Effects of a Community-Based Exercise Training Program on Cardiovascular Health in Breast Cancer Survivors

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EXSS
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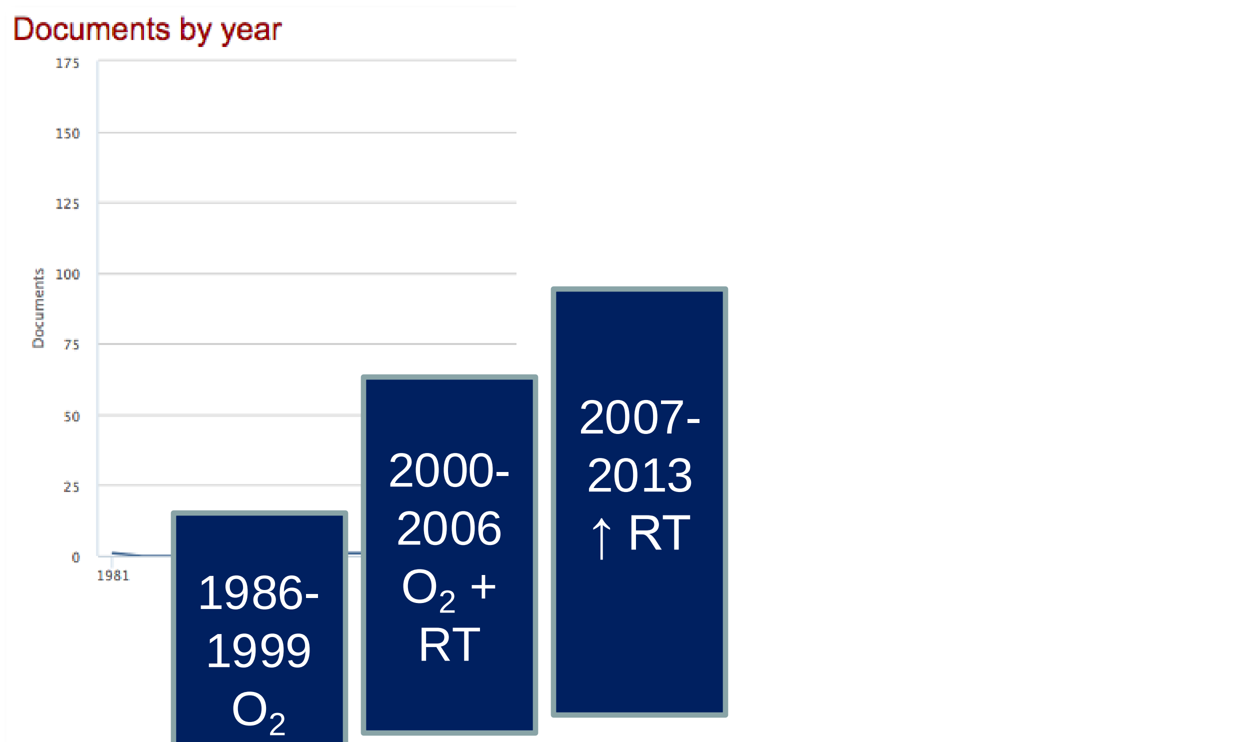
Talk Outline

- Brief Overview of Exercise Oncology
- UNC Get REAL & HEEL Breast Cancer Rehabilitation Program
- UNC Get REAL & HEEL Research Study (Cardiovascular Outcomes)
- Recommendations for Future Research

Exercise Oncology Through the Years

# of Exercise Oncology Publications



1986-1999 O_2

2000-2006 O_2 + RT

2007-2013 ↑ RT

Exercise Oncology Through the Years

Twenty-Five Years of Research on the Effects of Exercise Training in Breast Cancer Survivors: **Battaglini C.L.**, et. al., 2014, *World J Clin Oncol*

"…based on the current data available in this area, exercise training appears to be *safe* for most patients and *improvements* in physiological, psychological, and functional parameters can be attained with *regular participation in moderate intensity exercise*"


WJCO World Journal of Clinical Oncology

World J Clin Oncol 2014 May 10; 5(2): 177-190
ISSN 2218-4333 (online)

RETROSPECTIVE STUDY

Twenty-five years of research on the effects of exercise training in breast cancer survivors: A systematic review of the literature

Claudio L Battaglini, Robert C Mills, Brett L Phillips, Jordan T Lee, Christina E Story, Marcelo GB Nascimento, Anthony Carl Hackney

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Author contributions: Battaglini CL, Mills RC, Phillips BL, Lee JT, Story CE, Nascimento MGB and Hackney AC contributed to the manuscript.
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Received: January 2, 2014 Revised: January 29, 2014
Accepted: April 17, 2014
Published online: May 10, 2014

Abstract

AIM: To investigate the role of exercise training the past 25 years on major physiological-psychological outcomes studied thus far in this patient population.

METHODS: PubMed, MedlinePlus, the Cochrane Library, Web of Science, SportDiscus, Embase, Scorpus, and Google Scholar were searched from September to November 2013 to identify exercise training studies that used objective measurements of fitness and/or patient reported outcomes assessed pre and post-exercise training with statistical analyses performed in at least one of the following outcome measurements: Cardiorespiratory function, body composition, muscular strength, fatigue, depression, and overall quality of life. Five reviewers independently identified the studies that met the criteria for the review and discrepancies were resolved by consensus among all authors.

RESULTS: Fifty-one studies were included in this review with 5 from the period between 1989-1999, 11 from 2000-2006, and 35 from 2007-2013. The evolution of study designs changed from aerobic only exercise training interventions (1989-1999), to a combination of aerobic and resistance training (2000-2006), to studies including an arm of resistance training or examining the effects of resistance training as the main mode of exercise (2007-2013). Overall, the benefits of exercise showed improvements in cardiorespiratory function, body composition, strength, and patient reported outcomes including fatigue, depression, and quality of life.

CONCLUSION: Exercise training appears to be safe for most breast cancer patients and improvements in physiological, psychological, and functional parameters can be attained with regular participation in moderate intensity exercise.

Key words: Breast cancer; Exercise training; Complementary Alternative Medicine; Oncology; VO; Patients reported outcomes

Core tip: The purpose of this systematic literature review was to investigate the role of exercise training the past 25 years on major physiological-psychological outcomes studied thus far in this patient population. Exer-

The Independent Effects of Strength Training in Cancer Survivors: A Systematic Review: Hanson, E., Wagoner, C., Anderson, T., **Battaglini, C.L.** 2016, *Curr Oncol Rep*

Systematic review investigating *resistance training* outcomes across various cancer survivor populations

Resistance Training Outcomes	
Overall Muscular Strength	+ 25 – 50%
Physical Function	+ 7 – 38%


Curr Oncol Rep (2016) 18:31
DOI 10.1007/s11912-016-0511-3

INTEGRATIVE CARE (C LAMMERSFELD, SECTION EDITOR)

The Independent Effects of Strength Training in Cancer Survivors: a Systematic Review

Erik D. Hanson[1] · Chad W. Wagoner[1] · Travis Anderson[1] · Claudio L. Battaglini[1]

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Abstract Cancer treatment is associated with adverse changes in strength, body composition, physical function, and quality of life. Exercise training reduces cancer incidence and mortality rates and may offset some of the treatment-related effects. To determine the independent effects of strength training (ST) on the effects of cancer treatment, an initial search was performed in March and then updated in November 2015. Additional articles were identified by scanning references from relevant articles. Studies using traditional ST on strength, body composition, aerobic capacity, functional assessments, and psychosocial parameters were included. Excluded studies had no objective strength measurement or combined ST with additional exercise. Mean and standard deviations from 39 studies across seven cancer types were extracted for main outcomes. ST-induced change scores with 95 % confidence intervals were calculated and were evaluated with paired t tests, where appropriate. Twenty to fifty percent improvements in maximal strength were observed, indicating that the ST programs were effective. Physical function was also enhanced (7–38 %), although gains were less consistent. Body composition and psychosocial changes were rare, with only a few changes in selected cancer types. As such, ST appears to promote benefits that may be specific to cancer types. Strength was the only consistent outcome that improved in all cancer survivors. However, these gains in strength are still of tremendous importance, given its impact on functionality and quality of life. Several practical considerations for exercise testing, training, and data reporting are presented for consideration to improve the overall depth of the field.

