, Mobility & Longevity with Plyometrics & Sprinting | Stuart McMillan

Guest: Stuart McMillan
Date: 2025-03-17 · Duration: 3:01:06
URL: https://www.youtube.com/watch?v=U3cSnzdyyXU

KEYPOINTS

1. Sprinting is the purest test of human performance
McMillan, who has coached since 1984 and professionally since 1992, argues the fastest person on Earth really is the fastest. There's unlikely to be an undiscovered Usain Bolt, whereas the world's best linebacker may never have played. An NFL player might perform at about 80% of their best each game, but at less than 99.9% on a 100-meter start line, forget it. He prefers coaching the 200 for its tactics. Bolt's 9.58-second world record took about 40 steps.

2. There are about five gaits, and speed dictates your foot strike
Walking (usually heel-to-toe, up to roughly 2 to 2.3 meters per second), jogging, running, striding and sprinting each have an inverted-U of efficiency. You self-organize toward your most efficient speed and pattern within each one, then switch gaits when it breaks down. McMillan's cue is simply "flat-foot contact": at walking speed that produces a heel roll, and at sprint speed a slightly pointed foot landing more toward the toes. Don't consciously heel- or toe-strike unless a coach is fixing a specific problem.

3. Most adults can no longer sprint safely
Few people sprint past their 20s, and almost no one in their 30s. Our cardiovascular "engine" outlasts our tissues' and joints' ability to handle sprint forces. An all-out 50 meters after a short warm-up often ends in a pulled hamstring or calf. Most people can't go above about 75% of their capacity safely. McMillan's two substitutes are hill sprints, which stress tissue less, and above all skipping.

4. Skipping trains what sprinting trains
Skipping loads tissues and coordination patterns similarly to sprinting. It's plyometric, works the springiness of connective tissue, demands cross-body coordination, and drives "knee behind butt" hip extension, which commuting and sitting erode. McMillan skips 20 minutes every morning on the road and has skipped 10 miles. He urges skippers to be tall, expressive, rhythmic and stiff on the ground, the opposite of a closed, shuffling jog.

5. Eccentric force capacity separates elite performers, and older adults lose it first
From testing hundreds of athletes at the Canadian Sport Centre in Calgary starting in 1994, McMillan found concentric force measures didn't distinguish elite from sub-elite performers in almost any sport, while eccentric (braking) capacity did. Elite sprinting is essentially all braking forces. The same eccentric control is what keeps older people from falling off a curb, which Huberman connects to Peter Attia's point that falls often start a fatal decline.

6. Sprinting is a two-mass system
Jogging and striding work like a simple spring and mass. McMillan cites his friend Dr. Ken Clark's research showing that in true sprinting, the shank and foot act as a second mass, contributing up to about 8% of ground-contact force. Only athletes who can move their limbs fast enough get this. He says nearly every elite sprinter can, but only about a dozen NFL players.

7. Three sprint non-negotiables: high knees, stiff springs, hip extension
Elite sprinters' knees rise to about belly-button height, putting the action in front of the center of mass. On contact the foot and ankle must be rigid, like a boxer's fist on a heavy bag: both apply more than five times body weight in under three-hundredths of a second. McMillan judges a hip-extension pattern on five qualities: force, velocity, range of motion, control and repeatability.

8. Let the torso lead the eyes
In sprinting, lifting the eyes first raises the chin and throws the spine into hyperextension, so you push down the track instead of bouncing. McMillan's cue is to let the torso decide when the chin and eyes come up. Huberman says the same principle (chest and hips moving together, head last, and pushing your feet into the floor rather than pulling the bar) improved his squats and deadlifts.

9. Don't copy Usain Bolt
Movement is governed by what you're moving: limb ratios, tendon length, joints, fiber type and mobility. McMillan identifies an athlete's action capabilities, applies the known non-negotiables, and individualizes the rest instead of imitating a 6-foot-5, 215-pound outlier.

EXAMPLES

1. Spotting a sprinter by sound
Watching kids run around the Malibu High School track after school, McMillan picked out one boy as a sprinter. Despite flailing limbs, he made a sharp "pop" against the ground, like a good boxer on a heavy bag, while the others thudded. McMillan says he usually hears it before he sees it. He says the best athletes in every sport make it look easiest.

2. Andre De Grasse versus Ben Johnson
When McMillan began coaching De Grasse in 2015, he could barely squat his body weight or clean 60 kg, yet eight months later he won three Olympic medals. Ben Johnson reportedly squatted 600 pounds days before his 9.79 in 1988, later stripped for doping. Speed comes from force, rate, direction and mass in many combinations. Past a threshold, more strength (say from 385 to 405 pounds in the squat) won't make you faster.

3. McMillan's father's routine

A former elite athlete, his father ran the 2019 New York City Marathon in about 5:02 at roughly 73 or 74. At 78 he runs four days a week, 20 to 25 miles, and two of those days are cycles of walking, skipping and all-out striding, 30 seconds each.

4. Contaminated supplements and drug-testing tragedies

McMillan recalls bobsledder Pavle Jovanovic, who tested positive for nandrolone around 2001, which was later traced to a supplement at a time when some companies spiked protein with steroids. It ruined his career and he later took his own life. McMillan believes doping in track is far rarer than people assume, and that the public overestimates what drugs contribute at the elite level.

OTHER RELEVANT

1. How to start skipping

Don't begin with a 10-minute skip. Alternate 30 seconds of skipping with 30 seconds of jogging or walking. A simple on-ramp: jog about a mile as usual, then switch between skipping and jogging every 30 seconds or so. Progress to more powerful skips that drive the thigh up and back, or skips for distance, such as counting the steps to a tree 50 meters away.

2. Build toward strides

Strides come before sprints. Skipping, hills and strides let you work up to near-maximal speed safely. Both men favor sessions that leave you feeling energized, with better posture and sleep, over leaving it all on the mat, especially for people with stressful lives. McMillan suggests the ability to safely express your maximal speed may be the best single measure of vitality.

3. Testosterone and peptides

Huberman notes many young men take testosterone they don't need, which shuts down sperm production unless offset with something like HCG and could do lasting harm while the brain is still developing. He says he got good results without it until his mid-40s, with subtle but meaningful effects from supplements such as Tongkat Ali that he confirmed in blood work. Athletes should check their governing body's rules before taking anything.

How to Build Strength, Endurance & Flexibility at Any Age | Pavel Tsatsouline

Guest: Pavel Tsatsouline
Date: 2025-02-10 · Duration: 4:15:13
URL: https://www.youtube.com/watch?v=Z3OpxT65fKw

KEYPOINTS

1. Pick a few strength lifts and stick with them
Pavel recommends a short list of lifts that build strength beyond the lift itself. His examples are a posterior-chain lift such as the narrow-stance sumo deadlift (after learning to hip hinge), a Zercher squat, a press such as the bench press, plus pull-ups or dips. Varying grip or adding pauses is fine, but there's no need for constant novelty. He cites Canadian research from the 1980s showing leg extensions don't carry over to the squat because the coordination is so different.

2. The Zercher squat is a squat most people can do
The bar rests in the crooks of the elbows, so people with bad shoulders, wrists or elbows can still squat. It forces the midsection to stabilize by reflex, which teaches you what bracing feels like. Double bodyweight is a strong goal for an athlete.

3. Strength is a skill: 'greasing the groove'
Repeating a movement strengthens the neural pathway from brain to muscle, which he likens to Hebbian learning. Over time the same weight takes less effort. In the 1950s Soviet lifters did mostly singles, doubles and triples, so hypertrophy couldn't explain their gains. Intensity, he insists, means how heavy the weight is, not how hard you strain.

4. The core rules of greasing the groove
Use 75–85% of your one-rep max ('heavy enough to respect, light enough not to fear'). Do about half the reps you could, for example 3–4 reps with a weight you could lift 8 times. Rest at least 10 minutes between sets, train 2–3 days in a row and then take a day off. The long rests may help with memory consolidation, much like spacing out study sessions.

5. Mixing in short strength efforts can boost other work
Soviet coaches described a 'strength after-effect': a few non-exhausting, familiar sets, such as 3×3 at 80%, made athletes fresher during track practice and could be repeated when they began to flag. Pavel suggests dropping for a few one-arm push-ups every 10 minutes during a class, or keeping a kettlebell under your desk.

6. Many different programs can get you strong
Pavel contrasts the Soviet weightlifting system (frequent, moderate, sub-maximal) with 1980s American powerlifting (infrequent and heavy, close to Mike Mentzer's ideas). Both work because they rely on different mechanisms. He warns that maxing out every week produces quick gains that stall after about six weeks, or about three for experienced lifters.

7. Squeezing your grip makes you stronger in other lifts
Crushing the bar sends tension into nearby muscles, so you can get extra reps even in curls. Grip strength also correlates with longevity, though he stresses correlation isn't causation. To train crushing grip, climb a rope weekly, do pull-ups a few times a week, do heavy kettlebell snatches or use grippers. Hanging and farmer's carries do less for grip than people assume, and Stuart McGill warns that carrying two heavy objects loads the spine hard.

8. Concentric-only and assisted eccentric work each have a place
Lifting the weight and dropping it, with no lowering phase, builds strength with little muscle growth or soreness. Barry Ross used concentric-only deadlifts with a 17-year-old Allyson Felix. For eccentrics, after your heavy sets load 5–10 lb over your max, lower it at your normal max-attempt speed, pause on the chest while staying tight, and let skilled spotters take it, for 2–3 reps.

9. Train endurance without flooding your muscles with acid
Short efforts with short rests keep work running on phosphate and aerobic energy instead of acid-producing glycolysis. Swedish research from the 1950s–60s found that 10 seconds on and 20 seconds off lets you work very hard without much acid buildup. Seasoned manual workers such as loggers naturally work in brief bursts with short pauses.

10. Gain flexibility by easing in, not forcing
Much of a limited range of motion is protective inhibition, not tissue length. Go to the edge of discomfort, stay there until your body accepts the new range, then add contract-relax isometrics. 'There's never time for ripping yourself in half.' Loaded long-range work, such as overhead kettlebell presses and careful deep squats, can also lengthen muscle.

11. Core training comes down to tension and attention
Learn what tight abs feel like through Zercher or double-kettlebell front squats. Contract the pelvic floor, direct attention to specific parts of the abdomen, keep reps slow and low, and progress patiently. Huberman went from failing hanging pikes to doing five sets of five.

