Does research demonstrate a causal (cause-effect) relationship between physical activity/exercise and cognitive function?

- **Keyword searches of 5 databases (Pubmed, Scopus, Sports Discus, Web of Science, and The Cochrane Library).**
- 13,166 published studies in academic publications – general consensus supports this causal relationship.
  - 37 cognitively healthy, sedentary adults (57–75 years old).
  - 60-min aerobic exercise; 3x/week – 12 weeks + mental exercises.
  - Measurements: Cognition, resting cerebral blood flow (CBF), aerobic fitness (VO2max).
  - Results: Increased regional CBF – anterior cingulate and hippocampus (cognition and memory).
  - Conclusion: Combo – physical & mental exercise = best cognitive solution.

**Cognitive Decline Example:**
- Dementia – broad category of brain diseases (e.g., Alzheimer’s) – causes long term and gradual loss in processing and memory.
- Alzheimer’s = 60 – 70% of all dementia cases.
- New case of dementia is diagnosed every 4 sec = 7.9 million cases / year.
- Increasing physical activity by 25% = 1 million < new cases annually (Ferri, et al., 2005; Barnes, et al., 2011).

**Evolution of the Human Brain – Growth:**
- Survival – muscle fiber differentiation = bipedal species:
- Longer limbs, shorter toes, less hair, thermoregulation, inner-ear balance (movement shaped body).
- Brain size increase – 3x larger relative to body size v. other mammals.
- Need for social interaction – planning/thinking complicated patterns like group hunts.
- This increased capacity – stimulated brain growth.

Just as our brain grew, so to can it shrink:
- Decreased mental efficiency and memory decline = #1 cognitive complaint in older adults:
- By mid-late 20’s = 1% loss of hippocampus mass/year (learning, memory).
- 10 % of adults > age 65 have some form of cognitive impairment.
- 50 % of adults > age 80 have some form of cognitive impairment.

Generally attributed to:
- Physiological losses within cells, tissues, organs and systems.
- Disease (e.g., Alzheimer’s).
- Lack of use (repetition or practice)
- Lack of physical activity.
- Depression and medications.
Cognitive Decline – Outcomes:
- Reduced brain volume (hippocampus).
- Loss of myelin integrity (covers neurons).
- Dendrite thinning and synaptic inefficiency.
- Impaired NT (serotonin, dopamine, norepinephrine) levels, receptor binding sites and signaling compounds.
- Accumulation of neurofibrillary (protein) tangles (tau) and clumps (beta-amyloids) on neurons.

Neuroplasticity:
- Capacity of brain (neural pathways and synapses) to modify structure and function due to changes in behavior, environment, neural processes, thinking, and emotions.
- 1970’s – term replaced formerly-held notion of a static brain.
- Plasticity requires overload to trigger adaptation(s).
- Key influencers:
  - Learning
  - Exercise/Activity
  - Nutrition

Effects on Key Brain Regions:
- Corpus Callosum – connects L/R hemispheres.
  - Transfers information between sides.
  - Greater neural connectivity in females.
  - Activity strengthens connectivity.
  - Greater development with cross-lateral patterns.
  - High 5’s/10’s – contralateral arm/leg patterns.
**Hippocampus:**
- Area associated with learning and memory – region most affected by activity.
- By mid-late 20’s = begin a 1% loss of hippocampus mass / year.
- Studies demonstrate total 4% hippocampus growth (up to 5.6% in left hippocampus) with activity (greater growth with aerobic exercise).
- Growth = improved capacity for learning and information retention

**Neurogenesis / Neural Plasticity** – the development of new neurons within specific brain regions (e.g., hippocampus) – changing neural landscape.