Keywords Resistance training · Cancer · Exercise · Strength · Body composition · Quality of life

This article is part of the Topical Collection on *Integrative Care*

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Introduction

Cancer incidence rates in the USA rose steadily until the mid-1990s before plateauing, and available data from the most recent 5 years are showing signs of decline for certain cancers [1]. However, recent estimates suggest there are nearly 14.5 million cancer survivors and this number is expected to grow by another 4 million over the next 10 years [2] with treatment-related costs that exceed 75 billion dollars annually [3]. In 2015 alone, 1.7 million new cases were anticipated to be diagnosed with ~600,000 cancer-related deaths, although mortality rates have started to improve [1]. The decrease in mortality may be the result of early detection and treatment, improved treatment protocols, and lower smoking rates.

Cancer treatments may include surgery, radiation, chemotherapy, immunotherapy, and hormone therapies that effectively reduce tumor burden, as 5-year survival rates have increased regularly since the 1970s [1]. However, simply living longer poses many challenges for survivors, as numerous side effects persist during and after treatment with the most common ones including debilitating fatigue and reduced quality of life (QoL) [4, 5]. Additionally, treatment-related effects that alter muscle strength and body composition (either directly or indirectly via physical inactivity) promote loss of physical function, which further exacerbates fatigue and QoL [4]. Interestingly, many of these side effects are similar to those

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Springer

Cardio-Oncology

Effects of Exercise Training on Peak Oxygen Consumption in Patients with Cancer: A Meta-Analysis, 2011, *The Oncologist*

The Oncologist
Symptom Management and Supportive Care

Effect of Exercise Training on Peak Oxygen Consumption in Patients with Cancer: A Meta-Analysis

Lee W. Jones,[a] Yuanyuan Liang,[b] Edith N. Pituskin,[c] Claudio L. Battaglini,[d] Jessica M. Scott,[e] Whitney E. Hornsby,[a] Mark Haykowsky[c]

[a]Duke University Medical Center, Durham, North Carolina, USA; [b]University of Texas Health Science Center at San Antonio, San Antonio, Texas, USA; [c]University of Alberta, Edmonton, Alberta, Canada; [d]University of North Carolina at Chapel Hill, Chapel Hill, North Carolina, USA; [e]NASA Johnson Space Center, Houston, Texas, USA

Key Words. Aerobic training • Resistance training • Peak oxygen consumption • Aerobic capacity • Randomized controlled trials

Disclosures: Lee W. Jones: None; **Yuanyuan Liang:** None; **Edith N. Pituskin:** None; **Claudio L. Battaglini:** None; **Jessica M. Scott:** None; **Whitney E. Hornsby:** None; **Mark Haykowsky:** None.

The content of this article has been reviewed by independent peer reviewers to ensure that it is balanced, objective, and free from commercial bias. No financial relationships relevant to the content of this article have been disclosed by the authors or independent peer reviewers.

Abstract

Background. **We conducted a meta-analysis to determine the effects of supervised exercise training on peak oxygen consumption (VO_{2peak}) in adults with cancer.**

Methods. **A literature review using Ovid MEDLINE (1950–2010), the Cochrane Central Register of Controlled Trials (1991–2010), AMED (1985–2010), Embase (1988–2010), PubMed (1966–2010), Scopus (1950–2010), and Web of Science (1950–2010) was performed to identify randomized controlled trials examining the effects of supervised exercise training on measurement of VO_{2peak} (via gas exchange analysis) in adults with cancer. Studies were selected using predetermined criteria, and two independent reviewers extracted data. Weighted mean differences (WMDs) were calculated using random effect models.**

Results. **Six studies evaluated VO_{2peak} involving a total of 571 adult cancer patients (exercise, $n = 344$; usual care control, $n = 227$). Pooled data indicated that exercise training was associated with a statistically significant increase in VO_{2peak} (WMD, 2.90 ml·kg^{-1}·min^{-1}; 95% confidence interval [CI], 1.16–4.64); however, significant heterogeneity was evident in this estimate (I^2, 87%). Usual care (control) was associated with a significant decline in VO_{2peak} from baseline to postintervention (WMD, −1.02 ml·kg^{-1}·min^{-1}; 95% CI, −1.46 to −0.58; I^2, 22%). Sensitivity analyses indicated superior improvements in VO_{2peak} for studies conducted for a shorter duration (<4 months) and following the completion of adjuvant therapy (p-values < .001). Exercise training was not associated with a higher incidence of adverse events, although safety was not rigorously monitored or reported.**

Conclusions. **Supervised exercise training is associated with significant improvements in VO_{2peak} following a diagnosis of early-stage cancer, with minimal adverse events.** *The Oncologist* 2011;16:112–120

Clearly, more studies are required to inform such guidelines, but simply increasing the absolute number will not address the current limitations. Instead, in order to advance the field, it is critical that the next generation of studies logically build on and extend current scientific knowledge in homogeneous patient populations/settings applying rigorous RCT methodology.

Limited evidence is currently available to suggest that the exercise VO_{2peak} relationship is different based on exercise intervention or clinical patient characteristics.

Bottom Line

Exercise maintains and/or improves physical performance

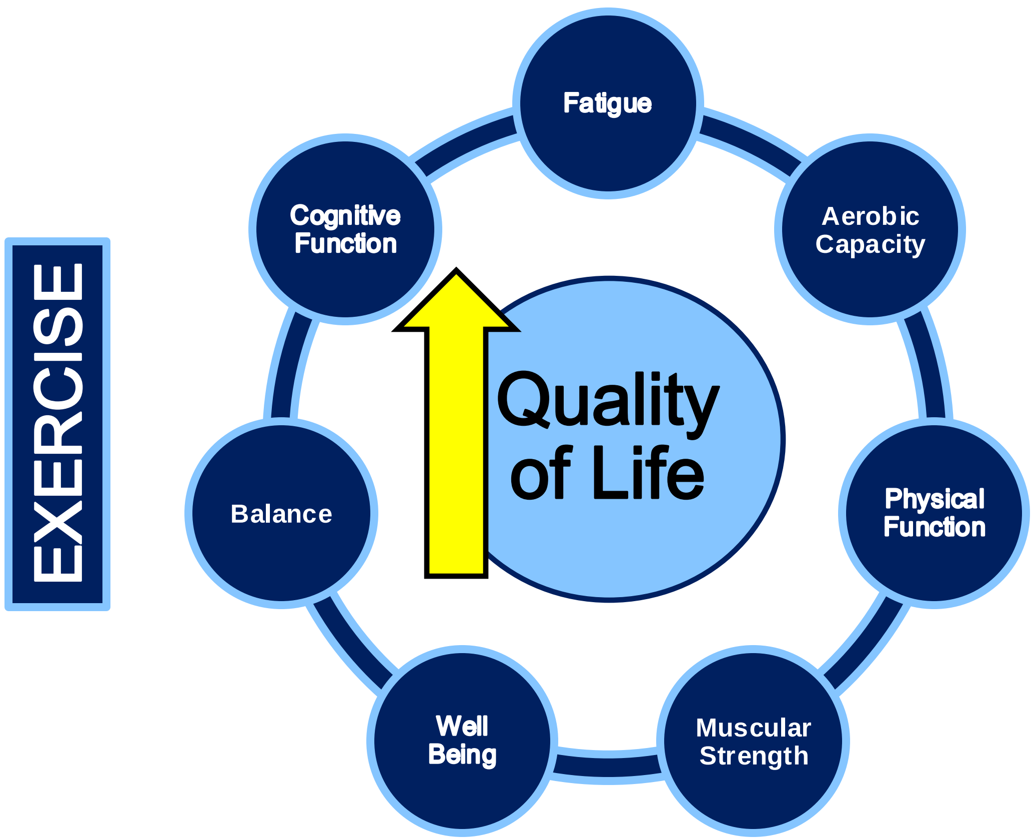
- Aerobic
- Strength
- Combined

UNC Get REAL & HEEL Breast Cancer Rehabilitation Program

Supported by:

