

A person is shown from the waist down, performing a squat with a barbell. They are wearing blue sneakers and white socks. The background is a gym floor with a dark mat in the foreground. The image is semi-transparent, allowing the text to be overlaid.

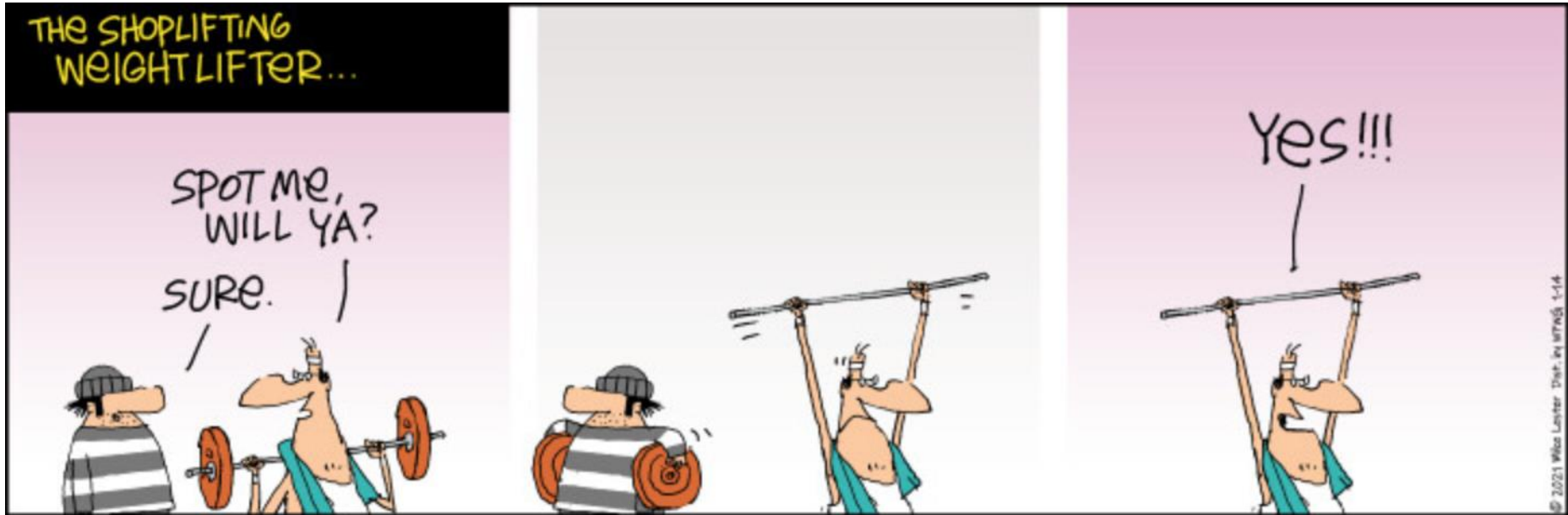
Strength Training: A Guide for the PCP

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Disclosures

None



Overview

1. **What is strength training?**
2. **What are the benefits of strength training?**
 - a. Obesity
 - b. Diabetes
 - c. HTN
 - d. Heart Failure
 - e. Osteoarthritis
 - f. Back pain
 - g. Osteopenia + Osteoporosis
 - h. Depression
3. **What are the risks of strength training?**
 - a. CAD
 - b. HTN
 - c. Back pain
 - d. Rhabdomyolysis
 - e. Other
4. **Strength training myths**
5. **Forms of strength training**
6. **Summary**

What is strength training?



Why do it?

Definitions:

- **Force:** Mass x Acceleration - being able to transfer energy into something.
- **Work:** Force x Distance
 - E.g. powerlifting
- **Strength:** Many definitions but for our purposes: ability to produce force against resistance, can be dynamic or static
- **Power:** Force x Velocity
 - or (Force x displacement) / time
 - E.g.: plyometrics, Olympic lifting


- Ability to generate muscular force needed for power, balance, flexibility, endurance
- Protection against injury/falls

What is it?

- **Strength training/resistance training:** a program of exercises performed over time to increase the “ability to produce muscular force in useful movement patterns”
- **Progressive overload:** a steady increase in the amount of stress applied to the muscles



What are the benefits of strength training?



