Workshop 3 and 7: Prescribing Exercise for Almost Anyone
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Saturday, February 10, 2018
1:30 p.m. – 3:00 p.m./ 3:30 p.m. – 5:00 p.m.

The purpose of this presentation is to allow the attendees to better understand the nuances of different types of physical activity (aerobic, resistance, flexibility, balance, combined, and high-intensity intervals), prescribe effective exercise using the current recommendations for various populations, such as youth, adults, and older adults, and provide guidance in the management of health complications during all exercise and physical activity.

References


Prior Exercise Guideline References (not listed in presentation):


Prescribing Exercise For Almost Anyone

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Presenter disclosure
In compliance with the accrediting board policies, the American Diabetes Association requires the following disclosure to the participants:

Sheri R. Colberg, Ph.D.
Has no conflicts to disclose

Exercise and Physical Activity Basics

Managing health with exercise

• Regular physical activity is underutilized to manage health
• Optimize blood glucose, lipid, and blood pressure to prevent or delay health problems and complications
• Greatly improve metabolic health by taking small steps away from sedentary behavior toward greater physical activity

What should everyone be doing?

• Get moving with aerobic activities
• Work on getting and staying strong
• Flex joints daily to stay limber
• Practice staying on their feet
• Move more all day long
• Break up sitting time with activity
• Get some physical activity every day

Many factors affect exercise responses

Exercise factors:
• Type, intensity, duration, training state

Environment:
• Heat, cold, humidity, altitude, air pollution
Exercise energy systems

Colberg S. Diabetic Athlete’s Handbook, 2009

Exercise can raise blood glucose

- Hormones increase production of glucose by the liver and reduce glucose uptake:
  - Glucagon
  - Epinephrine (adrenaline)
  - Norepinephrine
  - Growth hormone
  - Cortisol

- Exaggerated release during high-intensity activities in everyone; can cause lasting blood glucose rise in diabetes

Fuel use during exercise

Facimil JA et al., JAP, 88(5): 1707-1714, 2000

Glucose uptake during rest and exercise

- Contraction and insulin: separate, but additive, mechanisms

Physical activity improves insulin sensitivity

**Aerobic** exercise:
- A single bout increases insulin sensitivity for 2–72 hours
- Greater glucose storage in muscle (as glycogen) post-exercise
- Enhanced fat metabolism

**Resistance** training:
- Longer effect by increasing muscle mass (or slowing or preventing loss with aging)

Amati F et al., Diabetes Care, 32(8): 1547-9, 2009

No insulin action loss with aging in athletes
Why focus on muscle mass?

- Normal loss of muscle mass with aging
- Accelerated loss of muscle with:
  - Physical inactivity
  - Disease (including diabetes)
  - Rapid weight loss/dieting
- Carbohydrate storage tank critical
  - Both total capacity and depletion

Why is resistance training critical for us all?

- Normal loss of muscle mass with aging
- Accelerated loss of muscle with:
  - Physical inactivity
  - Disease (including diabetes)
  - Rapid weight loss/dieting
- Carbohydrate storage tank critical
  - Both total capacity and depletion

Is a checkup needed before starting exercise?

- Depends on a person’s age, health, and current activity
- Can usually start easy activities and walking without one
- May need checkup—or at least medical clearance—prior to starting harder exercise
  - Particularly if sedentary and plan to do vigorous exercise

Preparticipation health screening algorithm

- Body weight/BMI
- Heart rate, blood pressure
- Fasting cholesterol, triglycerides
- Fasting plasma glucose
- ID and risk stratification for CVD
  - Possible 12-lead ECG, labs
- Auscultation of lungs and heart
  - Possible pulmonary function testing
- Joint limitations, arterial pulses
Who needs an exercise stress test?

• Medical consultation, diagnostic exercise testing for CAD useful when clinically indicated
• Not universally recommended to enhance exercise safety


Exercise stress test for higher risk adults

May be recommended prior to training for higher risk adults:

• Smoker
• High blood pressure
• High blood cholesterol
• Known macrovascular disease
• Microvascular disease (eyes, kidney)
• Over 40 years old with diabetes
• Over 30 years with diabetes 10+ years

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Do exercise and physical activity differ?