- Petro Kulynych Foundation
- The Cannon Foundation of Concord NC
- LCCC Comprehensive Care Support Program
- Le Tour de Carrboro Cardinal Running Club
- Golf for the Pink @ The Governor’s Club

Get REAL and HEEL's ***Purpose***



Get REAL and HEEL Program

2006

15 Patients

2017

~ 100 patients / week

To date

Over 2000 patients served

Structured Group Exercise

16 Weeks of Structured Group Exercise

Monday
1 Hour

Wednesday
1 Hour

Thursday
1 Hour

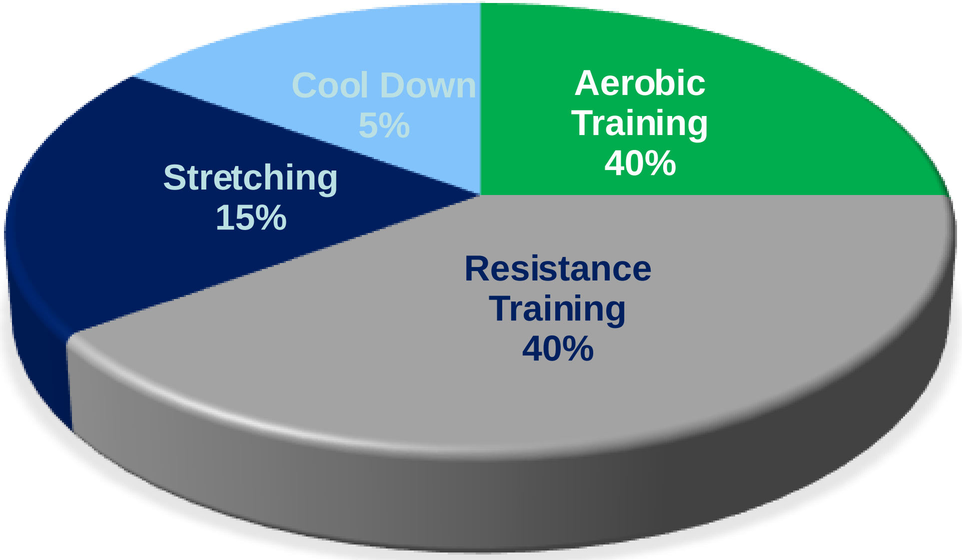
Combination of aerobic exercise and resistance training

7am – 1pm
3:30pm – 8:30pm

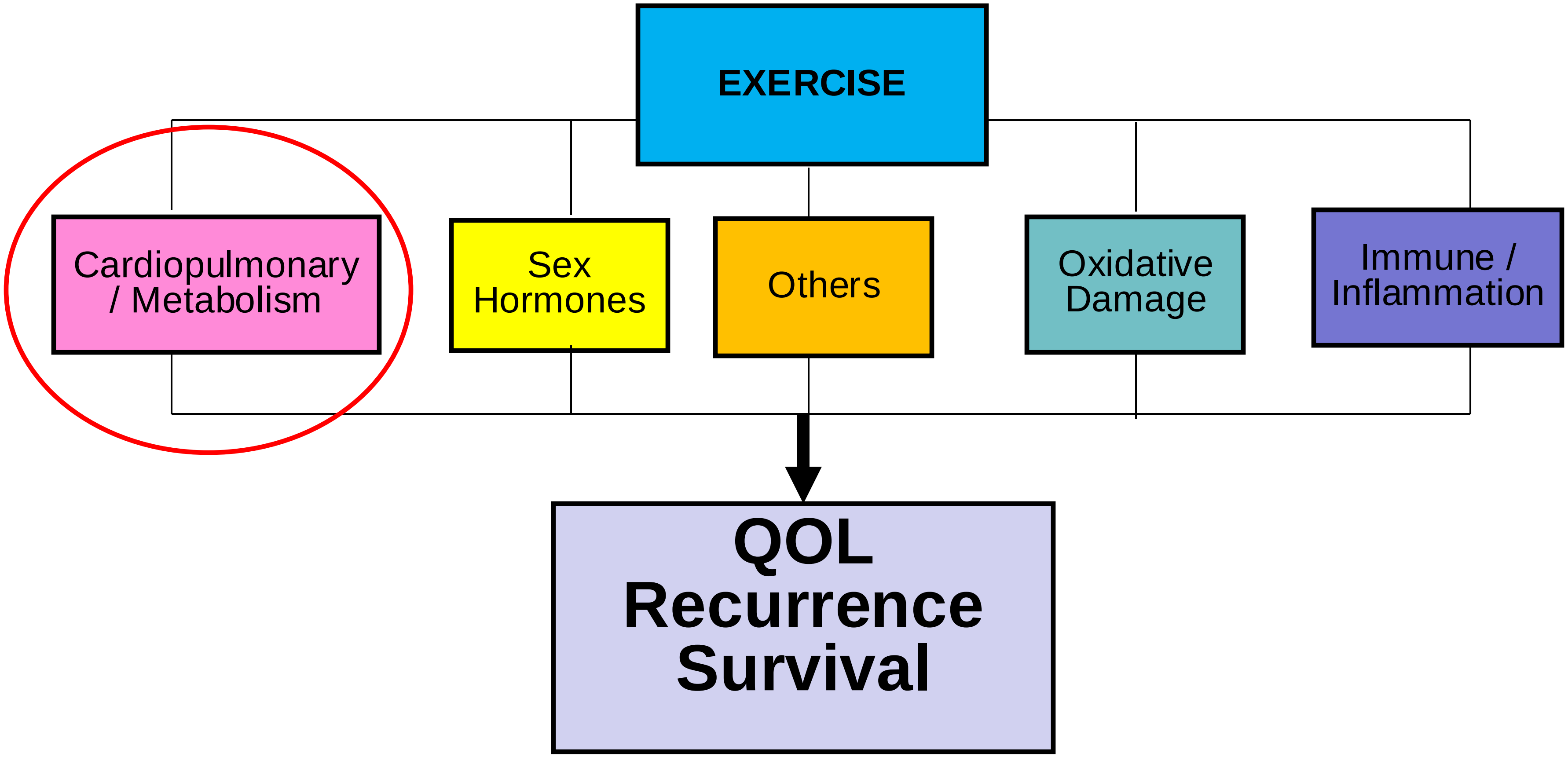
Exercise Prescription: Typical Session

Exercise Session Example

1. Resting Vitals
2. Aerobic Exercise
3. Stretching (whole body)
4. Weight Training
5. Cool Down (Stretches & Relaxation)



Exercise and Survival After a Cancer Diagnosis: Biological Mechanisms



Get REAL & Heel Breast Cancer Research Program

Integrative Cancer Therapies
Volume XX Number X
Month XXXX xx-xx
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Aerobic Exercise Intensit... Cancer Patients: A Prelin... Investigation

Elizabeth S. Evans, MA, Claudio L. Battaglini, F...
Diane G. Groff, EdD, and A. C. Hackney, PhD, ...

Purpose: This study compared the heart rate (HR), rat... perceived exertion (RPE), and blood lactate (BL) respo... to aerobic exercise between posttreated breast ca... patients and apparently healthy, age-matched contr...

Integrative Cancer Therapies
XX(X) 1–10
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DOI: 10.1177/1534735410387600
http://ict.sagepub.com
SAGE

Exercise in Patients With Breast Cancer and Healthy Controls: Energy Substrate Oxidation and Blood Lactate Responses

Karen P. Tosti, MA[1], Anthony C. Hackney, ...
Claudio L. Battaglini, PhD[1], Elizabeth S. Ev...
and Diane Groff, EdD[1]

Abstract
The aim of this study was to compare select aspects of ex... with that of healthy controls across a variety of exercise... matched with healthy women based on age, physical fitne...

