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# Cancer & Exercise Prescriptions

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## Overview of the Pathophysiology

- **Cancer** : Collection of hundreds of diseases  
Uncontrolled growth and spread of abnormal cells
- **The treatment of cancer** : surgery , radiation , chemotherapy
- **Goal of the treatment of cancer** : remission
- **Finish of the treatment of cancer** : permanent of remission
- **Subjects of rehabilitation , exercise training**
  - 1) Patients in remission
  - 2) Some patients who are undergoing treatment

## Effect on the Exercise Response

- ◆ Persons with cancer/survivor : Disease/Treatment-specific physical limitations  
→ pose challenges to exercise

Disease/Treatment-specific physical limitations	
musculoskeletal system	pain
lung	shortness of breath
central nervous system/brain	neural deficits, seizures
bone marrow	anemia
advanced cancer	easy fatigability

- ◆ Side effects of anticancer therapy → the exercise response

Type of anti-cancer therapy	Side effects (permanent)
▪ amputation	▪ permanent disability
▪ radiation / chemotherapy	▪ permanent scar formation in joints , lung and heart tissues
▪ drug-induced cardiomyopathy	▪ permanent limitation on cardiovascular function



Exercise training	benefits occur in skeletal muscle / psychological status
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## Management and Medications

The most common problems	
Surgery	<ul style="list-style-type: none"> <li>• loss of flexibility</li> <li>• amputation</li> <li>• motor / sensory nerve damage</li> </ul>
Radiation	<ul style="list-style-type: none"> <li>• loss of flexibility</li> <li>• cardiac / lung scarring</li> </ul>
Chemotherapy	<ul style="list-style-type: none"> <li>• peripheral nerve damage</li> <li>• cardiomyopathy</li> <li>• pulmonary fibrosis</li> <li>• anemia</li> </ul>

- acute : inflammatory response in lung tissue  
→ impair oxygen transfer
- delayed in onset : lung scarring , cardiomyopathy , anemia



### Effect on the Exercise Training

- Exercise training for persons with cancer  
→ dependent on individual circumstances
- 1) Survivors of cancer : returning them to their former level of physical and physiological function
- 2) Persons who are undergoing therapy for cancer  
: maintaining endurance , strength and level of function  
: profound psychological benefits (depression)
- Benefits of regular, moderate-intensity aerobic exercise during cancer therapy

<ul style="list-style-type: none"> <li>reduced levels of fatigue</li> <li>greater body satisfaction</li> <li>maintenance of body weight</li> <li>improved mood</li> <li>less side effect severity</li> </ul>	<ul style="list-style-type: none"> <li>a higher quality of life</li> <li>improve bone remodeling</li> <li>reduce muscle weakness</li> <li>reduce the muscle-wasting effects of glucocorticoids</li> </ul>
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### Summary of evidence on the relationship between physical activity and the prevention

Cancer site	IARC(2002) conclusion	Revised conclusion from current review	comments
Colon	Sufficient evidence to support a preventive role for physical activity	Well-established decreased risk	Relationship stronger in men than women
Breast	Sufficient evidence to support a preventive role for physical activity	Well-established decreased risk	Relationship stronger in post-menopausal than pre-menopausal women
Lung	Inadequate evidence to support a preventive role for physical activity	Consistent evidence of decreased risk	Some concern over residual confounding for smoking
Endometrium	Limited evidence to support a preventive role for physical activity	Mostly Consistent evidence of decreased risk	Inconsistency in type of activity important for risk and strongest as sociations were not adjusted for Body Mass Index
Prostate	Limited evidence to support a preventive role for physical activity	Evidence suggestive decreased risk	More evidence on relationship with advanced prostate cancer needed
Pancreas	Not Available	Weak evidence of decreased risk	limited evidence is likely to be confounding by smoking
ovary	Inadequate evidence to support a preventive role for physical activity	No relationship	Not Available

### Routine exercise training program

- aerobic capacity
- submaximal performance
- children = adult
- adult have co-morbid condition  
: CAD , HTN , DM , high blood lipid
- Exercise management  
: co-morbid condition > history of cancer

### Recommendations for Exercise Testing

- Cancer survivors : deconditioned / emaciated  
→ require very low level protocol

