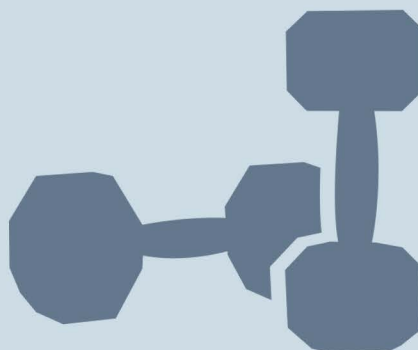


# RESISTANCE EXERCISE TOOLKIT

- 1 Definition and Benefits
- 2 Considerations and Flags
- 3 Exercise Physiology Foundations
- 4 Prescription Principles
- 5 Behaviour Change
- 6 Special Populations
- 7 Case Study and Integration into Practice
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# RESISTANCE EXERCISE TOOLKIT



## Definition

**Resistance Exercise** is defined as:

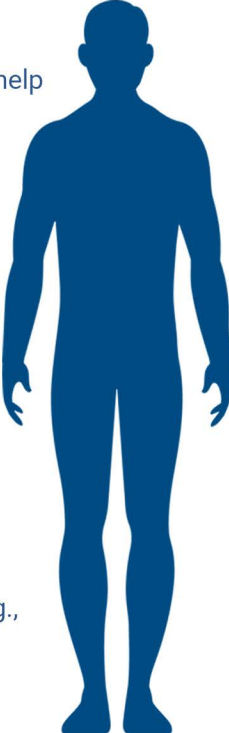















“Movement using body weight or external resistance that improves muscular strength, power, or endurance, and may ultimately positively impact mobility, function and independence.”



## Health Benefits of Resistance Training

# 1

Physical and mental health benefits that can be achieved through resistance training include:<sup>1</sup>

- 
- Improved muscle strength and tone, which can help to protect joints from injury 
  - Maintaining flexibility and balance, which can help to maintain independence as individuals age 
  - Weight management and increased muscle-to-fat ratio – more muscle is linked to burning more kilojoules at rest 
  - May help reduce or prevent cognitive decline in older people 
  - Greater stamina – with increased strength individuals will tire less easily 
  - Prevention or control of chronic conditions (e.g., diabetes, heart disease, arthritis, back pain, depression, and obesity) 
  - Pain management 
  - Improved mobility 
  - Improved posture 
  - Decreased risk of injury 
  - Increased bone density and strength and reduced risk of osteoporosis 
  - Improved sense of wellbeing – resistance training may boost self-confidence, improve body image and mood 
  - Improved sleep and avoidance of insomnia 
  - Increased self-esteem 
  - Enhanced performance of everyday tasks 

# RESISTANCE EXERCISE TOOLKIT



## Health Benefits of Resistance Training

2

- A position statement from the National Strength and Conditioning Association, written by Fragala et al. 2019, highlights the following benefits that are more specific to older adults.

A properly designed resistance training program can:<sup>2</sup>

- counteract the age-related changes in contractile function, atrophy, and morphology of aging human skeletal muscle
- enhance the muscular strength, power, and neuromuscular functioning of older adults
- improve mobility, physical functioning, performance in activities of daily living (ADL), and preserve the independence of older adults
- improve an older adults' resistance to injuries and catastrophic events such as falls
- help improve the psychosocial well-being of older adults

The Fragala et al. 2019 article consistently reinforces that resistance training programs must be properly designed to attain and optimize benefits.<sup>2</sup> This is also reinforced by the APTA's Choosing Wisely® Initiative, which highlights that a resistance training program must be matched appropriately to the individual's abilities and goals. Under-dosing resistance training programs will dilute the benefits.<sup>3</sup>

### Resistance Training for Health

People of all ages and abilities who regularly participate in resistance exercise reduce risk of numerous diseases, improve quality of life and reduce mortality.

#### Key Physiological Benefits of Resistance Exercise

- Muscle strength, endurance and power
- Bone, muscle and connective tissue growth and durability
- Communication between brain and muscle
- Blood glucose regulation
- Growth hormones
- Aerobic fitness

#### Resistance Exercise Can Help Manage and Treat Many Conditions Including:

- Arthritis
- Cancers
- Cardiovascular disease
- Dementia
- Depression
- Diabetes
- Fall risk
- Frailty
- Hypertension
- Insomnia
- Low back pain
- Mental health
- Movement disorders
- Obesity
- Osteoarthritis
- Osteoporosis
- Pulmonary disorders
- Peripheral vascular disease
- Stroke

#### Training can be time efficient and effective for health benefits:

For health benefits, muscles need to be challenged with a combination of weight lifted, repetitions and speed of lifting. The addition of resistance training to aerobic programs can also enhance other health gains throughout the life span from childhood to old age.

#### Exercise Plan:

- Free weights, machines and/or bands can be used
- Perform 8-10 multi-joint exercises that stress the major muscle groups
- Perform 2-3 sets of 8-12 repetitions with good form
- Lift and lower the weight in a controlled manner (2 seconds each up and down)
- The last repetition should be difficult to complete
- Perform exercise 2-3 times per week
- Progress weight lifted over time so that it feels like an 8 out of 10 difficulty (where 0 = no effort, 10 = hardest effort you can give)

Authors: Fiataroone Singh, Maria; Hackett, Daniel; Schoenfeld, Brad; Vincent, Heather K.; Wescott, Wayne. 2019

Image from: Singh et al. (2019)<sup>4</sup>

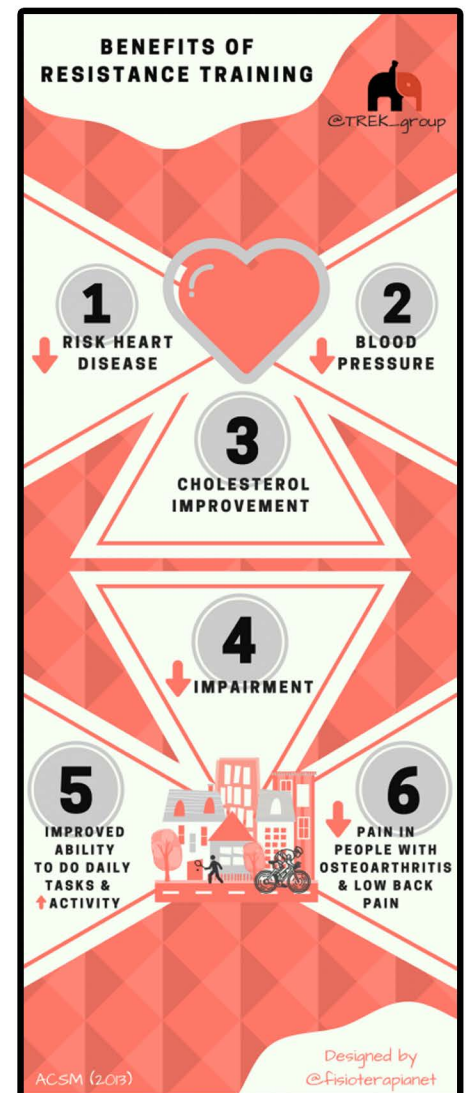


Image from: TREK. Benefits of Resistance Training (2013)<sup>1</sup>



# RESISTANCE EXERCISE TOOLKIT



## What to Assess Prior to Recommending Resistance Exercise: Considerations and Flags



Prior to beginning exercise, liaise with the patient's physician regarding your treatment plan, and discuss any signs or symptoms to monitor. Use your clinical judgement with each patient.

### The American College of Sports Medicine (ACSM) Screening Guidelines flow chart

First, use the ACSM or **PARQ+ (2020 version)** screening guidelines to determine whether REX is an appropriate treatment for your patient. <https://bit.ly/3eup5kH>

### Physical Activity History Tools

#### Physical Activity Vital Sign (PAVS)

• <https://bit.ly/3vfbS4V>

#### Rapid Assessment of Physical Activity (RAPA)

• <https://bit.ly/38xSp5R>

#### Physical Activity Screening for the Elderly

• <https://bit.ly/3cthsbE>

### Equipment Considerations<sup>1</sup>

- Lines
- Aids (eyewear, hearing aids, gait aids)
- Body weight as resistance
- External resistance

### Patient Considerations<sup>1</sup>

- Patient's chart (co-morbidities and medication)
- Activity orders (based on acuity/stability)
- Oxygen saturation/requirements, if applicable
- Need for supervision
- Pain (timing of pain medication)
- Fatigue management (endurance considerations)
- Strength
  - Condition
- Function
  - Barriers
- Ability to learn
  - Mobility assessment

**R**

### Hematological Considerations

- **Hemoglobin (Hgb):** Withhold mobilization for patients with hemoglobin (Hgb) levels lower than 70 g/L<sup>2</sup>; monitor the following symptoms and potential adverse effects: chest pain, pallor, leg cramps, dizziness, arrhythmias, shortness of breath, and respiratory distress<sup>2</sup>
- **Blood pressure (BP):** SBP > 200 mmHg or DBP > 110 mmHg, or a drop in SBP > 10 mmHg from baseline<sup>4</sup>
- **Heart rate (HR):** increases >120 bpm with activity<sup>4</sup>
- **Oxygen saturation (SpO<sub>2</sub>):** SpO<sub>2</sub> levels <88% with activity, and/or a positive orthostatic drop<sup>4</sup>
- **Platelets:** please refer to the table in the cancer section under Special Populations for platelet considerations.
- **Appropriate gear and injury prevention are important considerations for avoiding injury<sup>4</sup>**

**A**

### Cardiovascular Considerations<sup>3</sup>

- **Cardiac conditions:** unstable coronary heart disease (CHD); decompensated heart failure; acute myocarditis, endocarditis, or pericarditis
- **HR:** uncontrolled arrhythmias
- **BP:** uncontrolled hypertension (>180/110 mm Hg); severe pulmonary hypertension (mean pulmonary arterial pressure >55 mm Hg)
- **Connective tissue disorders:** Marfan syndrome; Ehlers Danlos (aortic dissection)
- **Blood flow:** severe and symptomatic aortic stenosis; deep vein thrombi (DVTs) and pulmonary emboli (PE)

**R**

### Musculoskeletal Considerations<sup>3</sup>

- Musculoskeletal limitations
- Joint pain or instability, from arthritis or other causes (these conditions require alternative ways to train the same muscle groups; consider different exercises)

**A**

### Other Considerations<sup>3</sup>

- High-intensity resistance training (80–100% of 1RM) in patients with active proliferative retinopathy, or moderate or worsening non-proliferative diabetic retinopathy

**R**

### Cardiovascular Considerations<sup>1</sup>

- Major risk factors for Coronary Artery Disease
- Uncontrolled hypertension (systolic blood pressure 160 mm Hg and/or diastolic blood pressure >100 mm Hg)
- Individuals who have implanted pacemakers or defibrillators

**R**

**Relative** Contraindications

**A**

**Absolute** Contraindications

**R**

### Other Considerations<sup>1</sup>

- Diabetes at any age



# RESISTANCE EXERCISE TOOLKIT



## Exercise Physiology Foundations

# 1.A Muscle Strength and the Life Course

### Take Home Message

Muscle strength decreases through the adult years and into older life. The decreases in strength are associated with increased disability, falls and mortality.