The Oncologist
Symptom Management and Supportive Care

Effect of Exercise Training on Peak Oxygen Consumption in Patients with Cancer: A Meta-Analysis

Lee W. Jones,[a] Yuanyuan Liang,[b] Edith N. Pituskin,[c] Claudio L. Battaglini,[d] Jessica M. Scott,[e] Whitney E. Hornsby,[a] Mark Haykowsky[c]

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Center at San Antonio, San Antonio, Tex...
[d]University of North Carolina at Chapel H...
Cent...

Key Words. Aerobic training • Resista...

Comparison of Body Composition Assessment Methods in Breast Cancer Survivors

Claudio Battaglini, PhD, Fiona Naumann, PhD, AEP, RCEP, MESSA, Diane Groff, EdD, Edgar Shields, PhD, A.C. Hackney, PhD, DSc, and Jeffrey Peppercorn, MD

Accurate and reliable assessment of body composition often is an integral component in the identification of clinically high-risk populations and is used in an attempt to prevent and manage certain chronic diseases (Heyward, 2006). Breast cancer survivors are a clinical population who frequently experience extremely altered body composition (e.g., changes in body fat [BF] percentage, muscle mass, bone mineral density) after diagnosis and treatment. Because of these alterations, it can be beneficial and clinically appropriate for body composition monitoring to be conducted during and after treatment in breast cancer survivors.

Purpose/Objectives: To examine and compare the reliability of four body composition methods commonly used in assessing breast cancer survivors.
Design: Cross-sectional.
Setting: A rehabilitation facility at a university-based comprehensive cancer center in the southeastern United States.
Sample: 14 breast cancer survivors aged 40–71 years.
Methods: Body fat (BF) percentage was estimated via bioelectric impedance analysis (BIA), air displacement plethysmography (ADP), and skinfold thickness (SKF) using both three- and seven-site algorithms, where reliability of the methods was evaluated by conducting two tests for each method (test 1 and test 2), one immediately after the other.

Cardiopulmonary Metabolism

Integrative Cancer Therapies
Volume 8 Number 2
June 2009 130-138

10.1177/1534735409334266
http://ict.sagepub.com

The Effects of an Exercise Program in Leukemia Patients

Claudio L. Battaglini, PhD, A. C. Hackney, PhD, DSc, Rey Garcia, RN, BSN, ONC, Diane Groff, EdD, Elizabeth Evans, MA, and Thomas Shea, MD

Purpose. To examine the feasibility of administering
hospital exercise program to acute leukemia patients
going chemotherapy. A secondary purpose explor
impact of exercise on selected physiological, psycho
and inflammatory markers. *Methods.* Ten patients, a
to 50 years, diagnosed with acute leukemia or newly r
were assessed for body weight, height, body comp
(skinfolds), cardiorespiratory endurance (total minu
bicycle ergometer at 60% heart rate reserve), dynami
cular endurance (Rocky Mountain Cancer Rehabi
Institute protocol), fatigue (Revised Piper Fatigue
depression (Center for Epidemiologic Studies Dep
scale, National Institute of Mental Health question

Bone Marrow Transplantation (2013), 1–8

www.nature.com/bmt

ORIGINAL ARTICLE

Cardiopulmonary fitness in patients undergoing hematopoietic SCT: a pilot study

WA Wood[1], AM Deal[2], BB Reeve[3], AP Abernethy[4], E Basch[1], SA Mitchell[5], C Shatten[1], Y Hie Kim[6], J Whitley[1], JS Serody[1], T Shea[1] and C Battaglini[7]

Hematopoietic cell transplantation (HCT) is a life-saving treatment for patients with
Prognostic measures to determine fitness for HCT are needed to inform decision-ma
measuring gas exchange during cycle ergometry and has not been studied as a progn
allogeneic HCT patients underwent VO_{2peak} and 6 Minute Walk (6MW) testing befor
health-related quality of life (HRQOL) assessments before HCT and concluding at Day
testing. Pre-HCT VO_{2peak} was positively correlated with pre-HCT 6MW ($r = 0.65$, $P < 0.0$
chemotherapy regimens and months of chemotherapy. Patients with lower VO_{2peak}
HRQOL at baseline and during early post-HCT period. Patients with pre-HCT VO_{2peak}
post HCT (entire cohort: hazard ratio (HR) 9.1 (1.75–47.0), $P = 0.01$; allogeneic HCT pa
more hospitalized days before Day 100 (entire cohort: median 33 vs 19, $P = 0.003$; a
$P = 0.004$). VO_{2peak} pre-HCT is feasible and might predict symptom severity, HRQOL a

Bone Marrow Transplantation advance online publication, 15 April 2013; doi:10.1038

Keywords: cardiopulmonary fitness; symptoms; health-related quality of life; hemat

Biol Blood Marrow Transplant xxx (2013) 1–10

Feasibility of Frequent Patient-Reported Outcome Surveillance in Patients Undergoing Hematopoietic Cell Transplantation

ASBMT
American Society for Blood and Marrow Transplantation

William A. Wood [1,*], Allison M. Deal [2], Amy Abernethy [3], Ethan Basch [1], Claudio Battaglini [4], Yoon Hie Kim [5], Julia Whitley [1], Charlotte Shatten [1], Jon Serody [1], Thomas Shea [1], Bryce B. Reeve [1,6]

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Chapel Hill, North Carolina

Research Article

Integrative Cancer Therapies
1–7

DOI: 10.1177/1534735417712009
journals.sagepub.com/home/ict
SAGE

Cancer-Related Fatigue and Muscle Quality in Hodgkin's Lymphoma Survivors

Filipe Dinato de Lima, MSc[1], Martim Bottaro, PhD[1], Ritielli de Oliveira Valeriano, MSc[1], Lorena Cruz, MSc[1], Claudio L. Battaglini, PhD, FACSM[2], Carlos Alexandre Vieira, PhD[3], and Ricardo Jacó de Oliveira, PhD[1]

Abstract
The purpose of this study was to compare fatigue, strength, body composition, muscle thickness, and muscle quality between Hodgkin's lymphoma survivors (HLS) and apparently healthy subjects matched by age, gender, and physical activity levels (CON). Twelve HLS (32.16 ± 8.06) and 36 CON (32.42 ± 7.64) were enrolled in the study. Fatigue was assessed using the 20-item Multidimensional Fatigue Inventory, muscle strength using an isokinetic dynamometer, body composition using dual-energy X-ray absorptiometry, and thickness and muscle quality using B-mode ultrasound. Differences between HLS and CON were analyzed using independent samples *t* tests. No significant differences were observed between groups

Immune / Inflammation

World Journal of Clinical Oncology

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ISSN 2218-4333 (online)

ORIGINAL ARTICLE

Clinical and Translational Research

Impact of community-based exercise program participation on aerobic capacity in women with and without breast cancer

Jordan T Lee, Chad W Wagoner, Stephanie A Sullivan, Dean J Amatuli, Kirsten A Nyrop, Erik D Hanson, Lee Stoner, Brian C Jensen, Hyman B Muss, Claudio L Battaglini

ORCID number: Jordan T Lee 0000-0002-3188-9792; Chad W Wagoner 0000-0002-4930-4238; Stephanie A Sullivan 0000-0001-7534-8616; Dean

Jordan T Lee, Chad W Wagoner, Stephanie A Sullivan, Dean J Amatuli, Erik D Hanson, Lee Stoner, Claudio L Battaglini, Department of Exercise and Sport Science, University of North Carolina at Chapel Hill, Chapel Hill, NC 27599, United States

