Gains Galore: Why Exercise is Critical in the Oncology Population

Andrew Chongaway PT, DPT
Board-Certified Oncologic Clinical Specialist
ACSM Certified Exercise Physiologist
ACSM/ACS Certified Cancer Exercise Trainer
Intended Learning Outcomes

• Review important statistics in the oncology population and differentiate three key definitions
• Inform on the importance of exercise and physical activity at the molecular level
• Review principles of exercise programming
• Discuss common shortcomings within exercise programming in the exercise oncology population
The number of cancer survivors is projected to increase by 31.4%, to 22.2 million, by 2030.\(^1\)

The number of cancer survivors is projected to grow to 26.1 million by 2040.\(^1\)
Statistics

• Only ~1/3 of persons living with & beyond cancer are meeting exercise recommendations
  • Number drops to about 10% of persons actively going through tx
  • Up to 34% report NO leisure time physical activity or exercise

• Multitude of reasons why this number is so low
  • Understanding of exercise & PA (Both physician and patient)
  • Fear (Both physician and patient)
  • Access
  • Time
  • Financial challenges
ADLs – Physical Activity – Exercise 5-8

• **Activities of Daily Living:** getting out of bed, bathing, eating, Transfers, dressing

• **Physical Activity:** any bodily movement produced by skeletal muscles that requires energy expenditure (i.e. gardening, house cleaning, playing with children or grandchildren, kayaking, pickleball...)

• **Exercise:** a subset of physical activity that is planned, structured, & repetitive & has as a final or an intermediate objective - the improvement or maintenance of physical fitness (i.e., aerobic capacity, muscle strength, power & endurance, balance, coordination, & flexibility)
Why *Appropriate* Exercise is Critical
Adverse Effects of Cancer & Treatment 9,10

- Fatigue
- Loss in muscle mass
- Reductions in muscle strength/power
- Decrease joint mobility
- Cardiotoxicity
- Impaired cognition
- Myelosuppression

- Bone loss
- Impaired functional capacity/ $\text{VO}_2\text{max}$
- Chemotherapy Induced polyneuropathy
- Pain
- Inflammation
- Altered nutrition
- Insulin resistance
- Depression/Anxiety
Adverse Effects on Quality of Life

- Reduced Quality of Life
- Fatigue
- Reduced Mobility
- Muscular Weakness
- Reduced Functional Capacity
- Reduced Physical Function
- Further Muscular Weakness
- Increased Sedentary Time
- Further Increase in Fatigue
- Reduced Activity
- Debility and Frailty
- Reduced Quality of Life
Molecular Effects of Cancer & Treatment

- Systemic Inflammation
- Altered Hormone Levels
- Mitochondrial Dysfunction
- Muscle Atrophy
- Vascular Dysfunction
Why Exercise Matters on a Molecular Level

- Anti-Neoplastic Effects
- Regulate Hormone Levels
- Mitochondrial Biogenesis
- Muscle Protein Synthesis
- Improvement in Vascular Dynamics
Potential Benefits of Exercise Oncology

- **Strong Evidence**
  - Anxiety
  - Fatigue
  - Health Related QoL
  - Lymphedema
  - Physical Function

- **Moderate Evidence**
  - Bone Health
  - Sleep

- **Insufficient Evidence**
  - Cardiotoxicity
  - CIPN
  - Cognitive Function
  - Falls
  - Pain
  - Tx Tolerance
  - Nausea
Effects of Aging on Physical Function

![Graph showing the relationship between age and physical function, debility/mortality, and the onset of cancer.](image-url)
ExRX in Individuals with Cancer

• Minimum recommendations by ACSM:
  • 30 minutes of aerobic exercise 3x per week
    • Resistance training 2x per week focusing on large muscle groups
      • 2 sets of 12-15 repetitions
    • However, individuals with cancer should attempt to be active everyday 3x for at least 10 minutes
  
• Should aim to meet the ACSM/WHO minimum requirements of 150 minutes of moderate & or 75 minutes of vigorous exercise per week.

• Due to the importance of exercise in the oncology population it should be considered a vital sign much like blood pressure, pain, heart rate, etc.
  • This is where we should regularly assess and advise about exercise
Assessing for Physical Activity/Exercise

• Regularly assess physical activity/exercise participation across multiple time points.
  • Prospective surveillance model
    • At time of diagnosis
    • As the person is moving through treatment
    • At the end of treatment
    • Into survivorship

• Integrate within the health system, Multi-D clinics, Community, etc.
  • Provide information on becoming physically active & refer if necessary & willing
    • Physicians have reported that they don’t feel confident in educating on exercise or don’t have the time to
Foundations of an Exercise Program
It Shouldn’t be a Siloed Approach

Exercise Program

- Aerobic
- Resistance
- Mobility
- Balance
Principles of Exercise Program (ACSM) 29

