

MODULE 7a

FATM EXERCISE STRATEGIES PART I

Learning Objectives:

1. Explain appropriate strategies to provide a training stimulus within the Cardiorespiratory, Musculoskeletal and Neuromuscular functional domains
2. Introduce multiple methods for assessing cardiovascular intensity during exercise
3. Describe cardiorespiratory training methods for older adults
4. Review the scientific evidence regarding strength and power training
5. Introduce the 7 fundamental movement patterns
6. Describe the benefits of and strategies for barefoot training
7. Describe proper three-dimensional core activation and training strategies
8. Explain proper flexibility and joint mobility strategies
9. List types of neuromuscular training

Introduction

There are numerous types of exercise movements and strategies that work well for adults of all ages. Some of these options are more appropriate for higher functioning individuals while others are more appropriate for lower functioning individuals. The choice of movements and strategies should not depend on a person's age but rather on their physical abilities, goals and individual concerns (e.g. diseases, injuries). In this module we will identify and describe training strategies for 3 of the 6 functional domains and provide evidence and rationale as to why these are important.

THE CARDIOVASCULAR DOMAIN

Mature adults engage in less physical activity than their younger counterparts. Aerobic exercise has been shown to be safe and beneficial for adults of all ages. By engaging in regular aerobic exercise mature adults can decrease their risk of chronic diseases; manage their current diseases better; and increase aerobic exercise capacity (Chodzko-Zajko et al 2009). Exercise should be of sufficient intensity ($> 60\%$ VO_{2max}), frequency (> 3 days/wk) and duration (> 20 min) to elicit cardiovascular and health adaptations. Individuals without significant health risks or conditions can participate in more vigorous exercise and sports activity such as basketball or running. The mode of aerobic exercise is an important consideration and depends on the individual's orthopedic conditions, goals and exercise history. Those with significant arthritis of the knees, hips or spine; joint replacements; osteoporosis and other orthopedic conditions should avoid high-impact exercises such as jogging and instead should engage in low or non-impact exercises such as bicycling or swimming. This includes cardiovascular equipment such as an upright bike, recumbent bike, recumbent stepper, treadmill, elliptical trainer and rower. Clients with a history of falling or with balance deficits should avoid activities that have an increased risk of falling such as skiing, horseback riding or skating.

Typical techniques to monitor exercise intensity such as heart rate and the "talk test" can still be used with mature clients. However, it is also useful to use rating of perceived exertion (RPE) in order to gauge intensity especially if the client is taking medications that suppress heart rate such as beta blockers. An RPE of 12-13 on the Borg 6-20 scale corresponds to moderate intensity aerobic exercise. RPE is often an easier tool for older clients to use when heart rate monitors are unavailable and counting a pulse rate is difficult. Maximal heart rate is typically calculated as 220

– age but more recent information indicates that a more accurate equation for determining maximal heart rate is $208 - (0.7 \times \text{age})$ in healthy adults over the age of 40 (Tanaka et al 2001). The original formula tends to overestimate maximal heart rate in younger populations and underestimate them for older populations. Target heart rate should be calculated using either the direct or heart rate reserve methods according to the intensity desired. Although moderate-intensity exercise is generally recommended the individual's health conditions and fitness status will determine the appropriate level of intensity that is both safe and effective. Many mature clients will be able to perform high-intensity interval training.

High Intensity Interval Training

This form of interval training simply involves periods of higher-intensity exercise (exercise intervals) alternated with periods of lower-intensity exercise (recovery periods) within the same exercise session. How challenging and how long these periods last vary depending on the person's goals and abilities. Typically, they are prescribed as a ratio such as 3:1 (e.g. 3 minutes of higher-intensity followed by 1 minute of recovery) or 2:1 (e.g. 60 seconds of higher-intensity followed by 30 seconds of recovery) or even 1:12 (e.g. 10 seconds of all-out effort followed by 120 seconds of rest). The more intense the exercise is the shorter it needs to be (because intense exercise cannot be sustained for very long) and the longer the rest period (in comparison to the exercise interval period) needs to be. Think about it this way. An all-out sprint of 100 yards would take the average individual about 15 seconds. But they would get so out of breath that they would need to rest for about 2-3 minutes or longer before they would be ready for the next sprint. That would be a ratio of 1:8 – 1:12. Conversely, if you just jogged the same distance and took 30 seconds to do so you

might only need a minute before you were ready to jog again because you wouldn't get out of breath nearly as much. That would be a ratio of only 1:2.

How does it work? During the exercise intervals (periods of high intensity exercise) heart rate and metabolism increase significantly. During the periods of recovery (lower-intensity exercise) heart rate, oxygen usage and metabolism remain elevated above the level that you would expect from the low-intensity exercise. Imagine if you had to run (or walk briskly) a couple blocks in order to catch up to a friend. Once you got there you would be breathing hard with your heart pounding fast in your chest and it would take several minutes of rest before they recovered to normal levels. Even though you are standing still you are burning way more calories compared to what you were burning while standing still before the little run. We call this extra calorie usage "the after burn". Here is a principle you need to remember: The greater the intensity during the workout the greater the afterburn. It is kind of like shaking a snow globe. If you give it just a little shake then you don't disturb all of the flakes and the snow disappears quickly. But if you give it a vigorous shake you disturb many more flakes and with the water swirling violently around inside it takes much longer for the snow to disappear. Exercise "shakes up" your metabolism and the harder you exercise the more calories you burn afterwards.

In addition, the afterburn specifically targets fat calories due to an interesting physiological mechanism called the crossover effect. As you are aware, during high-intensity aerobic exercise the body uses more calories, as a percentage, from carbohydrates than from fat in the body. During lower-intensity exercise the body uses more calories, as a percentage, from fat than from carbohydrates in the body. It is easy to be misled in thinking then that lower-intensity exercise

would be better for fat loss because more fat is used as energy. However, that is false for two reasons. The first reason is that although the body uses a lower percentage of calories from fat during higher-intensity exercise it burns calories much faster so this partially offsets the change in percentage. Secondly, because of the after-burn, following high-intensity aerobic exercise that uses lots of carbohydrates your body decides to save as much carbohydrate as it can and switches (or crosses over) to using fat as an energy source. Since the afterburn has been shown to last for 24 hours or more then you end up burning a lot more fat AFTER the exercise session than you did DURING the exercise session. The crossover effect combined with the after-burn is a very powerful 1-2 punch for losing body fat.

The advantages of HIIT training compared to traditional sustained cardiovascular exercise are many. Higher intensity exercise leads to greater gains in cardiorespiratory fitness. It is time-efficient so cardiovascular workouts can be shorter. The general cardio recommendations state that individuals should accumulate 150 minutes of moderate intensity exercise or only 75 minutes of high intensity exercise. HIIT seems to lead to greater loss of body fat and may provide some advantages for other aspects of metabolic health.

HIIT Program Basics

Gauging intensity is pretty important for HIIT to be successful. Exercise that is too easy (which is what most mature clients do) will not reap all of the benefits of the method. Prescribe exercise that is too hard and clients won't be able to recover enough to complete the entire routine. Rating of Perceived Exertion (RPE) is very useful to gauge intensity during HIIT rather than heart rate

because it is much simpler and doesn't require any math or pulse counting. Ideally RPE should reach 16-19 during the higher-intensity intervals and 9-12 during the lower-intensity intervals.

As stated previously, intensity, duration and recovery are interdependent. The harder the exercise interval the shorter the client will be able to do it and the longer recovery period they will require. So, they may only be able to last 30 sec at an RPE of 19 and require 3 minutes to recover but they may be able to last two minutes at an RPE of 17 and only require one minute to recover.

The lower-intensity "recovery" period in between the higher-intensity intervals is often called the base level. The base should be active recovery so no matter how out of breath they get during the high-intensity interval they should keep moving during recovery. Do not allow them to just stand still, sit or lie down. In fact, if they have to do any of these things then the interval was probably too intense (unless you are working with an athlete). Secondly, the optimal base level should be about an 11-13 (fairly light to somewhat hard) on the RPE scale. This will vary according to how hard the interval is. The harder the intervals are the easier the base level needs to be. Third, judge their base level intensity BEFORE they do any high-intensity intervals. Once they complete several intervals the base level is going to seem harder than it was at the beginning and that's normal. Lastly, it's okay to adjust their base level depending on how they are feeling that day.