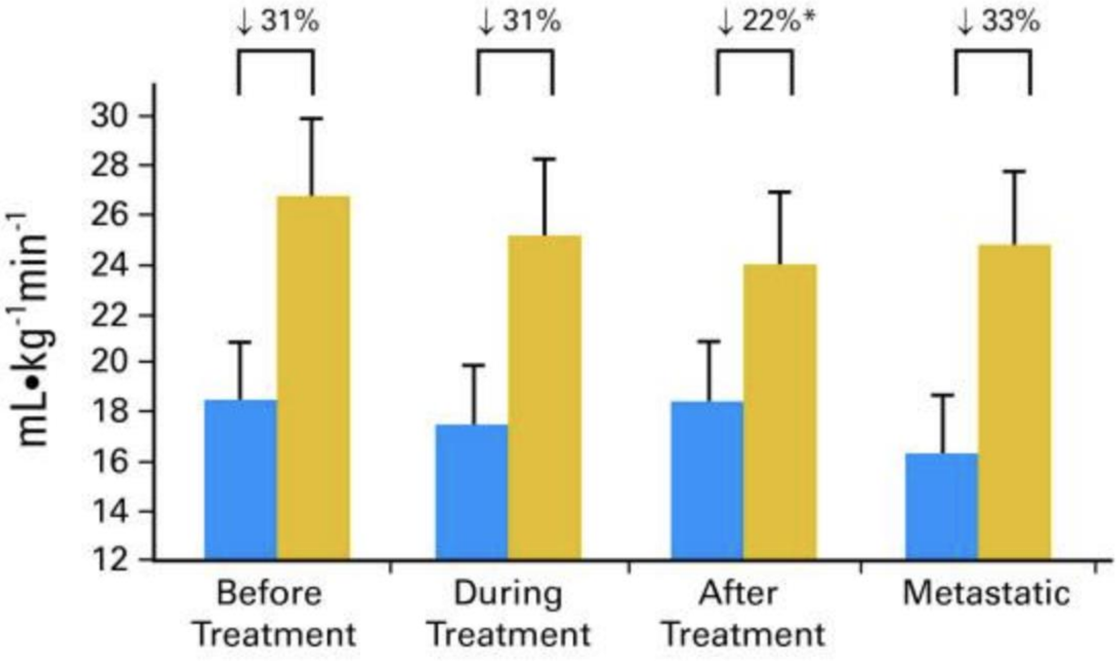
Others

Why aerobic capacity?

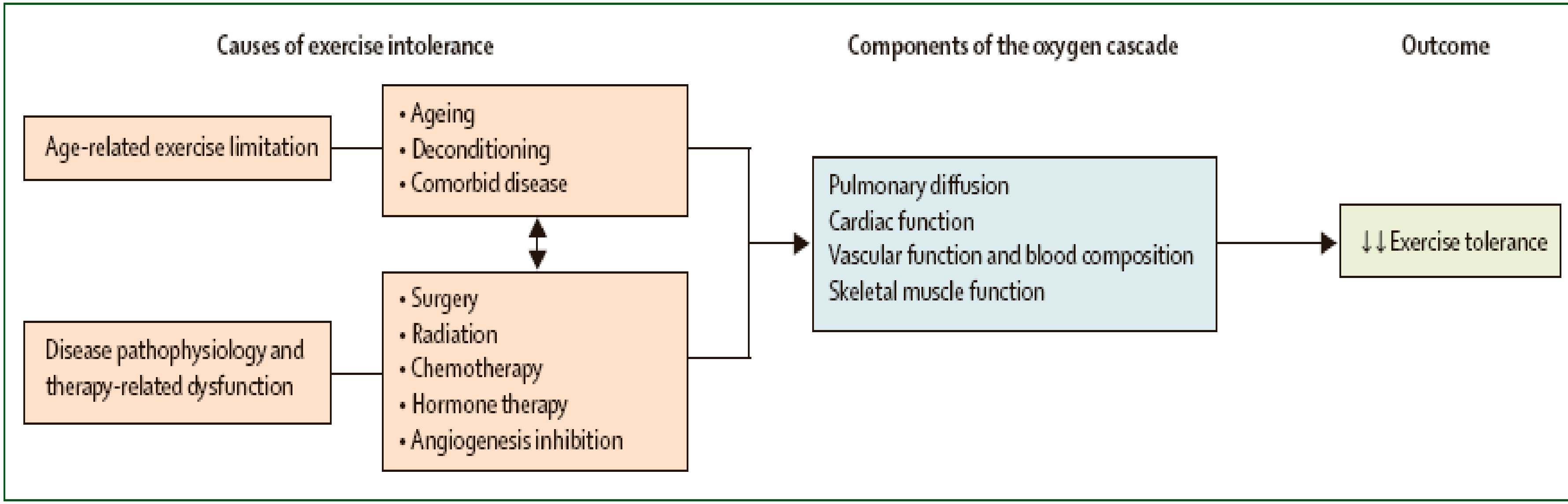
-Significantly reduced (~30%) in cancer patients[6,7]

-Critical impact on:

- Cancer **survival[5,6]**
- Cardiovascular **morbidity[7]**
- All-cause **mortality[7]**
- Independence[7]
- Quality of life[8]



Exercise Tolerance in Persons with Cancer

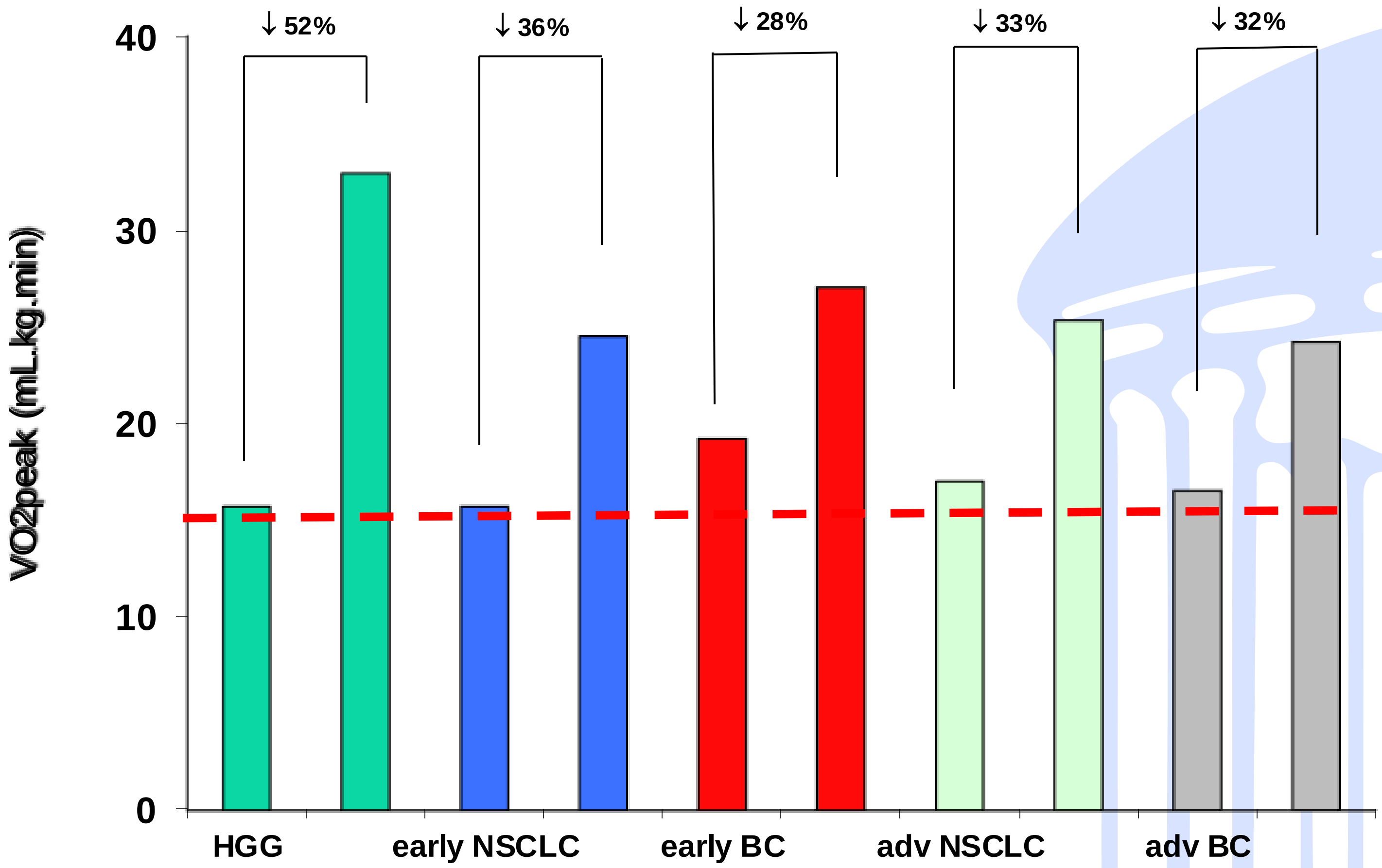


The potential causes of exercise intolerance in persons diagnosed with cancer. In brief, cancer patients are subject to the effects of normal **ageing**, **age-related and/or disease-related comorbid conditions**, and **deconditioning** that adversely impact components of the O_2 cascade leading to reduced exercise tolerance.