Loss in strength can be moderated through maximizing muscle in early adulthood, maintaining strength in middle age and minimizing loss in older age (see figure on the right). This can be achieved through resistance exercise training.

**While REx is more impactful if done earlier in life, it can still have positive effects if done later in life.** (See figure on the right)<sup>1</sup>

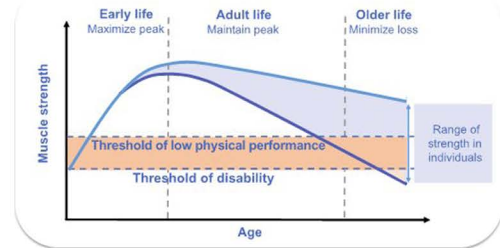


Image from: Cruz-Jentoft et al. (2019)<sup>1</sup>

### Types of Muscle Atrophy

	Disuse/Physiologic Atrophy	Neurogenic Atrophy	Myogenic Atrophy
SOURCE/ORIGIN	Bed rest, immobility	Injury or disease of nerve supplying muscle (upper or lower motor neuron); generally more sudden than in disuse atrophy, e.g. Amyotrophic lateral sclerosis (ALS, or Lou Gehrig's disease); spinal muscular atrophy; damage to a single nerve, such as axillary nerve; spinal cord injury; Guillain-Barre syndrome; nerve damage caused by injury, diabetes, toxins, or alcohol; polio. <sup>2</sup>	Muscle diseases (e.g. muscular dystrophy, polymyositis, dermatomyositis, metabolic myopathy, congenital myopathy, myotonia). <sup>2</sup>
RESULT	Same number of muscle fibers, but reduced volume/diameter with associated reduction in muscle mass; decrease in protein synthesis; Type 1 antigravity muscles most affected. Susceptible to sarcomere damage when reloading.	Atrophy of Type I and Type II fibers. Hypertrophy of Type I fibers can occur with re-innervation of denervated fibers by surviving collateral nerves. A shift of fiber type typically occurs from Type I to Type II. <sup>4</sup>	Simultaneous occurrence of atrophic and hypertrophic Type I and Type II fibers in most myopathies. Atrophy of Type II fibers is a non-specific event, and occurs in many myopathic disorders. Selective Type I atrophy happens in various congenital myopathies and myotonic dystrophy. <sup>4</sup>



Hospitalized older adults may experience muscle atrophy from one or more of disuse, neurogenic or myogenic atrophy. Sarcopenia and cachexia are distinct conditions that may also result in muscle atrophy. Please see the next page for more information.

# RESISTANCE EXERCISE TOOLKIT



## Exercise Physiology Foundations

## 1.B Muscle Strength and the Life Course

### Sarcopenia

“**Sarcopenia** is a progressive and **generalised skeletal muscle disorder** that is associated with an increased likelihood of adverse outcomes including falls, fractures, physical disability and mortality.”<sup>1</sup>

Sarcopenia is considered a muscle disease (muscle failure) with the following three criteria:<sup>1</sup>

**Table I.** 2018 operational definition of sarcopenia

Probable sarcopenia is identified by Criterion 1.  
Diagnosis is confirmed by additional documentation of Criterion 2.  
If Criteria 1, 2 and 3 are all met, sarcopenia is considered severe.

- (1) Low muscle strength
- (2) Low muscle quantity or quality
- (3) Low physical performance

#### Primary and Secondary Sarcopenia

Factors that cause and worsen muscle quantity and quality (sarcopenia) are categorized as primary (aging) and secondary (disease, inactivity, and poor nutrition). Given the wide range of factors that contribute to sarcopenia development, a number of muscle changes are possible when these factors interact.

Sarcopenia can occur with increasing age as muscle fibres die and are replaced by connective and adipose tissue. It is a major contributor to the development of frailty.<sup>1</sup> Frailty is a geriatric syndrome resulting in the cumulative decline of multiple body systems/function with pathogenesis involving physical and social dimensions.<sup>1</sup> Sarcopenia and frailty can co-exist.<sup>5</sup>

Probable sarcopenia is identified by low hand grip strength (<27kg for men, <16 kg for women) and/or poor chair stand ability (>15 seconds) and indicates a need for further assessment and treatment.<sup>1</sup>

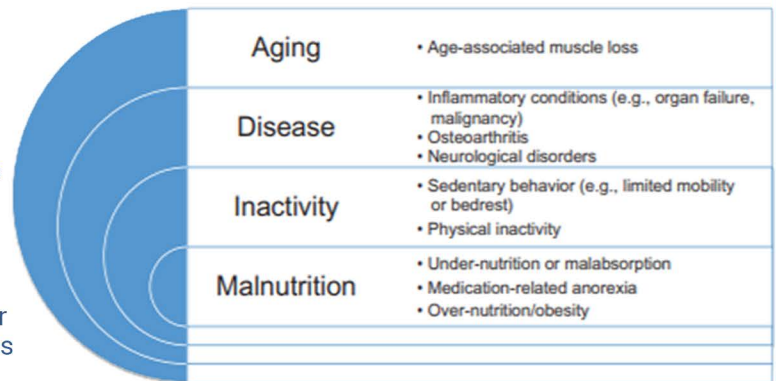


Image from: Cruz-Jentoft et al. (2019)<sup>1</sup>

Sarcopenia may be acute (<6 months related to an acute illness or injury) or chronic (>6 months).<sup>1</sup> Chronic sarcopenia is associated with adverse outcomes, including 2-3x increased 3 year mortality and increased number and days of hospitalization. By identifying and treating sarcopenia in the acute phase we can help prevent or delay sarcopenia progression and poor outcomes.<sup>6</sup>

### Cachexia

“Cachexia is a complex **metabolic syndrome** associated with underlying illness and characterized by loss of muscle with or without loss of fat mass. The prominent clinical feature of cachexia is weight loss in adults (corrected for fluid retention) or growth failure in children (excluding endocrine disorders). Anorexia, inflammation, insulin resistance, and increased muscle protein breakdown are frequently associated with cachexia. Cachexia is distinct from starvation, age-related loss of muscle mass, primary depression, malabsorption, and hyperthyroidism and is associated with increased morbidity.”<sup>7</sup> Sarcopenia is one of the factors that may cause cachexia.<sup>5</sup>



# RESISTANCE EXERCISE TOOLKIT



## Exercise Physiology Foundations

## 2 Regeneration of Injured Skeletal Muscle<sup>8</sup>

**i** If the patient has sustained an injury to skeletal muscle, the following information regarding types of muscle injuries and phases of muscle healing may be helpful in planning the progression of resisted exercise.

### Types of Muscle Injuries

#### 1 Shearing type

- Caused by contusion, strain or laceration
- Muscle fibers, their basal lamina, myofibrils sheaths, and nearby capillaries, all rupture

#### 2 Insitu necrosis (rhabdomyolysis)

- Myofibers are partially necrotized while basal lamina, myofibrils sheaths and blood vessels remain intact

### 3 Phases of Muscle Strain Healing Process

#### 1 Destruction Phase

- a. Ruptured myofiber becomes necrotized over a short distance (contained by a contraction band that forms within a couple of hours)
- b. Rupture is sealed by a new sarcolemma
- c. Damaged myofibers contract and the gap between stumps is filled by a hematoma
- d. Inflammatory cell reaction

#### 2 Repair Phase

- a. Phagocytosis of necrotized tissue by monocytes
- b. Satellite cells (myogenic reserve cells) are activated and begin to repair damaged myofibers
- c. Committed satellite cells start to differentiate into myoblasts
- d. Undifferentiated stem satellite cells start to proliferate by 24 hours, and undergo asymmetric cell division for future regeneration
- e. Activation, proliferation, and differentiation of satellite cells can be improved by exercise
- f. Myoblasts from satellite cells fuse to form myotubes within a couple of days
- g. Within 5-6 days the necrotized part of the damaged myofiber inside the remaining old basal lamina is replaced by the regenerating myofiber
- h. Injury site is revascularized by ingrowing capillaries with first capillary sprouts within 3 days after the injury

#### 3 Remodeling Phase

- a. Maturation of regenerating myofibers
- b. Formation of a mature contractile unit and attachment of the ends of the regenerated myofibers to the scar by newly formed musculotendinous junctions
- c. Retraction of the scar pulls the ends closer to each other
- d. Contraction of scar tissue driven by fibroblasts converting to myofibroblasts that have contractile capacity

### Some factors which may impact healing of muscle:<sup>10</sup>

- Oxygenation, infections, stress, sex hormones, diabetes, medications, obesity, alcohol, smoking, nutrition
- Age
  - o With age, there are fewer satellite cells which can differentiate into any type of cell
  - o Slower phagocytosis which delays healing
  - o Greater fibrosis with muscle injury
  - o Lower production of growth factors

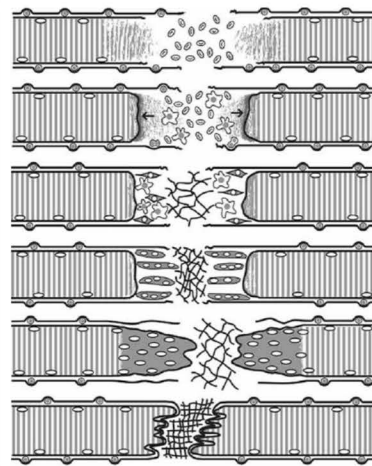


Figure 1. The regeneration of a shearing injury. (A) Torn myofiber and BL. (B) Contraction band and demarcation membrane seal the torn fiber ends. Satellite cells (SL) begin to proliferate and inflammation reaction begins. (C) SCs differentiate into myoblasts and fibroblasts begin to produce collagens and form scar tissue. (D) Myoblasts fuse into myotubes. (E) Myotubes fuse with the surviving parts of the torn fibers and start to form new MTJs. (F) Fully regenerated fiber with organized scar tissue and MTJs attached to it.