EXAMPLES

1. Anti-glycolytic training for MMA fighters
In the study Pavel describes, one group did 3 reps at 70% of their one-rep max (a weight fighters could lift 20+ times), moving through three exercises with one minute of rest between rounds. That group 'blew the traditional group out of the water', did more consecutive reps and performed better in competition. The test that best predicted fight performance (r"H0.88) was how fast heart rate recovered after an all-out set of deadlifts at 70%.

2. Pavel's father, a record holder in his 70s
His father first entered a powerlifting meet at 71. By 75 he held several American records and deadlifted in the low 400s without a belt at 198 lb, and Stuart McGill said his back muscles looked like a 40-year-old's. At 87 he still does 50+ pull-ups and 100+ bodyweight squats twice a week. Pavel's mother, a former ballerina, climbs a high-rise one floor at a time, walking

the hallway between flights.

3. A father-in-law's pull-ups at age 64

Roger, a retired firefighter and Marine with a 10-rep max, did sets of five whenever he passed the bar and added reps once they felt easy. Working up to sets of nine, he tested and did 20 pull-ups, passing the Marine pull-up test he couldn't pass as a young Marine.

4. German interval training for the heart

Run 60–90 seconds until heart rate peaks around 85–90% of max, then jog (never stop) until it drops to about 60–70%. Pavel says the blood still returning to a slowing heart stretches its walls.

5. Two other interval formats

Glycolytic power repeats, from research on Wingate-style sprints, are 30 seconds of hard work followed by about 5 minutes of rest, repeated several times. They train the heart and mitochondria and may even build muscle. For hypertrophy, an Italian method shared by Fabio Zonin uses sets of 5 at 80% with 30-second rests until you can't complete one, then repeats about 10 minutes later.

OTHER RELEVANT

1. A simple weekly program

Huberman suggests a Zercher squat, kettlebell swings or another posterior-chain lift, pull-ups and dips, and Pavel agrees. Dips require being able to do a full 'skin the cat' first. Several sets of five on the bench press once a week keeps progress going.

2. Add anti-glycolytic sessions for real-world endurance

Do 3 reps at about 70% of your max across 2–3 lifts, rest a minute, and repeat for up to 15 rounds, two to four times a week as a light day. He programmed Zerchers, towel pull-ups and close-grip bench presses for jiu-jitsu competitors.

3. Don't train to failure

Medium reps with medium effort and high total volume builds both strength and muscle safely, especially for older adults. Stay in the zone between boredom and anxiety that Csikszentmihalyi describes as flow.

4. Gaze and neck position

Most lifters do best with a neutral neck and eyes following the head, as 1,000-lb deadlifter Andy Bolton does. McGill notes that lifting your gaze can help some long-necked lifters, but it may overarch people who already have a big lumbar curve.

How to Improve Your Mobility, Posture & Flexibility | Dr. Kelly Starrett

Guest: Dr. Kelly Starrett
Date: 2024-12-09 · Duration: 3:26:10
URL: https://www.youtube.com/watch?v=8N7mdkrXgbc

KEYPOINTS

1. Most people's 'movement language' has shrunk to a few words
Starrett describes a typical day as sit, stand, walk slowly, with exercise that repeats the same shapes. An exercise bike or elliptical, for example, never asks for hip extension. Bodies are adaptation machines, so unused ranges stop being expressed and the brain may stop treating them as safe, which limits the movement options it will allow.

2. Exposure is the first lever for restoring range of motion
Before choosing techniques, Starrett asks how to expose the body to the range you want back. He cites a PT instructor's line that 'muscles and tissues are like obedient dogs': at no age do you stop adapting or healing, though both slow down. Time spent in hip, hamstring and ankle ranges lets tissue adapt.

3. Cultures that live on the floor show fewer age-related problems
Starrett notes that in cultures that toilet, sit and sleep on the ground, fall risk in older adults drops close to zero and rates of hip and low-back osteoarthritis are lower. He offers this as an association, suggesting that regularly using these shapes may tell the body to keep normal hip range.

4. The sit-and-rise test works like a movement vital sign
Cross your feet, lower yourself to the floor with control, then stand up without using hands or a knee. Ideally you should be able to do it with either foot in front. Starrett says the data show it predicts all-cause mortality and morbidity, but its real value is revealing a childhood skill you've lost because you're missing end ranges. He compares such 'movement minimums' to a blood pressure reference.

5. Protect gym time and move maintenance work elsewhere
Starrett criticizes 'decorative' fitness that fills sessions with accessory drills, and recursive training such as doing zone 2 only to do more zone 2. Gym time is 'sacred' and should go to squatting, pressing, sprinting and play. Mobility, floor time and small doses of loading belong at home, such as a loaded bar in the garage for sets while dinner cooks.

6. Pain and stiffness can be handled with the 'D2R2' sequence
Desensitize first (scraping, isometrics, rolling, blood-flow restriction), because a painful tissue can't produce normal force. Decongest next: swollen or congested tissue (including 'cankles' after a flight) is more sensitive and heals more slowly, and muscle contraction drives lymphatic drainage. Then reperfuse, since a pumped, warm tissue often hurts less; one example is a few minutes of leg extensions before heavy squats with an old knee issue. Finally, restore full normal range in the joint.

7. Most pain is an 'incident', not an injury
Starrett reserves 'injury' for pain or dysfunction so severe you can't fill your role at home, at work or on the team, which needs medical care. Everything else is an incident. He borrows Charles Perrow's idea of 'normal accidents' (via Laurence Gonzalez's 'Deep Survival'): breakdowns are often the system expressing itself after a long run of getting away with something.

8. Foam rolling has evidence for pain and range of motion, but it should target something
There's no wrong way to roll, says Starrett, only ways that waste time. The research is clear that soft-tissue work can reduce pain and restore range. He points to Brent Brookbush's institute for research summaries and recommends asking what's stiff or painful today rather than mindlessly rolling the whole body.

9. A tight pelvic floor needs relaxation, not more Kegels
Huberman recounts prostate pain in his 30s with a normal PSA that he traced to a tight pelvic floor. Citing Dr. Michael Eisenberg, he says Kegels can worsen urinary and erectile function when the pelvic floor is already tight. Starrett suggests mobilizing around the pelvis and glutes with a ball, staying away from the sit bones and soft areas and using contract-relax. Pain under compression tells you where the problem is.

10. Hip extension is a weak spot for most people
Starrett ties the back extensors, glutes, hamstrings and calves into one extension system (drawing on Philip Beach and Thomas Myers' Anatomy Trains). Without hip extension, the hamstrings take on extra work. Yoga's camel and wheel poses are useful tests of whole-spine extension, which he prefers to loading one or two segments as in an anterior pelvic tilt. He notes B.K.S. Iyengar introduced blocks and belts to support students into shapes they couldn't reach.

EXAMPLES

1. 10-10-10 at 10
With young kids and two businesses, Kelly and Juliet Starrett did 10 air squats, 10 kettlebell swings and 10 pull-ups at 10 p.m. for 10 minutes whenever they could. He offers this as proof that fitness doesn't need a one-hour block. Another option is kettlebell swings on the minute for 20 minutes in the kitchen.

2. The couch stretch
Starrett devised it on the couch for young athletes watching TV. Kneel facing away from a wall with one knee in the corner and that shin running up the wall, then rise to a high kneel with the front foot planted. Check whether you can squeeze your glutes and breathe normally; if your breath gets small whenever your knee is behind your body, that's a sign of poor hip extension.

3. Neck training and his goalie daughter

Starrett's daughter Caroline, a goalie, trains with an Iron Neck kept by the door. He says each pound of added neck strength sharply reduces concussion risk. Huberman adds that years of neck work (bridges, a four-way neck machine or plate work) have kept him free of the shoulder pain common among his peers.

4. Morning 'spin-ups' for teams

Starrett asks his athletes for 8–10 minutes each morning of one of three routines: a hip spin-up if the back or knee hurts, a shoulder spin-up for shoulder or neck pain, or a breath spin-up, cycling through them otherwise. If someone struggles with the hip spin-up, that reveals their movement and injury history.

5. The 800-gram rule and the three-vegetable dinner

Starrett follows E.C. Synkowski's 800-gram challenge (800 g of fruits and vegetables daily), which crowds out junk without restricting any diet identity, plus protein at every meal from varied, mostly leaner sources. At home, Margaret Garvy's rule of a protein plus three vegetables got even his pickiest daughter eating at least one vegetable.

OTHER RELEVANT

1. Spend 20–30 minutes on the floor each evening

Watch TV or answer email sitting cross-legged, squatting, long-sitting or in a 90/90 position, fidgeting between shapes. Keep a roller nearby so mobilizing takes no extra effort. Everyone, whatever their age, should get down to the ground and back up at least once a day, using whatever support they need at first.

2. Fold play and new skills into warm-ups

Instead of dreaded generic warm-ups, use games, a ball against a wall or a new skill such as David Weck's rope flow, which Starrett says delivers many PNF patterns. Play adds the varied, dynamic movement that rigid programs lack.

3. Supplements in the Starrett household

Kelly takes 5–10 g of creatine most days and doesn't worry about missed days while traveling. His daughter takes creatine, omega-3s (at night to avoid fish burps at school) and vitamin D, which he links to living in a northern climate. He says it's not his expertise, but he has heard early research that vitamin D, creatine and omega-3s might reduce concussion symptoms. He treats whey or vegetarian protein powder as food for filling protein gaps.

Build a Strong, Pain-Proof Back | Dr. Stuart McGill

Guest: Dr. Stuart McGill
Date: 2024-07-15 · Duration: 2:52:15
URL: https://www.youtube.com/watch?v=mAlt_HKX4as

KEYPOINTS

1. Back pain is a symptom, not a diagnosis
McGill compares asking for 'an exercise for back pain' to asking for one for leg pain: there are a hundred or more pathways that produce it. His summary is that genetics loads the gun, exposure pulls the trigger, and the psychosocial setting shapes how a person responds. So the starting point is always an assessment, not a generic routine.