Benefits of Strength Training

- **The same general benefits from any kind of regular exercise**
 - Insulin sensitivity
 - Resistance to oxidative stress
 - Increases lean body mass, decreases fat (visceral fat)
 - Improved blood pressure
 - Improved sleep, mood
- **Strength training-specific benefits:**
 - Improves power, which is tied to speed and agility
 - Increased muscle mass
 - Preserve/improve BMD
 - Increased anaerobic capacity
- **Benefits on mortality:**
 - 2012 Swedish study in *BMJ*
 - 2016 US study in *Preventive Medicine*
 - 2020 systematic review and meta-analysis in *European Journal of Preventive Cardiology*

Obesity

- **2005 systematic review in *International Journal of Obesity***
 - Diet + exercise (in general) is better than diet alone in terms of initial weight loss and keeping the weight off
- **Aerobic exercise may be better for reducing fat mass but increasing resistance training can increase lean mass**
 - Increase resting metabolic rate → prevent weight gain?
 - Increasing lean mass → decreased body fat percentage
- **More resistance to muscle protein synthesis to anabolic stimuli (exercise, dietary protein) in obesity**
 - Chronic inflammatory state, gene expression alteration, lipid accumulation in muscle cells
- **2021 study in *PLoS Med***
 - Resistance training (with or without aerobic training) is a/w lower risk of obesity
- **Bottom line: RT increases lean muscle mass → increase resting metabolic rate**

Diabetes

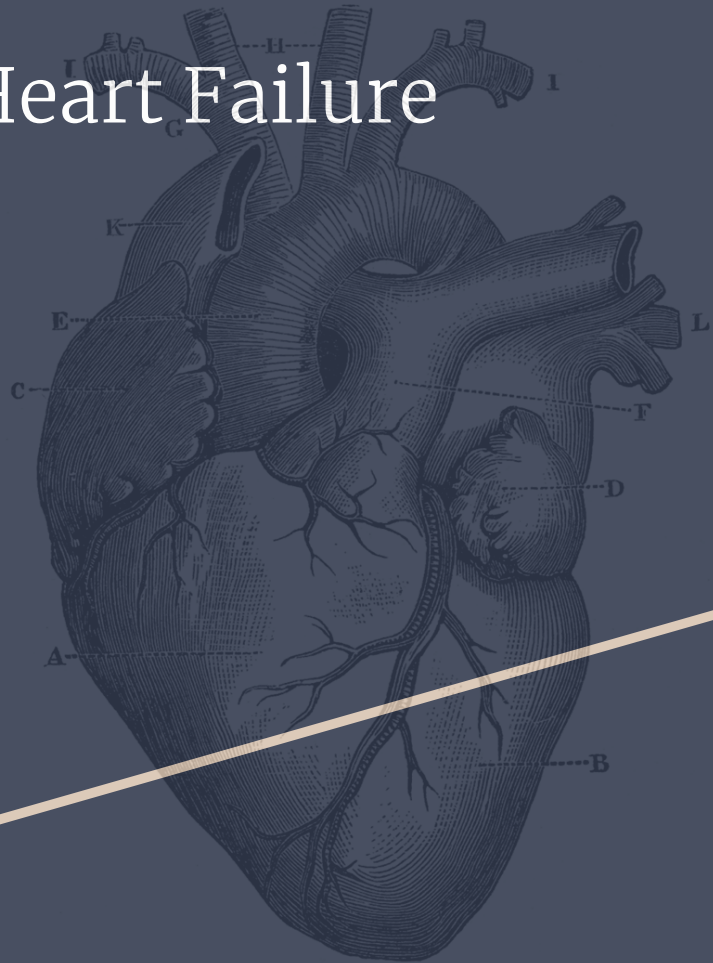
- **2010 systematic review and meta-analysis in *Sports Medicine***
 - Resistance training can help lower A1c
- RT increases blood glucose uptake into cells in both patients with DM and w/o DM
 - **2004 study:** Increased GLUT4 translocation to sarcolemma
- RT → increased skeletal muscle mass → improved glucose uptake at baseline
- RT can lower the risk of developing T2DM
 - **2012 prospective study in *Archives of Int Med***
- **Bottom line:** RT improves glucose uptake