To increase intensity during the intervals you can have the clients go faster with light resistance (sprints), slower with high resistance (climbs), or a faster with moderate resistance (hills). The combinations of challenges (sprints, climbs and hills), intensities, interval periods, rest periods, and total workout time means you are totally in control of their routine. And for those who crave

variety it means a virtually endless array of combinations so you really never even have to prescribe the exact same routine twice while to get amazing results. This type of HIIT does not work equally well with all modes of cardiovascular exercise and tends to work best with the treadmill, stationary or spin bikes and elliptical trainers.

HIIT for the Beginner

Here are some tips for those that are new to HIIT or are out of shape:

- Choose the cardio exercise that you feel the most comfortable with (treadmill, outdoor walking, stationary bike, elliptical, seated stepper, etc.)
- Experiment by exercising a little harder than usual until you feel like you are getting out of breath and then back off to your usual pace or even a little below it
- Note how you feel during the recovery period and when you have caught your breath then try it again
- Use longer intervals (2-3 minutes) and limit how hard you go during the higher-intensity intervals (RPE 16-17)
- The length of the recovery intervals should be longer than the higher-intensity intervals; shoot for a ratio of 1:2 or 1:3
- When you feel comfortable try one of our sample beginner routines

Beginner HIIT Workout # 1

Total time: 20min

Warm-Up (4:00) – Start easy and gradually increase exercise intensity so that you achieve an RPE of about 11-12 (this is your base level) by the end of the warm-up.

Stage 1 (9:00) 3 Hills

Hill #1: Increase speed and resistance/incline to an RPE of 15 for 1 minute. Return to base level for 2 minutes.

Repeat twice.

Stage 2 (4:00) 3 Sprints

Sprint #1: Increase speed to an RPE of 17 for 20 seconds. Return to base level for 60 seconds.

Repeat twice.

Cool-Down (3:00) – Decrease intensity to achieve an RPE of 9-10. Heart rate should return to within about 20-30 beats per minute of pre-exercise value.

Beginner HIIT Workout #2

Total time: 25min

Warm-Up (4:00) – Start easy and gradually increase exercise intensity so that you achieve an RPE of about 11-12 (this is your base level) by the end of the warm-up.

Stage 1 (12:00) 3 Climbs

Hill #1: Increase resistance/incline to an RPE of 15 for 2 minutes. Return to base level for 2 minutes.

Repeat twice.

Extra Recovery (1:00) – Stay at base level or adjust accordingly so that you are fully recovered for the next challenge.

Stage 2 (4:00) 4 Sprints

Sprint #1: Increase speed to an RPE of 17 for 20 seconds. Return to base level for 40 seconds.

Repeat three times.

Cool-Down (3:00) – Decrease intensity to achieve an RPE of 9-10. Heart rate should return to within about 20-30 beats per minute of pre-exercise value.

HIIT for the Experienced

Here are some tips for those that already perform cardio exercise on a regular basis and are in good shape:

- Try out one of the sample beginner programs to see how you respond
- Choose any mode of exercise that you are accustomed to but don't be afraid to experiment with new forms. For example, if you are having a difficult time challenging yourself while walking outside but don't want to jog or run (maybe due to joint issues) then try the elliptical trainer (allows greater increases in intensity while still being gentle on the joints)
- Play with the intervals and intensities to find out what works best for you and what you enjoy the most
- Mix up your HIIT routine so that you aren't always doing the same thing – keep it fresh and interesting, the possibilities are endless

Advanced HIIT Workout

Total Time: 32:30 min

Warm-Up (4:00) – Start easy and gradually increase exercise intensity so that you achieve an RPE of about 11-12 (this is your base level) by the end of the warm-up.

Stage 1 (7:30)

Sprint for 2min at RPE 18 with 30sec recovery

Hill for 2min at RPE 18 with 30 sec recovery

Sprint for 2 min at RPE 18 with 30 sec recovery

Extra Recovery (1:00)

Stage 2 (5:00)

Hill for 1 min at RPE 18 and 1 min at RPE 19-20 with 30 sec recovery

Repeat

Extra Recovery (1:00)

Stage 3 (11:00)

Hill for 3 min at RPE 17 with 60 sec recovery

Max sprint for 30 sec with 60 sec recovery

Repeat twice

Cool-Down (3:00) – Decrease intensity to achieve an RPE of 9-10. Heart rate should return to within about 20-30 beats per minute of pre-exercise value.

Cardiometabolic Resistance Training

Another effective and efficient method is to perform resistance and cardiovascular exercises in rapid succession. This style of training has been widely popularized by CrossFit. There are many different ways to perform this style of HIIT. One specific type of HIIT that has been used successfully with lower functioning older adults are EMOM's which stands for Every Minute On the Minute. These are performed by having the individual do a series of resistance or cardiovascular exercises (often a mixture of the two) for one minute each.

Typically, this means that they are trying to finish as many repetitions as possible (AMRAP) within each one-minute period. The continuous work without any rest between exercises creates a high-

metabolic environment. If exercisers get out of breath and need to rest they can do so but the clock continues to run. An alternate, less-intense method is to require an individual to perform a specific number of repetitions of an exercise. If they complete that number before the one-minute period is ended then they can rest for the remainder of the time before moving on to the next exercise. In this format, the exerciser is allowed small rest periods which decreases the overall metabolic demand of the workout. For beginners, or those with lower functional abilities, it is recommended that they receive a 1-2 minutes break after every 3-5 exercises.

Another form of AMRAP is to do as many rounds as possible. A round is a series of exercises with a set number of repetitions for each exercise. For example, one round may consist of 20 kettlebell swings, 20 squat jumps, 10 pushups, and a 200m run/jog. A timer is set for a certain period of time such as 15 or 20 minutes and the participants try to complete as many rounds as possible within that time frame. They can rest as much as they need to during or between the exercises but the goal is to push themselves to get as much work done as possible.

THE MUSCULOSKELETAL DOMAIN

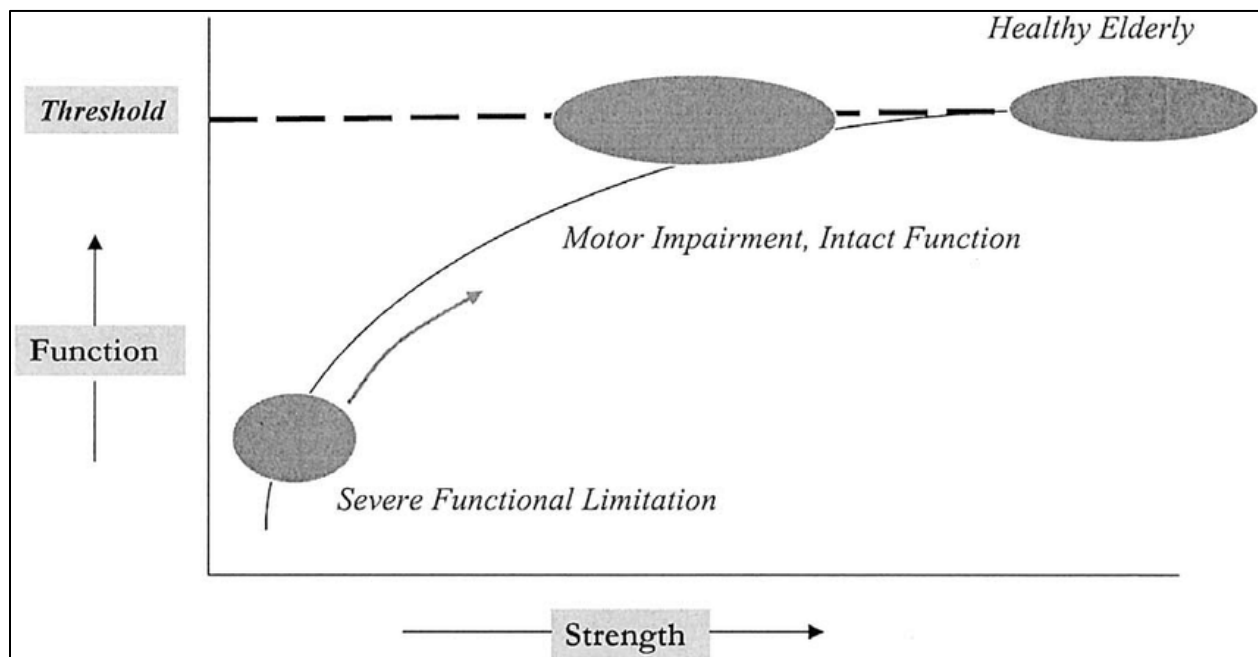
The musculoskeletal domain is composed of several components including strength, power, velocity, mobility and stability. Each of these will be discussed in this section as they all provide unique contributions to functional ability. Muscle strength has traditionally received the most attention and resistance exercise is highly recommended for older adults. Following traditional progressive resistance training the muscular strength of older adults can increase anywhere from 25% to more than 100% depending on the exercise program being used, the duration of the training, age and gender of the client, and the specific muscle groups being trained (Chodzko-Zajko et al 2009). It is generally recommended that mature adults engage in at least 2 days per week of moderate intensity strength training that includes 8-10 exercises involving the major muscle groups for 1-3 sets of 8-12 repetitions each (Chodzko-Zajko et al 2009).