These normal consequences are, however, dramatically compounded by the effects of conventional and modern cancer therapies which lead to marked reductions in exercise tolerance predisposing to serious health conditions that may shorten survival.

Jones et al. Lancet Oncology, 2009

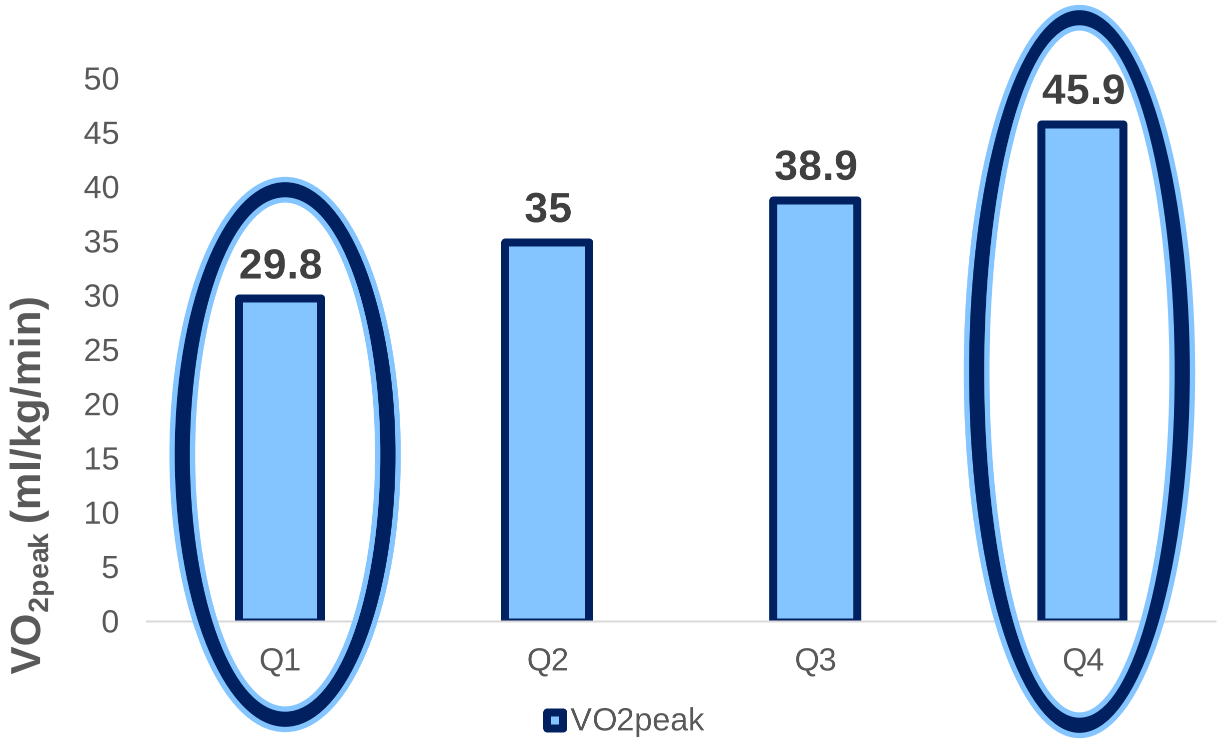
What are Typical Values of $VO2_{peak}$ in Cancer Patients?



Abbreviations: HGG, high grade glioma; age pred, age-predicted VO2peak, NSCLC, non-small cell lung cancer; BC, breast cancer, adv, advanced.

VO2peak levels as measured across several studies. As shown, mean VO2peak levels across the majority of cancer sites are approximately 30% below age-matched <u>sedentary</u> normative values. The only group found to be even lower was patients diagnosed with high grade glioma (primary brain tumors). The red dashed line represents what is considered to be the VO2peak for minimally independent living. As shown, the majority of cancer patients are just above this threshold.

Cardiorespiratory Fitness and Cancer



Greatest fit group (Q4) had a 59% reduced risk of cancer mortality when compared to the lowest fit group (Q1)

Cardiorespiratory Fitness and Cancer Mortality in Japanese Men: A Prospective Study: Sawada et. al, 2003, MSSE

Importance of VO2peak in cancer patients

Variable	VO2peak r	p
Post-Tx LVEF	0.63	<0.001
Resting HR, bpm	– 0.25	0.224
BMI, kg/m^2	– 0.63	<0.001
HDL, mmol/L	0.53	0.007
Fasting insulin, mU/L	– 0.59	0.003
Glucose, mmol/L	–0.64	0.001
QOL	0.59	<0.001
Fatigue	–0.53	0.030

Abbreviations: post-tx, LVEF, post-treatment left ventricular ejection fraction; HR, heart rate; BMI, body mass index; HDL, high density lipoprotein, QOL, quality of life.

This table displays the relationship between VO2peak and various other pertinent outcomes in women diagnosed with breast cancer. As shown, VO2peak is positively associated with LVEF (cardiac function) and QOL whereas VO2peak is inversely correlated with other outcomes. Overall, this data demonstrates that higher VO2peak is associated with more favorable outcomes in breast cancer patients

Spread PA throughout the week

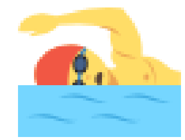
75-150 minutes of vigorous PA

American Cancer Society **PA Guidelines for Cancer Prevention**

Limit Sedentary Time

OR

150-300 minutes of moderate PA



American Cancer Society Guidelines on Nutrition and Physical Activity for Cancer Prevention: Rock et. al., 2020, CA Cancer J Clin

Campbell KL, Winters-Stone KM, Wiskemann J, May AM, Schwartz AL, Courneya KS, et al. Exercise Guidelines for Cancer Survivors: Consensus Statement From International Multidisciplinary Roundtable. Med Sci Sports Exercise (2019) 51(11):2375–90.

UNC Get REAL & HEEL Research Study

Funded by:

BCRF
BREAST CANCER RESEARCH FOUNDATION

Get REAL & HEEL Research Study

Can we measure *how* and *how much* GR&H impacts cancer survivors?

Multidisciplinary Team


Dr. Battaglini


Dr. Muss


Dr. Nyrop


Dr. Hanson


Dr. Bartlett


Dr. Stoner

UNC Graduate Students
GR&H Exercise Trainers
GR&H Program Staff
UNC Undergrad Research Assistants


Dr. Jensen


Dr. Piepmeier


Dr. Lee


Dr. Wagoner


DJ Amatuli


Stephanie Sullivan

Physical Performance

- Aerobic capacity (VO2peak)
- Strength (HUMAC)
- Balance (NeuroCOM)
- Functionality (6MWT, TUG)

Structural Components

- Vascular (XCEL, NIRS)
- Body Comp (DXA)
- Muscular (Ultrasound)

Biochemical Markers

- Immune system
- Inflammatory markers
- Molecular aging (p16)

Mental & Emotional Health (Q)

- Cognition
- Memory
- Self-Efficacy
- Depression, Anxiety

Other (Q)

- Sleep, Insomnia
- Pain
- Peripheral Neuropathy

Clinical Record (EMR)