Hypertension

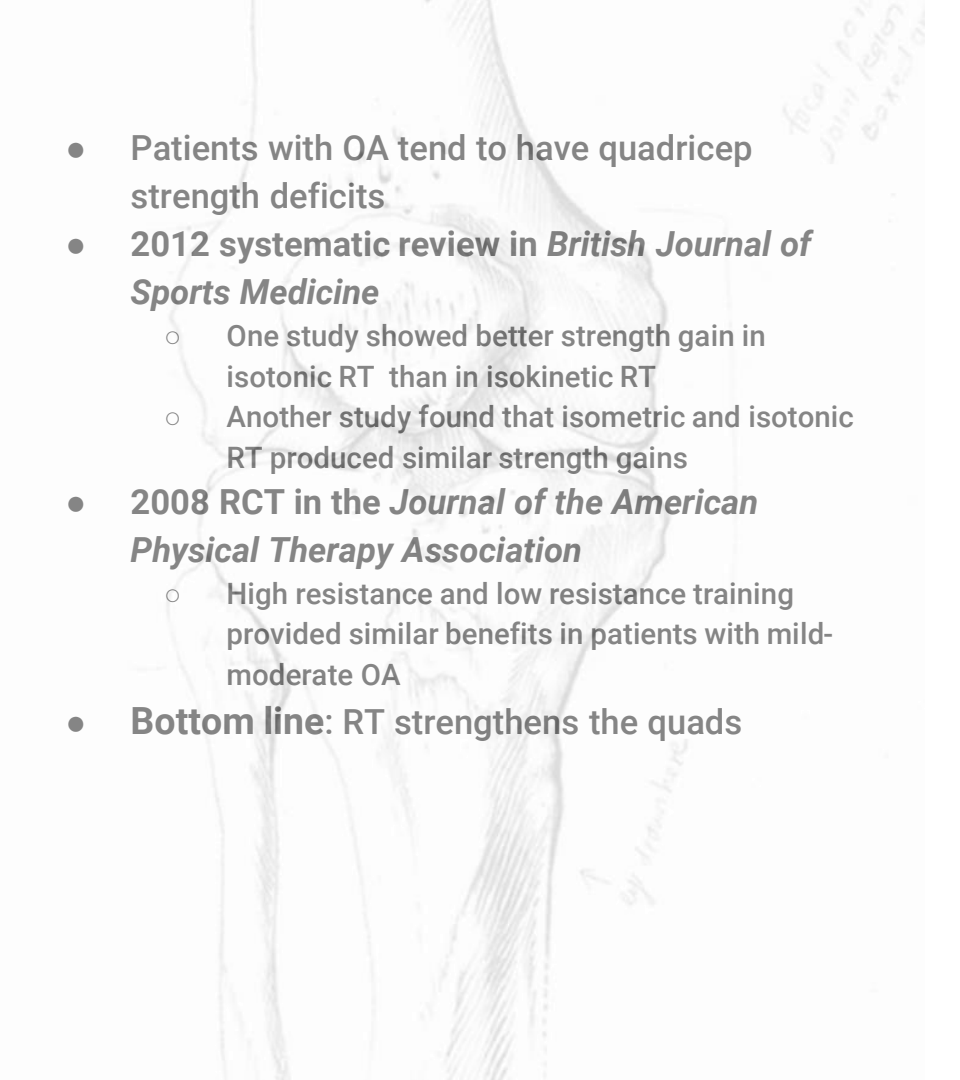
- **2016 meta-analysis in *Journal of the American Heart Association***
 - RT done ~2-3x/week reduced SBP by ~3 mmHg and DBP by ~ 2 mmHg
 - Greater drop in SBP, DBP in non-white samples and in those with HTN
- **Other reviews/meta-analyses:**
 - In normotensive to pre-HTN groups, SBP reduced by ~3.9 mmHg with RT ~ 3x/week
 - In pre-HTN and HTN groups, RT reduces SBP by ~8 mmHg and DBP by ~4 mmHg
- **Change in BP from RT may be different from that caused by AE**
 - Increase in vascular stiffness but with (?compensatory) increase in blood flow + increase in vasodilatory capacity
- **Bottom line:** For HTN, would recommend AE with RT