<table>
<thead>
<tr>
<th>Principle</th>
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<tbody>
<tr>
<td>Frequency</td>
</tr>
<tr>
<td>Intensity</td>
</tr>
<tr>
<td>Type</td>
</tr>
<tr>
<td>Time</td>
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<tr>
<td>Specificity</td>
</tr>
<tr>
<td>Volume</td>
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<tr>
<td>Progressive Loading</td>
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</table>
Aerobic Training

**Frequency**
- 3-5x per week

**Intensity**
- 40-90% of VO$_2$max or HRR
- METs:
  - Moderate – 3 to 6 METs (walking 3.0 mph, stationary bicycling at 100 watts with light effort, light effort calisthenics)
  - Vigorous - >6 METs (jogging, jumping rope, heavy effort calisthenics)
- RPE:
  - Moderate 11-13/20 or 4-6/10
  - Vigorous: 14-17/20 or 7-9/10

**Type**
- Can really be any type of movement that allows for appropriate intensity though at times a stationary bike or NuStep may be the most appropriate if there are balance concerns.
Resistance Training

**Frequency**

- 2-3x per week on non-consecutive days

**Volume (Sets x Reps x Resistance)**

- Often 60-70% or 1RM is often considered the baseline for improving strength
- Resistance as low as 30% of 1RM may promote improvement in physical function as long as volume is appropriate.
  
- **10-20 sets per week per muscle**
- Overall volume may be the biggest factor to improving strength/muscle mass/physical function when the resistance is at appropriate level

**Type**

- Can be free weights, machines, resistance bands, or bodyweight.*
- Focus on large muscle groups with supplementary exercises for smaller muscle groups.
## Rate of Perceived Exertion (RPE) scale

<table>
<thead>
<tr>
<th>Borg RPE Scale</th>
<th>Modified Borg (CR-10) RPE Scale</th>
<th>Perceived Effort</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>0</td>
<td>Very Light Effort</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>Light Effort</td>
</tr>
<tr>
<td>10</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>3</td>
<td>Moderate Effort</td>
</tr>
<tr>
<td>13</td>
<td>4</td>
<td>Somewhat Hard Effort</td>
</tr>
<tr>
<td>14</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>6</td>
<td>Hard Effort</td>
</tr>
<tr>
<td>16</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>8</td>
<td>Vigorous Effort</td>
</tr>
<tr>
<td>18</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>10</td>
<td>Maximum Effort</td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Adapted from Haddad et al. 2017
Repetitions in Reserve

<table>
<thead>
<tr>
<th>Rating</th>
<th>Perceived Effort with Reps Remaining</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Max Effort</td>
</tr>
<tr>
<td>9</td>
<td>1 rep remaining</td>
</tr>
<tr>
<td>8</td>
<td>2 reps remaining</td>
</tr>
<tr>
<td>7</td>
<td>3 reps remaining</td>
</tr>
<tr>
<td>6</td>
<td>4 reps remaining</td>
</tr>
<tr>
<td>5</td>
<td>6 reps remaining</td>
</tr>
<tr>
<td>3-4</td>
<td>Little Effort – 10+ reps remaining</td>
</tr>
<tr>
<td>1-2</td>
<td>No Effort</td>
</tr>
</tbody>
</table>

Adapted from Helms et al 2016
Designing an Exercise Program
Designing an Exercise Program

• **Assess**
  - Medical Background
    - Primary Diagnosis
    - Comorbidities
    - Lab Values
    - Cognition
    - Nutrition
  - Perceptions and Beliefs of Exercise
  - Goals and Main Concerns
  - Mobility and Physical Function

• Then we **synthesize** all of it to build an individualized exercise program

• Routinely **reassess** the to ensure progress with mobility and physical function
Performance Potential

- Performance may vary day to day & between sessions based on numerous intrinsic factors:
  - Fatigue
  - Sleep
  - Soreness
  - Pain
  - Anxiety
  - Lab Values

- Same weight/volume may not “feel” the same each session
  - 185 lb leg press 4x4 may be an RPE of 7 on Monday but on Thursday may be RPE of 10 which then could result in greater fatigue down the line.
<table>
<thead>
<tr>
<th>Pain vs. Soreness</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Soreness</strong></td>
</tr>
<tr>
<td>• Dull, tight, &amp; achy feeling</td>
</tr>
<tr>
<td>• Burning like feeling when exercising</td>
</tr>
<tr>
<td>• May experience symptoms during exercise or within 24 hrs after &amp; last 48-72 hrs</td>
</tr>
<tr>
<td><strong>Pain</strong></td>
</tr>
<tr>
<td>• Sharp pain (stabbing, throbbing, aching) at rest or with activity</td>
</tr>
<tr>
<td>• During exercise or within 24 hrs after exercise/ activity</td>
</tr>
<tr>
<td>• May linger &amp; get worse with each bout of exercise or activity</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Mobility, movement, rest, &amp; recovery may improve symptoms</td>
</tr>
</tbody>
</table>

Targeted exercises, recovery, mobility, & rest may improve pain.
Pain vs. Soreness 37,38

• If the person reports increased soreness from previous session(s) or pain with a specific movement may need to modify the session or movement.