#### The primary objectives of exercise testing

- aerobic capacity , submaximal endurance strength , functional performance
- reveal other co-morbidity

### CANCER : EXERCISE TESTING

METHODS	MEASURES	ENDPOINTS	COMMENTS
Aerobic Cycle Treadmill	<ul style="list-style-type: none"> <li>12-lead ECG, HR</li> <li>BP, RPP</li> <li>RPE(6-20)</li> </ul>	<ul style="list-style-type: none"> <li>O<sub>2</sub>peak/work rate</li> <li>Serious dysrhythmias</li> <li>&gt; 2mm ST-segment depression or elevation</li> <li>T-wave inversion</li> <li>SBP&gt;250 mmHg or DBP&gt;115 mmHg</li> </ul>	
Endurance 6 to 12-min walk	<ul style="list-style-type: none"> <li>Distance covered</li> </ul>	<ul style="list-style-type: none"> <li>volitional fatigue</li> </ul>	<ul style="list-style-type: none"> <li>Endurance often limited.</li> </ul>
Strength Isotonic/isokinetic	<ul style="list-style-type: none"> <li>1 RM</li> <li>3 RM</li> </ul>	<ul style="list-style-type: none"> <li>Maximum voluntary contraction</li> <li>Maximum number of reps</li> <li>Peak torque</li> </ul>	<ul style="list-style-type: none"> <li>Atrophy and frailty common.</li> </ul>
Flexibility Goniometry sit and reach			<ul style="list-style-type: none"> <li>Assess upper-extremity range of motion after mastectomy</li> <li>Atrophy can limit range of motion.</li> </ul>
Functional capacity Gait analysis			<ul style="list-style-type: none"> <li>Assess for neuropathy after vincristine or radiation</li> </ul>

### Recommendations for Exercise Programing

Goal	Survivor	Persons in therapy
return to a healthy , active lifestyle		<ul style="list-style-type: none"> <li>improve strength</li> <li>endurance</li> <li>psychological status</li> <li>maintain physical reserves</li> </ul>

MODES	GOALS	INTENSITY/FREQUENCY/DURATION	TIME TO GOAL
Aerobic Large muscle activities (walking, rowing, cycling, water aerobics)	<ul style="list-style-type: none"> <li>Improve/maintain work capacity</li> <li>Control body weight</li> <li>Improve mood</li> <li>Reduce fatigue</li> <li>Improve quality of life</li> </ul>	<ul style="list-style-type: none"> <li>Symptom limited ; moderate intensity</li> <li>Exercise at least every other day</li> <li>15-40min/session</li> </ul>	
Strength Free weights Weight machines Isometric machines Therabands Circuit training	<ul style="list-style-type: none"> <li>Maintain or improve strength in arms, legs, and trunk</li> <li>Increase maximal voluntary contraction, peak torque, and power</li> </ul>	<ul style="list-style-type: none"> <li>Symptom-limited intensity</li> <li>50% of 1RM</li> <li>2-3day/wk for 20-30min</li> <li>2-3 sets of 3-5 reps, building to 10-12 reps</li> </ul>	
Flexibility Stretching	<ul style="list-style-type: none"> <li>Increase /maintain ROM</li> <li>Decrease stiffness from disuse</li> </ul>	<ul style="list-style-type: none"> <li>5-7 days/wk</li> </ul>	<ul style="list-style-type: none"> <li>6-12Weeks</li> </ul>
Functional ADLs Gait and balance exercise	<ul style="list-style-type: none"> <li>Maintain as much independence as possible</li> <li>Increase daily living activities.</li> <li>Return to work</li> <li>Improve gait</li> <li>Improve balance</li> </ul>	<ul style="list-style-type: none"> <li>Daily</li> </ul>	