Image from: Jarvinen et al. (2013)<sup>8</sup>

# RESISTANCE EXERCISE TOOLKIT



## Exercise Physiology Foundations

## 3 Principles of Strength and Conditioning

### PRINCIPLE 1

#### INDIVIDUALITY

Each person will have unique responses to the same training stimulus, due to individual characteristics, such as biological age, training age, gender, genetics, body size and shape, past injuries, etc. Training should be adjusted to the individual's characteristics and needs.<sup>11</sup>

### PRINCIPLE 2

#### SPECIFICITY

Physiological adaptations to training are specific to the muscle groups trained, the intensity of the exercise, the metabolic demands of the exercise and specific movements and activities.<sup>11</sup>

### PRINCIPLE 3

#### PROGRESSIVE OVERLOAD

Certain adaptations require training with greater stimulus than that to which the body is accustomed.

This could be done by increasing the intensity, duration or frequency of training.<sup>11</sup> Overloading should occur at an optimal level and time frame to maximize performance.

Overloading too quickly may lead to poor technique or injury, while very slow overloading may result in little or no improvement.<sup>11</sup>

To continue to gain benefits, strength training activities need to be done to the point where it is difficult to do another repetition (close to maximal force generating capacity).

Overload leads to the immediate local upregulation of mechanogrowth factor, which leads to muscle hypertrophy via activation of satellite cells.<sup>12</sup>

**Stress → Response (Acute) → Adaptation (Chronic)**

### PRINCIPLE 4

#### DIMINISHING RETURNS

An individual's level of training determines how much improvement in performance is achieved due to training.

A novice will see large and relatively quick gains in performance when they begin training. However, the gains become smaller, and come about slower, as the individual becomes more experienced.<sup>11</sup>

### PRINCIPLE 5

#### REVERSIBILITY

The effects of training will be lost if a training stimulus is removed for an extended period of time: "Use it or lose it."<sup>11</sup>



# RESISTANCE EXERCISE TOOLKIT



## Exercise Physiology Foundations

## 3.A The Effects of Resistance Exercise on Muscle

### Key Terms<sup>13</sup>

#### Hypertrophy

Increase in skeletal muscle mass by increasing muscle fibre size<sup>14</sup>

#### Strength

The ability to produce force

#### Power

The ability to produce force at a high speed of movement (force x distance/time)

#### Motor Unit

Consists of an alpha motor neuron and the muscle fibres innervated by it

#### Fibre Types

**Type I** muscle fibres are considered slower but more fatigue-resistant fibres (e.g. beneficial for long distance runners)

**Type II** fibres are considered the faster, more powerful fibres, but are also more susceptible to fatigue (e.g. more beneficial for sprinters and lifters)

#### Henneman's Size Principle

As levels of activation increase (either through increased load or speed), larger motor units are recruited (i.e. Type I, Type IIa, and Type IIb in succession)

### How to Increase Hypertrophy, Strength, and Power

#### Motor Unit Recruitment<sup>13</sup>

The number of motor units recruited is one of the most important determinants of power, strength, and muscle size.

Two ways of accomplishing higher motor unit recruitment:

- 1 Heavier resistance: Henneman's size principle
- 2 Low resistance, high reps to momentary muscle failure or near failure:<sup>15</sup> Recent evidence supports that similar gains in hypertrophy are observed with this style of training as with using heavy resistance. Both low load and heavy load resistance training will induce strength benefits, though heavy loads typically induce greater strength benefits.

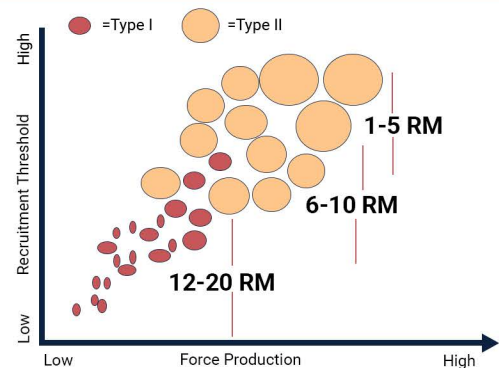


Image from: Kraemer and Looney (2012)<sup>13</sup>

**Fig. 3.** The size principle is depicted in this figure in which each circle represents a motor unit made up of different types and numbers of fibers. The maroon circles are Type I motor units and the light tan circles are Type II motor units, with larger circles depicting larger motor units containing more fibers. As one goes up the line of orderly recruitment, heavier and heavier resistances recruit more and more motor units and their associated muscle fibers.<sup>13</sup>

# RESISTANCE EXERCISE TOOLKIT



## Exercise Physiology Foundations

## 3.B The Effects of Resistance Exercise on Muscle

### (Continued) How to Increase Hypertrophy, Strength, and Power

#### Muscle Fibre Type

Aging and immobility both typically result in a decrease in Type II fibre size while Type I fibers are less affected. This results in a decrease in muscle power. Exercise prescription targeting power (e.g. greater motor unit recruitment) is important for decreasing the likelihood of falls.<sup>16, 4</sup>

As skeletal muscle ages, motor unit remodeling occurs. There is denervation of fast (Type II) muscle fibers and recovery/restoration of innervation of slow (Type I) muscle fibers. This alters the efficiency of excitation-contraction coupling— resulting in decreased muscle mass, strength and endurance.<sup>7</sup>

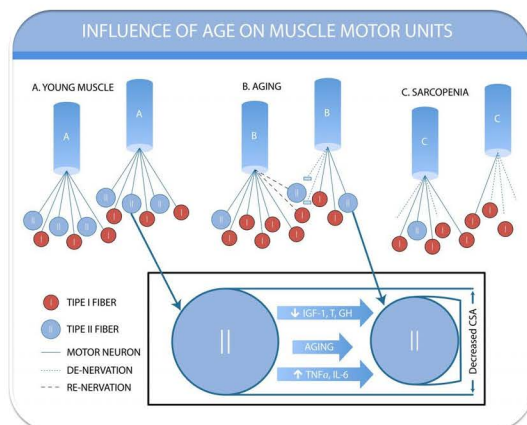


Image from: Physiospot, Sarcopenia: A Revised European Consensus<sup>17</sup>

#### Muscle Protein Synthesis<sup>14</sup>

Hypertrophy occurs when muscle protein synthesis (MPS) > muscle protein breakdown

After heavy resistance exercise, muscle protein synthesis is increased for at least 48 hours. The addition of protein ingestion can further increase muscle protein synthesis during this time period (See figure below).<sup>18</sup>

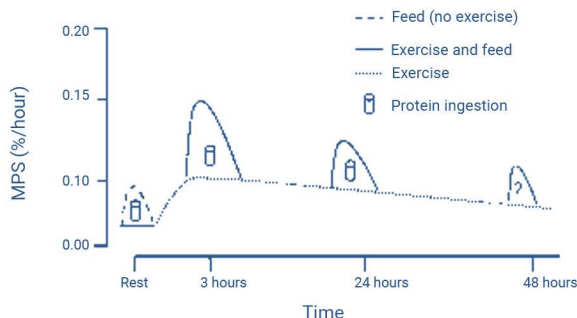


Image from: Churchward-venne et al. (2012)<sup>18</sup>

Resistance exercise stimulates a prolonged elevation of MPS that can remain elevated for at least 48 h (dotted line). protein ingestion at any point during this enhanced period of "anabolic potential" will have an additive effect to these already elevated exercise mediated rates (solid lines). Reproduced from Churchward-Venne et al.<sup>18</sup> (MPS = muscle protein synthesis)



# RESISTANCE EXERCISE TOOLKIT



## Prescription Principles (Older Adult)

1

- Assessment ● Prescription (FITT) ● Appropriate Intensity ● Monitoring ● Progression

### Assessment

- 1 Screen for contraindications.
- 2 Resistance exercise has been shown to be safe in the frail, elderly population, but if you have any questions or are unsure of medical stability for resistance exercises, check with the primary care provider, or use the **PAR Q+ e-PARmed-X**. <https://eparmedx.com>

### Prescription (FITT)



Goal is to work towards 2-3 sets of 1-2 multi-joint exercises per major muscle group (6-12 reps), 70-85% 1RM, 2-3 times/week (non-consecutive days).<sup>1</sup> You can start at one set for beginners or older adults with frailty.<sup>1,2</sup>

Program Variable	Recommendation	Details
Sets	1-3 sets per exercise/muscle group	1 set for beginners and older adults with frailty and progress to multiple sets.
Repetitions	6-12 or 10-15	6-12 for healthy older adults, 10-15 at a lower relative resistance for beginners.
Intensity	70-85% of 1RM	Begin at a resistance that is tolerated and progress to 70-85% of 1RM. Lighter loads are recommended for beginners, or adults with frailty or special considerations such as cardiovascular disease and osteoporosis.
Exercise Selection	8-10 different exercises	Include major muscle groups targeted through multi-joint movements.
Modality	Free weight or machine or theraband based	Beginners, frail older adults, those with functional limitations benefit from machine or band-based training. High functioning older adults gain added benefits from free-weight training.
Frequency	2-3 days/week per muscle group	Training on non-consecutive days may allow favorable adaptation, improvement, or maintenance.
Power/Explosive Training	40-60% of 1RM	Include high velocity movements in the concentric phase to promote muscular power, strength, size and functional tasks.
Functional Movement	Exercises to mimic tasks of daily living	Include exercises that simulate daily activities like sit-to-stand to optimize functional capacity.