<table>
<thead>
<tr>
<th>Compound</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brain-derived Neurotropic Factor (BDNF)</td>
<td>• Neurotrophin that triggers neural growth within CNS (e.g., hippocampus, cortex) and PNS.</td>
</tr>
<tr>
<td></td>
<td>• Physically grows neurons and dendrites (thin, less dense with age).</td>
</tr>
<tr>
<td></td>
<td>• Builds (synaptogenesis), strengthens and cleans synapses (nerve junctions) – improves synaptic connectivity and efficiency.</td>
</tr>
<tr>
<td>Insulin-like Growth Factor-1 (IGF-1)</td>
<td>• Manufactured within muscles (exercise) = crosses into brain.</td>
</tr>
<tr>
<td></td>
<td>• Increase glucose uptake into brain cells (fuel).</td>
</tr>
<tr>
<td></td>
<td>• Complements some BDNF actions.</td>
</tr>
<tr>
<td>Vascular Endothelial Growth Factor (VEGF)</td>
<td>• Increased following exercise – promotes angiogenesis.</td>
</tr>
<tr>
<td></td>
<td>• Builds new capillaries within brain – more O₂ and glucose.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Compound</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Fibroblast Growth Factor-2 (FGF-2)</td>
<td>• Neurotrophic – involved in neurogenesis.</td>
</tr>
<tr>
<td></td>
<td>• Involved in maintaining synaptic plasticity.</td>
</tr>
<tr>
<td></td>
<td>• More powerful than VEGF in angiogenesis.</td>
</tr>
<tr>
<td>Blood Brain Barrier (BBB) = brain filter</td>
<td>• Improves filtering efficiency to control amino acids entering brain (NT building blocks) – BCAA-tryptophan-tyrosine.</td>
</tr>
<tr>
<td></td>
<td>• More balanced NT levels = improved cognition, moods, etc.</td>
</tr>
<tr>
<td>Neurotransmitters</td>
<td>• More balance NT levels + increase glutamate (stimulatory NT)</td>
</tr>
</tbody>
</table>
**Regulatory Neurotransmitter Examples:**
- Serotonin affects moods (relaxation), anger, impulsivity and aggressiveness.
- Norepinephrine (NE) affects attention, motivation and arousal.
- Dopamine affects rewards (satisfaction), pleasure and focus.

**Learning:**
- Cognitive learning or motor skill development – repetitive signaling strengthens neural and synaptic connections = greater efficiency and accuracy of signal transmission.
- Important difference:
  - Physical practice (novel) = task specific (e.g., tennis serve does not improve cycling)
  - Mental stimulation (novel) = domain-wide improvements/spillover (e.g., playing chess can improve driving skills).
  - Synaptogenesis builds more general neural pathways – bypass breakdowns in other pathways (‘cognitive reserve’).
  - Exercise and improvements (MRI) = weeks to months.
  - Cognition and improvements (MRI) = instantaneous (≥ 2 hours).

**Mental Exercises:**
- Participate in frequent digital or analog games, tasks and challenges to stimulate neurogenesis and synaptogenesis.
- New Experiences – tastes; smells; using non-dominant hand; new tasks/trips, etc.
- Building self-efficacy and self-control:
  - Spend 3-4 hours/day resisting desires – willpower depletes throughout day (easier to gain victories in am).
  - Aim initially for early victories (e.g., breakfast snack) – spillover effect.