Heart Failure



- Patients with HF can have significantly less exercise tolerance, leading to further decreases in aerobic capacity and strength
- Heart failure → → imbalance between anabolism/catabolism → skeletal muscle wasting
- RT less studied in patients with HF compared to aerobic training due to concerns about risks, such as increase in afterload
- Most studies in patients with HFrEF and interventions are variable
- **2016 systematic review/meta-analysis in *International Journal of Cardiology***
 - RT, alone or with AE improved peak VO₂, QOL, and 6 min walking distance in HFrEF patients
- **2011 pilot RCT in *Journal of the American College of Cardiology***
 - AE + RT in HFpEF: no adverse events, increased peak VO₂, LVD function
- **Bottom line:** Would refer to cardiac rehab program

Osteoarthritis

- Patients with OA tend to have quadricep strength deficits
 - **2012 systematic review in *British Journal of Sports Medicine***
 - One study showed better strength gain in isotonic RT than in isokinetic RT
 - Another study found that isometric and isotonic RT produced similar strength gains
 - **2008 RCT in the *Journal of the American Physical Therapy Association***
 - High resistance and low resistance training provided similar benefits in patients with mild-moderate OA
 - **Bottom line:** RT strengthens the quads
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Back pain



- **Acute back pain (<4 weeks) = good prognosis**
 - Exercise has NOT been shown to improve short-term outcomes
 - Still would avoid bedrest
- **Subacute back pain (4-12 weeks) and cLBP = better evidence for exercise**
- **The challenge: pain creates a fear-avoidance cycle**
→ need to break this for rehab to work
 - Baseline psychosocial variables (catastrophizing, anxiety, kinesophobia, fear-avoidance) predict long-term pain more than structural findings on MRI
- **2011 study in the *Journal of Strength and Conditioning Research***
 - Resistance training 2-4x/week resulted in improvements in strength, pain, and QOL, particularly in the 4x/week group
- **2014 study in *Medicine and Science in Sports and Exercise***
 - Total body resistance training was associated with lower perceived disability, fear-avoidance, and pain catastrophizing
- **Bottom line: RT improves pain + psychosocial factors in cLBP**

Osteopenia + Osteoporosis


- Disuse and unloading of skeleton → reduced bone mass
- Most of us have reached peak bone mass by age 30
- **2011 meta-analysis in *Cochrane Database of Systematic Reviews***
 - In post-menopausal women, weight-bearing and non-weight-bearing resistance training slightly improves BMD and lowers risk of fracture
- **2018 RCT in *Journal of bone and mineral research***
 - High-intensity resistance and impact training in post-menopausal women with osteopenia/osteoporosis increased lumbar and proximal femur BMD and functional performance
- **Bottom line:** Encourage patients to build their bone mass while they are young. For older individuals, consider PT referral. Avoid high-impact exercises and things that twist/bend the spine - slow, controlled movements are better.