Table adapted from Table 1 (Fragala et al. 2019)<sup>1</sup>

# RESISTANCE EXERCISE TOOLKIT

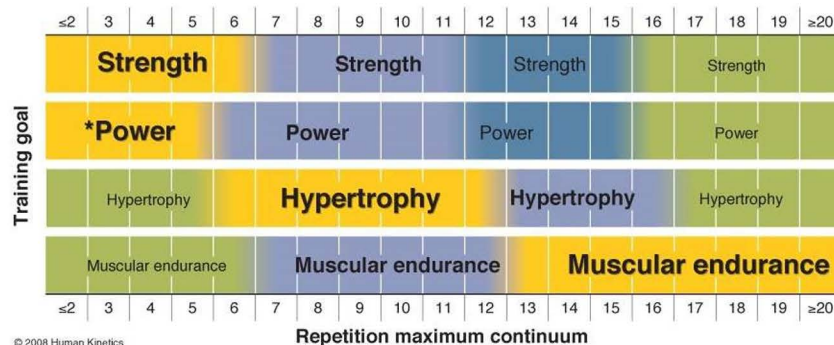


## Prescription Principles (Older Adult)

2

### Appropriate Intensity

- ▶ Including power exercises performed at higher velocities in concentric movements with moderate intensities (i.e. 40% - 60% 1RM) can be effective, especially in relation to improving activities of daily living.<sup>1</sup>



© 2008 Human Kinetics

Repetition maximum continuum

Image From: Sands et al., (2012)<sup>15</sup>

The image on the left suggests that the goal of training (i.e. strength vs. hypertrophy vs. endurance) can be targeted by using a specific repetition maximum. Contrary to this long-accepted principle, recent re-analysis of the literature questions this belief and suggests that strength and hypertrophy can be targeted and optimized across a range of loading zones.<sup>14</sup>

In other words, low loads with high reps produce similar results as heavy loads with low reps when effort is high. This suggests that low\* or moderate loads may be a useful strategy for improving strength and hypertrophy among individuals with joint-related conditions.

It should be noted that low loads done to fatigue or near-fatigue tend to produce more discomfort and a higher rating of perceived exertion than moderate-high loads.

- ▶ The higher velocity may promote greater **functional** improvement than resistance training at slower velocities. This may reflect the ability to perform Activities of Daily Living (ADL), which may be more dependent on the capacity to apply force quickly than the capacity to exert maximal strength. These exercises to develop power should be implemented with special attention to proper form and technique to reduce the risk of injury.<sup>1,3</sup>
- ▶ While the above prescription will optimize gains, changes in muscle morphology and functional performance may be achieved at low-to-moderate intensities (50-70% 1RM) and most resources recommend starting at 50% of 1 RM with slightly higher reps (10-15 reps), particularly for beginners or older adults with frailty, and progressing to 70-85% of 1 RM\* (6-12 reps).<sup>1</sup>

Doing true 1RM testing<sup>4</sup> (<https://exercise.trekeeducation.org/assessment/muscle-strength-assessment/>) is likely not appropriate in acute settings but it is very important to provide an adequate ('challenging') dose/intensity as this is often underestimated in the acute setting.

- ▶ Suggested alternatives to determine 70-85% of 1RM in the acute setting include:
  - 1 Using a **basic scale of 0-10** (0=no effort, 10=hardest effort you can give) suggested by ACSM. The last rep should feel hard to complete and you should progress the weight lifted over time so that it feels like 8/10 difficulty.<sup>5</sup>
  - 2 **Rate of Perceived Exertion (RPE) via the original or modified Borg.** Start with 'Somewhat Hard' on the scale and progress to 'Hard/Very hard'.<sup>6,7</sup>  
<https://www.healthlinkbc.ca/physical-activity/borg-rating-perceived-exertion-scale>
  - 3 An article referenced by APTA suggests: **"A physical therapist can carry out a high-intensity strength program by simply providing a patient with enough resistance to cause muscle fatigue to the point of failure at 8 to 12 repetitions, with form deterioration over the last 2 repetitions."**<sup>5</sup>
  - 4 **Determine 10 RM** (the max weight that a patient can lift for 10 reps with good form). 10RM is approximately equivalent to 75% of 1RM.



# RESISTANCE EXERCISE TOOLKIT



## Prescription Principles (Older Adult)

3

### (Continued) Appropriate Intensity

- ▶ **Free weights, machines, or bands or body weight** can be used. Beginners, frail older adults, or those with functional limitations, benefit from machine-based resistance training, training with resistance bands and isometric training to help simplify and/or stabilize movements. High functioning older adults gain added benefit from free-weight resistance training as these exercises may engage additional muscles for support and stability and are more similar to movements used in activities of daily living.<sup>1,8</sup>
- ▶ Lift and lower the weight in a **controlled** manner with a focus on good form.<sup>5</sup>
- ▶ **Rest 1.5-3 min between sets.** The greater the intensity, the longer rest period is needed. The rest allows the muscles' energy stores to be restored and therefore you can maximize the intensity of each set. Exercises done with the muscles in a fatigued state can lead to poor form and injury.<sup>1,9</sup>
- ▶ **Primary attention should be given to lower body exercises** as age-related reductions are more pronounced in the lower body.<sup>8</sup>
- ▶ In general, **larger muscle groups should be worked before smaller muscle groups and multi-joint exercises (encouraged) should be done before uni-joint.**<sup>1</sup>

### Muscle Groups

- ▶ The specific muscle groups targeted can be based on manual muscle testing, dynamometer testing, or functional muscle testing.
- ▶ Exercise selection should include **major muscle groups targeted through multijoint movements.**<sup>1</sup>
- ▶ Some examples of exercises that may be included in a whole-body resistance exercise session for general weakness or prevention of decline/deconditioning (if there is not a targeted area of weakness) include<sup>8</sup>: (see standardized exercise programs for more specifics)

#### Basic

- Squat (leg press if unable to do squat)
- Knee extension
- knee flexion (leg curl or Romanian deadlift; deadlift with caution in elderly patients with spine issues)
- Chest press
- Seated low row

#### Complementary

- Hip adduction/abduction
- Hip flexion/extension
- Calf raise (standing or seated)
- Elbow flexion/extension
- Core/abdominals

One multi-joint exercise should be prescribed for major muscle groups although lower limbs may respond better to 2 exercises.<sup>1</sup>

# RESISTANCE EXERCISE TOOLKIT



## Prescription Principles (Older Adult)

4

### Monitoring and Progression

- ▶ Progression should follow general exercise principles of individualization, periodization, and progression.<sup>1</sup>
- ▶ For progression of intensity, continue to use the method utilized for your initial strength testing prescription.

#### Progression

The following summarizes different methods of progression:

#### Simple Progression Recommendations

**Volume:** Manipulate sets, reps, weight

**Equipment:** Body weight, bands, machine, free weight

**Stability:** Lying, seated, kneeling, standing both feet on flat surface, standing single leg on flat surface, standing both legs on unstable surface, standing single leg on unstable surface

**Complexity:** Single joint + single exercise, multi-joint + single exercise, combined exercises

- ▶ It is important to explain to patients that, with resistance training, they should expect some delayed onset muscle soreness.<sup>10</sup>
- ▶ For patients with medical issues, continue to monitor as per clinical judgement (e.g. SpO<sub>2</sub> with patients with COPD; Borg for patients who are short of breath; heart rate for patients with a cardiac condition; or blood sugar for patients with diabetes).

### Additional Notes

Where possible, **resistance exercise should be prescribed in combination with aerobic training** because both types of exercise elicit distinct benefits.<sup>11</sup>

To optimize functional capacity, resistance training programs should include familiarization to training in which the patients' body mass is used for resistance and in which daily activities are simulated (like sit-to-stand). High speed motion (at low to moderate intensity 30-60% 1RM) can also be incorporated to promote greater improvements in the functional task performance of older adults.<sup>1,8</sup>

For more information about resistance training in the frail older adult, see the "Special Population" section on frailty.

Grip strength is a robust proxy indicator of overall strength. Grip strength of <26kg in men and <16 kg in women have been established as a biomarker of age related disability and early mortality and have been strongly related to incident mobility limitations and mortality.<sup>12,13</sup>



# RESISTANCE EXERCISE TOOLKIT



## Behaviour Change:

### Supporting Your Patient to Participate in Strength Training

1



Pair your prescription with a conversation that supports your client to carry out their resistance exercise prescription. Start with the **5 A's**:<sup>1</sup>

#### Assess

Physical activity level  
Physical abilities  
Beliefs and knowledge

"How much exercise do you currently get each day?"

"What kinds of things make it hard to exercise?"

#### Individual

#### Advise

Health risks  
Benefits of change  
Appropriate "dose" of physical activity

"The national guidelines recommend at least 150 minutes of moderate activity each week. I strongly recommend that you begin to move around more regularly. We always recommend starting from where you are and building up slowly."

#### Health Policy

#### Agree

Co-develop personalized action plan  
Set specific physical activity goals based on interests and confidence level

"I understand that you have a busy work and family schedule. How do you feel about starting with 20-minute walks for 3 days next week? Maybe you could also use that time to spend with your daughter?"

#### Social Support

#### Assist

Identify barriers and create strategies to address them  
Identify resources for physical activity and social support

"Do you have a gym, park, trail system, or other safe place to be active near your home or workplace?"

#### Community Resources

#### Arrange

Specify plan for follow-up (e.g. visits, phone calls, text messages)  
Check on progress/maintenance of physical activity change

"We would like to hear about how the walking is going for you. The nurse will call you in one week to check in and see if you have any questions or concerns."