2. Skeleton shape decides which loads a spine tolerates
A thin, willowy spine handles repeated bending but not heavy compression; a thick spine bears huge compression but tolerates little bending. The man with the world record for consecutive sit-ups has a slender spine. Knee width and the width across the iliac crests are rough surrogates for how heavy a skeleton is. Disc shape varies too: golfers tend to have ovoid discs, while people who carry big compressive loads have bean-shaped 'limacon' discs.

3. Discs are layered collagen, and the 'glue' between layers is partly inherited
A disc is about 80% type 1 (stiff) collagen and roughly 20% more elastic collagen, held together by binding collagens (types 3–10) where genetic variation is large. Repeated bending reversals can delaminate those layers, so how many flexion cycles someone tolerates is partly set by their parents. Discs evolved because a stack of ball-and-socket joints would be impossible to control; a disc's built-in stiffness acts like a shock absorber.

4. Facet angles and spacing make the same technique safe for one person and harmful for another
Open facet joints let pro golfers rotate; arching hard can stress the pars bone and cause the spondylolisthesis fractures seen in gymnasts and in a pro tennis player McGill rehabbed after a coach pushed extra extension into the serve. A big-arch bench press suits people with wide gaps between the spinous processes; others crush the interspinous ligaments copying it.

5. Every tissue needs stress, but crossing the tipping point builds cumulative damage
McGill's core principle: cardiovascular, musculoskeletal, endocrine and psychological systems all need stress to adapt, but beyond a personal tipping point you accumulate trauma. The job is to find that point, expand it slowly, and stay under it, which often means controlling volume and adding deloads rather than banning an exercise.

6. Assessment works by deliberately provoking the pain
He starts with the person's story and goals, then pain behaviour (morning, sitting, walking, does it travel down the leg). Provocative tests follow: if he can reproduce the pain, he has found the mechanism; if he can't, it isn't mechanical. Example: pulling up on the chair seat while sitting adds compression; if that sends pain down the leg, the person has compression intolerance and needs non-compressive exercise. Nerve flossing (extend the leg while looking up) helps tell nerve friction from nerve tension.

7. Injury is asymmetric, so protect joints over chasing muscle
Citing Nassim Taleb's Antifragile (which cites McGill's low-back disorders book), he argues a 50% loss hurts more than a 50% gain helps. Muscle is adaptive and resilient; joints are much less so. Training hard in youth for muscle can leave people at 70–80 unable to kneel.

8. Some pain is a rewired brain, not damaged tissue
In line with Sean Mackey's biopsychosocial model, McGill describes patients carrying trauma, such as surviving a crash in which a parent died, or past abuse, whose reactions to physical testing don't fit. More fitness won't break through; instead he finds movements that don't trigger pain, even a feather brushed over the back, and slowly expands that pain-free repertoire.

9. McGill's Big 3 build stiffness while sparing the spine
The bird dog, curl-up and side plank weren't his invention, but his lab measured spine stability quantitatively and found these the most efficient way to build it with low spine load. Proximal stiffness sends force out to the limbs: the pec major pulls on the rib cage as well as the arm, so a braced core turns more of that effort into the push. He does the Big 3 six days a week. He wouldn't name a universal fourth exercise; it depends on the assessment.

10. Disc height loss with age can't be reversed
Inversion or anti-gravity boots raise disc height for about 15 minutes before hydrostatic pressure pushes the fluid back out. He has seen no evidence that PRP restores discs, though he 'swears by' it for stubborn muscle tears and sometimes for ball-and-socket joints. After a disc injury the goal becomes management: people can usually keep mobility or keep heavy strength, not both.

EXAMPLES

1. Virtual surgery: 95% glad at two years
For patients who had failed every therapy and been told surgery was their last option, McGill 'anoints' them and prescribes a full post-surgical recovery: bed rest with short shuffles, then stability, mobility, endurance and only later strength. In his clinic's follow-ups, 95% of those who avoided surgery this way were glad they had. His view is that surgery often works because it forces rest.

2. Triathletes show the trade-offs
The fastest swimmer rarely wins: swimming rewards floppy ankles and long torsos, cycling rewards a stiffened core like a stiff bike frame, and elite running rewards tuned elastic 'springs' (he recommends Shane Benzie's The Lost Art of Running). Golfers who hit 330 yards are elastic athletes who don't test as very strong.

3. Pensacola firefighters
Two groups trained: one with coaches who explained good form, one with rep-pushing 'cheerleader' trainers. Both got fitter, but the cheerleader group showed more injury markers, such as knee valgus collapse, on fire-ground tasks they had never practised. McGill also cites Bill Marras's data showing about 10 times the disc-injury risk in workers who bend through the spine under load.

4. Pro golfers who took up heavy lifting
When some pros adopted Olympic lifts and heavy deadlifts, none he knows hit the ball farther, and several developed sore knees and disc bulges; those who backed off have less pain. Deadlift injuries often follow rushed progressions, such as trainers taking novices to twice bodyweight in six months when bone takes much longer to adapt.

5. Huberman's L3–L4 bulge
Doing the Big 3 eased Huberman's occasional right-side low-back pain and helped him run upright. McGill notes the Cobra can vacuum some disc bulges back in but worsens others, and that a lumbar pad, or a rolled towel, helps on flights and in restaurant booths.

OTHER RELEVANT

1. Dose walking instead of doing one long walk
If your tipping point is 40 minutes, a 40-minute walk guarantees pain; three 20-minute walks give a pain-free hour. People with discogenic pain should keep changing posture, for example roughly 20 minutes sitting, 30 standing and 10 walking at a sit-stand desk.

2. Try the 'biblical training week'
Six days on, one day off: two strength days (squat, lift, lunge, push and pull patterns plus some bodybuilding), two mobility days for stiff or injured areas, two cardio days. Never repeat the same type two days running. McGill, 67 and pain-free with a replaced hip, uses wood-splitting, kayaking, cycling, cross-country skiing and snow shovelling.

3. Build pain-free capacity before you flirt with pain
Rebuild a margin of pain-free training first, then expand volume toward your goal. Older trainees recover from flare-ups more slowly, so they have less reason to push.

4. Pick tools for your goal, not the trend
Deadlifts are one option for bone density or grinding strength, but McGill would usually start with hip-hinge training and choose based on hip socket depth and history. Belt squats or machine work can load the legs without compressing the spine. Loading the hands and feet (Indian clubs, heavy hands) also fits his view that the extremities need training.

How to Exercise & Eat for Optimal Health & Longevity | Dr. Gabrielle Lyon

Guest: Dr. Gabrielle Lyon
Date: 2024-06-24 · Duration: 3:03:37
URL: https://www.youtube.com/watch?v=WFcYF_pxLgA

KEYPOINTS

1. Skeletal muscle is 'the organ of longevity'
Lyon describes muscle as an endocrine and nutrient-sensing organ responsible for roughly 80% of glucose disposal. It is also the body's amino acid reservoir and 'body armor'. She argues that type 2 diabetes, obesity and cardiovascular disease often begin in muscle decades earlier. At rest, muscle is not very metabolically active, burning about 10 calories per pound and mainly using fatty acids.

2. The problem is often being under-muscled, not overfat
During her geriatrics fellowship, a yo-yo-dieting patient who followed a low-fat, high-carb diet and exercised had brain imaging resembling early Alzheimer's. Lyon concluded that the problem was too little muscle, not too much fat. She notes that no one knows the optimal amount of muscle, that DEXA only estimates lean tissue, and that sarcopenia was not classified as a disease until 2016.

3. Muscle quality matters as well as size
Inactive muscle can become fat-infiltrated 'like a marbled steak', impairing contraction and mitochondria. She compares an inactive, overfed person's muscle to a suitcase packed for 30 days on a four-day trip: glycogen-filled muscle has nowhere to put new fuel, so glucose, insulin, free fatty acids and branched-chain amino acids rise in the blood. High triglycerides, insulin or glucose on bloodwork are her clues to unhealthy muscle.

4. Earn your carbohydrates through activity
The liver stores about 100 g of glycogen and muscle perhaps 400–500 g. Lyon cites 130 g a day as the recommendation for sedentary people (largely for the brain), versus an average US intake of about 300 g. Outside exercise she suggests capping meals at 40–50 g of carbs, and allowing roughly 40–70 g more per hour of exercise depending on intensity. For people who are overweight or have type 2 diabetes she says there is evidence for going lower.

5. Make the first meal 30–50 g of high-quality protein
About 2.5 g of leucine, roughly 30 g of quality protein, triggers muscle protein synthesis, which lasts about 2–3 hours. Lyon says meal timing matters little for young, healthy people, but in your 60s and beyond, prolonged fasting may harm muscle. A protein-rich first meal also releases satiety peptides like GLP-1; she cites Heather Leidy's work showing adolescents given 30–40 g of protein were less likely to choose foods like donuts later.

6. Protein quality depends on the amino acid profile
Animal proteins such as eggs, whey, beef and poultry closely match human muscle's amino acid needs. Plant proteins can work if the total is high enough: Lyon suggests about 1.6 g/kg for plant-based eaters and a rice–pea blend, noting that six cups of quinoa roughly equal one small chicken breast in amino acids. She advises against adding leucine alone, because leucine, isoleucine and valine work together, but says essential amino acids can top up a low-protein meal.

7. The protein RDA is a minimum, not an optimum
The RDA of 0.8 g/kg (about 0.37 g per pound), set in the 1980s from nitrogen balance studies, would give a 115-pound woman about 45 g a day. Lyon recommends about 1 g per pound of ideal body weight. In her view, evidence does not show such intakes harm the kidneys or bones; obesity is a major cancer risk factor, and protein-forward diets improve body composition. These are her positions on a topic she acknowledges is contentious.

8. Older muscle needs more protein to respond, and becomes 'anabolic resistant'
Children respond to 5–15 g of protein, while older adults show little response unless a meal contains 30–50 g. Lyon notes that about 40% of women over 60 eat below the RDA, forcing the body to draw amino acids from existing muscle. On mTOR, she argues muscle activates it through contraction-specific pathways, and that fearing protein for cancer reasons is as 'myopic' as fearing resistance training. She cautions against loading protein while staying sedentary.

9. Prioritize hypertrophy with 'high ground' movements
Borrowing Pat Davidson's idea, Lyon recommends machine exercises with full support for unskilled lifters, such as hack squats, leg presses, leg extensions and curls, supported rows and lat pulldowns. She aims for sets where the final reps are hard (for example 5–10 reps, 4–5 sets), noting McMaster data that light weights work if the stimulus is sufficient. Walking alone will not preserve type II fibers, and tendon injuries are what 'take people out' in their 40s.