Stage, grade
Systemic therapy
Local therapy

Get REAL & HEEL

Aerobic capacity

Vascular function, Physical function, Balance, Cognition, PRO's

Immune, Inflammatory, Aging Blood Biomarkers

Oxygen Cascade

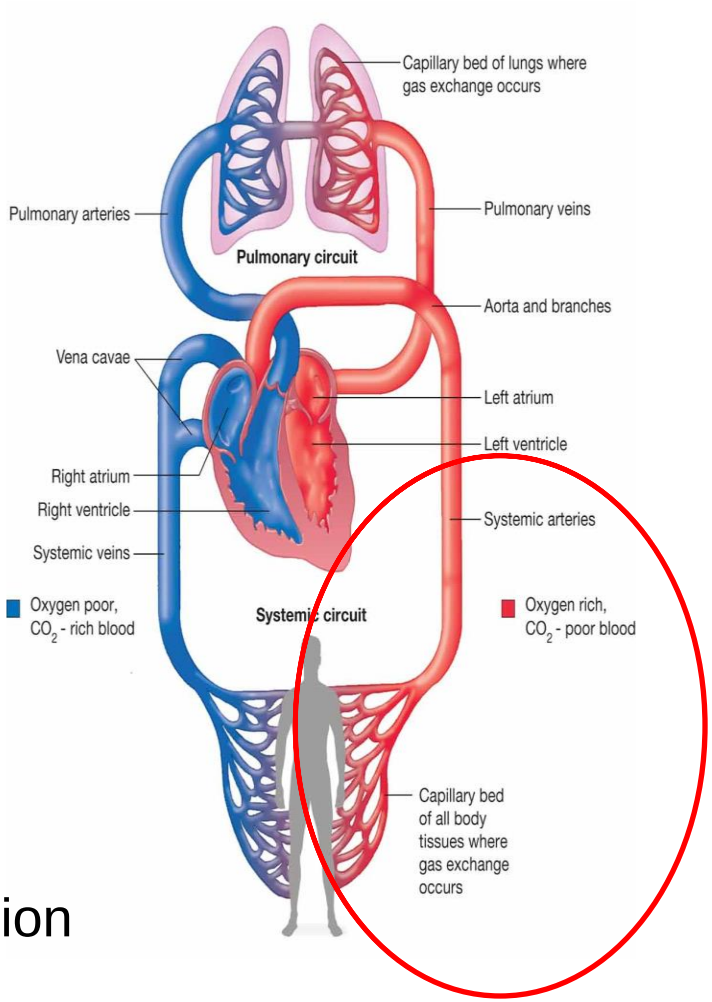
Aerobic Capacity (VO_2)

Pulmonary diffusion

*Delivery

*Transport

*Extraction/Consumption



Purpose

To characterize **aerobic capacity** and contributing **components of the O_2 cascade** in breast cancer survivors following completion of their primary treatment, and determine the **impact of GR&H** on changes in these profiles

Aim 1: Characterize aerobic capacity, CV-related components of the oxygen cascade, and their association with VO_{2peak} at baseline between BCS and otherwise healthy controls

BCS

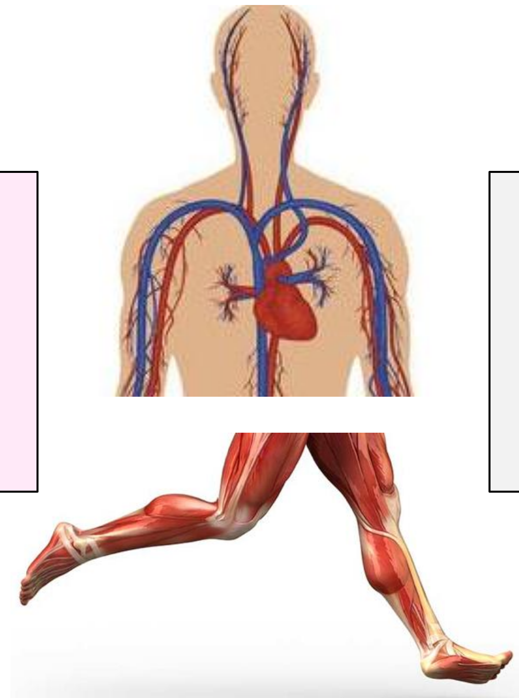
Aerobic Capacity (VO_{2peak})