Physical activity:• Includes all movement that increases energy use

Exercise:
• Planned, structured types of physical activity

Exercising program basics (FITT-VP)

Frequency: how often
Intensity: how hard
Time: how long (duration)
Type: mode of activity
Volume: F x I x T (expenditure)
Progression: moving forward

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Exercise/physical activity modes

Aerobic:
• Repeated and continuous movement, large muscle groups

Resistance:
• Increases muscular strength and/or endurance

Balance:
• Enhances lower extremity and core strength and flexibility, benefits gait, and prevents falls

Flexibility:
• Improves range of motion around joints

Daily movement:
• All unstructured activities done during the day, ADLs

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Aerobic exercise intensity

Recommended intensity for cardiovascular fitness training:

• “Moderate” to “vigorous” for most adults
• “Light” to “moderate” for deconditioned

Methods to monitor exercise intensity:
1. Talk test
2. Perceived exertion
3. Heart rate reserve


“Talk Test” method

Light (or low) intensity:
• Can talk, sing, or whistle while doing the activity

Moderate intensity:
• Can talk, but not sing, during activity

Vigorous intensity:
• Short of breath or winded and unable to talk easily or sing

Perceived exertion method

• Subjective rating based on total body sensations (increased heart and breathing rates, increased sweating, and muscle fatigue)

Heart rate reserve method

• Recommended intensity using Heart Rate Reserve (HRR):
  - Moderate: 40–59% HRR
  - Vigorous: 60–89% HRR
  - Low: 30–39% HRR (for deconditioned or older adults)
  - Use 40–89% HRR in place of 55–90% of maximal HR

Heart rate reserve method calculations

\[
\text{HRR} = \text{Maximal heart rate (MHR)} - \text{Rest heart rate (RHR)}
\]

- RHR should be measured in the morning, before rising
- MHR can be measured directly, or estimated as:
  - 220 – Age (years)
  - 208 – (0.7 x Age)

Percent HRR (% HRR) = HRR x intensity [as decimal]

Target HR = [(MHR – RHR) x target intensity] + RHR

Heart rate reserve sample calculation


Heart rate reserve method

- Subjective rating based on total body sensations (increased heart and breathing rates, increased sweating, and muscle fatigue)
- Recommended aerobic intensity (moderate to vigorous): “somewhat hard” to “hard”
  - 12 to 16 (on 6–20 scale)
  - 4 to 8 (on 1–10 scale)
Resistance exercise intensity

Muscular strength (based on 1-RM, repetition maximum):
- Older or sedentary: 40–50% 1-RM (very light to light)
- Novice to intermediate: 60–70% 1-RM (moderate to hard)
- Experienced: ≥80% 1-RM (hard to very hard)

Muscular endurance:
- <50% 1-RM (light to moderate intensity)

Power:
- Older adults: 20–50% 1-RM

Exercise frequency

Aerobic exercise:
- Recommended frequency based on exercise intensity:
  - ≥5 days per week if moderate,
  - ≥3 days per week if vigorous, or
  - combination of both types ≥3–5 days per week

Resistance exercise:
- 2–3 days per week (with ≥48 hours between sessions)

Flexibility and Balance/Neuromotor exercises:
- ≥2–3 days per week

Aerobic exercise duration

- Recommended duration based on exercise intensity:
  - 30–60 minutes per day (150 per week) if moderate,
  - 20–60 minutes per day (75 per week) if vigorous, or
  - combination of both types per day

- <20 minutes (<150 minutes per week) may be beneficial, if starting out sedentary

- Bouts of <10 min for very deconditioned

- Interval training can be effective in adults

Resistance training:
- No specific duration identified

Flexibility exercises:
- Hold static stretches for 10–30 seconds
- Older adults may need 30–60 seconds

Balance/Neuromotor exercises:
- ≥20–30 minutes per day

What about high-intensity interval training?