EXAMPLES

1. Layman's 12-month study of 130 people
In Don Layman's lab, overweight adults ate the same calories, 500 below maintenance, as either a food-pyramid diet (protein about 10/15/45 g at breakfast, lunch and dinner) or a 40/30/30 diet with protein spread evenly (about 45/35/35 g). The protein group lost about 24% more weight, 16 versus 11 pounds of fat, and lost less lean mass.

2. Protein plus simple exercise in 48 women
In a 16-week study of women averaging age 46 with a BMI of 33, the group eating 1.6 g/kg of protein and doing 30-minute walks five days a week plus two bodyweight sessions lost 46% more weight and 60% more fat than the low-protein exercise group, with 40% less lean mass loss.

3. Lyon's own training
At about 110 pounds, she trains whole-body three days a week, with a day between sessions, covering push, pull, hinge and

squat after a heavy sled push. She says she dreads every Monday session but never skips.

4. GLP-1 drugs

Lyon says semaglutide (about 13% weight loss over 24 weeks) and tirzepatide (up to about 22%) are the most effective tools short of bariatric surgery. In her clinic, with proper nutrition and resistance training, she does not see muscle loss. She notes possible pancreatitis risk and a rodent thyroid-cancer signal that she thinks may not apply to humans.

5. Lab quirks in strong people

Patients with lots of muscle often show high creatinine; she checks cystatin C to correct GFR. Hard training can transiently raise ALT and liver enzymes.

OTHER RELEVANT

1. Time protein around training if older or eating low protein

Young people eating about 1 g per pound need not worry about timing. Older people, or those eating less protein, may benefit from a shake within about an hour of resistance training.

2. Supplements Lyon uses

Creatine has benefits, especially for postmenopausal and older people; Lyon says about 5 g affects muscle and about 12 g may affect the brain, while a pound of steak has only about 2 g. She also takes 500–1,000 mg of urolithin A (citing human trials on strength and endurance), plus whey protein and collagen.

3. Set standards, not goals, and know your vulnerability points

Lyon says goals come and go but standards for how you operate remain. Predictable lapses come at peaks and right after big successes, when dopamine dips below baseline, and on Friday nights. She also stresses emotional neutrality.

Protocols to Strengthen & Pain Proof Your Back

Date: 2024-04-29 · Duration: 2:08:04
URL: https://www.youtube.com/watch?v=PVmQOLYckKQ

KEYPOINTS

1. Much back pain comes from nerve roots being pressed on as they leave the spine
The spine alternates bony vertebrae and softer discs, with the spinal cord running through the middle. Nerve bundles exit between segments to reach muscles and carry sensation back in. A bulging (herniated) disc, compressed vertebrae or local inflammation can impinge those roots, so much of relieving back pain is about creating space for them and stabilizing the spine so it doesn't happen again.

2. Spinal cord tissue does not regenerate, which is why the spine is armored
The cord is central nervous system tissue, like the brain; after injury it mostly scars rather than renewing neurons. Vertebrae protect it while discs let it bend and twist, and the cord itself moves when you lean or rotate.

3. Pain is neural and multi-factorial, not only structural
Citing the biopsychosocial model discussed with Dr. Sean Mackey, Huberman notes pain involves prediction, history, psychology and inflammation. That said, feet, toes, pelvis, neck position, spinal erectors and the abdominal wall all shape the environment the spine works in, which is why many protocols here target areas far from the sore spot.

4. Your frame hints at whether you have a 'thick' or 'thin' spine
Per Dr. Stuart McGill, people with thicker wrists, knees and ankles tend to have thicker spinal segments: good at handling compression along the spine but less able to twist. Thinner-framed people tend to have thinner, more 'bendy' spines that tolerate less vertical load. McGill's willow versus oak analogy: thin spines should build more surrounding muscle; thick spines may need more work on rotational mobility.

5. Get a real diagnosis for severe or persistent pain
Huberman is explicit that a podcast can't diagnose back pain. Overuse imbalances (such as one-sided golf swings), compression injuries and ruptured discs differ, and ruptured discs often need surgery. Epidurals, painkillers and supervised rehab all have their place, and many cases do resolve with time if you avoid the aggravating movement.

6. Crunches and sit-ups can worsen a posterior disc bulge
Flexing forward squeezes the front of the vertebra-disc-vertebra 'sandwich' and can push the disc further out onto the nerve. Huberman made his own herniation worse by doing crunches before a physical therapist told him to stop. The curl-up was designed to train the abdominal wall without that flexion.

7. McGill's Big 3 favor short, hard holds over long static ones
Curl-up, side plank and bird dog are each done as roughly 8–10 second maximal contractions. Repeating short, intense contractions builds the nerve-to-muscle pathways for strong stiffening better than holding 30–60 seconds. McGill himself says the Big 3 are not exhaustive. Quality matters more than volume, so stop sets once form breaks down.

8. Stabilizers far from the spine matter: feet, toes and the front of the neck
Strengthening the deep front neck muscles helps hold the head away from the chest and may support nasal breathing. Being able to spread all your toes and move them independently activates the arch and shin muscles that form a stable base for the pelvis and spine. Huberman credits foot work with ending his shin splints when running.

9. Direction of disc bulge determines which exercises help or hurt
Huberman's bulge (around L3–L4) pushes posteriorly, so spinal extension relieves it and flexion aggravates it. Someone whose bulge goes the other way may need different work. Knowing your pattern also guides strength choices: he emphasizes posterior-chain work such as glute-ham raises and Nordic curls.

EXAMPLES

1. Huberman's Seattle back injury
Doing weighted reverse bench dips with plates on his lap, he felt something 'go'. By that morning he had sciatica-like pain from his mid-right back into the hip and down the leg, and was walking bent over 20–30 degrees. A physical therapist had him stop crunches and start cobra-style push-ups. The pain was almost gone in two to three days with no medication. He notes there was no control, so it may have resolved anyway.

2. Cobra push-up details and the wall version
Lie face down with legs together and toes pointed back, keep your hips on the floor and push up with a neutral head. Do 8–10 reps and hold the last one until you start to shake. People in too much pain for the floor version can stand about six inches from a wall and push the hips toward it. When the same L3–L4 issue flared years later, it settled again quickly with these.

3. The Oreo analogy for discs
The cookies are vertebrae and the cream is the disc. Even pressure spreads the cream out in all directions; squeezing one side pushes it out the opposite side; crushing it is like a rupture. Flexion pushes the cream backward, toward the nerves, in posterior bulges.

4. Fist trick from Pavel Tsatsouline
Clenching a fist raises contraction strength elsewhere because of bilateral neural wiring. Making a fist on the other hand gives you a harder handshake squeeze. Huberman applies this by planting a fist rather than a flat hand in side planks and bird dogs.

5. Medial glute protocol from Jeff Cavaliere

Lie on your side with the bottom leg on the floor. Point the top foot's toe down, touch it in front of you, then sweep the heel back and up. Do 5–10 reps, then hold the last one for 10–20 seconds with a thumb pressed on the top of the glute. Huberman uses it for low-low back pain from sitting, flying or heavy hip-hinge work, and does both sides.

OTHER RELEVANT

1. Big 3 dosing

Curl-up: one knee bent, hands under the low-back arch, tongue on the roof of the mouth, chest leads (not the chin), lift 5–10 degrees, 10-second holds. Use a descending ladder of 5, 4, 3, 2, 1 holds with 10–30 seconds of rest, then switch legs. Side plank: start with knees bent 30–40 degrees and progress to straight legs with the top foot in front. Bird dog: reach long and low, without arching, for 8–10 second holds. One or two sets of each takes 5–10 minutes. Huberman aims for once or twice a week.

2. Supported bar hang for decompression

Hold an overhead bar with your toes or heels still touching the floor, rather than a full dead hang. Stay 10–30 seconds without twisting, walk around, and repeat two or three times. Inversion tables work on the same logic, but inverting raises eye pressure, so people with glaucoma or a predisposition to it should avoid it.

3. Neck and toe drills

Press your fists under both sides of your jaw, tongue on the roof of the mouth, and push your chin down for 10-second static holds: 3–4 reps, 2–5 sets. Practice spreading your toes so none touch, using tissue or toe spreaders if needed, then work on lifting each toe independently.

4. Bracing, stagger stance and the psoas stretch

For heavy lifts, brace by filling the trunk with air rather than doing a soft belly breath. For curls and overhead triceps work, use a wide staggered stance with your belly button facing forward to train the abs in real-world positions. McGill's psoas stretch: hold a long lunge, raise the arm on the back-leg side with the palm flat to the ceiling and the pinky rotated toward your head, 5–10 seconds per side.

5. Watch your daily posture

The last tool is awareness. Notice rounding while texting, foot position when sitting, and habitual leaning to one side. If you have a posterior bulge, a rolled towel behind your lower back while driving or flying keeps a slight arch. Stop any exercise that makes your pain worse.

Dr. Andy Galpin: Optimize Your Training Program for Fitness & Longevity | Huberman Lab Guest Series

Guest: Dr. Andy Galpin
Date: 2023-02-08 · Duration: 3:06:08
URL: https://www.youtube.com/watch?v=UIy-WQCZd4M

KEYPOINTS

1. Design the program in 10 steps, and pick exercises late

Galpin's sequence: set a specific goal, identify your "defenders," map the calendar, set days per week and session length, then select exercises, order them, set intensity, set volume, set rest intervals, and finally do "chaos management." No exercise is chosen until step five, because time and frequency limits narrow the options. Constraints create freedom, since choosing between two options is easier than choosing among dozens.

2. Make vague performance goals measurable with a proxy

"Feel better at the end of my round" depends on too much outside your control. Pick a measurable stand-in instead, such as a lower heart rate or faster heart-rate recovery after a regular 2-mile loop, or a faster 800-meter swim, and set something realistic like a 5% improvement in two months. Galpin's team uses the same proxy approach with pro athletes.

3. Identify your defenders: what's actually stopping you

Before choosing a program, figure out why past attempts failed: inconsistency, not knowing what to do, training hard without results, boredom, a gym that's too far, travel, frequent illness or old knee pain. Each points to a different program. A fat-loss plan from the internet may never address your actual point of failure. Galpin says life will win when it comes to kids and job, so fight battles you can win.