Depression/Anxiety

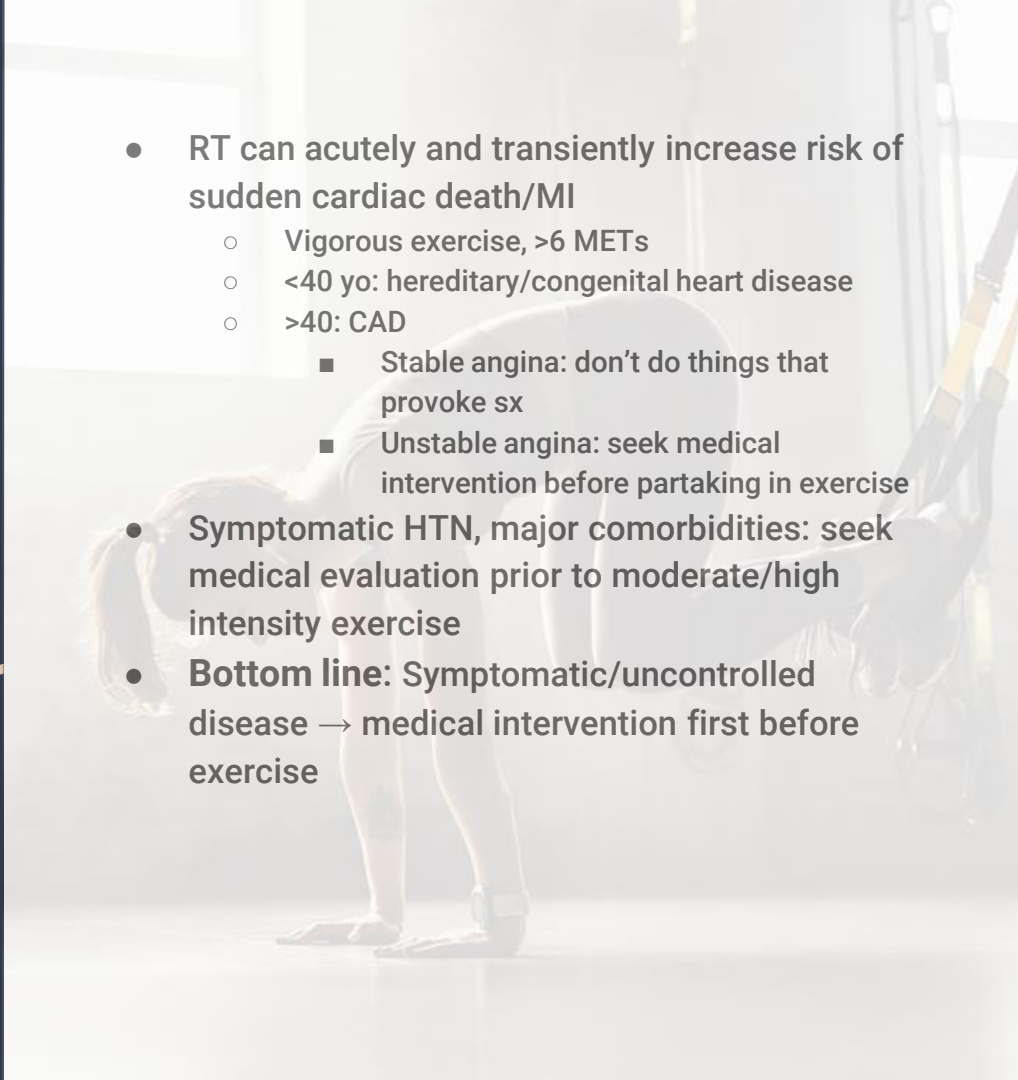
- **2018 meta-analysis in *JAMA Psychiatry***
 - RT improved depressive sx in patients
- **2017 meta-analysis in *Sports Medicine***
 - RT improved anxiety sx in patients
- **Bottom line:** Encourage patients with depression/anxiety to do any form of exercise



What are the risks of strength training?



CAD + HTN

- RT can acutely and transiently increase risk of sudden cardiac death/MI
 - Vigorous exercise, >6 METs
 - <40 yo: hereditary/congenital heart disease
 - >40: CAD
 - Stable angina: don't do things that provoke sx
 - Unstable angina: seek medical intervention before partaking in exercise
 - Symptomatic HTN, major comorbidities: seek medical evaluation prior to moderate/high intensity exercise
 - **Bottom line:** Symptomatic/uncontrolled disease → medical intervention first before exercise
- 

Back Pain + Rhabdomyolysis

- RT - if not done carefully, can increase risk of MSK injuries, including acute lumbar strain
 - And other MSK issues: tendon sprain/rupture, ligament tear. Can cause chronic conditions to flare.
- **2017 systematic review in *Sports Medicine***
 - Weight-training sports appeared to have lower injury rates compared to common team sports
- **2017 systematic review in *British Journal of Sports Medicine***
 - Risk of injury in Olympic and powerlifting is similar to other non-contact sports, low compared to contact sports.
- Rhabdo: many risk factors at play, RT is not inherently dangerous
 - New, sudden increase, unfamiliar programming
 - Recently ill/not exercising for a long time
 - Unforgiving weather conditions
 - Genetics/FHx
- **Bottom line:** No red flag sx in back pain → can still participate in RT. If concerned, can do careful programming to improve self-efficacy, reduce kinesophobia. Proper and sensible programming is key.