- Effective, but not a place to start for most adults with chronic diseases (high risk of injury, demotivation)

- Okay to start HiIT if younger, fitter
- Can work up to doing if older, unfit
- Possible with diabetes, other diseases

- For high-intensity intervals or training:
  - Medical clearance if older, unfit
  - Foundational fitness first
  - Start slowly (1 day per week)

Exercise duration

Aerobic training:
- ≥500–1,000 MET-min per week
- ~1,000 kcal per week
- ~150 minutes of moderate activity

Resistance training:
- 2–4 sets with 8–12 reps per set
- Even 1 set per muscle group works
- Older/unfit can start with ≥1 set of 10–15 reps with very light to light intensity


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Exercise volume

**Flexibility** training:
- Total of 60 sec per joint recommended
- Hold a single exercise for 10–30 seconds, 30–60 sec more effective for older adults
- ≥2–3 days per week, daily most effective

**Neuromotor/Balance** training:
- Optimal volume (reps, intensity) unknown
- Older adults: ≥60 minutes per week
- Balance, agility, coordination, and gait

Exercise progression

**Aerobic** exercise:
- Gradual progression of exercise volume: adjust duration, frequency, and/or intensity
- Enhances adherence and reduces risk of musculoskeletal injury and adverse cardiovascular events

**Resistance** exercise:
- Gradual progression of greater resistance, and/or more repetitions per set, and/or increasing frequency

**Flexibility and Balance/Neuromotor** exercise: Unknown

How quickly should people progress?

- Depends on:
  - Age
  - Prior fitness/activity level
  - Fitness/health goals
  - Physical limitations/health concerns

- For most individuals, prudent to err on the side of caution: start slowly, progress slowly

Resistance exercise recommendations

**Frequency:**
- 2–3 nonconsecutive days per week recommended
- Start with at least 2 weekly sessions

**Duration:**
- 1 set of repetitions to near fatigue
- Up to 3–4 sets per exercise, 1–2 to start
- Aim for 8–15 repetitions per set, but do 10–15 to start

Resistance exercise recommendations

**Progression:**
- Increase resistance when target repetitions or sets met
- Then increase number of sets
- Lastly increase training frequency

**Applicable to:**
- Older, overweight or obese, cardiovascular disease, diabetes, joint limitations, other health concerns

Sample resistance training exercises

- Seated row
- Bench press
- Leg press
- Triceps extension
- Seated biceps curl
- Leg curls
- Leg extension
- Shoulder press
- Abdominal crunches
Important core strength exercises

- Planks/knee planks
- Side planks/knee side planks
- Crunches/crunches with twist
- Medicine ball twists
- Leg lifts
- Core ball transfers
- Knee fold tucks
- Bridging/bridging with single leg raise

Neuromotor/balance training

“Functional fitness”

- Balance
- Agility
- Coordination
- Gait
- Proprioception

Neuromotor/balance training

- Recommended for everyone over 40 years
- At least 2–3 days per week, but daily better
- Lower-body strength exercises for balance
- Exercises using balance equipment, lower-body and core resistance exercises, tai chi, standing on one leg

Balance training reduces falls risk

Balance training

Simple balance exercise:

- Stand on one leg
- Hold on with one, both, or no hands
- Alternate legs
- Try with eyes open, closed

Other balance exercises

- Side leg raises
- Toe raises
- Calf raises
- Toe towel grab
- Cushion stand
- Changed position stand
- Sit-to-stand
- Heel-to-toe walk
- Backward walk
Flexibility training

- Stretches best done at least 2–3 days per week or after any exercise session
- Warm up muscles first; include all major muscle groups
- Static stretches 10–30 seconds, or do dynamic stretching
- Critical with aging and diabetes


Combined/other training

- Combined training (aerobic/resistance) for optimal health and blood glucose management
- Done on the same or different days during week
- Activities like yoga and tai chi work on balance, flexibility, and strength at same time
- Enjoyable activities increase motivation


Break up sedentary time frequently

- Gain metabolic and glycemic benefits from simply breaking up sitting time frequently
- Interrupt prolonged sitting with light to moderate activity
  - Walking or resistance exercises every 20 or 30 minutes

Effects of breaking up sitting time


Get more daily physical activity/movement

- Take more steps
- Move more all day long
- Activities of daily living (ADLs)


Flexibility training improves joint movement

Breaking up sedentary time (30 minutes)

3-minute walks or resistance exercise every 30 minutes in adults with type 2 diabetes


Other exercise considerations/recs

• Adults unable or unwilling to meet the exercise targets can benefit from doing less than recommended
• Health benefits from concurrently reducing total time in sedentary pursuits
• Intersperse frequent, short bouts of standing and physical activity between periods of sedentary activity
• Gradual progression of exercise intensity and volume may reduce any risks of exercise
• Screen for signs and symptoms of CAD