Mature adults can safely and effectively use a wide variety of resistance training methods and equipment such as resistance machines, resistance bands, free weights, body weight, hydraulic and pneumatic equipment. Equipment selection is dependent on the individual's capabilities and goals. Each has its advantages and disadvantages. It is a misconception that mature adults should only use light dumbbells or easy resistance bands because they might become injured. The muscles of older adults need to be challenged in order to grow just as the muscles of younger adults do and although this population has more orthopedic concerns than younger populations resistance exercise has been shown to be generally safe.

A widespread issue among fitness professionals and rehabilitation specialists is "under dosing". This means that older adults are not challenged enough to create a meaningful overload to their

musculoskeletal system which significantly limits their progress. Older adults CAN load heavy and there are benefits to doing so although more moderate loading schemes are also beneficial. It depends on the individual's abilities and goals.

It is clear that a strong relationship exists between muscle strength and functional abilities for older adults but this relationship starts to break down as a person's function improves. Bean et al (2004) proposed that this relationship is curvilinear and a threshold exists (see figure below). This means that individuals with the lowest levels of strength will benefit the most functionally from getting stronger. However, a person that has adequate levels of strength will not get that much benefit functionally from getting stronger.



The curvilinear relationship between impairments (ie, reduced strength) and function shows that, at low levels, small increases in strength lead to large increases in function. In contrast, for people at or above the functional threshold (Healthy Elderly), strength improvements have diminishing effects on function; nevertheless, these improvements add to strength reserves, thus augmenting one's resistance to functional decline. Source: Bean, Vora and Frontera (2004). Benefits of exercise for community-dwelling older adults; Archives of Physical Medicine and Rehabilitation 85(7 Suppl 3):S31-42; S43-4

Consider a person who barely has enough strength to get out of their chair. Getting stronger will likely have a significant effect on their ability to get out of a chair and it will become easier and easier to do so. At some point, however, the functional benefits from getting stronger will diminish. An individual that can squat 100 pounds can get out of a chair just as easily as someone who can squat 400 pounds. The second person is obviously a lot stronger but this doesn't translate to improved functional ability. In addition, getting stronger doesn't translate equally to all functional tasks. The benefits of getting stronger appear to be the largest for tasks that require strength. Getting out of a chair, climbing stairs, getting up from the floor, and carrying heavy objects are all tasks that depend on adequate muscle strength. Other tasks are dependent on other factors such as balance, agility, coordination, endurance, etc. Research has shown that balance, for example, does not significantly improve following strength training for most older adults UNLESS they have poor balance because their muscle strength is very low.

In 2001, Keysor and Jette published a paper with the provocative title "Have we oversold the benefit of late-life exercise?" They critically reviewed 31 studies that assessed the effects of exercise interventions (strength, aerobic, flexibility) in older subjects. Their analyses demonstrated a very strong improvement in impairment-level factors such as strength, joint range of motion, aerobic capacity, body composition, etc. following training. However, the effects on measures of function such as gait speed, chair rise time, stair climbing, balance and weighted lifting tasks was not as strong and rather inconsistent. The authors specifically noted that subjects who improved the most on the impairment level factors were not necessarily the ones who improved the most on the functional measures.

Latham and colleagues (2004) took this approach one step further and analyzed only randomized controlled trials with subjects aged 60 and above using progressive resistance strength training (the gold standard in many ways) as the intervention. The findings further confirmed what Keysor and Jette suggested a few years earlier. While there was a large positive effect on muscular strength following progressive resistance training the effect on functional ability was small to moderate. It appeared from their analysis that strength gains do not equate to similar functional gains and that this is likely due to the strength threshold effect described earlier.

So, given this strength threshold effect, how strong does an older adult need to be? The answer: “Strong enough”. Strong enough to perform the functional activities that are important to them. Since basic functional activities only require a minimal level of strength some experts are advocating for a “minimal dose approach” for older adults in order to protect them from functional decline as they get older (Fisher et al 2017). This approach recommends a resistance training program with the following characteristics:

- Low frequency (2 days/week)
- Low time commitment (<30 min/session)
- Single set routine
- Simple machine-based exercises
- Low intensity (fatigue at 8-12 repetitions)

Many research studies have demonstrated improvements in muscle mass, strength, physical function and a number of health variables by following this basic type of program. Muscle strength will likely improve slower than a more aggressive (higher loads, higher volume) program but systematic reviews suggest that the most important long-term variables for improving muscle strength in older adults are exercise volume and duration of training (Raymond et al 2013; Borde, Hortobagyi and Granacher 2015). It is important to note this approach is recommended for adults

who are still independent and therefore do not have major deficits in their muscle strength yet so the focus is on maintenance or slight improvement. Another benefit that has been proposed for this minimal dose approach is that older adults may be more likely to perform this type of program as it requires so little time, effort and skill. These experts also suggest that using multi-joint exercises whenever possible may increase the benefit of this type of program.

An individual who has already lost a significant amount of muscle strength would likely need a more aggressive program than the “minimal dose approach” described above. Frail, pre-frail and lower independent older adults often have significant strength deficits that are affecting their functional abilities. Improving their strength becomes a top priority and any improvements will likely lead to improvements in function. Therefore, they may benefit more from a heavy loading scheme which research has shown time and time again is safe and effective for even the oldest and frailest. They may also benefit more from isolated strengthening due to deficits in balance, mobility, core/trunk stability, cognition or other factors.

The recovery period is an important aspect to consider. Some research has suggested that older adults need more than the typical 48-hour rest period in between resistance training sessions for any given muscle group. This means that training 2 days per week may be more effective than training 3 days per week for some individuals. An individual that is loading heavy is more likely to need a longer recovery period than the person using light or moderate loads. Varying the loads from session to session may be beneficial for enhancing recovery.

Regardless of functional level, loaded multi-joint exercises may be the most beneficial for older adults as opposed to isolated exercises if they are able to perform them. As described earlier in the FATM, isolated exercises can complement or supplement their routine but should not form the basis of their routine unless they need to. Following a structured approach to multi-joint exercises, such as the 7 fundamental movement patterns described below, is an effective strategy.