Other

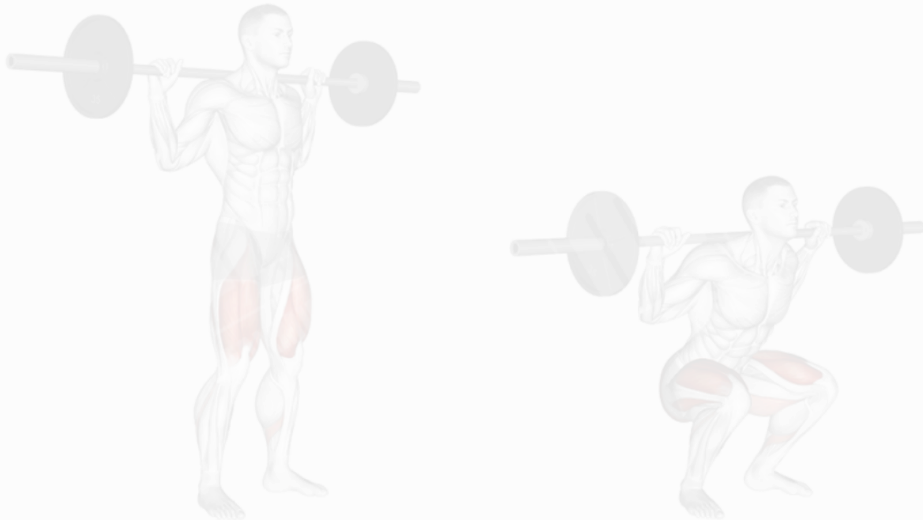
- Risk of hypoglycemia in patients on oral/IM DM meds
 - May need careful BG monitoring, reduction in insulin, ingestion of carbs during work-out
 - May need multi-specialty approach w/ Nutrition, Endocrine, Pharm
- Peripheral/autonomic neuropathy → increase risk of falls, orthostatic hypotension
 - May need supervision, adequate hydration

Strength training: *Myths*



I heard that ...

- The Valsalva maneuver during weight lifting can increase ICP and cause brain hemorrhages.



- Valsalva increase thoracoabdominal pressure → helps increase truncal rigidity.
 - Natural response to lifting heavy loads
 - People do it all the time: when having a BM, when delivering a child, when equalizing middle-ear pressure
 - During RT, Valsalva duration is relatively short
 - No studies to date showing causal relation between RT + Valsalva and ICH, though there are case reports
 - Risk is not necessarily with Valsalva but instead if patient has predisposing factors, such as aneurysm

I heard that ...

- I shouldn't strength training during pregnancy.

Box 1.

Examples of Exercises That Have Been Extensively Studied in Pregnancy and Found to Be Safe and Beneficial

- Walking
- Stationary cycling
- Aerobic exercises
- Dancing
- Resistance exercises (eg, using weights, elastic bands)
- Stretching exercises
- Hydrotherapy, water aerobics

Modified from Berghella V, Saccone G. Exercise in pregnancy! Am J Obstet Gynecol 2017;216:335-7.

- If pregnancy is uncomplicated (e.g. no pre-eclampsia), RT is not contraindicated
- 2015 ACOG Committee Opinion
 - **“Physical activity and exercise in pregnancy are associated with minimal risks and have been shown to benefit most women, although some modification to exercise routines may be necessary because of normal anatomic and physiologic changes and fetal requirements. In the absence of obstetric or medical complications or contraindications, physical activity in pregnancy is safe and desirable, and pregnant women should be encouraged to continue or to initiate safe physical activities.”**

I heard that ...

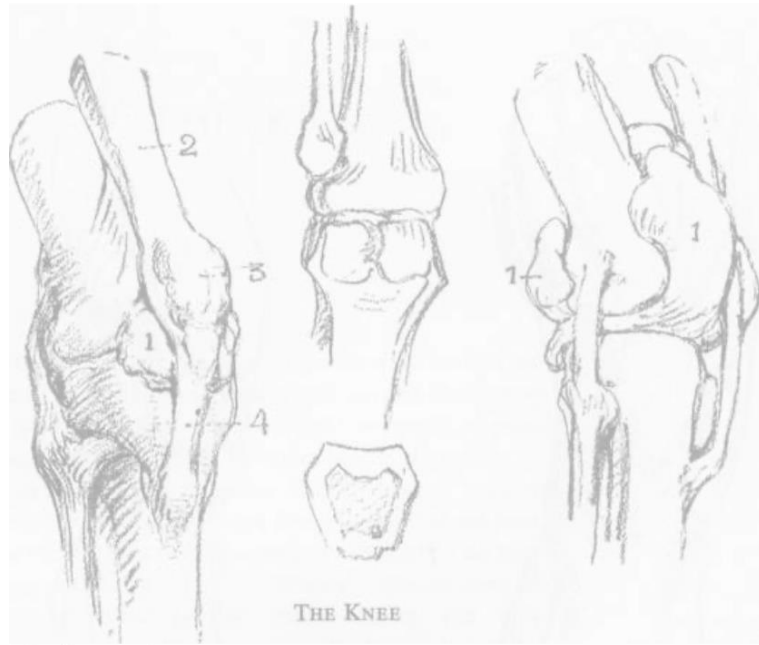
- Strength training will stunt my growth.