4. The quadrant system puts a budget on your energy

Adapted from Kenny Kane: divide 10 points across business, relationships, fitness and recovery. Huberman's split was 5-2-2-1, which Galpin calls the most common answer. Recovery should be at least half your fitness allocation and ideally 2 of 10, and it includes personal time, meditation, sleep and anything that restores you. If your fitness points can't support the goal and timeline, change the goal, the timeline or the split. Any change needs a concrete life action, not just "work less."

5. Underestimate your training time

Write deadlines, trips and family events on a physical calendar first, then plan backward. A 45-minute workout can become a two-and-a-half-hour block once travel, warm-up, showering and the transition back to work are counted. Schedule three days if you're sure of three. Extra time can always be added, but a plan you keep missing makes you feel like a failure and leads to quitting.

6. Balance across the week, and earn each progression

Balance movement patterns and muscle groups across the whole week, not within every session, and make sure any target (such as glutes) is checked off somewhere. Galpin's progression ladder for a movement like the squat: do it well with assistance, then unassisted, then with added load on the lowering phase, then holding the bottom isometrically, then adding the lifting phase, and only then adding speed and finally fatigue. This can take five minutes or two years depending on your injury history and confidence.

7. Put your top priority first, on your most reliable day

Generally do the most important exercise first in the workout and on the day you're most consistent in schedule and energy. Your week doesn't have to be seven days. Galpin ran a nine-day cycle for a Major League Baseball player who hit all-time velocity bests eight years into his career. Huberman puts legs on Monday, when he's most rested, and long cardio on Sunday.

8. Progress gradually, then deload

Galpin's rules of thumb: raise intensity about 3% per week and volume about 5 to 7%. Problems start above 10% per week. Adding a mile to each of three runs takes a 10-mile week to 13, a 30% jump. For lifting, total your weekly reps (three exercises of 3x10, three days a week, is 270) and add about 5%, for example going from sets of 10 to sets of 11. Progress for about six weeks, then deload to roughly 70% before building again, every four to eight weeks.

9. Rest intervals and chaos management

Rest 2 to 5 minutes between sets for speed, power and strength. Hypertrophy can use 30 seconds to 3 minutes, and endurance rest follows the type of endurance being trained. Last, look for likely failure points, like a disliked exercise or a clash with work, and solve them in advance. Your priorities then settle in-the-moment choices, such as a cut-short session or a hotel gym.

EXAMPLES

1. A year by quarters

Q1 (January to March): add muscle with a modest surplus of 10 to 15% (roughly 250 to 400 extra calories on a 2,500 baseline, not a "dirty bulk"), more sleep, three or four lifting sessions, an indoor sport and two long walks a week. Q2: get lean with a small deficit and outdoor sport as days lengthen. Q3: intervals and outdoor sport at maintenance calories. Q4: endurance with more calories, an indoor sport, trail running for proprioception and machines. Take a deload or vacation week between quarters.

2. The three-day template

Day 1: speed and power, then hypertrophy. Power goes first because fatigue would compromise it. Day 2: strength, then a high-heart-rate piece. Day 3: steady-state long-duration endurance. Use mostly whole-body exercises. Each session can be done in under 60 minutes, with 30 to 45 minutes of work.

3. The four-day template

Day 1: strength in the 5 to 10 rep range. Day 2: restorative long-duration work. Day 3: 11 to 30 reps or muscular-endurance work such as yoga, Pilates, a dance or spin class, or a circuit. Day 4: medium-intensity rolling intervals (for example one minute at 85 to 90% heart rate, one minute at 50%), finishing with 5 to 6 minutes near max, such as Galpin's 5-minute all-out assault bike effort. Sessions run in order rather than on fixed days, so a missed Monday just slides to Tuesday.

4. Drop Everything And...

At Barbell Shrugged, Galpin's team used "DETA" (drop everything and train at 3 p.m.). Huberman and Galpin extend it to drop everything and read, play or breathe. Limit yourself to one or two. Make the quadrant your phone background, post it at your "place of failure" (laptop, TV) and give it to an accountability partner.

OTHER RELEVANT

1. Timing exercise around sleep

Galpin says about 30-plus minutes a week in the top 10% of your heart rate tends to improve deep sleep if done well away from bedtime. Huberman cites papers suggesting hard exercise at least about six hours before sleep. If you must train late, extend post-workout down-regulation breathing. Galpin says some athletes' sleep complaints were solved by stopping 8 p.m. intervals. Huberman limits caffeine to before about 2 p.m., noting that caffeine in the hours before bed disrupts sleep architecture.

2. Exercise is not the same as physical activity

Lifting three days a week and sitting otherwise isn't optimal. Aim for roughly 150 to 180-plus minutes a week of low-intensity movement through walks, walking pads or exercise snacks. A nurse logging 15,000 steps may already cover it, but a desk worker likely needs deliberate walks. Galpin also wants at least one weekly session that challenges proprioception, such as a sport.

3. Hypertrophy reps versus strength reps

Sets of 15-plus reps build muscle as well as 5 to 12, but don't build much strength, so include some heavier work. Huberman recaps hypertrophy guidance from earlier in the series: at least 10, and more like 15 to 20, weekly sets per muscle, with 6 to 30 reps taken close to failure. Galpin adds that true failure is best saved for safer exercises.

Dr. Andy Galpin: Optimal Protocols to Build Strength & Grow Muscles | Huberman Lab Guest Series

Guest: Dr. Andy Galpin
Date: 2023-01-25 · Duration: 4:39:23
URL: https://www.youtube.com/watch?v=CyDLbrZK75U

KEYPOINTS

1. Strength training is the main tool against neuromuscular aging
Galpin calls heavy-overload resistance training the only exercise route that preserves the nerve–muscle–bone chain behind independent movement. After about age 40, people lose roughly 1% of muscle size a year, but 2–4% of strength and about 8–10% of power. Older adults can have 30–40% fewer motor units. Power is what lets you stand up, catch a fall and move confidently.

2. It is never too late to start
Starting in your 20s is ideal, but Galpin stresses that a 50-year-old who has never lifted is 'not toast' and can reach a very good level quickly. Bone mineral density responds best to axial (vertical) loading. In his lab's program, women in their 20s and 30s with low bone density showed DEXA-measurable gains within eight months, alongside nutrition and hormone work-ups.

3. The '3 to 5' framework covers speed, power and strength
Train 3–5 days a week, choosing 3–5 compound exercises, doing 3–5 sets of 3–5 reps with 3–5 minutes of rest between sets. Doing one or two reps is fine; going above five is generally not. The range runs from 3×3 of three exercises three days a week up to 5×5 of five exercises five days a week. Progress the load by roughly 3–5% a week, using smaller jumps on lifts where 5 lb is a big change.

4. Power and strength differ mainly in load and intent
Power work sets use 30–70% of your one-rep max: up to 50–60% on a squat, closer to 30–40% on a bench. Strength work sets use 70% or more. In both cases intent is critical: you don't get faster by moving 'kind of fast'. With maximal intent you can build strength at 50% of max, or with zero load by squeezing hard during a plank.

5. Prilepin's chart caps how much heavy work is productive
Galpin uses the old weightlifting chart to dose volume by intensity. At 55–65% of max it prescribes 3–6 reps per set and 18–30 total reps, with about 24 as ideal. At 90% and above it is only 1–2 reps per set and about 7 total. Most working sets live in the 70–90% band, and going beyond the totals brings diminishing or negative returns.

6. Hypertrophy is forgiving but needs about 10–20 hard sets per muscle per week
Count sets where a muscle is a primary or secondary mover, so biceps count on chin-ups but not pull-ups. Exercise choice matters less than covering all muscle groups (rear delts and calves included) with movements you can push near failure safely. Consistency in exercise selection beats constant variation.

7. Rep range barely matters for growth, but proximity to failure does
Anything from about 4 to 30 or more reps per set can build muscle if sets end close to failure, roughly two reps in reserve. A set of 25 that only 'started to get hard' does not count. Citing a review from Eric Helms's team, Galpin says total failure isn't required. Use it on safer movements (a hack squat rather than a barbell back squat), and very advanced lifters may need it more often.

8. Six to nine reps is a blend, not a dead zone
Galpin jokes that students assume 1–5 reps builds strength, 8–12 builds size and 6–9 does nothing. In fact the 6–9 range gives a balanced mix of strength and hypertrophy.

9. Cardio interferes with growth mainly through energy and eccentric damage
The interference effect largely disappears if you eat enough. Choose endurance modes that spare the trained muscles' eccentric loading, such as cycling instead of running for leg growth. Moderate work, like 25 minutes at 70% of max heart rate, is unlikely to hurt. Best is a separate day, then a separate session, then cardio at the end of the lift.

10. Bracing is about intra-abdominal pressure, not holding your breath for oxygen
Treat the torso as a cylinder, like a sealed can that resists crushing, and push the belly out front, sides and back without lifting the shoulders. The Valsalva maneuver uses air for that brace. Galpin argues you should learn to breathe and brace at the same time, and says hugely overdeveloped spinal erectors can signal poor bracing.

EXAMPLES

1. Non-responders often just need a different dose
When a training partner triples in size and you don't, Galpin's data reported person by person often show non-responders need more volume. Plateaus can be broken by swinging to the other end of the range: heavier and lower-volume, or sets of 20–25 that cause less soreness.

2. Hidden stressors act like a foot on the brake
When athletes get sleep and other invisible stressors under control, soreness from identical workouts drops and they can tolerate more volume and more sets to failure. Galpin's rule is to take the left foot off the brake before pressing the accelerator.

3. No cold plunge on hypertrophy days
Despite owning a deep-freezer plunge, Galpin advises against ice right after, right before, or even on the same day as hypertrophy training. Cold blocks the gene-expression and protein-synthesis signal that triggers growth. In-season recovery

after games is a different goal.

4. Rear delts and neck

For the rear delts he suggests chest-supported reverse flys with the shoulder blades down and back, and points to coach Eric Cressey for shoulder-girdle detail. For the neck he prefers isometrics and avoids neck bridges, which he says can damage discs.

OTHER RELEVANT

1. Sequence accessory work after 3×5 work

Arm or calf hypertrophy work can be added after the main lifts, but high-rep work can hurt recovery for the next strength or power session. If your goal is purely power or strength, leave other training out.