**Special Precautions When Prescribing Exercise for Cancer Survives**

Complication	Precaution
Complicate blood counts	
Hemoglobin level <8.0 g · dl <sup>-1</sup>	Avoid activities that require significant oxygen transport(e.g.high intensity).
Absolute neutrophil count <0.5×10 <sup>9</sup> /l	Avoid activities that may increase the risk of bacterial infection (e.g.swimming).
Platelet count <50×10 <sup>9</sup> /l	Avoid activities that increase the risk of bleeding (e.g.contact sports or high impact exercises).
Other	
Fever>38°C and >40°C	May indicate systemic infection and should be investigated. If neutropenic, avoid exercise altogether. If not neutropenic, avoid high intensity exercise if fever >38°C and all exercise if fever >40°C.
Ataxia, dizziness, peripheral	Avoid activities that require significant balance and sensory neuropathy coordination (e.g. treadmill).
Severe cachexia (loss of>35% of premorbid weight)	Loss of muscle mass usually limits exercise to mild intensity, depending on the degree of cachexia.
Dyspnea	Investigate etiology. Exercise to tolerance.
Bone metastases or pain	Avoid activities that increase risk of fracture at the location of the bone pain or metastases (e.g.contact sports or high impact exercises).
Severe nausea	Investigate etiology. Exercise to tolerance.
Extreme fatigue or muscle weakness	Investigate etiology. Exercise to tolerance.
Severe lymphedema	Avoid upper extremity exercises with the affected arm.
Dehydration	Ensure adequate hydration.

**General Aerobic Exercise Recommendations for Otherwise Healthy Cancer Survivors**

Parameter	Guidelines and comments
Mode	Most exercises involving large muscle groups are appropriate, but walking and cycling are especially recommended. The key is to modify exercise mode based on acute or chronic treatment effects from surgery, chemotherapy, or radiation therapy.
Frequency	At least three to five times per week, but daily exercise may be optimal for deconditioned survivors performing lighter intensity or shorter duration exercises.
Intensity	Moderate intensity depending on current fitness level and severity of side effects from treatments. Guidelines include 50% to 75% VO <sub>2</sub> max or HRreserve, 60% to 80% HRmax, or 11 to 14 RPE. HRreserve is best guideline if HRmax is estimated rather than measured.
Duration	From 20 to 60 continuous minutes, but this goal may have to be achieved through multiple intermittent shorter bouts ( e.g.,5 to 10 minutes) with rest intervals in deconditioned survivors or those experiencing severe side effects of treatment.
Progression	Initial progression should be in frequency and duration, and intensity be increased only when these goals are met should. Progression should be slower and more gradual for deconditioned survivors and those experiencing severe side effects of treatment.

**Cancer Risk Factors**

About 75% of cancers are preventable and are linked to lifestyle.

Here are the chief risk factors for cancer.

- Dietary factors (33% of all cancers)
- Tobacco use (31% of all cancers)
- Alcohol use (3-4% of all cancers)
- Reproductive factors (primarily for breast cancer)
- Unsafe sex (exposure to certain types of cancer promoting viruses)
- Environmental factors (especially sunlight, radiation and radon exposure, and air pollution)
- Family History
- Physical inactivity

**CANCER PREVENTION**

- lifestyle : very important risk factor
- physical activity reduce the risk of developing cancer
  - 1) colon/breast cancer : 30 - 35% risk reduction
  - 2) prostate , lung , endometrial cancer : protective effect

**Physical Activity Guidelines for Cancer Prevention**

- Adults : Engage in at least moderate activity for 30minutes or more on 5 or more days of the week; 45minutes or more of moderate to vigorous activity on 5 or more days per week may further enhance reductions in the risk of breast and colon cancer.
- Children and adolescents : Engage in at least 60minutes per day of moderate to vigorous physical activity at least 5days per week.

**Obesity and Cancer**

- Obesity is related to the following cancers :
  - Men. Colon and prostate
  - Women. Breast (postmenopausal), endometrium, uterine cervix, ovarian, gall bladder
- The relative risk of breast cancer in postmenopausal women is 50% higher for the obese
- The relative risk for colon cancer in men is 40% higher for the obese
- The relative risk of gallbladder and endometrial cancer are five times higher for obese individuals
- Some studies have related obesity to cancers of the kidney, pancreas, rectum, esophagus, and liver.

