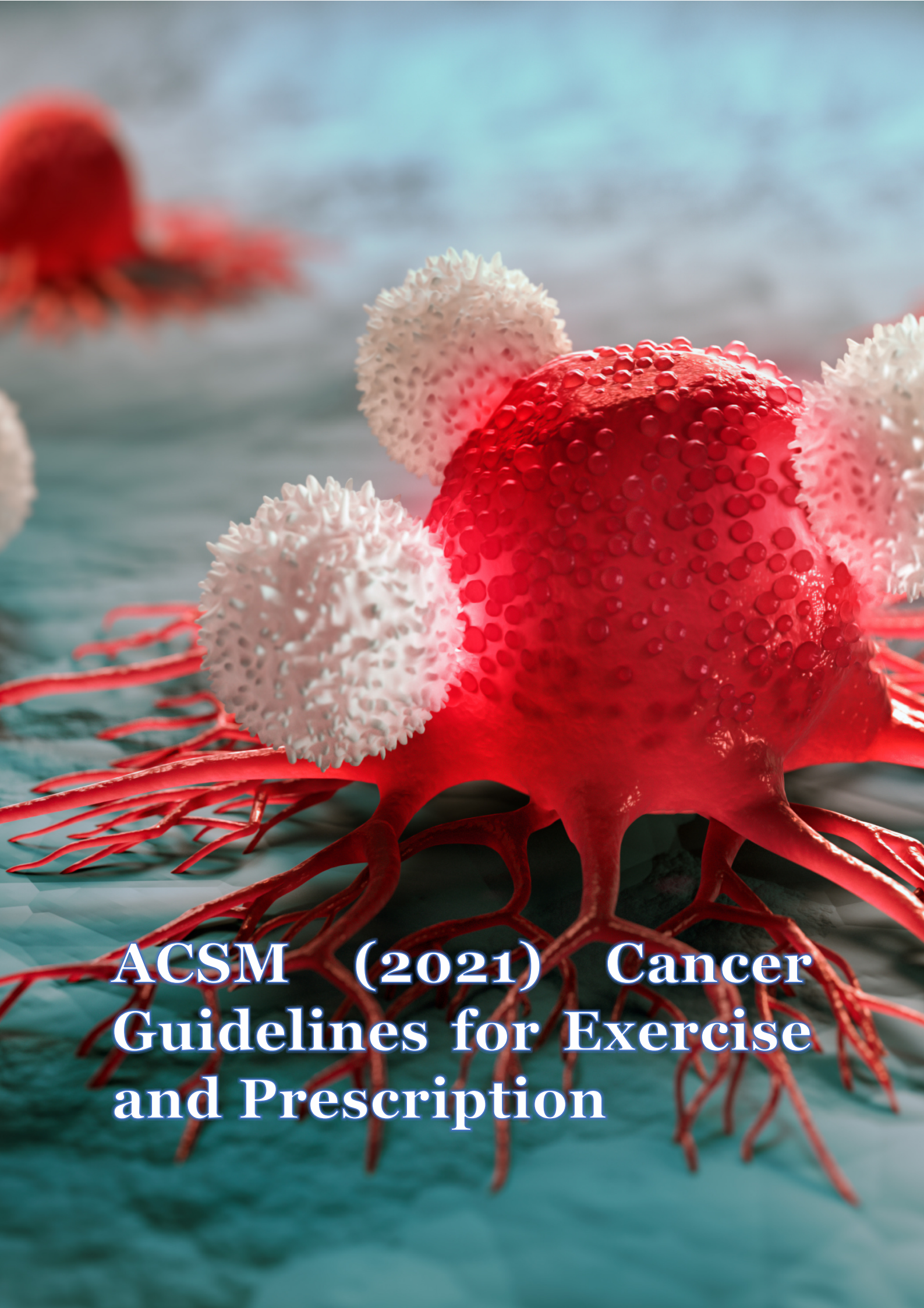

ACSM (2021) Cancer Guidelines for Exercise and Prescription

Physical Activity Patterns in Cancer Survivors

Exercise volume often decreases during cancer treatment and may not return to pre-diagnosis volume after completing treatment. In a nationally representative sample of cancer survivors, only 8% engaged in 150 min · wk-1 of moderate-to-vigorous intensity exercise. A similar study demonstrated that breast cancer survivors engaged in a daily average of 1 min of moderate-to-vigorous intensity exercise, spending most of their day in sedentary (66%) or light intensity activities (33%). Consequently, there are significant opportunities to utilize exercise as a therapeutic modality to improve numerous outcomes in cancer survivors. Also, more than 60% of cancer survivors are ≥65 yr. and will often have other pre-existing health conditions, such as CVD, T2DM, arthritis, and obesity. The combined result of cancer-related side effects, aging, and other health conditions often manifest as impaired cardiovascular fitness, functional limitations, and reduced quality of life in cancer survivors. Therefore, promoting exercise without creating unnecessary barriers to participation is of critical importance in cancer survivors. Exercise is safe for almost everyone, including most cancer survivors, and the health benefits of exercise outweigh the risks for most people (67).