**Dietary Ideas:**
- Caloric Reduction:
  - Typically by 20 – 30% below normal.
  - Creates favorable changes in peripheral insulin sensitivity.
  - Boosts some neurotrophic factor levels (e.g., BDNF).
- Overall Fat Intake:
  - Aim for 30% range – average US diet 32 - 33%.
  - May reduce flow of oxygen-rich blood to brain; may slow glucose metabolism rates.
  - More healthier mono/poly-unsaturated fats (less Ω-6) - Mediterranean diet.
- Omega-3 Fatty Acids:
  - 2 – 3 fish servings / week.
  - Framingham Heart Study – 1,200 mg EPA + 200 mg of DHA.
  - Slows yearly rate of cognitive decline by up to 10%.
  - Associated with a 50% decline in risk of developing dementia
  - Improves O2 circulation to brain; membrane integrity
<table>
<thead>
<tr>
<th>Food Group</th>
<th>Brain Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthocyanins (A)</td>
<td>• Combat cell-damaging oxygen free radicals – high metabolism.</td>
</tr>
<tr>
<td>Polyphenols (P),</td>
<td>• Blueberries (A) – stimulates neurogenesis (Hippocampus); inhibits</td>
</tr>
<tr>
<td>A = beets, pomegranate</td>
<td>acetylcholinesterase – preserves learning/memory.</td>
</tr>
<tr>
<td>P = spinach, red wine</td>
<td>• EGCG (Green tea) – also reduce damaging effects of amyloid-beta proteins</td>
</tr>
<tr>
<td></td>
<td>(Alzheimer’s).</td>
</tr>
<tr>
<td></td>
<td>• Resveratrol – may increase IGF-1 and BDNF, suppressing</td>
</tr>
<tr>
<td></td>
<td>inflammatory agents; reinforce BBB integrity.</td>
</tr>
<tr>
<td>Folate (800mg)</td>
<td>• Homocysteine (inflammatory amino acid) – from methionine</td>
</tr>
<tr>
<td>Spinach, broccoli,</td>
<td>(increased with high animal protein diets + low fruits/leafy</td>
</tr>
<tr>
<td>beans, asparagus</td>
<td>vegetables) – associated with Alzheimer’s.</td>
</tr>
<tr>
<td></td>
<td>• Folate helps regenerate methionine from homocysteine.</td>
</tr>
<tr>
<td>B-complex vitamins</td>
<td>• Same effect as folate.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Food Group</th>
<th>Brain Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcohol</td>
<td>• Binge drinking – rat studies – less hippocampus cell growth after</td>
</tr>
<tr>
<td></td>
<td>binge + virtually none a month later.</td>
</tr>
<tr>
<td></td>
<td>• Possible - large amounts of alcohol = damage + limit cell repair.</td>
</tr>
<tr>
<td>Caffeine</td>
<td>• May increase BDNF in hippocampus – improve memory retention?</td>
</tr>
</tbody>
</table>

BCAAs: ________________________________________________________________________

**Stress: Biological Design**

![Stress Diagram]

- Elevated cortisol = appetite; food = insulin – lowers cortisol
- Increased catabolic events + decreased anabolic events

<table>
<thead>
<tr>
<th>Acute Events Activated</th>
<th>Acute Events Inhibited</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased cardiopulmonary responses.</td>
<td>Decreased salivary and digestive enzyme secretion, and digestion.</td>
</tr>
<tr>
<td>Increased vasodilation.</td>
<td>Decreased stomach/small intestinal contractility.</td>
</tr>
<tr>
<td>Increased mobilization of fuels.</td>
<td>Decreased pain perception (analgesia).</td>
</tr>
<tr>
<td>Increased blood clotting ability.</td>
<td>Decreased growth, repair and maintenance.</td>
</tr>
<tr>
<td>Increased large intestinal contractility.</td>
<td></td>
</tr>
<tr>
<td>Increased bladder contractility.</td>
<td>Decreased reproduction capacity.</td>
</tr>
<tr>
<td>Increased immune function.</td>
<td></td>
</tr>
<tr>
<td>Increased sweat rates.</td>
<td></td>
</tr>
</tbody>
</table>
However…….. Chronic Stress

- Chronic psychological stress and sustained high levels of cortisol

<table>
<thead>
<tr>
<th>Stress</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elevated Cortisol</td>
<td>Impairs cells in the hippocampus involved with short-term memory, learning and memory.</td>
</tr>
<tr>
<td>Elevated Cortisol</td>
<td>Ultimately can damage hippocampus – becomes smaller due to free radical attacks (reduces long-term memory), destroys and shortens dendrites, decreases levels of BDNF, reduces neurogenesis, and increases neural atrophy</td>
</tr>
<tr>
<td>Elevated Cortisol</td>
<td>Amygdala (emotions) will control hippocampus = increased emotional stress – vicious cycle.</td>
</tr>
<tr>
<td>Elevated Cortisol</td>
<td>Cortisol also impedes transition to stage 4 sleep (delta or deep sleep) where short-term memory is converted to long-term memory.</td>
</tr>
</tbody>
</table>

Dinner – Carbohydrates

- Muscle and liver glycogen filled.
- Evening activities – bedtime.
- Overnight fast – bodily functions:
  - Muscle cannot release glucose to blood
  - Liver’s role is to maintain blood glucose
- Results = increased cortisol (highest of the day).
- Eating Breakfast – effect on cognitive function = improved concentration/retention.