7 Fundamental Movement Patterns

Regardless of functional level loaded multi-joint exercises may be the most beneficial for older adults as opposed to isolated exercises. Following a structured approach to multi-joint exercises, such as the 7 fundamental movement patterns, is also beneficial. The 7 fundamental movement patterns, and some of their variations, are:

1. Squat/Sit-to-stand
 - a. Stand up from a chair
 - b. Box squat
 - c. Goblet squat
 - d. Back barbell squat
 - e. Front barbell squat
 - f. Overhead squat
2. Hinge/Deadlift
 - a. Romanian (Stiff-Legged) Deadlift with kettlebell, dumbbell, barbell or resistance band
 - b. Deadlift with kettlebell, dumbbell, barbell or resistance band
3. Lunge/Step Up
 - a. Step Ups and Step Downs
 - b. Front Lunge
 - c. Back Lunge
 - d. Side Lunge
4. Push/Press
 - a. Vertical
 - i. Overhead Shoulder Press with barbell, dumbbell or kettlebell in standing, seated, half-kneeling or kneeling
 - ii. Seated Machine Shoulder Press
 - b. Horizontal
 - i. Lying Chest Press with barbell or dumbbell

- ii. Standing Chest Press with resistance band or cable machine
 - iii. Seated Machine Chest Press
- 5. Pull/Row
 - a. Vertical
 - i. Pull Up
 - ii. Lat Pull Down with cable machine or resistance band
 - b. Horizontal
 - i. Standing Row with resistance band or cable machine
 - ii. Bent Over Row with barbell or dumbbell
 - iii. Seated Machine Row
- 6. Anti-Rotation
 - a. Unilateral horizontal press or row in standing, half-kneeling or kneeling with resistance band or cable machine
 - b. Palof press with cable machine or resistance band
- 7. Carry
 - a. Farmer's Carry (bilateral loads) with kettle bells or dumbbells
 - b. Suitcase Carry (unilateral load) with kettle bell or dumbbell

These are all multi-joint patterns that can be performed in a variety of ways with different types of loads and are easily scaled to an individual's level of function or modified according to their chronic conditions.

It is a myth that older adults should not (fill-in-the-blank with an exercise) because of their age. Older adults should not be restricted from performing a movement pattern merely because they are a certain age. Restrictions should be based on their functional abilities, chronic conditions, and whether or not they have “earned the right” to perform that pattern. Earning the right means that they have the prerequisite mobility, stability and movement pattern efficiency to load a pattern. For example, squatting is a great exercise for older adults that strengthens the lower body and trunk musculature and is a functional activity that is performed every day. Many people, young and old, have difficulty performing the squat correctly due to limitations in foot stability, ankle mobility, knee mobility, hip mobility, core stability, leg strength, hip strength and/or thoracic mobility. And even if a person is sufficient in all of these areas they still need to learn the squat pattern. These

are the factors that determine whether or not someone has “earned the right” to load the squat...not their age.

One could argue that many older adults will never have the necessary mobility and stability in all of these areas because the restrictions are really too significant to correct. This could be due to a lifetime of inactivity, past injuries or surgeries, the effects of chronic conditions (e.g. osteoarthritis, osteoporosis), or a combination of several of these. Therefore, they will never be able to perform a loaded squat pattern. This is not true. If a person is able to stand up from a chair then they are performing a loaded squat pattern using their body weight and this gives the trainer something to build on. Plus, there are many variations of these patterns that account for some of their restrictions and allow them to perform the pattern in a modified manner.

For example, a person with limited ankle mobility will find it much easier to squat if their heels are slightly elevated or if they adopt a much wider, toe-out position. These modifications reduce the amount of ankle dorsiflexion that is required during a squat. A person who continues to fall backwards or lean their trunk too far forward during a squat could perform a goblet squat (front-loaded squat using a kettle bell or dumbbell). This creates a forward shift in their center of mass which then allows them to “sit back” more during the squat and keep a more erect trunk posture. An individual who falls into valgus (knees collapse in) during a squat could place a mini-band (resistance band loop) around their knees when squatting. This will cause a greater activation of their gluteus Medius muscles teaching them to abduct during the squat and fixing the valgus. And if someone has numerous restrictions simply loading the sit-to-stand is an appropriate alternative.

There are many ways to perform these fundamental movement patterns for older adults of all ages and ability levels. It is up to the fitness professional to select the most effective movements and strategies for their clients in order to facilitate these patterns and improve their functional capacity.

As discussed in the FATM, using isolated exercise movements such as leg extension, leg curl and hip abduction can also have a place in an older adult's training routine if they are being used to help facilitate these fundamental movement patterns. Sometimes older adults have specific strength deficits that need to be addressed because they are limiting their functional performance. Use these isolated muscle strengthening exercises strategically.

Training for Muscle Power

Recently, a lot of focus has been given to the importance of power training for older adults with many experts now recommending that it is more important to develop power for older adults than it is to develop strength. Muscle power declines earlier and faster than muscle strength with advancing age (Chodzko-Zajko et al 2009; Porter, 2006) and is more important than muscle strength for performing many functional tasks such as stair-climbing and rising from a chair (Bean et al. 2002; Tschopp et al 2011) as shown in the following graph. The data for muscle power consistently shows that it has a closer relationship with functional performance than muscular strength (Sayers 2008, Hazell et al 2007, Porter 2006) and that power training is a potentially more effective intervention than PRT (Sayers 2008, Hazell et al 2007, Porter 2006) for improving function. It has been suggested that this is due to two reasons: 1) Many daily tasks rely on power for successful completion (e.g. stair climbing, rising from a chair); and 2) Power is a combination of two functional components (strength and contractile velocity). The data continues to grow as even the most recent systematic reviews and meta-analyses suggest that power training may improve function to a greater degree than traditional "slow and controlled" resistance training for both community-dwelling older adults and frail, institutionalized older adults (Byrne, Faure, Keene and Lamb 2016; Izquierdo and Cadore 2014).

The evidence is so compelling that many experts are urging power development over, or in combination with, strength development in older adults. In the systematic review by Byrne (2016), the authors argue that muscle power should be the “primary therapeutic target” for interventions aimed at enhancing physical function and preserving independence in later life. In their commentary on the subject (Cadore et al. 2018) titled “Explosive type of contractions should not be avoided during resistance training in elderly”, the authors make the case for using explosive movements over slow and controlled movements during resistance training for its added benefits and because it has shown to be safe and effective for even frail older adults (in part because lower loads can be used).

Let’s define muscle power and take a closer look at the relationship between strength, power and function as well as power training methods appropriate for older adults that have been recommended in the literature. Muscle power is the ability to generate force rapidly (calculated as force multiplied by velocity). For older adults, muscle power has been identified as a critical component for the performance of many functional tasks such as climbing stairs and rising from a chair as well as for many sporting events. Cross-sectional studies indicate that muscle power is much more highly correlated to functional task performance than muscle strength. The following image provides a good example of the relationship between muscle strength, power and functional abilities. Strength is related to function but power is more closely related to function indicating that while they are both important it is muscle power that is a more critical factor as shown in the image below from Bean et al (2002). This conclusion has been supported by numerous studies and systematic reviews across a range of older adult populations.

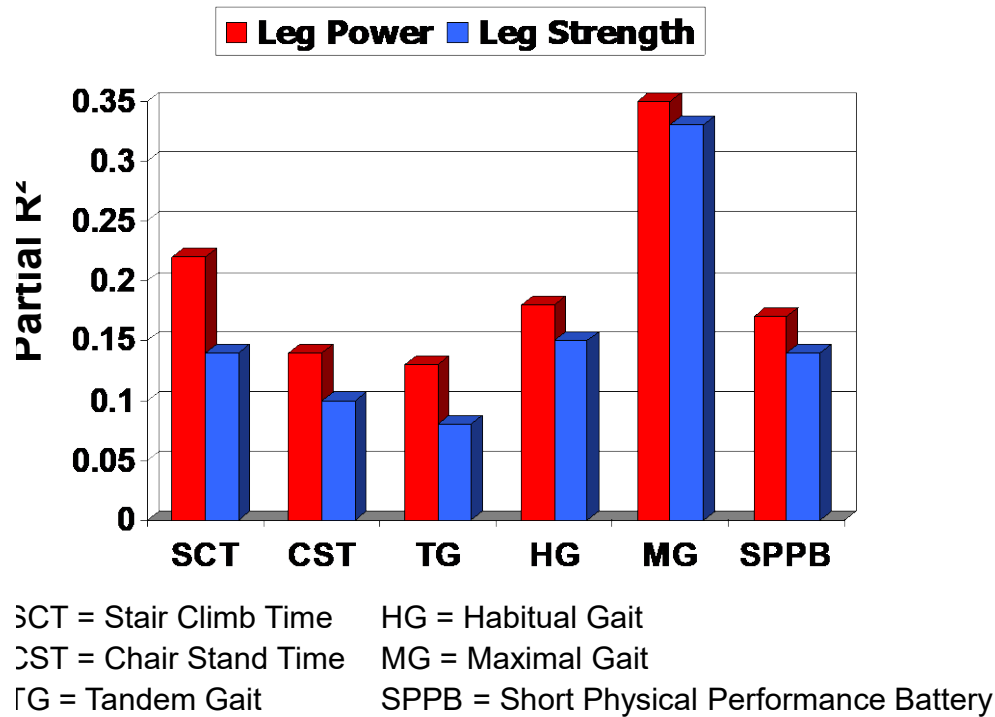


Figure: The relationship between leg power and physical performance in community dwelling mobility limited older people (Bean 2002)