Preparticipation Evaluation

Pre-exercise Assessments

Given the known benefits of exercise in cancer survivors and the current low adherence to exercise guidelines, it is important to not create barriers to exercise. Given the low absolute risk of serious adverse events that occur with exercise, most screening methods in asymptomatic individuals will produce high false positive rates. However, cancer survivors often experience a variety of acute, chronic, and late side effects from cancer and its treatments that may influence the approach to exercise testing and prescription. A pre-exercise assessment based on self-reported instruments such as the Physical Activity Readiness Questionnaire for Everyone (PAR-Q+) can identify cancer survivors with overt cardiopulmonary symptoms (e.g., chest discomfort at rest) who may benefit from a medical evaluation or exercise testing prior to engaging in moderate-to-vigorous intensity exercise. Health/fitness professionals can administer a brief cancer history and symptom inventory to inform

the design of the exercise prescription along with knowing the recommended pre-exercise assessments specific to individuals with cancer (**Figure 1**).

Sample Cancer History Questions

- What kind of cancer?
- Whether the individual is currently receiving cancer treatment (and if so, what agents)?
- Whether the cancer was removed or is still present?
- If the individual has any symptoms or side effects attributed to cancer treatment? Including:
- Neuropathy
- Lymphedema
- Ostomy
- Bone metastases
- Any other symptom the individual believes may influence their ability to exercise

Medical Assessment and Exercise Testing

The ACSM preparticipation screening algorithm can be used to determine whether exercise testing is needed for cancer survivors prior to participation in moderate-to-vigorous intensity exercise. As described earlier, exercise testing is not required for preparticipation assessment for most cancer survivors, and the 2019 American College of Sports Medicine Roundtable on Exercise Guidelines for Cancer Survivors concluded that exercise testing is not required before walking, resistance, or flexibility activities. Specific cancer survivor populations for whom medical evaluation and/or exercise testing should be considered include those with metastatic disease, those with persistent and significant cancer treatment-related side effects, or those with significant comorbidities. Given the lack of precision regarding the definition of “significant” side effects and comorbidities, collaboration between health fitness professionals and the oncology team and/or primary care provider is strongly encouraged. In addition, a pre-exercise medical assessment is suggested (**Table 1**).

There is no evidence that the level of medical supervision required for symptom-limited or maximal exercise testing needs to be different for cancer survivors than for other populations. Exercise testing techniques and contraindications for the general population are appropriate for cancer survivors, with the following cancer-specific considerations:

- **Arm morbidity and lymphedema**: Cancer survivors with arm or shoulder morbidity that makes it unsafe or not possible for resistance exercise testing should be referred to physical therapy for rehabilitation. Resistance exercise with one repetition maximum testing is safe among breast cancer survivors with and at-risk for upper extremity lymphedema.

- **Bone metastases**: Cancer survivors with bone metastases are at an increased risk of skeletal fracture, spinal compression, and exacerbation of bone pain. Selected modalities for exercise testing should avoid direct musculoskeletal loading to metastatic lesions or loading of muscles that are proximal to metastatic lesions.

- **Neuropathy**: Cancer survivors with peripheral neuropathy may have instability, balance difficulty, and altered gait biomechanics that increase the risk of falls. Assessment of stability, balance, and gait biomechanics may be useful to refi ne selection of exercise testing modality (e.g., stationary cycle vs. treadmill).

- **Ostomy**: During resistance exercise testing, survivors should be reminded to avoid inducing excessive intra-abdominal pressure (e.g., Valsalva manoeuvre). There is no empirical evidence to support this recommendation, and it is based on expert opinion.