**Colon and Rectum Cancer**

<b>Risk Factors</b> <ul style="list-style-type: none"> <li>• Personal or family history of colorectal cancer or polyps</li> <li>• Inflammatory bowel disease</li> <li>• Physical inactivity</li> <li>• Alcohol consumption</li> <li>• Inadequate consumption of fruits and vegetables</li> <li>• Smoking</li> <li>• High-fat and/or low-fiber diet</li> </ul>	
<b>Physical Activity</b> <ul style="list-style-type: none"> <li>• The epidemiological evidence for a link between activity and lowered risk of colon cancer is convincing</li> <li>• Of 45 published studies, 38 show a 20-70 % decrease in risk of colon cancer among the most physically active men and women (average, 50%).</li> </ul>	<b>Potential Mechanisms Mediating Association with Physical Activity</b> <ul style="list-style-type: none"> <li>• Exercise has a "fiberlike effect" in decreasing stool transit time, reducing exposure of colon cells to carcinogens (e.g.secondary bile acids).</li> </ul>



Breast Cancer	
<b>Risk Factors</b> <ul style="list-style-type: none"> <li>• Age</li> <li>• Biopsy-confirmed atypical hyperplasia</li> <li>• Consume alcoholic drinks</li> <li>• Obesity after menopause</li> <li>• Never had children or first child after age 30</li> <li>• Diet factors uncertain; increasing evidence for physical inactivity</li> <li>• Recent use of oral contraceptives or postmenopausal estrogens and progestins</li> <li>• Personal or family history</li> <li>• Long-term menstrual history (early to late in life)</li> <li>• Higher education and socioeconomic status</li> </ul>	
<b>Physical Activity</b> <ul style="list-style-type: none"> <li>• The epidemiological evidence on link between activity and breast cancer is supportive of a protective relationship, but not as strongly as with colon cancer.</li> <li>• Of 36 published studies, 25 support an inverse association between activity and breast cancer.</li> <li>• Risk reduction ranges from 10 to 70% (average of 40-50%)</li> </ul>	<b>Potential Mechanisms Mediating Association with Physical Activity</b> <ul style="list-style-type: none"> <li>• Reductions in endogenous steroid exposure</li> <li>• Alterations in menstrual cycle patterns</li> <li>• Delay of age at menarche</li> <li>• Increase in energy expenditure and reduction in body weight</li> <li>• Changes in insulinlike and other growth factors</li> <li>• Enhancement of natural immune mechanisms</li> </ul>

• Women with breast cancer : best studied

Exercise training in women who have had breast removal
<ul style="list-style-type: none"> <li>• improved shoulder range of motion</li> <li>• reduced fatigue, nausea, and other treatment-related side effects</li> <li>• improved functional ability</li> <li>• improved ability to maintain body weight</li> <li>• enhanced self-image / sense of control</li> <li>• increased muscle mass in women receiving postoperative chemotherapy</li> <li>• improved mood and quality of life</li> </ul>
<p>Children who have been cured of leukemia → persistent mild cardiovascular compromise</p> <p style="text-align: center;">↓</p> <ul style="list-style-type: none"> <li>• Not usually impair function at moderate exercise levels</li> <li>• prevent outstanding athletic performance at a later age</li> </ul>

Prostate Cancer	
<b>Risk Factors</b> <ul style="list-style-type: none"> <li>• Age (over 70% diagnosed in those 65 years and older)</li> <li>• Being African American</li> <li>• Family history</li> <li>• Live in North America or northwestern Europe (rare in Asia, Africa, South America)</li> <li>• High dietary fat intake</li> <li>• New evidence : inactivity and obesity</li> </ul>	
<b>Physical Activity</b> <ul style="list-style-type: none"> <li>• The epidemiological evidence suggests only a possible relationship between physical activity and prostate cancer.</li> <li>• Of 23 published studies, only 13 show a decrease in risk with an average reduction of 10-30%.</li> </ul>	<b>Potential Mechanisms Mediating Association with Physical Activity</b> <ul style="list-style-type: none"> <li>• Antitestosterone therapy can often control prostate cancer for prolonged periods by shrinking the size of the tumor, thus relieving pain and other symptoms.</li> <li>• After a long bout of exercise (&gt;90minutes), testosterone levels drop in male athletes. The long-term effects are currently unknown as is the exercise threshold linked to this acute decrease.</li> </ul>