Unfortunately, muscle power starts to decline earlier and more rapidly than muscle strength with advancing age indicating that movement velocity also decreases with advancing age. It has been suggested that this may be due to the preferential atrophy of fast-twitch (Type II) muscle fibers but it is the loss of contractile velocity that may hold the key to many aspects of functional decline for some individuals. Recent studies have found that some older adults are force-deficit while others are velocity-deficit (Alcazar et al. 2018) indicating that there is variability between older adults as to why their muscle power is declining. Some individuals cannot generate adequate power because they lack proper force production but they are able to move quickly (contractile velocity). Others cannot generate adequate power because they lack proper contractile velocity but they are able to produce force. In either case the lack of power generation is impacting their

functional abilities but the intervention may need to differ. The force-deficit individual may need to perform high-load power training (to maximize force production) while the velocity-deficit individual may need to perform low-load power training (to maximize speed). Loading schemes will be covered in more detail later but some data indicates that using lower loads (20-40% 1 RM) and higher movement speeds may be more effective than higher loads (50-70% 1 RM) for improving functional capabilities.

Many studies indicate that power training may be more advantageous in improving function than traditional strength training methods (Porter, 2006; Tschopp et al 2011). This may be because high-velocity (power-specific) training also increases muscle power to a greater degree than traditional low-velocity strength training. Low-velocity strength training still improves power because it improves force production but it does not improve contractile velocity so it is only affecting half of the power equation. Power training has been shown to improve both force production and contractile velocity although how much it improves each factor is dependent on the type of loading used during training. Higher loads tend to improve force production to a greater degree while lower loads tend to improve contractile velocity to a greater degree which is in alignment with the principle of specificity.

Many trainers may be skeptical of having their older clients perform fast and explosive movements due to concerns over safety. Dozens and dozens of studies with thousands of older adults confirm that power training is as safe as traditional strength training. Minor musculoskeletal discomfort (soreness) is the most commonly reported adverse event in the literature although joint pain and falls are also potential concerns (Porter 2006). However, studies report no difference in adverse events between power training and strength training with most injuries occurring during maximal power and strength testing. Power training has been used safely and effectively with a wide variety

of older adults including the oldest-old, the frail, those with musculoskeletal conditions such as osteoarthritis and osteoporosis and those with other disease conditions like Parkinson's disease, dementia and post-stroke.

Power training often brings to mind images of Olympic power lifters performing snatches and clean-and-jerk movements with near-maximal weight but this is not the type of power training recommended for older adults. For mature adults, power training is typically accomplished by performing the concentric phase of standard resistance exercise movements much more rapidly (< 1 sec) and the eccentric phase at normal controlled speed (2-3 sec). Studies have used a variety of equipment including body weight, weighted vests, sand bags, medicine balls, resistance bands, free weights, aquatics and pneumatic resistance exercise equipment safely and effectively (de Vreede et al 2005). An optimal prescription for power training has yet to be developed but there are a number of guidelines that have been developed to help guide the fitness professional.

Guidelines for Power Training with Mature Adults

1. Most power training studies have used programs similar to traditional strength training (2-3 sessions per week; 1-3 sets of 8-12 repetitions) although this may not be the optimal approach. Repetition ranges as low as 3-5 per set have been recommended in order to maintain a greater velocity of movement and power output (de Vreede 2005) because power output drops off considerably after about the fourth or fifth repetition. A recent study (Ramirez-Campillo et al 2018) found that cluster sets increased function more than traditional sets in a group of older adults. The cluster set group performed sets of 8 repetitions but included 30 seconds of rest after every two consecutive repetitions while the traditional set group performed all 8 repetitions consecutively. The cluster set approach reduced fatigue so that power output remained higher across all of the repetitions. Since similar results have also been found using cluster sets with younger populations the authors

concluded that cluster set training may be a more effective and efficient design compared to traditional power training design.

2. Some studies suggest that power training should be preceded by a conditioning phase that focuses on muscular strength and endurance as well as proper technique (de Vreede et al 2005). Not all studies include a conditioning phase in their design and there appears to be no increased risk from not doing so. However, all studies focus on teaching proper movement and technique over several acclimation sessions with many slowly increasing volumes over time. They also include an appropriate warm-up before each training session.
3. Muscle power can be maximally improved by using loads around 60% 1RM (Porter 2006) but using lower loads (20-40% 1RM) and higher movement velocities may offer several advantages. Some studies have suggested that lower loads may be more effective at improving overall physical function, and specifically balance, than higher loads. Lower loads are perceived to be easier with subjects reporting lower Ratings of Perceived Exertion. They also tend to lead to less soreness and joint discomfort.
4. The concentric phase of the movement should be performed “as rapidly as possible” but the eccentric phase should be performed in a “slow and controlled” manner (typically over 2-3 seconds) when performing most power training movements and especially with lower functioning clients. The slow eccentric portion allows the person to reset and load properly (e.g. proper joint alignment and body positioning) before attempting the next explosive movement. However, more fit and athletic clients will be able to perform more rapid eccentric movements, such as in a counter-movement jump, in order to take advantage of the stretch-shortening cycle of the muscles.
5. Fast, explosive movements can lead to greater movement error. If a client cannot perform the movement correctly at slower speeds then they should not attempt to perform the movement at maximal speeds. Movement error is of little concern when performing machine-based movements but more so when performing movements with bands, balls and free weights.
6. A wide variety of equipment can be used but weight stack machines may not be the safest choice due to potential injuries that can occur at the end range of motion. The momentum developed by the weight stack during a leg press or leg extension movement may cause the foot or leg pad to lose contact with the limb. If this occurs then the individual must “catch”

the weight when it returns. The force generated from this impact, especially if the limbs are not in proper position, may exceed the individual's capabilities and may lead to injury. This is why most research studies have used Keiser equipment which relies on pneumatic resistance via compressed air cylinders. This allows users to perform high speed movement smoothly without any concerns related to inertia or momentum. It also enables users to vary the resistance in one-pound increments quickly – even while performing repetitions. One study that directly compared Keiser to weight stack machines concluded that there was no difference in adverse events or functional outcomes between the two (Balachandran et al 2017). However, this was a single study using moderate loading that has not been replicated with a larger, more diverse group or with different loading schemes.

7. Plyometric-type exercises, such as squat jumps, must be used judiciously since there is a greater risk of falling and joint injuries during these movements. However, these types of explosive movements have been found to be both safe and effective for older adults (Moran et al. 2018). Teaching older adults proper jumping technique, including how to land softly, is a critical piece of ensuring safety during jump training movements (see suggestions below).
8. The primary focus of power training should be on lower-body musculature and tasks related to mobility but upper-body muscle power may also be important for the maintenance of function (de Vreede et al 2005). Some movements naturally engage both lower and upper body musculature for generating power but the majority of power training exercises should involve the lower body.

Power Training Exercises

Just like with traditional strength training, power training movements can easily be scaled to the individual's abilities so that older adults of all ability levels can perform them safely. Power movements typically fall into four categories: Lifts; Throws; Jumps; and Start/Stop.

Lifts include traditional strength training movements such as leg press, leg extensions, squats, deadlifts, presses, pulls, etc. These can be performed with a variety of equipment such as weight

stack machines, resistance bands, ankle straps and free weights but the precautions regarding inertia and momentum must be taken into consideration for each client.