2. Protein: about 1 g per pound (1.6–2.2+ g/kg)

Following Don Layman and Stu Phillips, Galpin says that if total protein is high enough, timing, type and leucine content matter much less, and plant proteins work too. Carbohydrate timing still matters for glycogen and training quality.

3. Creatine monohydrate, about 5 g a day, any time

Monohydrate has the largest evidence base. Smaller people may need about 3 g, and very large athletes 7–10 g. He calls timing irrelevant. Evidence is strongest for muscle; bone density and cognition benefits are being studied with mixed results.

4. Vary rest and intensity between workouts

For hypertrophy, rest anywhere from 30 seconds to 3–4 minutes depending on load and how close to failure you train. Take failure on the last set or in an occasional workout, and allow extra recovery when you do.

Optimize Your Exercise Program with Science-Based Tools | Jeff Cavaliere

Guest: Jeff Cavaliere
Date: 2022-07-04 · Duration: 2:40:47
URL: https://www.youtube.com/watch?v=UNCwdFxPtE8

KEYPOINTS

1. A 60/40 split between strength and conditioning
For general health with some muscle gain and leanness, Cavaliere, a physical therapist and strength coach behind ATHLEAN-X, suggests about 60% strength training and 40% conditioning. A simple week is lifting Monday, Wednesday and Friday with conditioning Tuesday and Thursday. He considers two conditioning sessions a week the bare minimum, and more is needed if cardiovascular performance is a priority.

2. Train long or train hard, but not both
Both men keep sessions to about an hour or less. Huberman does roughly 10 minutes of warm-up and 50 minutes of hard resistance work, plus 30 to 45 minutes for cardio sessions. He finds that going past about 60 minutes leaves him getting colds and weaker from session to session. Cavaliere says that as he's aged, workout length causes more problems than intensity, provided he warms up properly, which he now treats as an integral part of the session.

3. The best split is the one you'll stick to
Full-body, push-pull-legs (once or twice a week) and the "bro split" (one muscle group a day) can all work. A split you don't do isn't effective. Cavaliere notes the bro split helps people who need a few sets to lock in on how an exercise feels. Huberman's teenage split, given by Mike Mentzer, was shoulders and arms, two days off, legs, two days off, chest and back. Huberman now trains every other day because he wants to show up with fire.

4. Lift first, then do cardio
When conditioning and lifting share a day and lifting quality matters most, do the cardio afterward. Cardio before lifting impairs strength performance. Done fatigued afterward, it still taxes cardiac output. Two-a-days, such as pushing in the morning and pulling at night, can restore focus late in a workout but are impractical and systemically demanding for most people.

5. The Cavaliere cramp test predicts how well you can grow a muscle
If you can flex a muscle, such as the biceps or calf, so hard without load that it nearly cramps, you can likely stimulate it well under load. That intense contraction is the feeling to chase on each rep. Huberman says applying this made lagging body parts start growing. Cavaliere says the ability varies by exercise as well as muscle, and practice improves it.

6. Seek inefficiency for hypertrophy and efficiency for strength
For strength, let muscles work together, as chest, shoulders and triceps do in the bench press. For muscle growth, adjust the movement to make the target muscle work harder and feel more uncomfortable. If you don't feel it, something's off. Cavaliere says better neural connection also raises a muscle's resting tone, which he calls "muscularity."

7. Train external rotation of the shoulder
Daily life, sitting, and big muscles like the chest and lats pull the shoulder into internal rotation, while only small rotator cuff muscles rotate it externally. Reviewing a popular program, Cavaliere counted roughly 890 reps in a week and zero dedicated to external rotation. Add band external rotations. He swaps the upright row, which mirrors the Hawkins-Kennedy impingement test position, for a high pull with the hands rising above the elbows.

8. Much "back pain" starts elsewhere
A tight, weak gluteus medius can irritate the sciatic nerve and cause pseudo-sciatica that isn't from a disc. Cavaliere's fix, from what he calls his proudest video (30-plus million views): lie on your side, point the top toe down, press a thumb into the trigger point near the top of the glute, and lift the leg against the pressure. Huberman says repeating it a few times a day for three or four days resolved pain he'd thought was sciatica. Cavaliere notes it won't fix a genuine structural disc problem.

9. Grip in the palm to prevent golfer's elbow
On pulling exercises such as curls and chin-ups, the bar tends to drift into the fingertips, overloading the flexor digitorum superficialis (especially at the fourth finger), which attaches at the inner elbow. This is a common cause of medial epicondylitis, or golfer's elbow. Keep the weight deep in the palm, knuckles well over the bar. Huberman says this cured elbow pain he'd blamed on his triceps work.

EXAMPLES

1. Grip strength as a daily readiness check
With the Mets, Cavaliere's staff took grip baselines in spring training and retested every two or three weeks. At home, squeeze an analog bathroom scale. If your output drops by about 10% or more, consider skipping the gym that day. Huberman adds that grip strength follows a circadian rhythm, low at night and rising into the afternoon, so test at the same time each day.

2. Jump rope and landing
Progress from two-foot jumps to single legs, side-to-side hops and small twists to train all three planes. Aim to bounce off the balls of your feet. To feel why heel landing is bad, stand with toes raised and hop on your heels: your jaw will rattle, because heels have no shock absorption.

3. The plate method
Picture the plate as a clock showing 9:20, then draw a line to 12. The largest section is fibrous vegetables (broccoli, Brussels sprouts, asparagus). The next largest is protein, cooked to be enjoyable (Cavaliere gave up boiled chicken as a teenager).

The smallest is starchy carbs such as sweet potato, rice or pasta. Starches are the easiest to overeat, so controlling their portion matters most. As he puts it, nobody eats 10 chicken breasts.

4. Sheets and sleep position

Huberman untucked the sheets at the foot of his bed after hearing Cavaliere explain that tight sheets keep the toes pointed all night. Combined with tibialis work, this resolved his shin splints and running-related back pain. Cavaliere advises against stomach sleeping because it extends the lumbar spine, puts the arms overhead in internal rotation and cranks the neck.

OTHER RELEVANT

1. Stretching timing

Save passive stretching for later in the day, away from training or competition, because it temporarily disrupts the muscle's length-tension relationship and stored motor patterns. Cavaliere says muscles tend to heal shorter during overnight repair, so evening stretching may help. Before training, use dynamic moves like leg swings, butt kicks, walking lunges and toe touches.

2. Nutrient timing is flexible

Cavaliere says the strict post-workout anabolic window has been largely debunked, with refueling still beneficial three to five hours after training. Get protein either before or after, whichever doesn't hurt your session. He rejects "no carbs after 6 p.m." Huberman's pre-workout is good sleep, hydration, caffeine and music.

3. Kids and lifting

Cavaliere suggests around age 13, at puberty, to start adding external weight. Before that, and for any beginner, bodyweight work like lunges, pull-ups and chin-ups provides plenty of stimulus and builds control of the body. He also recommends tracking rest times and lifts, and staying off social media between sets.

The Science & Practice of Movement | Ido Portal

Guest: Ido Portal
Date: 2022-06-20 · Duration: 2:34:37
URL: https://www.youtube.com/watch?v=a9yFKPmPZ90

KEYPOINTS

1. Movements are containers; movement is the content
Portal separates specific movements, such as squats, push-ups or pirouettes, from the broader quality of being in motion. Exercises are like a cup handed to you with water in it: the point is to drink the water, not chew on the cup. A practice can start from any entry point, whether the spine, the pelvis, playfulness or a sport, as long as you keep asking whether you are collecting exercises or actually developing movement.

2. Movement practice begins with education and awareness
Before any technique, Portal wants people to notice that they live in a body that is always in motion, and that emotions and thinking move too. He describes three braided streams, action, emotion and thought, and says many practitioners never pay attention to how a movement feels. He borrows from Moshe Feldenkrais the view of a person as nervous system, mechanical body and environment together.

3. Discomfort is a marker that you are in the right place
Portal doesn't chase discomfort, but treats it as a gauge. If it is absent, you are probably just gratifying yourself; if it is so high you cannot make progress, you went overboard. Huberman adds the neuroscience: after a failed motor attempt, the forebrain enters a heightened state of focus for seconds to minutes, and the frustration of an error is the cue that primes the nervous system to learn from the next attempts.

4. Skill is a flexible 'sleeve', not a fixed pattern
Portal cites the Soviet movement scientist Nikolai Bernstein, who filmed workers swinging sledgehammers and found that accuracy at the hammer head improved while variation in the joints increased. The system self-adjusts to hit a stable result. Portal calls this a movement sleeve: many paths lead to the goal, and exploring that variety is what produces virtuosity. Huberman links it to Bence Ölveczky's work, where an expert's racket path in a tennis serve is highly consistent.

5. The deep squat is a resting position we have lost
Portal frames the squat not as a strength exercise but as a basic resting and working posture that chairs replaced. People also neglect overhead and behind-the-back positions, which he calls the 'back realm'. He notes anatomy varies: deeper or shallower hip sockets, femur shapes and Q angles make the squat easier for some populations than others.

6. Spinal waves may unlock more than mobility
Portal favours starting from the torso with dorsal, ventral, side-to-side, rotational and spiralling undulations, because big movements can mobilise some regions while others stay held. He says he has no evidence, only experience, that emotional material can be stored in tissue and released through spine work, echoing Ida Rolf's 'the issues are in the tissues'.

7. Train how you use your eyes
Portal argues that we don't move our eyes as well as we think, and that head and eye position lead whole-body movement. There is no single correct mode; sometimes vision should be soft and peripheral, sometimes tightly focused. He separates awareness from focus, which people often fuse, and uses the eyes as the easiest way into either state.

8. Linear gym movements are a narrow slice of what bodies do
Portal sees modern training, and even much modern yoga, as very linear, whereas traditional dances and martial arts are rounded and curved like movement in nature. He extends this to walking: swaying and coiling can help breathing pump naturally. Changing a single stance in the gym is a good start, but the value lies in continued examination rather than one new trick.

9. Touch and proximity are underused skills
He believes adults are touched too little and suggests many people join jiu-jitsu classes partly for contact. Learning to adjust how reactive you are to people close to you, and sometimes to switch reactivity off, matters for performance and clear thinking. Huberman notes that many people feel anxious in close face-to-face settings.