Can Stretching Improve Brain Plasticity?

- Stretching + Breathing - increases PNS dominance.
- Lower cortisol levels.
- Less impairment upon hippocampus – less damage to cells.
- Any stress-reducing mechanism may have similar effects (meditation, yoga, Tai-Chi, Qigong; Feldenkrais).

Restful Sleep:

- Sleep – 2 basic stages:
  - Rapid eye movement (REM) sleep (dreams)
  - Non-rapid eye movement (NREM) sleep (stages 1 – 4) with each stage lasting 5 – 15 minutes (quiet sleep).
- Sleep = cycles between non-REM and REM sleep
- Initiated with NREM stages, followed by short REM sleep, before repeating cycle between Stage 2 – 4 (NREM) and REM.
Key Considerations:

- Exercise can release ‘feel good’ endorphins = relaxation – later in day may promote restful sleep – BUT not too late – lowering of core temperature.
- Stress or overtraining = elevated cortisol levels = poor quality of sleep = further elevated cortisol levels.

<table>
<thead>
<tr>
<th>Stage 1</th>
<th>Stage 2</th>
<th>Stage 3 – 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Reduced wakefulness with closed eyes; easily awakened – not restful.</td>
<td>• Intermittent high/low periods of muscle tone mixed and muscle relaxation.</td>
<td>• Less responsive and noises and activity in the environment may fail to generate a response. If aroused during these stages – disoriented feeling.</td>
</tr>
<tr>
<td>• 5 – 10 minutes.</td>
<td>• 20 minutes</td>
<td>(slow-wave delta sleep; stage 4 = more intense).</td>
</tr>
<tr>
<td>(high-amplitude, low-frequency theta waves)</td>
<td>(bursts of rhythmic, small, fast [beta] waves – sleep spindles)</td>
<td>Stage 3 = transition into deep sleep (stage 4)</td>
</tr>
<tr>
<td>Traits:</td>
<td>• Core temperature and HR lower – prepares body for deep sleep – Important for Proper Recovery !!!</td>
<td>• Body repairs/regenerates tissues; builds bone/muscle; strengthens immune system.</td>
</tr>
<tr>
<td>• Sudden muscle contractions (myoclonic jerks).</td>
<td></td>
<td>• Hippocampus – imprints ST into LT memory (learning, information retention).</td>
</tr>
<tr>
<td>• Vivid sensations (hypnagogic hallucinations) – falling.</td>
<td></td>
<td>• Stress and aging = less deep sleep.</td>
</tr>
</tbody>
</table>

REM

- 1st REM stage: ~ 90 minutes after sleep onset – lasts about 10 minutes, but each recurring REM stage lengthens with final REM stage = up to 60 minutes.
- Paradox: Increased brainwave activity (similar to wakeful states) + accelerated and erratic heart/breath rates – muscles become more relaxed (appears protective to prevent harm associated with dreams – vivid and intense.
- Why REM?
  - (1) Restful sleep, but be alert to defend ourselves.
  - (2) Turns off NTs (e.g., serotonin, norepinephrine) – replenish, reset receptors.
- Aging declines REM sleep
HIIT, HVIT and VIIT Training
Fabio Comana, MA., MS., NASM CPT, CES & PES; ACE CPT & LWMC; ACSM HFS, NSCA CSCS; CISSN
National Academy of Sports Medicine – fabio.comana@nasm.org

Trending: HIIT workouts – why?
• Weight loss – potentially increased caloric burn during session + EPOC (afterburn)?
• Time-efficiency – shorter workout sessions (as short as 3 x 20 sec)?
  o Up to 90% less training volume (amount of work performed).
  o Up to 67% lower training time.
• Improved performance – aerobic and anaerobic improvements?
• Improved health – blood glucose control?
• Increased metabolism – fat burning ability?