Throws include any type of movement when any object is thrown. This includes wall balls, slams, and chest passes which are typically performed with some type of medicine ball. Since focusing on lower body power is more important, any type of throw should use the lower body to initiate and provide power to the throw.

Jumps include any movement where both feet leave the floor and are known as plyometric exercises. They include hops, vertical jumps, broad/horizontal jumps, box jumps, skipping, bounding, etc. These are more appropriate for higher functioning individuals since they require adequate power and balance to be able to perform. As stated previously, a recent meta-analysis has confirmed the safety and effectiveness of plyometric exercises for older adults (Moran et al. 2018). It suggests performing more than one exercise; more than two sets per exercise; 3-10 jumps per set; and 60 seconds of recovery between sets for up to three training sessions per week in order to ensure effectiveness.

Balance becomes more difficult and risk of falling increases during some of the more dynamic power movements such as jumping. The trainer must be aware of these risks and provide close monitoring for their clients as well as teach their client how to be successful with the movements. Getting clients to jump safely and effectively may take some time but as their lower body power improves jumping becomes the next appropriate progression. Below are some recommendations on how to prepare an older client to jump.

Teaching How to Jump

1. Stand with feet shoulder width apart. Start with controlled eccentric movement into the “down” position driving arms down. Check balance. Hold for 2-3 seconds. Stand up slowly.

2. Moderate but controlled eccentric movement into the “down” position. Check balance. Hold for 2-3 seconds. Stand up slowly.
3. Repeat with fast eccentric speed.
4. Repeat with fast eccentric speed and moderate concentric speed driving arms overhead.
5. Repeat with fast eccentric and concentric speeds driving arms overhead but with feet remaining on the floor (no jump).

Teaching How to Land

1. First go through the “How to Jump” progression.
2. Bunny Hops – Small jumps where the feet barely leave the ground. Bend knees slightly to jump and to land using arms appropriately. Hold 2-3 seconds before next hop.
3. Bunny Hops into Squat – Same as before but upon landing descend into a deep squat. Hold 2-3 seconds. Reset and repeat.

Four Part Jump Progression

1. Moderate “down”; moderate “up”; feet stay flat
2. Moderate “down”; faster “up” onto toes
3. Faster “down”; explode “up” with small jump (land softly)
4. Explode “down”; explode “up” with large jump (land softly)
5. Reset and repeat.

Starts and Stops are gait exercises that require a person to accelerate and decelerate quickly. They include movements such as get up and go, Red Light/Green Light, bug stomps, fast feet and fake falls. These exercises are performed without any external loading or equipment other than a chair. The goal is for the client to either move as quickly as possible from a resting position or to stop as quickly as possible from a moving position.

Similar to strength training, power training exercises must be scaled to the individual's level of function. Isolated power exercises, such as leg extension and leg curl, are not as ideal as more functional movement patterns, such as chair stands, but they have proven effective for increasing power and function. Therefore, power training should be considered an essential part of a resistance exercise program for all levels of function.

Barefoot Training

Performing exercises movements without shoes on is encouraged for older adults as it improves the sensorimotor system in the foot and ankle. The “short foot” exercise, originally popularized by Vladimir Janda, is an effective technique for maximizing proprioceptive input and improving motor responses (Page 2006). Performing “short foot” during loaded movements such as squat, deadlift and lunge help to provide a solid connection with the ground which can improve balance and lower limb control. Short foot is accomplished by contracting the intrinsic muscles of the foot in order to increase the amount of arch and “shorten” the length of the foot. According to Janda, proprioception and postural stability improve when exercises are performed with a short foot (Janda and VaVrova, 1996). This is likely because short foot creates a reflex activation of the pelvic floor and deep hip stabilizers which then allows proper activation of the abdominals, hip flexors and glutes. Recent evidence supports this claim of improved postural control. One study (Moon, Kim and Lee, 2014) demonstrated that the short-foot exercise immediately improves dynamic balance in people with excessively pronated feet (or flat feet) which is a very common occurrence as people age.

The short foot exercise can be taught first in a seated position but then needs to be taught in the standing position. After short foot has been mastered it can be utilized in a number of different

exercise movements and progressions. The ideal is to train the short foot position until it becomes automatic in your clients. However, this takes time and effort.

The short foot position can be initially taught using the following simple steps:

- 1 Sit on a chair with feet on a firm surface without shoes or socks
- 2 Focus on feeling the texture of the ground with the foot
- 3 Spread digits out wide (like spreading your fingers) and place them all on the ground
- 4 Press big toe into ground in order to lift the arch
- 5 Hold for several seconds then release (repeat several times)
- 6 Move to a standing position
- 7 Shift weight to one foot while using the other foot for balance (clients may hold onto a rail or chair to help with their balance if necessary)
- 8 Bend knee slightly on the weighted leg
- 9 Repeat steps 3-5, stand up and relax between sets

Clients should be encouraged to train with and without shoes but not all will do so. Training without shoes on may be uncomfortable or embarrassing for some individuals; difficult for people with certain foot conditions; or impractical in certain situations.

Trunk Stability: Training the Core in Three Dimensions

The core/trunk musculature is the connection between the upper and lower body. It is important to build three-dimensional stability in older clients in order help protect the spine during daily activities such as work, sport, recreation and leisure. Traditionally, many abdominal exercises are dynamic movements in the sagittal plane (front to back) such as crunches, sit-ups, leg raises and ball slams. In order to build core stability appropriately it is important to focus on isometric exercises that challenge the sagittal, frontal and transverse planes. Exercises such as front planks (sagittal plane), side planks (frontal plane) and shoulder-tap planks (transverse plane) are good examples of isometric core stability exercises.

Core stability is the ability of the trunk musculature to keep the spine in a neutral position. Therefore, effective core stabilization requires bracing the spine (through isometric activation of the core musculature) while maintaining the spinal neutral position. Clients will need to first be taught how to find neutral spine; how to brace through the core; and how to hip hinge properly.

1. How to Find Neutral Spine: In a standing position have the client stand tall and then perform several posterior and anterior pelvic tilts without changing their upper trunk position. Tell them to find the “happy place” in between those two positions that feels the most comfortable. Their pelvis should be fairly level which is going to be their neutral spine position. Have them relax and move around a bit before returning to the standing position and repeating the sequence. Since the goal is for them to be able to find the neutral spine position on their own while they are performing exercises then it is necessary to keep practicing this. It is also helpful to have them find neutral spine in the seated and quadruped positions.
2. How to Brace: Bracing the trunk requires activation of all of the core musculature (rectus abdominis, transverse abdominis, internal obliques, external obliques, erector spinae, etc.). The challenge is that many older adults have a difficult time volitionally activating these muscles. There are several techniques that can be helpful-

- Tell them to cough and feel the core muscles tense
- Tell them to pretend that someone is punching them in the stomach and tense up accordingly
- Use your fingers to “grab” or push in to their core muscles. Do not do this lightly. The goal is for it to be somewhat uncomfortable so that they tense their muscles against your fingers.
- Have them stand tall in neutral spine with feet just outside of shoulder-width apart to create a strong base. Tell them that you want them to stay tall and rigid like a statue. Apply pressure on their shoulder from the side with one hand and tell them to resist your pushing. This will activate their lateral core muscles. While applying pressure with one hand you can use your other hand to “grab” or “poke” those activated muscles so that they can feel what is happening. It is also helpful to have

them put their hand on those muscles to feel their activation. Repeat on the other side. Next have them stand tall in a staggered stance position and apply pressure to their chest (pushing them backwards) while they resist. Next, apply pressure on their back (pushing them forwards). Each time have them notice the muscle activation through the core and use your fingers to give tactile feedback. When you apply pressure, you should start with low force and gradually increase force (do not just shove them quickly). Do not apply so much force that it pushes them out of neutral spine.

When bracing the spine, the client should continue to breathe shallowly through their chest.

Full, deep “belly” breathes will not be possible because the diaphragm will not be able to draw downwards. The focus, instead, will be on expansion of the rib cage for breathing.