• Before removing an exercise completely should attempt to modify
  • Modify the range of motion
  • Reduce the load or volume
  • Change the tempo
  • Break the movement into parts
  • Focus on either concentric or eccentric only

• Want to avoid promoting fear of movement and kinesiophobia
  • Resistance training has strong potential to reduce pain
Where Exercise Programs Fall Short
The Pitfalls in an Exercise Program

• Often the exercise program is insufficient in:
  • Specificity
  • Volume
  • Progressive Loading to Adaptation
1. **Specificity**: Exercise program needs to be specific to the goals
   - If the goals are to improve strength, then the program needs to reflect that
     - A walking program won’t improve strength

2. **Volume**: Needs to be sufficient volume to the program to promote the required gains
   - Depending on the intensity (% of max, RPE, RIR) the volume may differ but percentages as low as 30% have shown to promote gains
   - Total Time Under Tension (TUT) per session or week

3. **Progressive Loading**: To get positive adaptations there needs to be progressive loading & to get progressive loading there needs to be positive adaptations
   - Moving away from the progressive overload where the thought is to just keep putting weight on the bar or machine
Specificity 41-43

• Making the case for Reps over Steps
  • Often strength/power is significantly lacking in this population
    • Muscle Weakness is routinely seen before Muscle Atrophy
    • Type IIa/IIx atrophy is escalated due to sedentary nature
  • A walking program is beneficial to promote activity but isn’t specific in this case
    • **If they’re weak, can they even walk a meaningful distance to promote physical function?**
  • Further looking at mortality and overall survival there is a correlation with muscle strength/mass and improved outcomes

• There is the thought of repetition range for producing strength, hypertrophy, or endurance
  • If strength increases hypertrophy will most likely occur and vice versa
  • First → Neuromuscular adaptations: Then → Structural Changes
Volume

• Volume (load x sets x reps) is often the critical factor in eliciting positive adaptations
  • Often what is lacking in the oncology population for exercise programs
• Don’t want to just pick a resistance but want to progressively load within the exercise program
  • This is where initial and then continual assessment of function and performance potential is important
• When volume is sub-threshold there will either be null or blunted positive adaptations & improvement in physical function
Food for Thought 44, 45

• Heavy resistance isn’t the end all for promoting strength/hypertrophy
  • Higher loads will = greater strength gains (some hypertrophic adaptations)
  • Lighter loads will = strength/hypertrophic adaptations (to an extent)

• Load management is intricately intertwined with overall sets and repetitions (Volume)
  • Need to sufficiently stimulate motor units to promote strength/hypertrophic gains
    • Whether it be with low/moderate/high loads
    • May easily miss the mark for strength/hypertrophic gains depending on chosen load and/or volume

• Movement of exercise also has important neuromuscular adaptations that can be critical for overall physical function in the oncology population
HZ – Hypertrophy Zone; SZ – Strength Zone
HL/LV – High Load/ Low Volume
ML/MV – Moderate Load/Moderate Volume
LL/HV – Low Low/High Volume
LL/LV – Low Load/ Low Volume
Progressive Loading

• There are almost an infinite number of ways to alter/modify an exercise program
  • Rest
  • Sets
  • Reps
  • Resistance
  • Routine
  • Sequencing

• There is a high likelihood to see significant variations across sessions with exercise prescription.

• To ensure adequate volume and progressive adaptations there needs to be some consistency with exercise selection across sessions
  • Can mix it up between sessions but can’t have completely new exercise(s) every session
Progressive Loading

So how do we progressively load or progress an exercise program?
- Consider Performance Potential
- Shouldn’t just arbitrarily select a weight and/or exercise(s)
  - Consistency is key
- Use of Rating of Perceived Exertion (RPE) & Reps in Reserve (RIR) - best option
  - Allows for autoregulation from a session to session/ week to week basis

Don’t have to only manipulate exercise volume, intensity, & duration to progressively load
- Lying/sitting → Standing
- Uni-planar or one-dimensional → Multi-planar or three-dimensional
- Stable → Unstable
- Without visual deprivation → With visual deprivation
- Bilateral → Unilateral
- Single task → Double task
Exercise Periodization

• **Macrocycle:** Traditionally thought of a full season or year

• **Meso- & Microcycles** can be broken into weeks or sessions to allow for optimal programming
  - Allows for considerations of chemotherapy, radiation therapy, surgery, functional performance status