Big Question: Are you delivering HIIT programs or HVIT Programs?
• HIIT = High-intensity (Movement Quality – performance).
• HVIT = High-volume (Movement Quantity – calories?)
  o Work intervals > 3 – 4 minutes
  o Work intervals < 75% of maximal performance (e.g., 1RM).
  o Body weight training is not HIIT

NEVER confuse maximal performance with maximal effort – very different!! NEVER confuse maximal performance with maximal effort – very different!

<table>
<thead>
<tr>
<th>Maximal Performance</th>
<th>Maximal Effort</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example: best 40-m sprint time (e.g., 5 seconds).</td>
<td>Example: Pushing as hard as possible under fatigue, but completing same 40-m dash in 7-seconds.</td>
</tr>
<tr>
<td>Goal = improve performance</td>
<td>Goal = burn calories, but at what cost? As intensity drops, so does kcal burn rate.</td>
</tr>
</tbody>
</table>

Energy Systems:

- **Aerobic Pathway (Oxidative)**
  - Large Energy Source
  - Produces Energy Slowly
  - Uses all 3 Macronutrients

- **Anaerobic Pathway**
  - Limited Energy Source
  - Produces Energy Rapidly
  - Uses Carbohydrates Only

Energy Pathways:

- Phosphagen System
- Glycolytic (Fast) System
<table>
<thead>
<tr>
<th>Duration of Event</th>
<th>Event Intensity</th>
<th>Primary Energy System</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 6 seconds</td>
<td>Extremely High</td>
<td>Phosphagen</td>
</tr>
<tr>
<td>6 – 30 seconds</td>
<td>Very High</td>
<td>Phosphagen and Fast Glycolytic</td>
</tr>
<tr>
<td>30 – 120 seconds</td>
<td>High</td>
<td>Fast Glycolytic</td>
</tr>
<tr>
<td>2 – 3 minutes</td>
<td>Moderate</td>
<td>Fast Glycolytic and Oxidative</td>
</tr>
<tr>
<td>&gt; 3 minutes</td>
<td>Lower</td>
<td>Oxidative</td>
</tr>
</tbody>
</table>
HIIT:

Inappropriate recoveries =
  - Reduction in performance.
  - Calorie burn decreases.
  - More work bouts, but is it more kcal?

Example: 2-min x 10 sets (20 min):
  - 60 sec HVIT #1 – 2 = 20 kcal/min.
  - 60 kcal recovery = 5 kcal/min.
  - 60 sec HVIT #3 – 6 = 17 kcal/min.
  - 60 sec HVIT #7 – 8 = 12 kcal/min.
  - 60 sec HVIT #9 – 10 = 9 kcal/min.
  - Total workout = 200 kcal.

Does EPOC Contribute Significantly to Weight Loss?
  - Research Studies:

---

Sodium Bicarbonate buffer (NaHCO₃)

Lactate (Lactate⁻ + H⁺) lowers blood pH (7.35 – 7.45)

CARSBOHYDRATES (Glucose/Glycogen)

Glycolysis (ANAEROBIC)

Pyruvate

Lactate (lactic acid) + H⁺

AEROBIC RESPIRATION

Larger Amounts of Energy

Small Amounts of Energy

Carbohydrates

Recovery within Blood

---

NOTES

Recovery within Blood

HIIT:

Research Studies:

- Does EPOC Contribute Significantly to Weight Loss?
  - Research Studies:
NOTES

EPOC = influenced by 1st by intensity, then 2nd by duration.

- ~14 % of exercise energy (research don’t account for EPOC between intervals).
- Consensus: 7 % of exercise energy up to 37 % (11 – 190 kcal).
  - EPOC for light-to-moderate activity = almost 0 kcal.
  - Which program contains greater intensities - HIIT v. HVIT?