Pregnant females

• Do 30 minutes of moderate intensity activity (either aerobic or resistance) on most, if not all, days of the week
• Increase duration of moderate exercise slowly
• If already active, maintain or lower intensity for pregnancy
• Include light or moderate resistance exercises
• Avoid during pregnancy:
  • Lying flat on the back after 1st trimester
  • Activities with increased risk of falling or abdominal trauma (e.g., contact sports, soccer, horseback riding, downhill or water skiing, outdoor cycling, or racquet sports)

Special Populations and Health Conditions

Children and adolescents

• Not just mini-adults in terms of physical responses
• Engage in 60 minutes or more of daily moderate or vigorous intensity aerobic activity
• Vigorous, muscle-strengthening, and bone-strengthening activities as part of this time at least 3 days per week

Older adults

• Often have comorbid health conditions, including obesity, hypertension, joint issues, and physical limitations
• Encourage to be as active as possible, given constraints
• Include aerobic, resistance, balance, and flexibility training to increase strength and decrease risk of falling
• Start at lower intensity
• Consider power training
Overweight/obese

- Overweight/obese often with health issues, joint or other physical limitations
- Do activities that are easier with excess weight (aquatic, stationary cycling, seated)
- If self-conscious, do home-based or other activities alone
- Start out slowly and progress slowly
- Aim for ≥250 minutes weekly
- 5–7 days per week for weight control

Orthopedic/joint limitations

- Focus on regular stretching and flexibility
- Progress slowly to manage joint changes and limitations
- Avoid activities that aggravate joints or worsen symptoms
- Individuals with diabetes more prone to structural changes to joints that can limit movement
- Shoulder adhesive capsulitis, carpal tunnel syndrome, trigger finger, metatarsal fractures, and neuropathy-related joint disorders (Charcot foot)

Osteoarthritis

- Overweight/obese often with arthritis in lower extremities
- Regular activity encouraged, may lessen joint pain
- Low, moderate, and/or non-weight-bearing is best
- Include range of motion activities and resistance training to strengthen muscles around joints
- Avoid activities causing joint trauma

Osteoporosis/osteopenia

- Decrease in bone mineral density, greater fracture risk
- Aerobic weight-bearing activities better (walking, standing)
- Avoid excessive twisting, bending, compression of spine during certain activities (e.g., yoga, Pilates)
- No explosive movements or high-impact loading
- Resistance training to prevent falls
- Focus on lower extremity, core
- High-velocity resistance exercises

Low back pain

- Manage low back pain with exercise and avoid bed rest
- Walking, biking, and swimming recommended
- Include aerobic, resistance, and flexibility exercise
- Limit activities that cause spread of symptoms
- Only avoid activity in first few days following acute and severe episode of LBP
- Reintroduce activities within two weeks

Hypertension

- Both aerobic and resistance training may lower resting BP
- Hypertensive responses exaggerated during activity
- Avoid Valsalva maneuver during resistance training
- BP meds and exercise-related hypotension (e.g., diuretics)
Vascular diseases (general)

- Exercise safe with precautions
- Coronary perfusion may be enhanced during higher-intensity aerobic or resistance exercise
- Watch for signs of myocardial infarction, such as chest pain, radiating pain, shortness of breath

Heart (coronary artery) disease

- Possible to do all types of physical activity
- Recommend supervised exercise training initially
- If chest pain on exertion, keep heart rate at least 10 beats per minute below onset
- Silent ischemia in many with diabetes

Post-myocardial infarction or stroke

- Restart exercise after myocardial infarction or stroke in a supervised cardiac rehabilitation program
- Start at a low intensity and progress as able to more moderate activities
- Include both aerobic and resistance exercises

Chronic heart failure

- CHF causes exertional dyspnea, fatigue
- Exercise training recommended for stable, chronic HF to reverse exercise intolerance and decrease risk of event
- Include aerobic activities, as well as resistance, flexibility
- Aim for moderate aerobic intensity (RPE 11-13)
- Intermittent exercise may reduce level of fatigue during subsequent training sessions