PHYSICAL ACTIVITY ASSESSMENT

Ask about prior and current participation in physical activity and assess level of current physical activity at regular intervals

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Focused clinical evaluation
- Weight/BMI
- Blood pressure
- History of anemia (consider CBC)
- Functional status/performance status
- Assess baseline level of activity prior to diagnosis and current level of activity
- Barriers to physical activity as assessed by survivor
  - Environmental (home, gym, access, outdoor space)
  - Financial
  - Physical limits
  - Time/competing demands
  - Social support
  - Stress
- Review of systems
- Disease status

Assessment of treatable contributing factors
- Pain
- Fatigue
- Emotional distress
- Nutritional deficits/imbalance
- Medications

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Assessment of comorbidities and treatment effects as appropriate:
- Cardiovascular disease (including cardiomyopathy)
- Pulmonary disease
- Arthritis/musculoskeletal issues
- Lymphedema
- Peripheral neuropathy
- Bone health/bone strength (including presence of bone metastases)
- Incontinence
- Presence of stoma or ostomy
- Fall risk assessment
- Need for assistive devices (cane, walker, brace, etc)
- History or presence of anemia/thrombocytopenia
- Steroid myopathy

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Determine risk level for exercise-induced adverse event

Table 1. Pre-exercise Medical Assessments for Individuals with Cancer						
Cancer Site	**Breast**	**Prostate**	**Colon**	**Adult Hematologic (No HSCT)**	**Adult (HSCT)**	**Gynaecologic**
General medical assessments recommended prior to exercise	Recommend evaluation for peripheral neuropathies and musculoskeletal morbidities secondary to treatment regardless of time since treatment. If there has been hormonal therapy, recommend evaluation of fracture risk. Individuals with known metastatic disease to the bone will require evaluation to discern what is safe prior to starting exercise. Individuals with known cardiac conditions (secondary to cancer or not) require medical assessment of the safety of exercise prior to starting. There is always a risk that metastasis to the bone or cardiac toxicity secondary to cancer treatments will be undetected. This risk will vary widely across the population of survivors. Fitness professionals may want to consult with the patient's medical team to discern this likelihood. However, requiring medical assessment for metastatic disease and cardiotoxicity for all survivors prior to exercise is not recommended, as this would create an unnecessary barrier to obtaining the well-established health benefits of exercise for most survivors, for whom metastasis and cardiotoxicity are unlikely to occur.					
Cancer site specific medical assessments recommended prior to starting an exercise program	Recommend evaluation for arm/shoulder morbidity prior to upper body exercise	Evaluation of muscle strength & wasting.	Patient should be evaluated as having established consistent and proactive infection prevention behaviours for an existing ostomy prior to engaging in exercise training more vigorous than a walking program	None	None	Patients with morbid obesity may require additional medical assessment for the safety of activity beyond cancer-specific risk. Recommend evaluation for lower extremity lymphedema prior to vigorous aerobic exercise or resistance training.
HSCT, hematopoietic stem cell transplantation.						

Exercise Prescription

General Recommendations

The 2018 Physical Activity Guidelines for Americans forms the basis from which adaptations are made for cancer survivors. Important recommendations from these guidelines that are applicable to cancer survivors include avoiding inactivity, accumulating at least 150–300 min · wk. -1 of moderate intensity, or 75–150 min · wk. -1 of vigorous intensity aerobic exercise when possible, engaging in resistance exercise on 2 or more days each week, and integrating balance and flexibility exercises on days that aerobic and resistance exercises are performed. Multiple organizations including ACSM, American Cancer Society, and the National Comprehensive Cancer Network have endorsed similar guidelines for exercise programming in cancer survivors. As part of the general recommendations for exercise testing and prescription, the fitness professionals should understand the relevant contraindications (**Table 2**).

Table 2. FITT Recommendations for Cancer Survivors.

	Aerobic	**Resistance**	**Flexibility**
Frequency	3–5 d · wk−1	2–3 d · wk−1 with a minimum of 48 h between sessions	2–3 d · wk−1 up to daily
Intensity	40%–<60% V̇O2R or HRR. Survivors may find RPE useful to gauge exercise intensity.	60%–80% 1-RM or allow for 6–15 repetitions. Increase weight as tolerated and when repetitions>15. RPE is correlated with % 1-RM in cancer survivors (83).	Stretch within limits of pain to the point of tightness or slight discomfort
Time	≥30 min · d−1. No lower limit on bout length. During treatment, exercise length may need to be modified due to chemotherapy or radiation- related toxicities.	≥1 set, ≥8 repetitions per set; ≥60 s rest between sets	Hold each stretch for 10–30 s.
Type	Walking, cycling, swimming. Swimming should not be prescribed for survivors with central lines, those with ostomies, those in an immunocompromised state or who are currently receiving radiation therapy.	8–10 exercises of major muscle groups; machines or free weights	Static stretches (passive and/or active), for all major muscle tendon groups. Tai chi and yoga may be preferred.
1-RM, one repetition maximum; HRR, heart rate reserve; RPE, rating of perceived exertion; V̇O2R, oxygen uptake reserve			