- **2006 review in *Clinical Journal of Sports Medicine***
 - RT in pre/early-pubertal youth
 - No negative effect on growth
- **2009 study in *Journal of Strength and Conditioning Research***
 - Most common injury in kids (age 8-13) was due to “dropping” the weight on hands/feet
 - This is preventable with proper supervision
- **2020 statement from AAP**
 - “Appropriately designed resistance training programs have no apparent negative effect on linear growth, physical health, or the cardiovascular system.”
 - Explosive contractions of muscle/tendon attachment at apophyseal areas can lead to avulsion fx
- Genetics and nutritional status also influence skeletal health
- Remember: RT is not limited to weight lifting. It can be body weight!
- Technique, supervision, proper progression are important

I heard that ...

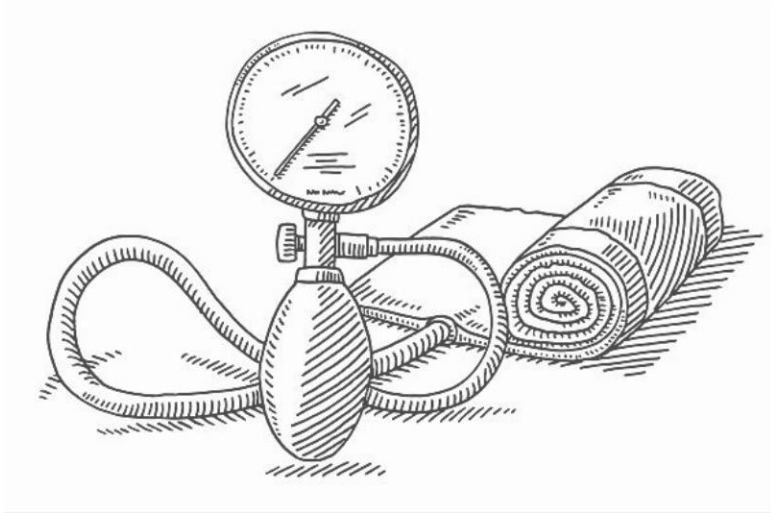
- Strength training will worsen my OA.



- Gradual RT improves muscle strength, function, and pain scores
- Inactivity → weight gain/loss of strength → more stress on joints/deconditioning/frailty
- **1998 study in *Arthritis Care and Research***
 - RT (and exercise in general) can decrease pain and self-efficacy scores

I heard that ...

- Strength training will worsen my blood pressure.



- RT may transiently increase BP during training but not long-term
- **2020 RCT in JAMA**
 - ~2k adults, 70+ yo, followed for 3 years.
 - Some assigned to RT (some also vit D, omega 3 group)
 - No e/o of harm from RT (CV events)
 - No chronic worsening of BP

I heard that ...

- Strength training will make me less flexible.



- Flexibility is trainable
- RT can even improve mobility with proper technique

I heard that ...

- I will “bulk up” too much.



- RT is not the same as bodybuilding, although bodybuilding does involve RT
- Bodybuilding is not necessarily focused on strength, but rather focuses on muscle hypertrophy and building an “ideal” physique
- Genetics helps determine body’s response to RT

Forms of strength training



The spectrum



Summary



Take home points

- RT can benefit health overall, as with any sort of exercise
- RT can improve CVD risk factors, pain scores and perceptions of pain, and depression/anxiety
- When in doubt, refer to PT or a supervised rehab program
- Encourage your otherwise young and healthy patients to engage in RT - the key is prevention!
- Consider recommending RT in addition to the “AE 150 min/week min” during exercise counseling
- Focus on what the patient CAN do and not what they CANNOT do
- RT comes in a variety of forms - from body weight to barbell - one size does not fit all

Questions?

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