**True HIIT Training: Goal = performance:**

<table>
<thead>
<tr>
<th>Study</th>
<th>Design</th>
<th>Results</th>
<th>EPOC</th>
<th>Weight Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knib et al. (2011). <em>Medicine &amp; Science in Sports and Exercise</em></td>
<td>N= 10; cycling, 45-min @73% VO₂ max (85% MHR)</td>
<td>519 kcal expended; 37 % more kcal burned with EPOC</td>
<td>EPOC was 190 kcal – 14 hours 13.5 kcal/hour.</td>
<td>3x/week = 8½ lbs. per year</td>
</tr>
<tr>
<td>Heden et al. (2011). <em>European Journal of Applied Physiology</em></td>
<td>N= 8; resistance: 1 v. 3 sets of 10 reps (10 exercises)</td>
<td>Both groups showed increased EPOC regardless of volume</td>
<td>EPOC = 100 kcal. Exercise volume has small effect on EPOC</td>
<td>3x/week = 4½ lbs. per year</td>
</tr>
<tr>
<td>Scott et al. (2011). <em>Applied Physiology Nutrition and Metabolism.</em></td>
<td>N= 10; 2 sets BP @ 70%, 80%, and 90% 1RM x reps to failure.</td>
<td>More kcal expended with 70% / 80% 1RM v. 90% (less reps)</td>
<td>EPOC was same although more work performed with LI sets. EPOC = 45 kcal</td>
<td>3x/week = 2 lbs. per year</td>
</tr>
<tr>
<td>Phelan, et al. (1997). <em>Journal of the American College of Nutrition</em></td>
<td>N=8, 500 kcal session 50%VO₂ max v. 70% VO₂ max</td>
<td>EPOC elevated after 70% VO₂ max session for 3-hours post-exercise</td>
<td>EPOC was 45 kcal v. 24 kcal</td>
<td>3x/week = 2 lbs. per year</td>
</tr>
<tr>
<td>Laforgia, et al. (1997). <em>Journal of Applied Physiology</em></td>
<td>N=8; 30-min continuous run (70% VO₂ max) v. 1-min intervals (105% VO₂ max) + 2-min rest</td>
<td>EPOC elevated for 9-hours; 7.1% and 13.8% of kcal</td>
<td>EPOC was 32 kcal (tempo) v. 64 kcal (intervals)</td>
<td>3x/week = 2.8 lbs. per year</td>
</tr>
<tr>
<td>Thornton, et al. (2002). <em>Medicine &amp; Science in Sports and Exercise</em></td>
<td>N=14; 2x15 @ 45% 8RM v. 2x8@ 85% 8RM</td>
<td>EPOC larger with HI resistance workout</td>
<td>EPOC was 11 kcal (HI) v. 5 kcal (LI)</td>
<td>3x/week = ½ lb. per year</td>
</tr>
</tbody>
</table>

Women – Physiological Differences:

- Women have smaller concentrations of type II (fast-glycolytic) fibers - 3.5 – 5.0 % less than men.
- Reduced Glycolytic Capacity:
- Reduced glycogen loading capacity = less glycogen.
- Reduced glycolytic enzymes.
• Reduced LDH (lactate dehydrogenase) activity
**Men:**

<table>
<thead>
<tr>
<th>Energy System</th>
<th>% of Maximal Power</th>
<th>Bout Duration</th>
<th>Work-to-Recovery Ratio</th>
<th>Type of Recovery</th>
<th>Recovery Time between Sessions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast Glycolytic</td>
<td>75 – 90 %</td>
<td>15/30 sec to 3 min</td>
<td>1:3 to 1:5</td>
<td>Active</td>
<td>48 hours minimum</td>
</tr>
</tbody>
</table>

**Anaerobic Systems – Performance Training Principle:**
- Specificity utilizes the following variables (FITR / FIVR):
  - Number of repetitions (F)
  - Intensity (I)
  - Interval duration (time – T / volume – V)
  - Recovery length (R)

**Women:** Generally cannot train as hard as men – bouts need to be shorter and less intense, but recoveries can be shorter (1:2 or less).

<table>
<thead>
<tr>
<th>Energy System</th>
<th>% of Maximal Power</th>
<th>Bout Duration</th>
<th>Work-to-Recovery Ratio</th>
<th>Type of Recovery</th>
<th>Recovery Time between Sessions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast Glycolytic</td>
<td>&lt; 75 – 90 %</td>
<td>15/30 sec to 2 min</td>
<td>1:1 to 1:3</td>
<td>Active</td>
<td>48 hours minimum</td>
</tr>
</tbody>
</table>

**What are we supposed to do during recovery intervals?**
- Transition from Type II fibers (anaerobic) to type I (aerobic)
  - How?
  - Need for movement – active recovery.
  - Stabilization exercises.
  - Balance and postural control.