Pacemakers and defibrillators

- Rate-responsive, single- or dual-chambered, or three-lead
- ICDs safe during physical activity (prevent SCD)
- Evaluate heart rate and rhythm responses prior to start of exercise training
- Adjust devices to allow HR to rise during activities
- If ICD present, keep peak heart rate 10 to 10 beats below programmed HR threshold for pacing and defibrillation

Post-cardiac transplantation

- Peak cardiac output reduced 20% to 25% due to lack of direct cardiac sympathetic innervation post-surgery
- HR response during activity and at peak lower
- Include aerobic, resistance, and flexibility exercise
- Resistance train to combat immunosuppressive drug effects on bone and muscle strength
- Do not use HR-based training range
Peripheral artery disease

- Lower-extremity resistance training to overall function, even if painful during activity
- Choose low- or moderate-intensity walking, arm ergometer, and leg ergometer as aerobic activities
- If leg pain is excessive, stop activity and try another

Pulmonary disorders: asthma

- Exercise training generally well tolerated if asthma managed
- Avoid environmental triggers (cold, dry, dusty, pollution)
- Longer duration, higher intensity may trigger bronchospasm
- Begin with moderate activity; wait one month to progress to harder activities if tolerated
- Asthma control meds may affect HR
- Resistance train if use corticosteroids
- Keep bronchodilators handy

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Pulmonary disease: COPD (emphysema)

- Dyspnea, chronic cough, sputum, and SOB common symptoms
- Frequent weight loss, sarcopenia, skeletal muscle dysfunction
- Loss of strength, power, endurance
- Aerobic training recommended, esp. higher intensities, if appropriate
- Lighter if COPD severe, deconditioned
- Use dyspnea scale over HR one
- Add in resistance and flexibility training

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Cancer

- Common in older adults, >200 types
- Exercise safe for all types of cancer; avoid inactivity
- Evaluate for peripheral neuropathy, musculoskeletal changes due to cancer treatment prior to start of exercise
- No assessment needed for easy walking, resistance or flexibility exercises prior to start
- Potential arm/shoulder morbidity with breast cancer
- Monitor symptoms and be aware of fracture risks

Neurogenerative/neural diseases

- Multiple sclerosis, cerebral palsy, Parkinson's, fibromyalgia
- Lower levels of fitness, ROM, balance, motor skills common
- All types of exercise can be beneficial to improve function
- Start out slowly, progress slowly
- Incorporate functional activities (stair climbing, sit-to-stand)
- Balance training to prevent falls
- Avoid exercise with worse symptoms
- Watch for medication side effects

Diabetes and prediabetes

- Exercise (aerobic and resistance) for insulin sensitivity
- Aerobic, resistance, flexibility, & balance (if over 40) training
- For most with type 1, follow guidelines for all adults; with type 2, may need a greater amount (150 minutes) aerobic
- Avoid going more than two days without activity
- Adjust food and medications for exercise
- Use care when exercising with complications

Eye diseases/visual impairment

- With advanced or unstable diabetic proliferative retinopathy, avoid vigorous exercise, heavy resistance training, and jumping, jarring, head-down and breath-holding activities
- Don’t exercise while having a vitreous hemorrhage
- If cataracts or macular degeneration limit sight, avoid activities like outdoor cycling or use guide

Peripheral neuropathy/ulcers

- Moderate activity may improve symptoms, but...
- Proper foot care needed to avoid ulceration and amputation
- Non-weight-bearing activity may be better
- Keep feet dry and use appropriate footwear, silica gel or air midsoles, and polyester or blend socks (not pure cotton)
- Check feet daily for signs of trauma, irritation
- Avoid bearing weight on unhealed ulcers
- Properly care for amputation sites daily, and avoid jogging

Autonomic neuropathy

- May impact ability to exercise safely
- See doctor first if have cardiac autonomic neuropathy
- Avoid positional changes if get faint
- Use subjective ratings of perceived exertion to monitor intensity if exercise heart rate blunted
- Monitor hydration levels carefully (can overheat)

Kidney disease

- Most can be physically active without restrictions at any stage of kidney disease
- Start at low intensity and volume if aerobic function, muscle function reduced
- Tiredness with dialysis; adjust daily activities based on energy levels
- Light to moderate activities possible during dialysis sessions (but monitor electrolytes)

Motivation and Case Study

What are the barriers to being active?