#### Provider/ Team

# RESISTANCE EXERCISE TOOLKIT



## Behaviour Change:

### Supporting Your Patient to Participate in Strength Training

2

#### Additional Resources

##### Brief action planning

A well-supported behaviour change strategy to develop SMART goals and a plan that your client is confident that they can do:

- **Brief Action Planning Guide**  
[https://centrecmi.ca/wp-content/uploads/2018/11/BAP\\_guide\\_2016-08-08.pdf](https://centrecmi.ca/wp-content/uploads/2018/11/BAP_guide_2016-08-08.pdf)
- **Brief Action Planning Flow Chart**  
[https://centrecmi.ca/wp-content/uploads/2018/11/BAP\\_flow\\_Chart\\_2016-08-08.pdf](https://centrecmi.ca/wp-content/uploads/2018/11/BAP_flow_Chart_2016-08-08.pdf)
- **Brief Action Planning Skills Checklist**  
[https://centrecmi.ca/wp-content/uploads/2018/05/BAP\\_Skills\\_Checklist\\_2018-05-01.pdf](https://centrecmi.ca/wp-content/uploads/2018/05/BAP_Skills_Checklist_2018-05-01.pdf)
- **Brief Action Planning, Centre for Collaboration Motivation & Innovation, Canada**  
<https://centrecmi.ca/brief-action-planning/>

##### Motivational interviewing

A client-centred conversation style and toolbox of strategies that help to resolve ambivalence:

- **Ask-Tell-Ask**  
[https://centrecmi.ca/wp-content/uploads/2019/03/12-Ask\\_Tell\\_Ask\\_2018-12-21.pdf](https://centrecmi.ca/wp-content/uploads/2019/03/12-Ask_Tell_Ask_2018-12-21.pdf)
- **Ask-Tell-Ask Skills Checklist**  
[https://centrecmi.ca/wp-content/uploads/2019/03/Ask-Tell-Ask\\_Skills\\_Checklist\\_2018-12-12.pdf](https://centrecmi.ca/wp-content/uploads/2019/03/Ask-Tell-Ask_Skills_Checklist_2018-12-12.pdf)
- **Motivational Interviewing, Centre for Collaboration Motivation & Innovation, Canada**  
<https://centrecmi.ca/motivational-interviewing/>



# RESISTANCE EXERCISE TOOLKIT



## Special Populations

1

- |            |                        |                 |              |                  |
|------------|------------------------|-----------------|--------------|------------------|
| 1. COPD    | 4. Parkinson's Disease | 7. Arthritis    | 10. Diabetes | 13. Poor Vision  |
| 2. Cardiac | 5. Multiple Sclerosis  | 8. Chronic Pain | 11. Cancer   | 14. Poor Balance |
| 3. Stroke  | 6. Spinal Cord Injury  | 9. Osteoporosis | 12. Frailty  | 15. Back Pain    |

### 1 COPD

#### Key Points:

- Performing pursed lip breathing and diaphragmatic breathing can increase breathing efficiency.<sup>3</sup>
- Increasing oxygen therapy during exercise may help to prevent exercise-induced hypoxemia.<sup>3</sup>
- Instruct the patient to avoid extreme weather conditions and schedule exercise sessions during mid-late morning hours.<sup>3</sup>
- Exercise frequency, duration, intensity as well as a list of exercises are included in the document AECOPD-Mob: Clinical Decision-Making Tool for Safe and Effective Mobilization of Hospitalized Patients with AECOPD.<sup>14</sup>

#### Resources:

- [https://med-fom-clone-pt.sites.olt.ubc.ca/files/2020/10/AECOPD-MOB-Decision-Making-Tool-FINAL-June-2015\\_1.pdf](https://med-fom-clone-pt.sites.olt.ubc.ca/files/2020/10/AECOPD-MOB-Decision-Making-Tool-FINAL-June-2015_1.pdf)
- [https://www.exerciseismedicine.org/assets/page\\_documents/YPH\\_All.pdf](https://www.exerciseismedicine.org/assets/page_documents/YPH_All.pdf)

### 2 Cardiac

#### Key Points:

- Patients with left ventricular outflow, decompensated chronic heart failure or unstable dysrhythmias should not exercise.<sup>3</sup>
- Patients with significant aortic stenosis should avoid strength training.<sup>3</sup>
- Patients who have had a myocardial infarction should closely monitor intensity level and stay within the patient's recommended exercise heart rate range.<sup>3</sup>
- Patients with congestive heart failure should closely monitor the intensity level and adjust workout if feeling fatigued. Instruct patient to stop exercising if they experience chest pain/angina.<sup>3</sup>
- Patients with atrial fibrillation should adjust how hard and how long exercises are performed based on how they feel.<sup>3</sup>
- Exercise should be performed without Valsalva maneuver (i.e. exhaling against a closed glottis).<sup>13</sup>
- Instruct the patient to stop exercising immediately if experiencing angina.<sup>3</sup>
- Upper body exercises may precipitate angina more readily than lower body exercises because of a higher pressor response.<sup>3</sup>
- An extended warm up and cool down may reduce the risk of angina or other cardiovascular complications following exercise.<sup>3</sup>
- If nitroglycerin has been prescribed, instruct the patient to carry it when exercising.<sup>3</sup>
- Instruct the patient to avoid exercising in extreme weather conditions.<sup>3</sup>

#### Resources:

- [https://physio-pedia.com/Resistance\\_Exercises#cite\\_note-:1-6](https://physio-pedia.com/Resistance_Exercises#cite_note-:1-6)
- <https://www.heartandstroke.ca/articles/exercising-when-you-have-heart-disease>
- [https://www.exerciseismedicine.org/assets/page\\_documents/YPH\\_All.pdf](https://www.exerciseismedicine.org/assets/page_documents/YPH_All.pdf)



### 3 Stroke

#### Key Points:

- Add task-oriented circuit training to improve transfer skills, mobility and ADLs/functional tasks.<sup>1</sup>
- Avoid putting the most challenging or complex exercises at the end of an exercise program as the patient might be tired—potentially increasing risk of falls, injury and/or undue fatigue.<sup>1</sup>
- Encourage frequent rest breaks or reduce exercise intensity to decrease fatigue.
- Be mindful of use of compensatory strategies (drop foot, knee hyperextension, circumduction.)<sup>2</sup>
- Cue patients to be aware of neglected side, adjust movements and integrate exercises at midline for patients with neglect.<sup>2</sup>
- Encourage bilateral movements with safe mechanics if patient has a painful shoulder. (e.g. during arm raises, hold on to paretic arm, avoid pulling on paretic arm).<sup>2</sup>
- Keep arm movements at or below shoulder level if the arm that is most affected by the stroke is weak and has decreased ROM. Arm movements above shoulder height can cause shoulder impingement and other injuries.<sup>3</sup>
- Incorporate task related activities such as sit to stand, heel raises, step-ups, squats, and lunges.<sup>3</sup>
- Avoid exercises that overload the joints or increase risk of falling. Begin each exercise in a stable position.<sup>3</sup>
- Instruct the patient to avoid holding their breath during strength training because this can cause large fluctuations in blood pressure.<sup>3</sup>

#### Resources:

- <https://www.strokenetworkseo.ca/sites/strokenetworkseo.ca/files/osn-post-stroke-community-based-exercise-guidelines-2016-final.pdf>
- <http://fameexercise.com/wp-content/uploads/3.-Considerations-for-stroke-exercise.pdf>
- [https://www.exerciseismedicine.org/assets/page\\_documents/YPH\\_All.pdf](https://www.exerciseismedicine.org/assets/page_documents/YPH_All.pdf)

### 4 Parkinson's Disease

#### Key Points:

- Choose the time of day for exercise that is best for the patient. It may be more effective to time exercises with medications. If fatigue is an issue, instruct the patient to try exercising first thing in the morning.<sup>4</sup>
- Patients may enjoy doing the exercises to music.<sup>4</sup>
- Consider exercising with supervision for those at risk of falls or who have had a recent change in medications (e.g. Levodopa/Carbidopa may produce exercise bradycardia).<sup>27</sup>
- If the patient is at risk of falling or freezing (becoming rigid), instruct them to hold on to a chair when performing standing exercises or do chair-based exercises instead.<sup>3</sup>

#### Resources:

- <http://www.parkinson.ca>
- <https://www.pwr4life.org>
- <https://www.parkinson.bc.ca/resources-services/resources/>
- <https://www.parkinson.bc.ca/resources-services/exercise-active-living/>
- [https://www.exerciseismedicine.org/assets/page\\_documents/YPH\\_All.pdf](https://www.exerciseismedicine.org/assets/page_documents/YPH_All.pdf)





### 5 Multiple Sclerosis (MS)

#### Key Points:

- As MS patients lack endurance, increase the number of repetitions rather than the weight or resistance to help improve endurance.<sup>7</sup>
- Instruct patients to avoid exercising in high temperatures and during the hottest part of the day.<sup>3</sup>
- Encourage the patient to drink cool fluids before, during and after your exercise session.
- Avoid exercises/activities that may increase risk of falling.<sup>3</sup>
- Set reasonable expectations for progression; i.e. some patients may not see improvements in strength over time depending on their disease progression, but resistance exercise is still beneficial in prevention of deterioration.

#### Resources:

- <https://vch.eduhealth.ca/PDFs/FM/FM.460.Ex23.pdf>
- [https://www.exerciseismedicine.org/assets/page\\_documents/YPH\\_All.pdf](https://www.exerciseismedicine.org/assets/page_documents/YPH_All.pdf)
- [https://csepguidelines.ca/wp-content/uploads/2018/10/CSEP\\_MS\\_PAGuidelines\\_adults\\_en.pdf](https://csepguidelines.ca/wp-content/uploads/2018/10/CSEP_MS_PAGuidelines_adults_en.pdf)

### 6 Spinal Cord Injury

#### Key Points:

- An individual with a SCI should do at least 20 minutes of moderate to vigorous physical activity plus 3 sets of strength training exercises for each major functional muscle group at a moderate to vigorous intensity, 2x/week to reach a minimum threshold for improving cardiorespiratory health (cardiorespiratory fitness).<sup>15</sup>
- Patients with cervical or high thoracic injury (i.e. T6 and above) should be aware of the symptoms of autonomic dysreflexia before beginning.<sup>15</sup> If a patient is experiencing autonomic dysreflexia, keep them sitting upright, address the suspected cause (e.g. full bladder, kinked catheter, or other stimulus below the level of injury). If symptoms persist, seek medical attention.

#### Resources:

- <https://icord.org/2019/02/exercise-guidelines-for-individuals-with-sci>
- <https://sciguideines.ubc.ca>
- [http://fhsc-sciactioncanada-2019.sites.olt.ubc.ca/files/2019/12/Proactive\\_SCI\\_Toolkit\\_Nov.pdf](http://fhsc-sciactioncanada-2019.sites.olt.ubc.ca/files/2019/12/Proactive_SCI_Toolkit_Nov.pdf)



### 7 Arthritis

#### A Osteoarthritis

##### Key Points:

- Combining exercise to increase strength, flexibility and aerobic capacity is likely to be the most effective in the management of lower limb osteoarthritis.<sup>5</sup>
- Proper technique/alignment during joint loading is very important for patients with OA.