EXAMPLES

1. The squat challenge
Portal's prescription is to accumulate 30 minutes a day in an unloaded resting squat, spread through the day rather than in one sitting. You don't need to hold an upright torso. Build up gradually, since some people get hurt going too fast. He reports benefits for digestion, lower back, hips, knees and ageing in general, as a way of keeping the body's ability to fold.

2. Walking a crowded city as practice
Without a gym or nature nearby in Hong Kong, Portal would strap on a bag and spend two hours weaving through packed streets and escalators, trying not to touch anyone. It's a fully engaged, adaptive session that needs no equipment: 'the more low-tech are your tools, the more high-tech you are.'

3. Let kids fidget
Portal would make school chairs more mobile, not less, saying constant instructions to sit still remove self-discovery and can even hurt focus. Huberman recalls rolling his skateboard under his desk.

4. The stick-balancing honesty test
Anyone can balance a stick on a fingertip for 10 seconds, but holding it for 10 minutes exposes whether claimed focus holds up. For Portal, movement keeps self-assessment honest.

5. Counting to nine

Portal sometimes counts reps only to nine so people stay in the movement rather than mentally finishing at 10, a small example of leaving the process deliberately unfinished.

OTHER RELEVANT

1. Experiment with gait

Try different walks for different situations, such as entering a meeting or leaving a bad one, including approaching with the chin slightly down, and notice how each changes your state.

2. Thread movement through the day

Breath rhythm, how you get out of bed, or taking stairs playfully all count, alongside any dedicated session.

3. Approach practice as a researcher

Portal tries combinations, notices what he discovers and avoids forcing a predetermined answer, a humility he sees as central to progress.

Dr. Andy Galpin: How to Build Strength, Muscle Size & Endurance

Guest: Dr. Andy Galpin
Date: 2022-03-28 · Duration: 3:31:28
URL: https://www.youtube.com/watch?v=IAnhFUUCq6c

KEYPOINTS

1. Exercise produces about nine distinct adaptations, and fat loss is not one of them

Galpin lists skill, speed, power, strength, hypertrophy, muscular endurance, anaerobic power (roughly 30 seconds to 2 minutes), VO2 max (about 3 to 12 minutes) and long-duration endurance (30+ minutes without a break). Fat loss is a byproduct rather than a trainable quality. Some of these carry over to each other (power is strength multiplied by speed), while others compete, so pushing one hard can cost you another.

2. Every adaptation depends on progressive overload

Adaptation is a response to stress, so repeating the same Monday-Wednesday-Saturday routine indefinitely will maintain fitness but won't improve it. Overload can come from more weight, more reps, more frequent sessions, more movement complexity, or a bigger range of motion. Galpin stresses that the core concepts are few and the methods are many.

3. Default to taking every joint through its full range of motion across the training week

Galpin says the research fairly consistently shows larger ranges of motion improve both strength and hypertrophy, and they also reduce injury. The caveat is that full range is a target, not a licence for bad technique. If reaching depth in a deadlift means rounding your lower back, shorten the range and keep the spine neutral.

4. Strength training means heavy loads, few reps and long rests

Because of Henneman's size principle, high-threshold fast-twitch fibres only get recruited when the muscle has to produce a lot of force. For moderately trained people, that means roughly 85% or more of your one-rep max (about 75% can work for less-trained lifters), five reps or fewer per set, and 2 to 4 minutes of rest between sets so fatigue doesn't cut into intensity. Keeping fast-twitch fibres matters for aging, because they're the ones lost first.

5. Beginners respond to almost anything

In Galpin's lab, untrained subjects doing just 30 minutes of cycling gained muscle strength and size. Specificity, meaning that what improves reflects what you demanded, only becomes important once you're past the beginner stage. That's when 'imposing a demand of strength, not repetitions' starts to pay off.

6. Hypertrophy is forgiving on reps but strict on effort

Anywhere from about 5 to 30 reps per set produces broadly similar muscle growth in the research, with 8 to 30 roughly equally effective. The non-negotiables are taking sets close to muscular failure and recovering enough for protein synthesis to happen. He cites recent meta-analyses suggesting a minimum of about 10 working sets per muscle group per week, and suggests rotating rep ranges simply to keep training interesting.

7. Muscle growth has three likely drivers, and any one can be enough

The three candidates are mechanical tension (heavy loads), muscle damage and metabolic stress (the burn). Galpin says the mechanisms are still a 'guessing game.' Metabolic stress probably explains why very light blood flow restriction training still builds muscle. More soreness isn't better, and a little is only a rough proxy.

8. Endurance work should start with concentric-dominant exercise

Running is a series of single-leg eccentric landings, so jumping straight back into 25-minute jogs often leads to sore quads, shin splints and knee or back pain from compensating. Galpin suggests building endurance first with cycling, swimming and similar low-eccentric work, then adding running once the tissue can handle it.

9. Hit maximum heart rate about once a week

Galpin doesn't count conversational-pace movement as exercise, though it's still essential: walk while you take calls, pace around. He recommends one session a week that reaches near-maximal heart rate, which takes at least about 30 seconds of all-out work (e.g. a bike sprint or 90 seconds of burpees). His reasoning is specificity: stroke volume, cardiac output, endothelial function and mitochondrial adaptations only get pushed if you push them. He calls the 220-minus-age formula a rough guide only; his own max is close to 210.

10. Sodium bicarbonate and beta-alanine buffer the acid that drives fatigue

Galpin explains that fatigue usually reflects a pH signal long before you run out of fuel or oxygen, because enzymes stop working well outside a narrow pH range. Bicarbonate buffers that acid, and beta-alanine is stored as carnosine, which buffers inside the muscle. He calls both cheap, safe and well studied for repeated high-intensity efforts.

EXAMPLES

1. The '3 to 5' strength and power template

Do 3 to 5 exercises for 3 to 5 sets of 3 to 5 reps, rest 3 to 5 minutes, and train 3 to 5 days a week. That ranges from a 20-minute session (3×3 of three exercises, three times weekly) up to 5×5 of five exercises, five days a week. For strength, use 85%+ of your max. For power, use roughly 40–70% and move fast.

2. The Galpin equation for hydration

Research suggests about 2 ml of fluid per kg of body weight every 15 minutes during exercise. Galpin converts this to body weight in pounds divided by 30, in ounces, every 15–20 minutes. A 200-lb person would drink about 6.5 oz. He also suggests about 500 mg of sodium before and after training (more for salty sweaters), and notes Himalayan salt is relatively low in sodium. The gut can be trained to tolerate fluid while running.

3. Ice baths straight after hypertrophy training

Galpin, who calls himself a big believer in cold water immersion, says getting into ice right after a hypertrophy session is 'getting pretty close to you just shouldn't have done the session.' He estimates roughly 10% blunted growth, more in some individuals. He suggests waiting about 4 hours, a figure he admits is theoretical, or doing cold before training. Cold showers are a much weaker stimulus.

4. Heat after training

A handful of studies suggest about 20 minutes of sauna after hypertrophy work may augment growth, possibly through increased blood flow, though he says there's no established dose for time or temperature. A hot bath is the next-best option. He warns against assuming a 300% rise in growth hormone translates into more muscle.

OTHER RELEVANT

1. A simple balanced session

Pick one each of an upper-body press, upper-body pull, lower-body push (squat, lunge) and lower-body hinge (deadlift, RDL), covering both horizontal and vertical pushing and pulling over the week. Warm up in ramps, for example 10 reps at 50%, 8 at 60%, 8 at 70% and 5 at 75%, before your working sets.

2. Train strength at least twice a week per muscle

Galpin says twice per week per muscle is a good minimum for getting most people strong, and three is great. Daily training is possible but unnecessary unless strength is your job.

3. Downregulate for five minutes after training

His athletes finish every session with breathing and dimmed light, lying on their backs if possible. Use exhales about twice as long as inhales (e.g. 4 seconds in, 8 out) or box breathing. Huberman reports that adding this improved his recovery between workouts. During lifts, Galpin says bracing matters more than when you exhale.

4. Creatine is the standout supplement

Galpin calls creatine monohydrate the 'Michael Jordan' of supplements: cheap, safe and effective across many domains, with much of the research now clinical, including brain and mood. He's explicit that it is not a cure for depression. Huberman takes 5 g a day, mainly for cognition.

5. Watch total stress against recovery capacity

Galpin frames recovery as visible stressors plus hidden stressors set against recovery capacity. When stress outpaces recovery, you regress. Morning grip strength and a CO2-tolerance exhale test are tools his group uses, with CO2–anxiety findings still unpublished at the time.

How to Build Endurance in Your Brain & Body

Date: 2021-06-07 · Duration: 2:05:30
URL: https://www.youtube.com/watch?v=VQLU7gpk_X8

KEYPOINTS

1. Quitting is decided by neurons, not by a '90% mental' split
Huberman cites a Cell paper in which subjects pushed toward a goal while a virtual environment made their effort look futile. Neurons in the locus coeruleus release epinephrine as an effort signal. Glial cells track that release, and at a threshold they shut it off, which is the moment of quitting. When epinephrine release was extended, subjects kept going. He calls the 'mental versus physical' debate meaningless: endurance is 100% nervous system.

2. Five systems limit endurance: nerves, muscle, blood, heart and lungs
Neurons need glucose (or ketones if fully keto-adapted) plus sodium, potassium and magnesium, because action potentials and the sodium-potassium pump depend on ATP and the right pH. Muscle burns phosphocreatine and stored glycogen, and its ATP production is temperature-sensitive. Blood carries glucose, fatty acids and oxygen; the heart moves it and the lungs bring in the oxygen. The episode draws heavily on exercise physiologist Dr. Andy Galpin.

3. Muscular endurance: 3–5 sets of 12–100 reps with no major eccentric load
Muscular endurance fails at the muscle, not the cardiovascular system; push-ups are the classic example. The protocol is 3–5 sets of 12–25 reps (up to 100), resting 30–180 seconds and going to or near failure. Planks or wall sits of 1–2 minutes also work. Avoid slow lowering phases and jumping or deceleration, since eccentric work drives soreness and damage. Push-ups should touch the chest to the floor. Isometrics also build the postural endurance that 'text neck' erodes.