FITT Principle

Exercise training is safe during and after cancer treatment, and cancer survivors should avoid physical inactivity and engage in exercise on a regular basis. Health fitness professionals may wish to implement these recommendations sequentially, first prescribing a small volume of activity, then incrementally increasing the frequency, intensity, and time of exercise, as tolerated. In addition to the ACSM guidelines, the U.S. Department of Health and Human Services publishes exercise guideline alterations needed for cancer survivors (**Table 3**). Ex Rx for the general population are appropriate for cancer survivors, with the following cancer-specific considerations:

Arm morbidity and upper extremity lymphedema: Survivors with established upper extremity lymphedema should wear a compression garment during resistance exercise, progress weight slowly, and should consider working with a certified health fitness professional. There is no upper limit on the amount that breast cancer survivors with or at risk for lymphedema can lift. The safety of exercise for lower extremity lymphedema remains unknown.

Bone metastases: Selected modalities for exercise should avoid direct musculoskeletal loading to metastatic lesions or loading of muscles that are proximal to metastatic lesions. Bone pain should be monitored during and after exercise. If bone pain worsens, exercise should be ceased; if pain does not improve with cessation of exercise, referral to medical provider is encouraged.

Neuropathy: Systematic assessment of falls may be informative in older cancer survivors or those with a history of falls and/or significant neuropathy of the lower extremities. Weight-bearing activities should be carefully selected to reduce risk of falls. Neuropathy symptoms should be monitored during and after exercise. If neuropathy worsens, exercise should be ceased or alternative exercises considered; if neuropathy symptoms do not improve with cessation of exercise, referral to medical provider is encouraged.

Ostomy: Cancer survivors with an ostomy should adhere to infection risk reduction practices. Resistance exercise should start with low resistance and progress slowly.

Avoid contact sports and exercises that cause excessive intra-abdominal pressure (e.g., Valsalva manoeuvre). There is no empirical evidence to support this recommendation, and it is based on expert opinion.

Among all cancer survivors, the presence of ataxia, severe fatigue, significant anaemia, profound weakness, or any other worsening or changing physical condition that may make it unsafe to exercise should be referred to medical providers for care. To date, there are no established recommendations regarding the supervision of exercise across the continuum of survivorship or in various exercise settings. Health fitness professionals should use prudent judgment in deciding the level of exercise supervision as needed on an individual basis.

Table 2. Contraindications for Starting Exercise, Stopping Exercise, and Injury Risk for Cancer Survivors.						
	Breast	**Prostate**	**Colon**	**Adult Hematologic (No HSCT)**	**Adult (HSCT)**	**Gynaecologic**
General contraindications for starting an exercise program common across all cancer sites	Allow adequate time to heal after surgery. The number of weeks required for surgical recovery may be as high as 8. Do not exercise individuals who are experiencing fever, extreme fatigue, significant anaemia, or ataxia. Follow ACSM Guidelines for exercise prescription about cardiovascular and pulmonary contraindications for starting an exercise program. However, the potential for an adverse cardiopulmonary event might be higher among cancer survivors than age matched comparisons given the toxicity of radiotherapy and chemotherapy and long term/late effects of cancer surgery.					
Cancer specific contraindications for starting an exercise program	The arms/shoulders should be exercised, but proactive injury prevention approaches are encouraged, given the high incidence of arm/ shoulder morbidity in breast cancer survivors. Women with lymphedema should wear a well-fitting compression garment during exercise. Be aware of risk for fracture among those treated with hormonal therapy, a diagnosis of osteoporosis, or bony metastases.	Be aware of risk for fracture among patients treated with ADT, a diagnosis of osteoporosis	Advisable to avoid excessive intraabdominal pressures for patients with an ostomy.	Multiple myeloma patients should be treated as if they are osteoporotic.	None	The lower body should be exercised, but proactive injury prevention approaches are encouraged, given the potential for lower extremity swelling or inflammation in this population. Women with lymphedema should wear a well- fitting compression garment during exercise. Be aware of risk for fractures among those treated with hormonal therapies, with diagnosed osteoporosis, or with bony metastases.
ACSM, American College of Sports Medicine; ADT, androgen deprivation therapy; HSCT, hematopoietic stem cell transplantation.						