#### B Rheumatoid Arthritis

##### Key Points:

- Schedule exercise each day when pain is lowest and pain medication is most effective.<sup>6</sup>
- Continue being physically active during a flare or periods of inflammation, but modify to avoid vigorous, highly repetitive activities, or stressing the affected joint(s). Prescribe gentle stretching to help increase ROM— especially if joints are unstable.<sup>6</sup>
- Instruct patient to avoid over stretching.<sup>3</sup>
- If the patient has been inactive for a long time, start with shorter sessions (10 to 15 minutes) at a lower intensity. Add 5 minutes to each session, increasing every 2-4 weeks. Over time, build up to at least 30 minutes a day on most days of the week.<sup>6</sup>
- The patient should expect some discomfort (not pain) after the workouts. If pain is greater 2 hours after exercise than it was before, reduce the length and intensity of the next session.<sup>6</sup>
- Total exercise time is more important than intensity. If the patient exercises at too high an intensity, he/she may not be able to exercise very long thus potentially increasing risk of injury.<sup>6</sup>
- Avoid overuse or repetitive stress injuries by alternating types of exercise over consecutive days.<sup>6</sup>
- Drink plenty of fluids before, during and after exercise.<sup>6</sup>

##### Resources for A:

- <https://gladcanada.ca/>
- <http://boneandjointcanada.com/>

##### Resources for B:

- <https://exercise.trekeeducation.org/populations/comobidities>
- [https://www.exerciseismedicine.org/assets/page\\_documents/YPH\\_All.pdf](https://www.exerciseismedicine.org/assets/page_documents/YPH_All.pdf)

### 8 Chronic Pain

##### Key Points:

- Basic Guidelines:<sup>16</sup>
  1. Find the patient's baseline. Even if this is a very small amount of activity, this is where they need to start.
  2. Push the patient in moderation. Do this until there is a small increase in pain. Encourage keeping the breath calm, body tension low and monitoring pain.
  3. Choose an activity they want to do. Choose something that will make life easier, more fun, or help reconnect with friends.
  4. Instruct the patient to be persistent and patient. It takes practice to change the nervous system when there is persistent pain.
- Gentle exercises help distract patients from the pain.<sup>4</sup>

##### Resources:

- <https://www.painbc.ca/sites/default/files/inline-files/PainBC-PainToolbox-2016-Digital.pdf>





### 9 Osteoporosis

#### Key Points:

- Resistance training machines should be avoided in individuals at high risk of vertebral fracture unless there is certainty that they can be used and adjusted with proper form.<sup>19</sup>
- Avoid unstable surfaces.<sup>3</sup>
- Begin at a lower intensity. Exert care to prevent falls.<sup>3</sup>
- Strength and resistance exercises are recommended as well as:<sup>17</sup>
  - Weight bearing aerobic exercises
  - Multicomponent exercises
  - Whole body vibration
- Spine movements should minimize repeated/sustained, weighted, end-range, rapid/forceful or combined flexion/rotation/side bending.<sup>18,19</sup>
- Instruct the patient to focus on form and good alignment over intensity. Emphasize neutral spine without twisting the spine. Training in technique and supervision is essential.<sup>19</sup>
- Add spine-sparing strategies to decrease spine loads.<sup>19</sup>
- Patients are recommended to perform 5-10 minutes of posture/back extensor training daily:<sup>19</sup>
  - Basic: Lie face up on firm surface, knees bent, feet flat. Use pillow only if head does not reach the floor.
  - Progressions:
    - Lying with gentle head press; without changing chin position, perform 3-5 second “holds.”
    - Erector spinae activation in standing.
- Avoid positions/exercises that increase compressive loads such as:<sup>20</sup>
  - Sit ups
  - Full neck rotations
  - Forced spinal rotation with flexion
  - Flexion exercises (especially forced or extreme forward flexion)
  - Lifting both legs (compresses the lumbar spine)
  - High impact exercises
  - Excessive loading of the spine
  - Sudden jerky movements
  - Weighted lifting with arms away from the body
- Intensity: High to very high (80–85% 1RM;  $\geq 16$  on Borg 6–20 point RPE scale or ‘Very hard’).<sup>22</sup>
- Frequency: 2 or more times per week.<sup>22</sup>
- Sets/Repetitions: 2–3 sets of 8-12 repetitions.<sup>22,28</sup>

#### Resources:

- <https://www.hindawi.com/journals/bmri/2018/4840531/>
- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5112023/>
- <https://osteoporosis.ca/wp-content/uploads/OC-Too-Fit-To-Fracture-Osteo-Exercise-Book.pdf>  
VCH Fall & Injury Prevention Program: SteadyFeet® Instructor Manual Version 4
- [https://osteoporosis.ca/wp-content/uploads/2014-06-27-Module-5-Part-1-Slides1.pdf?\\_ga=2.226723549.1103263631.1605037680-166632702.1605037680](https://osteoporosis.ca/wp-content/uploads/2014-06-27-Module-5-Part-1-Slides1.pdf?_ga=2.226723549.1103263631.1605037680-166632702.1605037680)
- [https://www.jsams.org/article/S1440-2440\(16\)30217-1/fulltext](https://www.jsams.org/article/S1440-2440(16)30217-1/fulltext)



### 10 Diabetes

#### Key Points:

- Include general whole-body resistance exercises 2x/week without worrying about exercise intensity for glycemic control.<sup>13</sup>
- Patients should inject away from the site that may be exercised (i.e. not in quads on a leg day).
- Extended or vigorous activity may trigger an excessive release of adrenaline and other hormones that can counteract the effects of insulin, thereby increasing blood glucose levels.<sup>3</sup>
- Instruct patients to drink plenty of fluids before and after exercise.<sup>3</sup>
- Encourage patients to exercise at approximately the same time, and for the same length of time, each day, to help keep your blood sugar levels in the same range.<sup>23</sup>
- Instruct the patient to avoid exercising alone if possible. The patient may need help if the blood sugar drops below target range.<sup>23</sup>
- If the patient takes insulin or other medications for diabetes:<sup>23</sup>
  - If their blood sugar is over 16.7 mmol/L, they do not feel well, and there are ketones present, patient should not exercise.
  - If their blood sugar is over 16.7 mmol/L, they feel unwell, and no ketones are present, exercise with caution.
- Watch for signs of low blood sugar.<sup>23,24,25</sup>
  - Some medications, such as glyburide or insulin, can cause low blood sugar emergencies. Instruct the patient to check his/her blood sugar before performing exercises. If blood sugar is less than 5.5 mmol/L, instruct the patient to eat a carbohydrate snack first.
- Instruct the patient to have some glucose/sucrose tablets or solution or other type of quick-sugar food with their exercise. The patient may have symptoms of low blood sugar while exercising or up to 24 hours after exercise.<sup>23</sup>
- Instruct the patient to check with their physician if they felt symptoms of low blood sugar more than 2 or 3 times in one week with exercise. The medication or insulin dose may need to be changed.<sup>23</sup>
- During exercise:<sup>23</sup>
  - If the patient tends to get low blood sugar, instruct the patient to exercise only after they check blood sugar level.
  - Instruct the patient to wear shoes that fit well (may use silica gel or air midsoles) and polyester or cotton-polyester blend socks to keep feet comfortable and to prevent blisters.
  - Encourage the patient to wear medical identification at all times.
- After exercise:<sup>23</sup>
  - Instruct the patient to test blood sugar and have a plan for treating low blood sugar.
  - Adrenaline released with short bouts of vigorous exercise can cause high blood sugar. Combining short bursts of vigorous activity with longer moderate-intensity exercises can help prevent this problem.

#### Resources:

- [https://physio-pedia.com/Resistance\\_Exercises#cite\\_note:1-6](https://physio-pedia.com/Resistance_Exercises#cite_note:1-6)
- <https://www.healthlinkbc.ca/health-topics/hw133134>
- <https://healthlinkbc.ca/health-topics/aa20831#aa20831-sec>
- <https://healthlinkbc.ca/health-topics/stc15525#stc15525-sec>
- <https://bit.ly/2NnRuNZ>
- <https://www.frontiersin.org/articles/10.3389/fphys.2019.00645/full>
- [https://www.exerciseismedicine.org/assets/page\\_documents/YPH\\_All.pdf](https://www.exerciseismedicine.org/assets/page_documents/YPH_All.pdf)



# RESISTANCE EXERCISE TOOLKIT



## Special Populations

7

### 11 Cancer

#### Key Points:

- Start with short periods of exercise (5-10 minute sessions) and rest after each session. Gradually build up to 20-30 minutes of continuous activity.<sup>8</sup>
- Encourage the patient to be active when they have energy as this may change from day-to-day.<sup>8</sup>
- Instruct the patient to listen to their body. Take breaks or change activities as needed.
- Patients may prefer to be active every second day to have time to recover.<sup>8</sup>
- Patients with significant nerve damage may have reduced ability to use the affected limbs because of weakness or loss of balance.<sup>8</sup>
- Instruct patients with compromised immune function to avoid public gyms and pools until white blood cell levels return to safe levels. Survivors who completed a bone marrow transplant are advised to avoid such exposures for one year after transplantation.<sup>8</sup>
- Instruct patients with an indwelling catheter or feeding tube to be careful of dislodging lines during resistance training.<sup>8</sup>
- Patients with severe anemia should delay exercise until the anemia has improved.<sup>8</sup>

Platelets	Recommendations <sup>11</sup>
<10,000/ $\mu$ L	Limit activity. Patient may receive a transfusion of platelets. Use caution to avoid injury and bleeding due to falls. Gentle range of motion (ROM) can be done in supine or sitting.
<10,000/ $\mu$ L- 20,000/ $\mu$ L	Perform gentle exercises without resistance or strain to avoid bleeding from high exertional blood pressure. Standing exercises and ambulation is recommended only if patient is steady on feet and exhibit no signs of bleeding.
<20,000/ $\mu$ L- 40,000/ $\mu$ L	May use light resistance (e.g. elastic tubing, Thera Band) if patient exhibits no signs of bleeding without strain.
>50,000/ $\mu$ L	May do resisted exercise.
>100,000/ $\mu$ L	May consider using heavier resistance.