4. Long-duration endurance: one continuous bout of 12+ minutes builds efficiency
Long-duration work below maximal oxygen uptake builds efficiency of movement and mitochondrial density, so you make more ATP for the same effort and burn less fuel overall. It also builds new capillary beds in muscle; Huberman compares this to swapping a single hose for a sprinkler system. That is why a run that ended at 20 minutes feels easier the next time.

5. Anaerobic HIIT: 3–12 sets pushing above VO2 max
Work-to-rest ratios run from 3:1 (30 seconds on, 10 off) to 1:5 (20 seconds on, 100 off). The shorter rest suits low-skill movements like assault bikes; the longer rest preserves form with kettlebells or loaded squats, where reps degrade and injury risk rises. Start with about three sets once or twice a week and add a set or two weekly. It improves mitochondrial respiration and the neurons' ability to recruit muscle, which helps with repeated sprints in field and racquet sports.

6. Aerobic HIIT works best at a 1:1 work-to-rest ratio
An example is running a mile in about seven minutes, resting seven, and repeating for four or more miles of work. Huberman says many people use this to complete half marathons or marathons without having run the full distance in training. It trains nearly all the energy systems at once.

7. Intense intervals strengthen the heart and support the brain
The extra blood returned to the heart during repeated hard efforts eccentrically loads the left ventricle, increasing stroke volume and lowering resting heart rate. That delivers more glucose and oxygen to muscle and brain, including the hippocampus. Huberman says the brain benefits come through vascularization and factors like IGF-1, not from new neurons. Strength and hypertrophy work has been studied less for the brain and does not produce the same stroke-volume gains.

8. Breathing can be trained as a gear system
Nasal breathing filters air and is more efficient. Following Brian McKenzie's gear model, do long-duration work through the nose and add mouth breathing as intensity climbs, exhaling on the effort. Galpin's lab found that warming up the intercostals and diaphragm before endurance work lets you breathe more deeply and deliver more oxygen.

9. Hitting 'the wall' can mean over-relying on one fuel
Briefly speeding up, not to an all-out sprint, can shift muscles toward phosphocreatine or another mix of lipids and carbohydrate. Huberman notes that elite athletes now carb-load and also take exogenous ketones during long races, because the body is built to use multiple fuels at once.

10. Visual focus is a performance tool, which is why pacers are restricted
Narrowing your gaze to a point activates alertness circuits, including the locus coeruleus, while panoramic vision relaxes you. Run hard to a landmark, then widen your gaze to recover, rather than chaining milestones nonstop, which drains more energy. Visual pacers often invalidate record times, and a runner being passed can suddenly find a 'kick', as with Steve Prefontaine.

EXAMPLES

1. Huberman's futile Pacific swim
Swimming south against a current, he looked left and saw the same hotel after 20 minutes of effort. This real-world version of the futility experiment illustrates how lack of progress pushes you toward quitting.

2. Dehydration costs 20–30% of capacity
You lose about 1–5 pounds of water per hour of exercise. Losing 1–4% of body weight in water cuts work capacity by roughly 20–30% and also impairs thinking. Huberman warns that drinking far too much water without electrolytes can be lethal.

3. The Galpin equation
Divide body weight in pounds by 30 to get the ounces of fluid to drink every 15 minutes of exercise; adjust upward for heavy sweating. Above about 70% of VO2 max, gastric emptying slows, so build up the ability to drink during intense work by starting with small sips.

4. Fixing a side stitch
A side stitch is usually referred pain from the phrenic nerve, which drives the diaphragm and branches near the liver. Huberman relieves it with repeated physiological sighs: a deep inhale, a second sneaked-in inhale, then a long exhale.

5. The CO2 tolerance test for recovery
Take four breaths in and out, then a big inhale and a slow, controlled exhale. Sixty seconds or more suggests your nervous system has recovered; under about 45–60 seconds suggests a rest day may help.

OTHER RELEVANT

1. Stop deliberating and just schedule it
Ruminating over whether and when to train burns neural energy, glucose and epinephrine, possibly as much as the workout itself. Huberman is not a 'just do it' advocate, but recommends deciding cleanly.

2. Space sessions and protect recovery
Allow at least 4–6 hours, ideally 24, between different workouts, and take one or two full rest days a week. Avoid ice baths within about six hours of strength or hypertrophy work. Cold after endurance work may boost mitochondrial adaptations, though this is still debated. Finish each session with at least five minutes of slow nasal breathing with long exhales, or lying down, to downshift. To maintain muscle, do at least five sets per muscle per week.

3. Supplements with modest roles
Caffeine improves endurance and power output, though one study suggests it may inhibit the creatine system. Magnesium malate reduces delayed-onset soreness (it is different from the forms used for sleep). Beet-based nitric oxide boosters and beta-alanine help some people, but beta-alanine can cause a tingling, niacin-like flush.

Science of Muscle Growth, Increasing Strength & Muscular Recovery

Date: 2021-05-31 · Duration: 2:04:20
URL: https://www.youtube.com/watch?v=XLr2RKoD-oY

KEYPOINTS

1. The 'burn' isn't lactic acid: lactate fights it
Huberman says humans make lactate, not lactic acid. Lactate buffers the acidity you feel as the burn, serves as fuel for continued contraction, and acts as a hormone-like signal to the heart, liver and brain, partly by improving astrocyte function in the brain. He recommends reaching that burn safely for about 10% of training, and breathing deeply through it rather than holding your breath, since these lactate effects depend on oxygen.

2. Exercise helps the brain through blood-borne signals, not new neurons
Exercise reliably boosts neurogenesis in mice, but Huberman says human evidence is weak beyond, possibly, the hippocampus's dentate gyrus. The benefits more likely come from factors like IGF-1 and lactate supporting existing connections, which he argues may be preferable, since circuits struggle to integrate brand-new elements.

3. Henneman's size principle doesn't require heavy weights
Motor units are recruited from low to high threshold, using the minimum needed, and more are recruited as effort continues. So the high-threshold units that drive adaptation can be reached with loads anywhere from about 30% to 80% of your one-rep max, taken to or near failure. Heavier loads (75–90%) bias toward strength; lighter loads with more reps bias toward hypertrophy.

4. Muscles adapt to stress, tension and damage by thickening myosin
Huberman compares myosin filaments to a disorganized bouquet of balloons on strings of different lengths. Adequate stress, tension or damage triggers synthesis of more myosin, so the 'balloons' get bigger and the muscle grows thicker. He credits Andy Galpin and Brad Schoenfeld for much of the episode's framework.

5. Strength means distributing work; hypertrophy means isolating it
The nervous system naturally spreads effort across muscles for efficiency. Getting stronger is about moving progressively greater loads with many muscles working together. Hypertrophy depends on hard, localized, almost painful contractions of a specific muscle. If you can voluntarily contract a muscle hard without any weight, it likely has good growth potential.

6. About five sets per muscle per week maintains it; more builds it
For relatively untrained people, 5 sets per muscle per week is roughly the maintenance minimum, and 10–15 (up to 20) sets drive gains. Trained lifters may benefit from up to 25–30 sets. Muscles you contract easily need fewer sets; hard-to-activate muscles need more. Sets can be split across sessions.

7. Take about 10% of sets to failure; stop the rest near it
Most sets should end close to failure, so you can accumulate volume without overtaxing the nervous system. Sessions of about 45–60 minutes are recommended, since longer, intense sessions tilt toward cortisol and inflammation. Repetition speed between 0.5 and 8 seconds doesn't seem to matter for size or strength. Moving loads as fast as is safe builds explosiveness, mainly through neural changes.

8. Some common habits can blunt your gains
Huberman cites emerging data that whole-body cold within about four hours after resistance training may interfere with mTOR and other pathways that build muscle, even though it reduces soreness. Antihistamines and NSAIDs taken within about four hours before or after training may also dampen the useful inflammatory signal and mask pain. Inflammation during and right after training is part of the stimulus.

9. Hard training can temporarily dull thinking
Per Galpin, intense sessions of 30–60 minutes, or interval-heavy runs, reduce brain oxygenation afterward. On the upside, training at a regular time conditions the body's clocks to expect focus then, so non-training days at that hour are good for demanding cognitive work.

EXAMPLES

1. Duncan French's testosterone protocol
Six sets of 10 reps on big compound lifts with exactly two minutes of rest raised serum testosterone; 10 sets of 10 did not and leaned catabolic. French suggests doing it at most twice a week.

2. Morning recovery checks
Track your grip strength (with a hard rubber ring or by squeezing a floor scale) against a well-rested baseline; a 10–20% drop is a warning sign. For the CO2 discard test, take four deep breaths, then a fifth full inhale, then exhale as slowly as possible and time it. Under about 25 seconds suggests incomplete recovery, 30–60 seconds is a green zone, and 65–120 seconds indicates full systemic recovery. A 15–20% drop from your usual time is a cue to ease off.

3. Between-set tactics
Flexing a target muscle between sets aids hypertrophy but hurts performance on the next set. Pre-exhausting with an isolation move (leg extensions before squats) targets the muscle at the cost of the compound lift. Rest 2–6 minutes for strength and size. Palmar cooling can preserve reps across sets. A few physiological sighs between sets, and five minutes of downregulation at the end, start recovery.

4. Supplements discussed
Creatine: about 5 g a day for a 180-lb person (10–15 g if heavier, 1–5 g if lighter), with no loading needed. Huberman notes it can raise DHT and, in some men, hair loss. Beta-alanine (2–5 g) is for 60–240-second efforts. Arginine and citrulline may aid

long efforts but can trigger cold sores. For inflammation, Galpin's trio is more than 1,000 mg EPA a day, vitamin D and magnesium malate. Check with a doctor first.

OTHER RELEVANT

1. Don't neglect electrolytes

Sodium, potassium and magnesium let nerves fire and drive muscle. Needs rise with heat, sweat, caffeine and diuretics, and plain water alone won't cover them.

2. Aim for leucine-dense protein two to four times a day

Huberman suggests 700–3,000 mg of leucine per meal, ideally from whole foods. Animal proteins are denser per calorie, and plant-based eaters may consider leucine supplements. He suggests a 10–15% calorie surplus if gaining muscle is the goal.

3. Pick a consistent training time

Results for size and strength don't depend much on the time of day, though afternoon may favor performance. Huberman suggests 30 minutes, 3 hours or 11 hours after waking. Then run one- to six-month experiments to find what works for you.