• **Linear**
  - Incremental increase in volume & load
  - In traditional setting of S&C for an athlete: Hypertrophy → Strength → Power
  - May not necessarily conform to the rehab/wellness settings

• **Undulating**
  - Varying volume & load from week to week
    - Strength → Deload → Maintain → Strength → Hypertrophy
    - Fitting for the rehab/wellness setting
      - Stabilize → Restore → Strengthen
      - Balance → Strengthen → Multimodal → Maintenance
Example Routines to Build Exercise Programs

• Full Body & Split Routines
  - Aerobic/ Balance/ Resistance
  - Upper/ Lower Body
  - Push or Pull or Combined

• Metcons
  - Couplet
  - Triplet

• Circuit Training

• Interval Training

• Traditional Sets

• Cluster Sets

• High Speed Resistance Training

• SuperSets

• Drop Sets

• Isometrics

• Eccentrics
Exercise Programming: Metcon

- Couplet (2 movements)
- Triplet (3 movements)
- Can be for time or have a time limit
- Predetermined volume prior to starting the movements
  - Useful for including aerobic movements & resistance movements
  - As much rest as needed & whenever just has to complete all the repetitions

- Couplet:
  - 40-30-20-10
    - Step Up and Overs
    - Wall Push Ups

- Triplet
  - 3 Rounds
    - 25 squats
    - 10 Modified Burpees
    - 12 TRX Rows
Exercise Programming: Circuit Training

• Circuit Training
  • Beneficial as it can include all four groups of the program within a session
  • Use of balance exercises as planned rest periods
  • Exercises can be completed for time or repetitions to include aerobic & resistance training
  • Also allows for continuous volume accumulation

• 4 Rounds
  • 20 reps - TRX Lunges
  • 12 reps - Machine Rows
  • 40 reps - Modified Mountain Climbers
  • 12 reps - Lat Pulldowns
  • 8 reps - Leg Press
  • 12 reps - Modified Push Ups
Exercise Programming: Intervals

• Interval Training
  • More based on Work to Rest Intervals
  • Will often be a higher effort whether perceived (RPE) or physiologically (heart rate)
  • Work to Rest ratio can vary based on the person
  • Work can be as little as 10 sec. up to 180 sec.

• Tabata
  • 8 Rounds of 20 sec/ 10 sec (W/R)

• 6 Rounds
  • 30 sec/30 sec (W/R)
    • Mini Squats
    • Wall Push Ups
    • Step Ups
    • Modified Mountain Climbers
  • After each round 2 minute rest
Resistance Training: Cluster Sets

Traditional set (TS)

(A)  

Cluster sets (CS)

(B)  Intra-set rest  

| Rep 1 | Rep 2 | Rep 3 |

| Rep 4 | Rep 5 | Rep N |

15-45 s

120-180 s inter-set rest

(C)  Inter-repetition rest  

| Rep 1 |

| Rep 2 |

| Rep 3 |

| Rep 4 |

| Rep 5 |

| Rep N |

6-20 s

6-20 s

6-20 s

6-20 s

6-20 s

120-180 s inter-set rest

(D)  Rest pause  

| Rep 1 | Rep 2 | Rep 3 | Rep 4 | Rep 5 | Rep N | Failure |  

| Rep N |

Pre-determined s

Cont. Pre-determined amount of rest at each failure point until desired repetitions completed.
Resistance Training: High Speed Resistance Training (HSRT)/ Power Training (PT) 49,50

• Load is usually heavier but lower load (40-60% 1RM)

• Moves away from the “don’t go too fast/ fast is not better” philosophy

• Concentric phase is completed as fast as possible with a controlled eccentric phase

• Promotion of power; maximal motor unit recruitment; favoring of Type IIa & Type IIx fibers (fast twitch) which are more prone to disuse & atrophy

• Focus on multi-joint movements utilizing larger musculature
Wrap Up
Key Points 51,52

• If you really want Exercise to be Medicine, then it needs to be specific & at the correct dose (volume) just like chemotherapy, radiation therapy, etc.
  • However, some exercise is better than none – we all start somewhere
• The exercise program and exercises need to be thoughtful to the person and situation
  • You don’t have to chase the fancy/shiny exercises
    • Keep It Simple and Straightforward (KISS)
  • One exercise can be used an infinite number of ways for an infinite number of responses.
• Consistency within the exercise program to allow for positive adaptations
  • Routinely assess RPE, RIR, performance potential, and benchmarks to ensure progression
Key Points 51,52

Moving exercise forward in oncology population

• We know exercise is beneficial, but we need to figure out how to
  • Get persons living with & beyond cancer moving
  • Improve understanding of the benefits of exercise to other healthcare professionals, patients, family members, and other persons within the community
  • Promote the use of perspective surveillance with exercise
  • Integrate within health systems, Multi-D clinics, and develop programs to promote exercise and physical activity
Questions?
References


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