- If experiencing severe fatigue from therapy, the patient may not feel up to an exercise program, recommend doing just 10 minutes of light activity daily.<sup>8</sup>
- Exercise is the number one treatment for the most common and debilitating side effects of cancer.<sup>9</sup>
- There is also emerging data that exercise during toxic cancer treatments can improve the effectiveness and completion rates of chemotherapy.<sup>6,10</sup>
- Minimize risk of fractures for patients with bony lesions (i.e. avoid high-impact activities, end range-hyper and rotational movements that increase compressive and shearing forces, follow back care principles, and use appropriate mobility aids and braces).<sup>11</sup>
- Use caution when prescribing twisting movements, forward bending, overhead reaching, pushing, pulling and lifting weights as this can cause or worsen vertebral fractures in patients with bony lesions.<sup>12</sup>
- If a patient is receiving radiation therapy, perspiration may irritate their skin due to skin breakdown.<sup>3</sup>

#### Resources:

- [http://www.bccancer.bc.ca/survivorship-site/Documents/Cancer%20Healthy%20Eating%20a%20nd%20Active%20Living%20\(CANHEAL\)%202014.pdf](http://www.bccancer.bc.ca/survivorship-site/Documents/Cancer%20Healthy%20Eating%20a%20nd%20Active%20Living%20(CANHEAL)%202014.pdf)
- <http://www.bccancer.bc.ca/health-info/coping-with-cancer/exercise-support#Health-Info>  
<https://bit.ly/3AU91RE>
- <https://exercise.trekeeducation.org/populations/comobidities/>
- <https://academic.oup.com/ptj/article/101/1/pzaa180/5911069>
- <https://educationdespatientscsm.ca/cancer-guides.html>
- <https://www.exerciseismedicine.org/eim-in-action/moving-through-cancer/>



### 12 Frailty

**Key Points:**

- Patients with frailty can follow the general guidelines but for intensity, start at a lower level (20%-30% 1RM) and progress to 80%.<sup>26</sup>
- Patients may be susceptible to dehydration and insulin insensitivity - be alert to the warning signs of these conditions.<sup>3</sup>
- Avoid exercises that overload the joints or increase risk of falling.<sup>3</sup>

**Resources:**

- [https://journals.lww.com/nsca-jscr/Fulltext/2019/08000/Resistance\\_Training\\_for\\_Older\\_Adults\\_\\_Position.1.aspx](https://journals.lww.com/nsca-jscr/Fulltext/2019/08000/Resistance_Training_for_Older_Adults__Position.1.aspx)
- [https://www.exerciseismedicine.org/assets/page\\_documents/YPH\\_All.pdf](https://www.exerciseismedicine.org/assets/page_documents/YPH_All.pdf)

### 13 Poor Vision

**Key Points:**

- Consider using weight machines (as opposed to free weights).<sup>3</sup>

**Resources:**

- [https://www.exerciseismedicine.org/assets/page\\_documents/YPH\\_All.pdf](https://www.exerciseismedicine.org/assets/page_documents/YPH_All.pdf)

### 14 Poor Balance

**Key Points:**

- Consider using weight machines (as opposed to free weights).<sup>3</sup>

**Resources:**

- [https://www.exerciseismedicine.org/assets/page\\_documents/YPH\\_All.pdf](https://www.exerciseismedicine.org/assets/page_documents/YPH_All.pdf)

### 15 Back Pain

**Key Points:**

- Delay exercises that target the trunk region until at least 2 weeks after the first sign of symptoms.<sup>3</sup>
- Consider using weight machines (as opposed to free weights).<sup>3</sup>

**Resources:**

- [https://www.exerciseismedicine.org/assets/page\\_documents/YPH\\_All.pdf](https://www.exerciseismedicine.org/assets/page_documents/YPH_All.pdf)



# RESISTANCE EXERCISE TOOLKIT



## Case Study & Integration into Practice

1

### Part 1: Case Study

AB is 75 y.o. person who was admitted to hospital for treatment of their renal failure.

Prior to admission, they were experiencing increased weakness, and had a fall without fracture.

**PMHx:** Myocardial infarction five-years ago (stented), osteoarthritis knees (bilaterally), diabetes mellitus type 2, and depression.

**Social Hx:** They live independently.

Their renal failure is being treated and it is appropriate to progress their activity at this time to meet their functional goals.

#### Functional Goals:

They need to be able to climb one flight of 12 stairs in their living space, and ambulate with a straight cane.

Functional mobility assessment indicates:

- Lie to sit - 1 min assist; needs feet on floor to feel safe sitting at bedside.
- Sit to stand - 1 mod assist.
- Ambulation - 1 min assist with 2 wheeled walker for 10 metres.
- Stairs - Not appropriate to attempt this safely at this time.

#### Screen for functional ROM, MMT, and 30 sec. sit-to-stand test indicates:

Weakness in their quadriceps, gluteals, and hip abductors.

#### What else might you want to assess before recommending REx in this individual's treatment?

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- Based on these findings, how would you best apply **Resistance Exercise** to your treatment plan? Consider options that include body weight resistance, and external resistance, with parameters.

Issue/Weakness	Exercise Type	Intensity	Sets x Reps	Equipment

- How and when would you reassess? \_\_\_\_\_  
\_\_\_\_\_

# RESISTANCE EXERCISE TOOLKIT



## Standardized Exercise Programs Physiotherapist Instructions

1

*For more detailed information and references, see the RExI Prescription Document*



These sample resistance exercise programs target general strengthening of the major muscle groups (you can select the exercises that are most appropriate for your patient):

- **Chest** (Pectorals)
- **Shoulder** (Deltoids, Rotator Cuff, Scapula)
- **Arms** (Biceps, Triceps, Forearm)
- **Back** (Latissimus Dorsi, Erector Spinae)
- **Abdominals** (Rectus Abdominus, Obliques)
- **Legs** (Hip Flexors, Gluteals, Quadriceps, Hamstrings)

- ▶ There is one exercise set for **supine/seated** exercises and one for **standing** exercises.
- ▶ The programs can be modified if your patient has a specific area of weakness.
- ▶ Start with 1 set for beginners or patients with frailty with the goal of working towards 2-3 sets of 6-12 reps at 70-85% of 1RM\*.<sup>1</sup>

\* True 1RM testing is likely not appropriate in acute settings but it is very important to provide an adequate, "challenging" dose/ intensity as this is often underestimated in the acute setting. Suggested alternatives to determine 70-85% of 1RM in the acute setting include:

1. Using a basic scale of 0-10 (0=no effort, 10=hardest effort you can give) suggested by ACSM. The last rep should feel hard to complete and you should progress the weight lifted over time so that it feels like 8/10 difficulty.
2. Rate of Perceived Exertion (RPE) via the original or modified Borg Scale. Start with somewhat hard on the scale and progress to Hard/Very hard.
3. An article referenced by APTA suggests: "A physical therapist can carry out a high-intensity strength program by simply providing a patient with enough resistance to cause muscle fatigue to the point of failure at 8 to 12 repetitions, with form deterioration over the last 2 repetitions".<sup>2</sup>
4. Determine 10 RM (the max weight that a patient can lift for 10 reps with good form). 10RM is approximately equivalent to 75% of 1RM.

- ▶ Including power exercises (higher velocity with moderate intensity like 40-60% 1RM) can be effective, especially when the goal is to improve ADLs.
- ▶ You can **progress** the exercises by:
  - **Increasing volume and intensity** (sets, reps, weight)
  - **Changing equipment** (body weight, bands, machine, free weight)
  - **Changing position relative to gravity**
  - **Decreasing stability or increasing complexity** (single joint & single exercise, multi-joint & single exercise, combined exercises)
- ▶ Some special populations have more specific restrictions around resisted exercise. For example, for an individual with osteoporosis, consider which factors increase compressive forces through the spine, and potentially increase the risk for compression fractures. You may consider changing the position (i.e. lying or standing instead of sitting) or changing the range of motion (i.e. avoid overhead lifting and end range/combined spinal flexion/rotation/side flexion) for these individuals. Please see the special populations section for more information.



# RESISTANCE EXERCISE TOOLKIT



## Standardized Exercise Programs Patient Instructions Resistance Exercises - Lying Down/sitting

2

### Resistance Exercises - Lying down/Sitting

- To get health benefits from resistance exercises, they need to feel at least somewhat hard to do.
- Progress the weight lifted over time so that it feels like an 8 out of 10 difficulty (where 0=no effort, 10=hardest effort you can give).
- The last repetition of each exercise should be difficult to complete. If it is easy to complete, you need to make the exercise harder by adding more weight or increasing the number of repetitions that you are doing.
- Remember to lift and lower the weight with control.
- Try to do these exercises at least 2x/week.
- Rest 1.5-3 minutes between your exercise sets to allow your muscles to recover.
- These exercises are shown with a band but your physiotherapist may modify them to use weights instead of a band.
- With resistance exercise, you should expect some muscle soreness. Taking a 2 day break between exercise sessions is a good idea.