Under very heavy loading, such as heavy squats or deadlifts, a Valsalva technique is appropriate. A Valsalva occurs when there is forced expiration against a closed glottis meaning that the person is creating lots of intra-abdominal pressure by holding their breath.

This should only be performed during a single repetition with exhalation and inhalation occurring between each repetition to prevent lightheadedness or even unconsciousness.

3. How to Hip Hinge: The hip hinge involves flexion and extension of the hip while maintaining spinal neutral through proper bracing. It is very difficult for some individuals to separate hip flexion from spinal flexion which is easily evidenced when someone bends forward at the waist. Proper hip hinge is necessary for performing a deadlift exercise as well as performing tasks in daily life, such as lifting something from the floor. Several cues can be helpful when teaching the hip hinge.

- a. Telling them to “shut the file cabinet drawer” with their bottom is typically a good place to start. Place them a few inches from a wall so that their bottom touches the wall.
- b. Add a resistance band around their hips pulling them backwards (light resistance) while they perform the “shut the drawer” maneuver.
- c. Place a dowel rod along their spine so that it touches the back of their head, the top of their thoracic spine and their tailbone while they perform the “shut the drawer” maneuver. All three points of contact should remain during the movement.

- d. Teach them the “shortstop position” by having them slide their hands down their thighs until they rest just above the knees. Adjust their spinal position to neutral if they have flexed or extended the spine.
- e. Perform bridges while lying on their back.

During a hip hinge movement, the amount of hip flexion or forward bending they can achieve will be limited mainly by their posterior chain flexibility. Have them lean forward to the point where they experience tightness in their hamstrings and glutes while maintaining spinal neutral and then stop. This becomes their maximal hip hinge ability because anymore forward bending will need to come from spinal flexion which is to be avoided. Only after they can perform a proper hip hinge repeatedly should you add resistance such as a resistance band or kettlebell.

Core stability exercises should challenge the trunk musculature without deviating from spinal neutral. This means the exercises should be isometric and the first goal is to build isometric endurance. Once endurance is established the client can progress to more dynamic exercises; heavier loading to build strength; or power movements. Here are some isometric exercises that are effective for building core endurance.

1. Bird Dog – From a quadruped position slowly extend arm or extend leg or extend opposite arm and leg (transverse)
2. Dead Bug – Lie on back with arms extended towards ceiling and bent legs extended towards ceiling (quadruped position but on your back). Extend one arm over head and return to the start. Extend a leg and return to start. Extend opposite arm and leg and return to start. (transverse)
3. Planks – There are many variations of the plank position which can accommodate users with varying abilities and challenge multiple planes of movement.
 - a. Front Plank (sagittal)
 - i. Low Front Plank – performed prone on elbow(s)
 - ii. High Front Plank – performed prone on hand(s)
 - iii. Elevated Front Plank – performed prone with hands/elbows on an elevated surface such as a bench, table or wall
 - iv. Modified Front Plank – performed prone with knees on ground instead of toes/feet

- v. Reverse Plank – performed in supine typically with feet elevated onto a bench or chair
 - b. Side Plank – performed on one elbow (low plank) or hand (high plank) with body turned to the side (frontal)
 - c. Shoulder-Tap Plank – from the high plank position slowly touch one hand to the opposite shoulder, return to start position and repeat with the other hand (transverse)
 - d. Rolling Plank – from the low or high plank position “roll” into a side plank position, return to the start and roll to a side plank position on the other side (sagittal, frontal and transverse)
4. Glute Bridges
- a. Double-leg (sagittal)
 - b. Single-leg (transverse)
5. Palof Press – Hold cable or tubing in both hands in front of the navel with arms bent. Resistance should be pulling laterally (anchored beside you). (transverse)
- a. Add sideways stepping to make it a dynamic exercise

Many standard resistance exercises can also be performed in a manner that requires a great deal of trunk stability. This is an effective and efficient way to build endurance and strength in the trunk musculature and has many direct functional applications. Movements such as presses and rows, if performed without external support, will automatically require trunk stability. These can be performed in standing, half-kneeling and kneeling positions with bands/tubing, cables and free weights (depending on the body position and movement). Using either bilateral or unilateral movements will also change the challenge to the trunk musculature. Also note that horizontal presses will predominantly activate the anterior chain musculature (e.g. rectus abdominis) while a horizontal row will predominantly activate the posterior chain musculature (e.g. erector spinae). It is important to include a wide variety of core stability exercises so that all three planes are challenged consistently in a program. Here are just a few examples:

1. Horizontal Press/Row

- a. Bilateral chest press or row in a standing staggered stance (to increase anterior-posterior stability) – sagittal plane
- b. Unilateral chest press or row in a standing staggered stance– transverse plane

2. Vertical Press/Row

- a. Bilateral shoulder press or lat pull-down/pull-up – no specific plane
- b. Unilateral should press or lat pull-down – frontal plane

Joint Mobility/Flexibility

Deficits in flexibility with advancing age have been identified as contributing to the development of a number of acute and chronic conditions including postural deviations (kyphosis, forward head), low back pain and rotator cuff tendinitis. However, the impact on physical function and the functional benefits of stretching for older adults are somewhat unclear. A recent systematic review (Stathokosta et al 2012) concluded that the evidence for flexibility training to positively influence functional ability is inconclusive.

The authors state:

“From the present review, there is not enough consistent evidence to make recommendations for any specific prescriptions of type, frequency, duration, or length of program related to flexibility training; particularly no specific recommendations can be made regarding the program or dose response of flexibility training to the focus of the present study, the transfer of flexibility gains to functions of daily life, or ability to live independently.”

“While flexibility training interventions synthesized in the present paper have been shown to increase flexibility and joint ROM, no consistent increases in functional outcomes have been observed. Therefore, future studies should consider the relationship that increased flexibility and joint ROM have with functional outcomes to determine if the increased flexibility is beneficial and worthwhile in terms of maintaining or increasing functional capacity for healthy older adults.”

Despite the lack of empirical evidence regarding the benefits of improving flexibility globally it is well understood that improving joint mobility (which includes flexibility) is an important aspect of maintaining proper movement. In the Functional Aging Training™ model mobility and flexibility exercises should target areas of significant deficit, especially if they have an acute or chronic condition that has been directly linked to poor flexibility.

There are several areas of the body that warrant special attention – the ankles, hips and thoracic spine. These are areas that tend to make an impact on function when mobility is lost. Following is some specific information on each of these areas including some recommended exercises in order to regain mobility.

Ankle Dorsiflexion: Lack of ankle dorsiflexion can significantly impact squatting/sitting and gait patterns and can increase fall risk. Limited dorsiflexion can be due to soft tissue inflexibility (calf tightness), improper roll and slide of the ankle joint, or a combination of the two. To evaluate ankle dorsiflexion, have the client assume a half-kneeling position without shoes on with their front foot touching a wall. The person should drive their front knee forward as far as they can go without their heel coming off of the ground. At a minimum they should be able to get their knee to touch the wall (ideally, they should still be able to touch the wall when their foot is 1-2 inches away). If they cannot then this indicates limited dorsiflexion. While they are performing this test ask them where they feel the limitation – a tight stretch in the calf muscle or discomfort in the front of the ankle. If they say the calf muscle then traditional calf stretches and foam rolling will be helpful. However, if they say they feel discomfort in the front of the ankle then they probably have a roll and slide issue in the ankle itself. Individuals that have severely or repeatedly “rolled” their ankle when they were younger are more likely to have roll and slide issues due to the build-up of scar tissue.

To correct the roll and slide limitation, have the client place a strong narrow resistance band around their ankle while their foot is propped up on a small stool or box. The band should be anchored behind them at a slightly downward angle and stretched to provide a significant amount of resistance. From this position have the client perform bent-knee calf stretches with their knee tracking towards their second toe (beside their pinky toe). If performed correctly they should feel more of a stretch in their calf than discomfort in the front of the ankle but it may take a little time to restore roll and slide. Hold that position for 3-5 seconds and repeat for a total of 10 repetitions. For best results, perform 3 sets daily.