- Fear of exercise (older adults, insulin users)
- Physically inactive/sedentary lifestyle
- Health complications
- Environmental barriers
What causes people to stop exercising?

• Perceived lack of time
• Start out at too high intensity
• Exercise-related injuries
• Demotivation

Why are injuries more common in some?

• Body weight/osteoarthritis issues
• Glucose “sticks” to collagen, joint surfaces
• Greater incidence of overuse injuries
• Overweight/obese
• Diabetes
• Use of statins, some diabetes medications

How can injuries be prevented?

• Proper warm-up and cool-down
• Appropriate starting intensity
• Slower progression
• Adequate rest
• Cross-training/variety

What else is important to keep in mind?

• Not every day the same physically or mentally
• Expect some good days and some bad ones
• Have contingency plans/workouts planned
• Make adjustments as needed
• Err on the side of caution

Case study (older, health issues)

77-year-old female (DH): rheumatoid arthritis, emphysema (on supplemental oxygen), 2x cancer survivor (breast cancer and mantle cell lymphoma), osteoporosis, frailty, peripheral neuropathy (due to chemotherapy)

• Taking methotrexate, naproxen, tamoxifen, sodium clodronate, iron, calcium, vitamin D, and alpha-lipoic acid
• Used to be more physically active, but rarely does any planned exercise due to emphysema, frailty, and fatigue
• Loss of feeling in feet (numb on soles, unable to feel ground when walking) due to prior chemo for lymphoma

Case study (older, health issues)

Which modes of aerobic physical activity should DH focus on, given all of her myriad health issues?

• Due to neuropathic feet and instability, prescribe activities that are non-weight-bearing and have a lesser falls risk:
  • Seated aerobic activities
  • Aquatic exercise
  • Stationary cycling
  • Rowing
  • Limited walking (with walker or cane)
• Dependent on preferences, skill level, other limitations
Case study (older, health issues)

What intensity, frequency, and duration of aerobic physical activity would be appropriate for DH to undertake?

- Light to moderate intensity (due to COPD, frailty)
- 3–5 days per week (at least every other day)
- Goal of 150 minutes of aerobic activity per week
- Can be intermittent, 5–10 minutes at a time to start
- Start slowly and progress very slowly towards goals
- Increase intensity last (or include faster intervals)

What other types of physical activity would be appropriate and recommended for DH to undertake?

- **Resistance** exercise, 2–3 nonconsecutive days per week
  - Older or sedentary: 40–50% 1-RM (very light to light)
  - Resistance bands, hand weights, body weight exercises
  - Minimum of 1 set of repetitions to near fatigue
  - Work up to as many as 3–4 sets per exercise
  - 10–15 reps per set to start

- **Balance** exercises, daily, if possible
  - May just start by practicing standing on one leg at a time
  - Some activities can be done seated (toe towel grab)

- **Flexibility** training, at least 2–3 days per week
  - Simple static stretching or dynamic movement
  - Yoga and tai chi also possible

How should DH progress with physical activity to best manage her health complications?

- Focus on duration of training to enhance endurance capacity
- Worry less exercise intensity (keep at light to moderate)
- Include more non-weight-bearing activities

- Increase resistance, then # of sets, and lastly resistance training frequency
- Work on functional fitness to reduce falls risk

What will be DH’s main concern(s) and/or precautions once she starts doing more planned physical activity?

- Supervision during activities recommended for safety
- Prevention of falls during physical activity
- Prevention of injury to insensate feet
  - Use of proper footwear and socks to keep feet dry
  - Daily foot inspection
- Use of supplemental oxygen during activities (as needed)

Conclusions
Remember: more SPA time for everyone

- More spontaneous physical activity (SPA), or daily movement
- Adding in SPA during the day easier for many
- Fitness gains less, but still bestows health benefits
- Metabolic benefits from breaking up sedentary time

Key activity take-aways for everyone

- Be regularly physically active to enhance metabolic health
- Do both aerobic and resistance exercise to maximize muscle mass and insulin action
- Include flexibility exercise, along with neuromotor/balance training for older adults
- Move all day long, and break up sedentary time frequently
- Start out slowly and progress slowly
- Stay physically active if you want to live long and well

Questions?