**HIIT Example:** (> 75% of maximal performance (1RM test))
- **Goal:** Improve performance
- **SS:** Bb Clean and Press (45-sec) + Bb Side Lunges (30-sec each way)?
- ~ 105 seconds of work = 1:3 (315 sec recovery) - generalized recovery – lactate buffer
- **Active Recovery:**
  - Light Movement – walking (30-sec)
  - Plank walk-ups (40-sec) / Rotational Planks (40-sec) / transition.
  - Single-leg Leg Swings and Hip Drivers (3D) (40-sec per leg) / transition.
  - Turkish Get-up (40-sec each side) / transition
  - Light Movement – walking (20-sec)
- **SS:** Bb Deadlift (30-sec) + Standing Kb Rear Rotational Presses (30-sec / side)

**HVIT Example:** (< 75% of maximal performance)
- **Goal:** High work-rate – kcal burn?
- **SS:** Burpees with OH Wall Ball (45-sec) + Push-ups (45-sec)
- ~ 90 seconds of work = 3:2 (60-sec) - Generalized recovery – lactate buffer?
- **Active Recovery:**
  - Plank walk-ups (30-sec)
  - Rotational Planks (30-sec) / transition.
- **SS:** Box jumps (45-sec) + Pull-ups / Kips (45-sec)
- Technique and injury?
New Solution ……

- HIIT = High-intensity (Movement Quality – performance).
- VIIT = Variable-intensity – transitional between HIIT and HVIT
  - Aim is to pursue smaller improvement in performance, yet maintain higher work rates to burn kcal.
- HVIT = High-volume pursuing maximal efforts (Movement Quantity – calories).

VIIT…..

- A hybrid between both styles:
  - VIIT – variable intensity interval training:
- Mixed pursuit of:
  - Performance
  - Calories (EPOC)
  - Sustained intensities = calories + EPOC
  - Reduced potential for injury
Scope of practice

- Never create nutrition plans for special populations-medical nutrition
  - Diabetes, pregnant, high blood pressure
  - For medical nutrition refer out
- Generally outside scope of practice to write out diets

For healthy populations you can:

- Advise on healthy snacks
- Discuss food preparation methods
- Educate about macro and micro nutrients
- Discuss hydration guidelines
- Review food logs
- Develop strategies for long term success

Why do Clients Struggle with Nutrition?

- Knowledge
  - Not knowing what to do
  - Unrealistic expectations
- Behaviors
  - Lacking skills
  - Lacking habits to be successful
- Environment
  - Grocery store, home, restaurants, office

Behavior Influences:

Thoughts, Emotions, Sensations, Social Influences

Habits triggered by a cue which start a routine and lead to a reward.

A large part of our behavior occurs automatically with conscious decisions being made.

Nutrition Coaching

- Is your client ready to change?
  - Stages of change model
    - Precontemplation
    - Contemplation
    - Preparation
    - Action
    - Maintenance
    - Termination
- What does your client struggle with?
  - Understand their unique issues

Goal Setting

- Outcome goals
- Performance goals
- Process goals
- Action items
Review goals on set schedule and provide feedback

Behavior Coaching

- Advantage response cards
- Implementation intentions
  - Specify where, when, and how to act to obtain a goal
- Though strategies
  - Positive coping statements
  - Though reframing
- Emotion strategies
  - Behaviors that stimulate positive emotions
  - Coping mechanisms
- Sensation strategies
  - Ways to limit hunger
- Social strategies
  - Communicating how important goal is to others
  - Positive influence
  - Social activities that support goal

Change Environment

Remove the cue or stimulus

Change the routine. Example meditation to relax vs. alcohol

Improve home environment and work by reducing, removing, or making stimulus harder to get.
Quick Fixes for Squats and Lunges
Rich Fahmy