As ankle dorsiflexion improves it is important to load it in functional positions such as during squatting. This will help them to learn how to use that new-found range of motion in a functional pattern. The body will have made compensations for the lack of ankle dorsiflexion and will need to re-learn proper muscle activation patterns in order to fully take advantage of this improvement.

Hip Mobility: Proper hip mobility is required for many functional activities and when it is lacking it can create issues all along the kinetic chain (especially for the ankles, knees and lower back) which may lead to acute or chronic pain. It is also a factor in performing, or as a pre-requisite for performing, many exercises appropriately such as squats, deadlifts and lunges. Since the hips move in extension/flexion, abduction/adduction and internal/external rotation a variety of mobility exercises are recommended that address each of these movements. Some examples are listed below:

- Hamstring and Quadriceps Stretches
- Pigeon Stretch/Figure 4
- Perfect Stretch
- Runner's Lunge
- Box Stretch
- Couch Stretch

- Butterfly Stretch
- Frog Stretch
- Bretzel

There are multiple tests than can be used to formally assess hip mobility, such as the Thomas Test, but these are usually reserved for physical therapists and orthopedic physicians. More appropriate for fitness professionals are assessments such as the toe-touch screen and Active Straight Leg Raise (both included in the Functional Movement Screen) or the YMCA sit and reach test (or seated sit and reach test such as in the Senior Fitness Test Battery). Most older adults will likely need to work on improving their hip mobility.

Thoracic Spine Mobility: A lack of mobility in the thoracic spine can lead to postural deviations, decreased shoulder mobility, compensation patterns and a general decrease in upper-body function. The most common postural deviation is kyphosis (forward flexion) which is often accompanied for a forward-head position (often called “turtle head”). If they have an obvious thoracic kyphosis then you can assume that they have limited thoracic mobility. If they do not present with kyphosis then a quick screen for thoracic mobility is to assess rotation while seated. Have the client sit towards the front of a chair with feet planted firmly on the floor about shoulder width-apart. Have them hold a bolster or foam roller between their knees. Place a dowel or plastic tube across their clavicles just below the neck. They should cross their arms over their chest to hold the tube in place. Have them turn their shoulders and head as far to the right as they can without changing the position of their feet or knees. Using the tube as a guide approximate how many degrees they were able to turn. Repeat on the left side. If they cannot achieve at least 40 degrees on both sides then this is an indication that they have limited thoracic mobility. Since spinal extension and rotation are inter-dependent in the thoracic spine it is important to work on both as well as lateral flexion.

- Cat/Cow
- Cobra
- T-spine rotations in quadruped
- Open the book in side-lying
- Bretzel
- Child's Pose
- Puppy Pose
- Foam rolling

The appropriate precautions should be taken when working with individuals that have existing spinal issues such as degenerative discs, spinal fusions or osteoporosis.

THE NEUROMUSCULAR DOMAIN

The neuromuscular domain includes components such as reaction time, proprioception, coordination, movement accuracy and motor control. Numerous research studies have demonstrated the importance of these factors when performing functional activities including recreation and sports. It is also a domain that is significantly affected by certain disease processes such as Parkinson's disease.

There are many different types of techniques and strategies that can be used to improve neuromuscular performance. Several of these are similar to strategies used for the Mobility and Balance domains as there is significant overlap between them. Here are a few that you may want to consider integrating into your programs.

Diaphragmatic Breathing – The diaphragm is the most efficient muscle of breathing. It is a large, dome-shaped muscle located at the base of the lungs. Your abdominal muscles help move the diaphragm and give you more power to empty your lungs. Many people adopt shallow, “chest” breathing which requires much more muscular effort and is less efficient at oxygenation as the lower parts of the lungs are not inflated well.

Diaphragmatic breathing is intended to help you use the diaphragm correctly while breathing to:

- Strengthen the diaphragm
- Decrease the work of breathing by slowing your breathing rate
- Decrease oxygen demand
- Use less effort and energy to breathe

Have your client lie on their back on a flat surface or in bed, with knees bent and head supported. Have them place one hand on their upper chest and the other just below their rib cage. This will allow them to feel your diaphragm move as they breathe. Instruct them to breathe in slowly through their nose so that the stomach moves against their hand. Breathe deeply trying to fill the

lungs with as much air as possible. The hand on the chest should remain as still as possible. Tell them to tighten their stomach muscles, letting them fall inward as they exhale through pursed lips so they exhale as much air as possible. Repeat with deep slow breathes for several minutes. As they get better at it they can try the diaphragmatic breathing technique while sitting in a chair.

Another diaphragmatic breathing technique is called Crocodile Breathing. Have the client lie on their stomach with their forehead resting on stacked hands or fists. Perform the same technique as described earlier but have them focus on feeling the abdomen push against the floor and expanding their rib cage three-dimensionally. Place your hands on their sides and back to give them some tactile cues on where to breathe into.

Segmental Rolling is a developmental strategy learned by infants as they figure out how to move around their environment. For adults and older adults using segmental rolling techniques can reinforce or re-learn proper motor control patterns. There are 8 conditions:

- Prone to supine, roll left to right with upper body
- Prone to supine, roll right to left with upper body
- Prone to supine, roll left to right with lower body
- Prone to supine, roll right to left with lower body
- Supine to prone, roll left to right with upper body
- Supine to prone, roll right to left with upper body
- Supine to prone, roll left to right with lower body
- Supine to prone, roll right to left with lower body

In both the prone and supine positions, the arms are extended overhead. The upper body rolls are initiated with one arm and the head. The lower body rolls are initiated with one leg only. When the upper body is initiating the rolling the lower body should remain as inactive as possible and vice versa. When the right side is being used to initiate the rolling the left side of the body should remain as inactive as possible and vice versa. It is common for people to unconsciously use the

other parts of their body to try to assist them especially when they get “stuck” at a certain part of the roll.

Crawling is an effective neuromuscular exercise that also helps with gait re-training since it is a similar contralateral pattern to walking. Basic crawling technique occurs in the quadruped position in a spinal neutral position with mild abdominal bracing and eyes fixed a few feet in front of the hands. The feet can be in plantar flexion. Initiate the movement by simultaneously moving one hand and the opposite knee forward. The knee should touch or almost touch the hand that is one the ground. Both the hand and the knee should only be lifted high enough to clear the ground. Repeat with the other limbs. Smooth and simultaneous movements are key to performing this correctly. Do not let clients move a hand before they move their leg and vice versa. Perform the crawling slowly to focus on control and coordination. This can also be performed backwards.

Sideways crawling requires a slightly different set up. Start in quadruped but have the client bring their hands close together so thumbs are touching. To initiate the movement to the right simultaneously move the hand laterally to the right and the opposite knee medially (to the right) so that the hands are now shoulder-width apart and the knees are close together. To continue in the same direction, move the left hand medially to the right and the right knee laterally to the right. Continue this pattern with the hands and feet coming together and apart.

Reaction Drills: These require a person to respond as quickly as possible to a stimulus such as a visual, verbal/auditory or tactile cue with a physical movement. It challenges a person to identify sensory input, process the input and then respond with the appropriate motor pattern. The fake falls discussed in the balance section are a good example of challenging reaction time (along with movement speed). Reaction time slows with aging mainly due to the gradual loss of neurons. The key to true reaction drills is to keep the stimulus and response simple. If the situation is more

complex then you get into training cognitive processing speed instead of reaction time. The easiest way to train reaction time is to simply have the client perform a fast movement upon your command (either verbal or visual). For example, have them shuffle in place and lunge to touch a cone on the floor that you point to; or toss tennis balls to them that they have to quickly grab and drop in a bucket; or toss a tennis ball over their shoulder from behind that they have to grab before it bounces twice.

Fine Motor Skill Tasks: These are not a typical part of a fitness program but are often utilized in retirement centers, senior centers, nursing/care homes and by therapists. Exercises to work on fine motor skills include:

- Poking straws into holes.
- Making pasta necklaces.
- Weaving yarn into cardboard.
- Using scissors
- Putting Lego blocks together and taking them apart
- Manipulating play dough or putty
- Getting dressed with belts, buttons, zippers and snaps
- Opening and closing latches
- Puzzles
- Picking up small objects with fingers
- Sorting jewelry