Table 3. Contraindications for Starting Exercise, Stopping Exercise, and Injury Risk for Cancer Survivors.						
	Breast	**Prostate**	**Colon**	**Adult Hematologic (No HSCT)**	**Adult (HSCT)**	**Gynaecologic**
General Statement	Avoid inactivity, return to normal daily activities as quickly as possible after surgery. Continue normal daily activities and exercise as much as possible during and after non-surgical treatments. Individuals with known metastatic bone disease will require modifications to avoid fractures. Individuals with cardiac conditions (secondary to cancer or not) may require modifications and may require greater supervision for safety.					
Aerobic exercise training (volume, intensity, progression)	Recommendations are the same as age-appropriate guidelines from the PAGs for Americans.				Ok to exercise every day, lighter intensity and lower progression of intensity recommended.	Recommendations are the same as age-appropriate guidelines from the PAGs for Americans. Women with morbid obesity may require additional supervision and altered programming.
Cancer specific contraindications for starting an exercise program	Be aware of fracture risk.	Be aware of increased potential for fracture	Physician permission recommended for patients with an ostomy prior to participation in contact sports (risk of blow).	None	Care should be taken to avoiding overtraining given immune effects of vigorous exercise.	If peripheral neuropathy is present, a stationary bike might be preferable overweight bearing exercise
Cancer site specific comments on resistance training prescription	Altered recommendations. See below.	Recommendations same as age appropriate PAGs.	Altered recommendations. See below.	Recommendations same as age appropriate PAGs.		Altered recommendations. See below.
Cancer site specific comments on	Start with a supervised program of at least 16	Add pelvic floor exercises for those who	Recommendations same as age-appropriate PAGs.	None	Resistance training might be more	There is no data on the safety of resistance training in women with

resistance training prescription	sessions and very low resistance, progress resistance at small increments. No upper limit on the amount of weight to which survivors can progress. Watch for arm/shoulder symptoms, including lymphedema, and reduce resistance or stop specific exercises according to symptom response. If a break is taken, lower the level of resistance by 2 wk worth for every wk of no exercise (e.g., a 2 wk exercise vacation = lower to the resistance used 4 wk ago). Be aware of risk for fracture in this population.	undergo radical prostatectomy. Be aware of risk for fracture.	For patients with a stoma, start with low resistance and progress resistance slowly to avoid herniation at the stoma		important than aerobic exercise in BMT patients. See text for further discussion on this point.	lower limb lymphedema secondary to gynecologic cancer. This condition is very complex to manage. It may not be possible to extrapolate from the findings on upper limb lymphedema. Proceed with caution if the patient has had lymph node removal and/or radiation to lymph nodes in the groin.
Flexibility training (volume, intensity, progression)	Recommendations are the same as age appropriate PAGs for Americans		Recommendations same as age appropriate PAGs, with care to avoid excessive intraabdominal pressure for patients with ostomies.	Recommendations are the same as age appropriate PAGs for Americans.		
Exercises with special	Yoga appears safe as long as arm and	Research gap.	If an ostomy is present,	Research gap.	Research gap.	Research gap.

considerations (e.g., yoga, organized sports, and Pilates)	shoulder morbidities are taken into consideration. Dragon boat racing not empirically tested, but the volume of participants provides face validity of safety for this activity. No evidence on organized sport or Pilates.		modifications will be needed for swimming or contact sports. Research gap			
BMT, bone marrow transplantation; HSCT, hematopoietic stem cell transplantation; U.S. DHHS, U.S. Department of Health and Human Services.						

Summary

- All cancer survivors should be encouraged to avoid inactivity and be as physically active as possible.

- Exercise is generally safe for cancer survivors during and after cancer treatment.

- General exercise program for most* cancer survivors:

    - At least 150 min · wk-1 of moderate intensity or 75 min · wk-1 of vigorous intensity or an equivalent combination of moderate and vigorous intensity aerobic activity. Preferably, aerobic activity should be spread throughout the week.

    - Resistance training activities of moderate-to-vigorous intensity and that involve all major muscle groups on 2 or more days a week, as these activities provide additional health benefits.

    - Stretch major muscle groups and engage in balance and neuromuscular activities on as many days as tolerable.

- Exercise may be tailored to minimize risk of adverse events and maximize likelihood of desired health outcome. Tailoring should incorporate an individual's abilities, preferences, pre-existing health conditions, and treatment-related side effects.

- Symptom response may be used to guide to the exercise program. Starting at light intensity and progressing slowly may reduce the risk of symptom exacerbation. The mnemonic, start low and progress slow, may be useful for survivors.

- For individuals undergoing active cancer treatment and those living with metastatic cancer, health fitness professional collaboration with oncology providers may be able to offer information that is useful to tailor the exercise program.

*Cancer survivors for whom the exercise program may be individualized include those with metastatic disease, persistent and significant cancer treatment-related side effects, or significant comorbidities.