 ***If you have any questions, please contact your physiotherapist.***

Images courtesy of SimpleSet™

# RESISTANCE EXERCISE TOOLKIT



## Standardized Exercise Programs Resistance Exercises - Lying down/Sitting

# 3

### Lying Down

#### Bridge

Sets: \_\_\_\_\_ | Reps: \_\_\_\_\_ | Hold: 5 seconds | Frequency: 2 x/week

##### Preparation:

- Lie on your back with arms resting at your sides, palms up
- Bend hips and knees, placing feet on flat surface
- Pull belly button in

##### Execution:

- Lift your hips off the surface to make a bridge
- Do not arch your back
- Keep belly button pulled and squeeze glutes during movement
- Lower slowly



Lie on back, arms resting at your side, palms up; Bend hips and knees, place feet on flat surface



Keep belly button pulled and squeeze glutes during movement



Lower slowly back to start position

#### Hip Abduction Sidelying (Band)

Sets: \_\_\_\_\_ | Reps: \_\_\_\_\_ | Frequency: 2 x/week

##### Preparation:

- Lay straight as an arrow, band around knees or just above your knees
- Keep pelvis still (you can lie with your back against the wall)
- Support your head with your hand or on a pillow

##### Execution:

- Lift top leg 1-2 inches against resistance

##### Progression:

- Hold your leg up for 3 seconds



On side, both legs straight



Raise top leg



# RESISTANCE EXERCISE TOOLKIT



## Standardized Exercise Programs Resistance Exercises - Lying down/Sitting

# 4

### Lying Down

#### Dead Bug | Heel Touches + Shoulder Flexion

Sets: \_\_\_\_ | Reps: \_\_\_\_ | Frequency: 2 x/week

##### Preparation:

- Lie on your back, arms straight up to the ceiling, hips and knees at 90 degrees
- Engage core by pulling belly button in

##### Execution:

- Slowly lower one heel to the ground
- At the same time reach overhead with opposite arm
- Alternate sides
- Keep core engaged by pulling belly button in



Start position



Lower one heel, reach overhead with opposite arm

### Sitting

#### Leg Press (Band)

Sets: \_\_\_\_ | Reps: \_\_\_\_ | Hold: 3 seconds | Frequency: 2 x/week

##### Preparation:

- Loop exercise band under foot as shown
- Sit tall with good posture

##### Execution:

- Straighten leg

This exercise can also be done while laying on your back



Loop exercise band under foot



Straighten leg

#### Hip Flexion (Band)

Sets: \_\_\_\_ | Reps: \_\_\_\_ | Frequency: 2 x/week

##### Preparation:

- Attach band over your knee and to the leg of the chair as shown
- Sit tall with good posture

##### Execution:

- Lift knee, as in marching

This exercise can also be done while laying on your back

##### Progression:

- Hold your knee up for 3 seconds



Sit in a chair with good posture



Lift knee, as in marching

# RESISTANCE EXERCISE TOOLKIT



## Standardized Exercise Programs Resistance Exercises - Lying down/Sitting

# 5

### Sitting

#### Knee Extension (Band)

Sets: \_\_\_\_\_ | Reps: \_\_\_\_\_ | Hold: 3 seconds | Frequency: 2 x/week

##### Preparation:

- Loop band around your ankle and the leg of the chair as shown
- Sit tall with good posture

##### Execution:

- Straighten knee against resistance



Sit in a chair with good posture



Straighten knee against resistance

#### Knee Flexion (Band)

Sets: \_\_\_\_\_ | Reps: \_\_\_\_\_ | Frequency: 2 x/week

##### Preparation:

- Attach band to your ankle (the other end of the band can be attached to a stable object)
- Sit tall with good posture with your knee straight

##### Execution:

- Bend knee against resistance



Start position



Bend knee against resistance

#### Chest Press (Band)

Sets: \_\_\_\_\_ | Reps: \_\_\_\_\_ | Frequency: 2 x/week

##### Preparation:

- Loop band around trunk/shoulders
- Sit tall with good posture, arms at shoulder height

##### Execution:

- Push arms forward against resistance
- Make sure band does not slide up to your neck



Band looped around trunk



Push arms forward



# RESISTANCE EXERCISE TOOLKIT



## Standardized Exercise Programs Resistance Exercises - Lying down/Sitting

6

### Sitting

#### Shoulder press (Wrist Weights)

Sets: \_\_\_\_\_ | Reps: \_\_\_\_\_ | Frequency: 2 x/week

##### Preparation:

- Attach wrist weights
- Sit tall with good posture

##### Execution:

- Hands beside ears
- Reach straight overhead

You can also do this with a band by sitting on the band



Hands beside ears



Reach straight overhead

#### Row | Wide Grip (Band)

Sets: \_\_\_\_\_ | Reps: \_\_\_\_\_ | Frequency: 2 x/week

##### Preparation:

- Sit tall with good posture
- Attach band to a stable object

##### Execution:

- Pull your hands back to your shoulders
- Pull your shoulder blades back and down



Sit with good posture



Pull against resistance

#### Tricep Extension-Dips (Chair)

Sets: \_\_\_\_\_ | Reps: \_\_\_\_\_ | Frequency: 2 x/week

##### Preparation:

- Sit with feet flat on the floor away from the chair
- Hold the arm rests firmly with elbows bent

##### Execution:

- Push up by straightening your elbows to lift yourself a few inches off the chair
- Keep your upper body tall (if you need to make this easier you can lean forward)
- Slowly lower yourself down

##### Progression:

- Lift yourself higher than a few inches off the chair



Sit, feet away from chair



Use arms to push body up

# RESISTANCE EXERCISE TOOLKIT



## Standardized Exercise Programs Resistance Exercises - Lying down/Sitting

# 7

### Sitting

#### Elbow Extension (Band)

Sets: \_\_\_\_\_ | Reps: \_\_\_\_\_ | Frequency: 2 x/week

##### Preparation:

- Sit tall with good posture, band looped around body
- Band held in hand with elbow bent as shown

##### Execution:

- Straighten elbow against resistance



Loop band around trunk



Straighten elbow

#### Elbow Flexion (Band)

Sets: \_\_\_\_\_ | Reps: \_\_\_\_\_ | Frequency: 2 x/week

##### Preparation:

- Sit tall with good posture
- Band looped around feet

##### Execution:

- Bend elbow, bringing hand towards shoulder



Band looped around legs



Bend elbow, bring hand towards shoulder



# RESISTANCE EXERCISE TOOLKIT



## Standardized Exercise Programs Patient Instructions Resistance Exercises - Standing

8

### Resistance Exercises-Standing

- To get health benefits from resistance exercises, they need to feel at least somewhat hard to do.
- Progress the weight lifted over time so that it feels like an 8 out of 10 difficulty (where 0=no effort, 10=hardest effort you can give).
- The last repetition of each exercise should be difficult to complete. If it is easy to complete, you need to make the exercise harder by adding more weight or increasing the number of repetitions that you are doing.
- Remember to lift and lower the weight with control.
- Try to do these exercises at least 2x/week.
- Rest 1.5-3 minutes between your exercise sets to allow your muscles to recover.
- With resistance exercise, you should expect some muscle soreness. Taking a 2 day break between exercise sessions is a good idea.

 ***If you have any questions, please contact your physiotherapist.***

Images courtesy of SimpleSet™

# RESISTANCE EXERCISE TOOLKIT



## Standardized Exercise Programs Resistance Exercises-Standing

9

### Partial Squat (Dumbbells)

Sets: \_\_\_\_\_ | Reps: \_\_\_\_\_ | Frequency: 2 x/week

#### Preparation:

- Stand with good posture, feet shoulder-width apart
- Hold dumbbells as shown

#### Execution:

- Initiate squat by bending at the hips and sticking your bottom out (like you are going to sit in a chair)
- Squat part way down
- Rise up at the hips



#### Progression:

- Hold squat position for 3 seconds

### Deadlift | Stiff-Legged (Dumbbell)

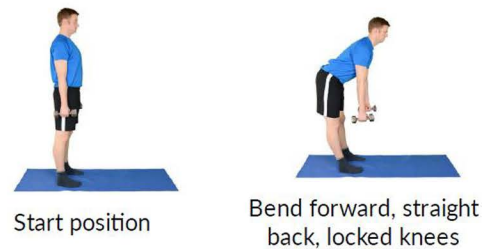
Sets: \_\_\_\_\_ | Reps: \_\_\_\_\_ | Frequency: 2 x/week

#### Preparation:

- Hold dumbbells as shown

#### Execution:

- Bend forward at the hips
- Rise back up keeping back knee straight



### Reverse Lunge (Dumbbell)

Sets: \_\_\_\_\_ | Reps: \_\_\_\_\_ | Frequency: 2 x/week

#### Preparation:

- Stand with good posture
- Hold dumbbells by your side

#### Execution:

- Engage deep core by pulling your belly button in
- Step one leg back, and bend your knees as shown
- Return to start position, or continue lunging backwards



#### NOTE:

- Keep your front knee lined-up with your middle toe



# RESISTANCE EXERCISE TOOLKIT



## Standardized Exercise Programs Resistance Exercises-Standing

# 10

### Bicep Curl to Shoulder Press (Dumbbell)

Sets: \_\_\_\_\_ | Reps: \_\_\_\_\_ | Frequency: 2 x/week

#### Preparation:

- Stand with good posture
- Hold weights, arms relaxed at sides

#### Execution:

- Bend elbows, lifting weights to shoulders (keep elbows close to your body)
- Now raise arms overhead
- Return to starting position



Start Position



Lift dumbbells to shoulders



Press overhead

### Chest Press (Band)

Sets: \_\_\_\_\_ | Reps: \_\_\_\_\_ | Frequency: 2 x/week

#### Preparation:

- Stand holding band in both hands at shoulder height as shown

#### Execution:

- Press arms straight out in front



Stand tall



Press arms straight out

### Bilateral Row | Wide Grip (Band)

Sets: \_\_\_\_\_ | Reps: \_\_\_\_\_ | Frequency: 2 x/week

#### Preparation:

- Stand with good posture
- Hold band in both hands with arms straight out in front

#### Execution:

- Pull hands to shoulders, elbows out
- Pull your shoulder blades back and down



Start Position



Pull toward chest, elbows out

# RESISTANCE EXERCISE TOOLKIT



## Standardized Exercise Programs Resistance Exercises-Standing

# 11

### Wall Plank | Forearms

Sets: \_\_\_\_\_ | Reps: \_\_\_\_\_ | Hold: 10 seconds and increase time as able |  
Frequency: 2 x/week

#### Preparation:

- Position yourself with forearms against the wall as shown

#### Execution:

- Keep body straight, do not let lower back arch
- Hold this position



Plank against wall

### Push Up (Wall)

Sets: \_\_\_\_\_ | Reps: \_\_\_\_\_ | Frequency: 2 x/week

#### Preparation:

- Stand an arm's length away from a wall
- Place palms on the wall at shoulder level
- Engage core by pulling belly button in, squeeze glutes

#### Execution:

- Imagine your body is a solid plank of wood.
- Bend elbows to lean forwards toward the wall, using your arms to control the movement
- Slowly return to the start position

#### Important:

- Keep hips and back straight



Start position



Push-Up against wall

### Wood Chopper

Sets: \_\_\_\_\_ | Reps: \_\_\_\_\_ | Frequency: 2 x/week

#### Preparation:

- Hold a weight with both hands above your head

#### Execution:

- Slowly lower with arms straight down to your waist
- Maintain an upright position during the movement
- Return to starting position with control





# RESISTANCE EXERCISE TOOLKIT



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