Objectives
• Discuss and review ideal mechanics for squats and lunges
• Review common deviations to squat and lunge form
• Practice correcting these deviations

Overhead Squat Assessment
• A two-legged squat performed with:
  – the arms held overhead
• From a bilateral standing posture assesses:
  – total body structural alignment, dynamic flexibility, and neuromuscular control
• Squatting requires:
  – optimal motion in the ankles, knees, and hips.
• Having the arms elevated overhead:
  – stresses the musculature surrounding the shoulder complex
  – increases the demand placed upon the core stabilizing muscles

Front View: Feet Turn Out
Front View: Knees Move Inward
Side View: LPHC Excessive Forward Lean
Side View: LPHC Low Back Arch
Side View: Upper Body Arms Fall Forward
Asymmetrical Weight Shift

Cueing
• Auditory
• Visual
• Kinesthetic
• Show, tell, do

Lunges
• Squats with a “kickstand”
• Upright versus leaning forward

Squat correction - ankles
• Elevating the heels-temporary fix
• Using a stability ball
• Range of motion adjustments
• Flexibility intervention
  – Static stretch
  – Self myofascial release

Squat correction – the upright squatter
• Flexibility intervention
  – Static stretch
  – Self myofascial release
• Ways to push the hips back
  – Cues in front of the body
  – Cues behind the body

Squat correction – the “deadlifter”
• Flexibility intervention
  – Static stretch
  – Self myofascial release
• Practice cues in front of the body
• Practice cues behind the body

Lunge correction – the 90/90
• Flexibility intervention
- Static stretch
- Self myofascial release
  - Weight distribution across the feet
  - Cues in front of the body
Lunge correction – the huge step
  - Flexibility intervention
    - Static stretch
    - Self myofascial release
  - Adjusting stance and depth of drop
Training Considerations for Older Adults
Rich Fahmy

Goals
• Discuss different categories of age-related changes
  – Neurological
  – Cardiovascular
  – Respiratory
  – Psychosocial
• Discuss and apply different exercises to integrated training model
  – Flexibility
  – Core
  – Balance
  – Plyometric
  – Resistance Training

Neurological Considerations of Aging
• 10-15% decrease in brain matter
• Decrease in dendritic branching
• Response speed increased
• Ability to process info
• Ability to learn new motor skills impaired

Cardiovascular Considerations of Aging
• Enlargement of the heart
• Slowing of the heart’s electrical activity
• Large arteries thicken, widen and stiffen—heart works harder to push blood
• Increase in risk of hypertension and heart rate abnormalities

Respiratory Considerations of Aging
• Lungs have reduced elasticity—airways remain open for shorter periods
• Stiffness in the chest wall—harder to expand lungs

The Good News
• Many structural changes can be halted or reversed with exercise

Psychosocial Considerations of Aging
• Quality of life directly related to physical health, independence and functional ability
• Exercise programs improve self-efficacy and self esteem
• Fear of injury and intolerance lead to discomfort in health clubs

Psychosocial Considerations of Aging-Programming
• Encourage daily activity
• Meet them where they are at
• Assessments based on the client, not “norms”
• Reward success
• Fight boredom

Program Design Principles
• Periodization – systematically changing the variables of a program to bring about specific responses (adaptations) in the body
• Based on SAID principle – what I repeatedly do, I get good at
• Progress and Regress based on client’s ability to move free of pain and compensation through a full ROM

Program Design
• Discuss traditional versus integrated training
  – Flexibility
  – Core
  – Balance
  – Plyometrics
  – SAQ
Strength
  - OPT Model

Flexibility
  - Self Myofascial Release
    - Considerations
    - Contraindications
    - Modifications
  - Static Stretching
    - Considerations
    - Modifications
  - Practice

Core Training
  - Progression through the OPT model
  - Modifications
  - Practice

Balance Training
  - Progression through the OPT model
  - Modifications
  - Practice

Plyometrics
  - Applying plyometrics to the older adult population
  - Rationale
  - Modifications
  - Practice

Resistance Training
  - Progression through the OPT model
  - Modifications
  - “I just want to learn the machines.”
  - Practice