Central/Cardiac

Conduit Vascular/Blood

Periphery

Systemic VO_{2peak}



Controls

Central/Cardiac

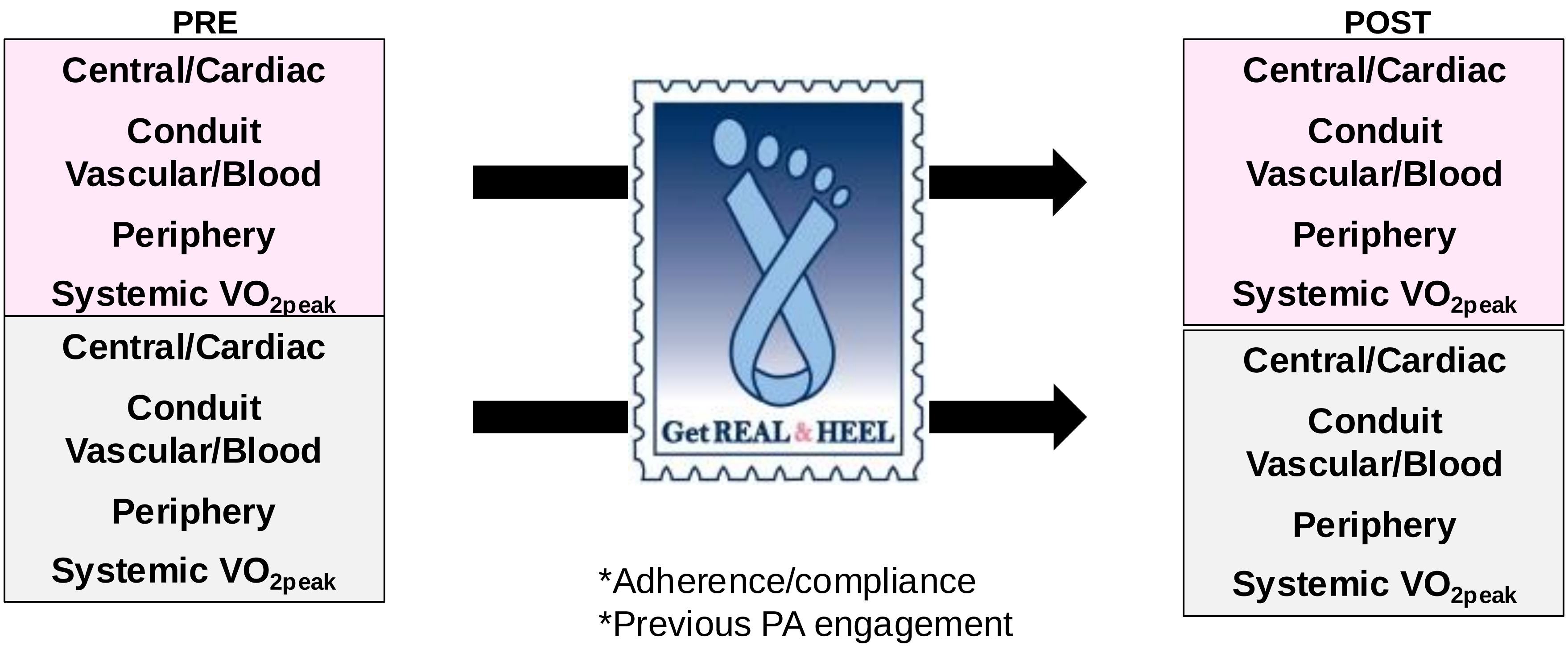
Conduit Vascular/Blood

Periphery

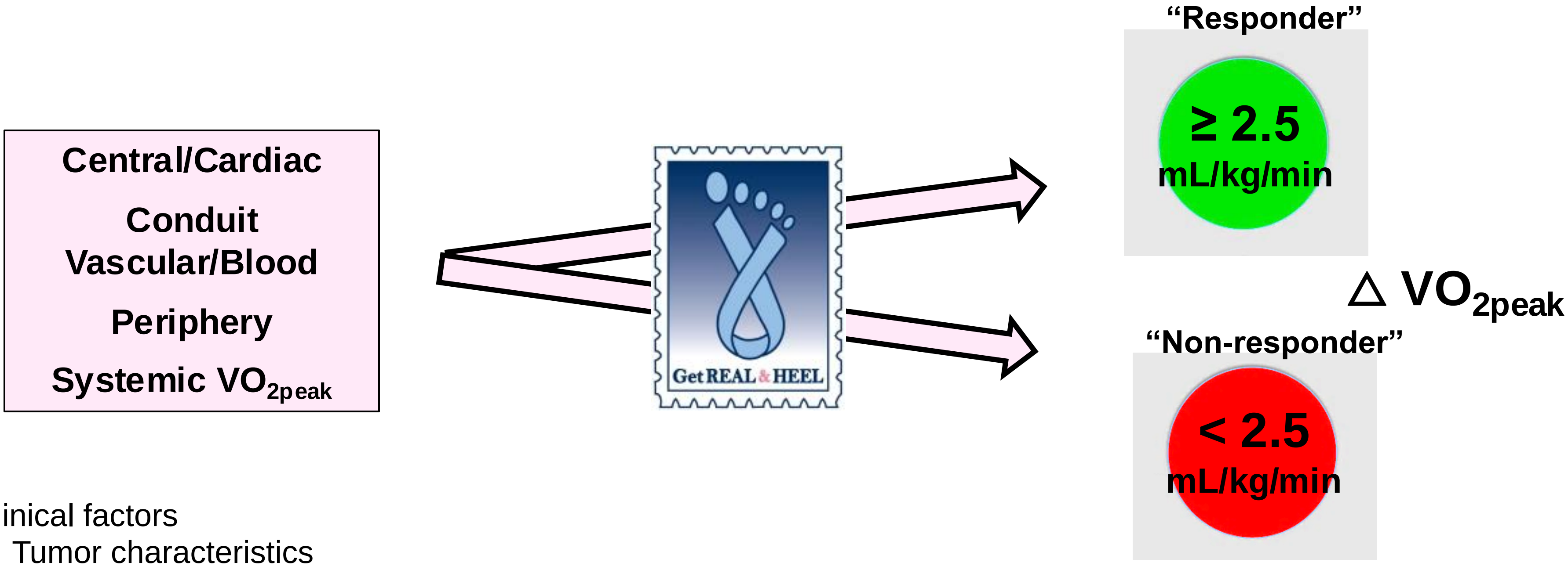
Systemic VO_{2peak}

Aerobic Capacity (VO_{2peak})

Aim 2: Determine the effect of a community-based exercise program on aerobic capacity and CV-related components of the oxygen cascade between BCS and otherwise healthy controls



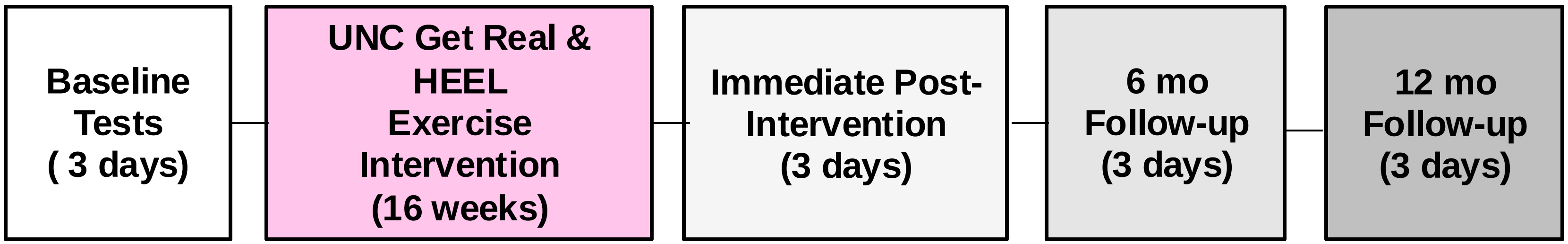
Exploratory Aims: Determine baseline components of the oxygen cascade that predict exercise response in terms of VO_{2peak}



Clinical factors

- Tumor characteristics
- Treatment types and duration
- Time since Dx and/or Tx

Methods



Inclusion Criteria

Early stage (0-III) Breast Cancer survivors (n=20)

≥ 21 years old

≤ 1 year of completing primary cancer therapy

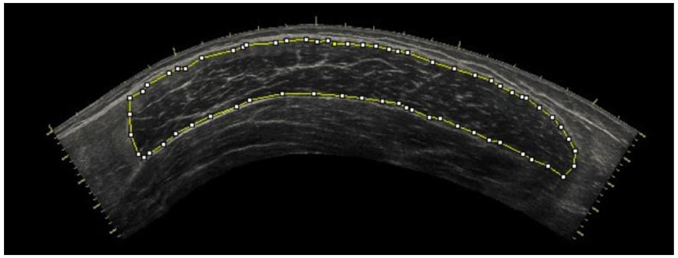
No overt cardiovascular, musculoskeletal, neurologic pathologies

Oncologist and Cardiologist approved

Comparison group = “healthy”, no known pathology

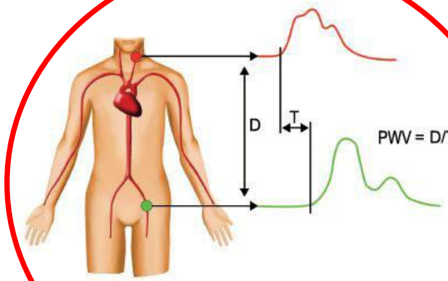
Day One

Body composition



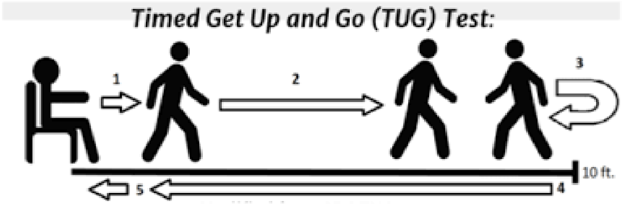
Vastus lateralis size and composition

Resting ECG



function

6 Minute Walk Test



Timed Up and Go

CPET Familiarization

Strength Familiarization

Day Two

Cognitive Testing

NeuroCOM Sensory Organization Test

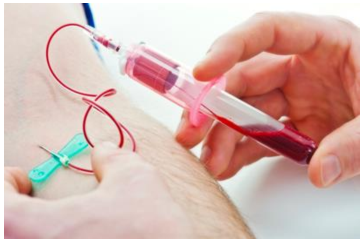
VO_{2peak} Test + NIRS

Isometric / Isokinetic Strength Test

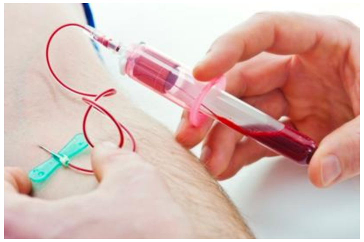
Day Three
(subset)

Baseline blood draw

Intermittent cycling at
60% Max Wattage



Immediately post-exercise
blood draw

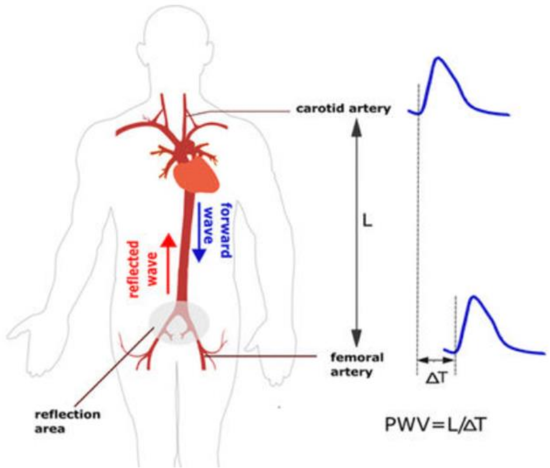


1 hour post-exercise
blood draw

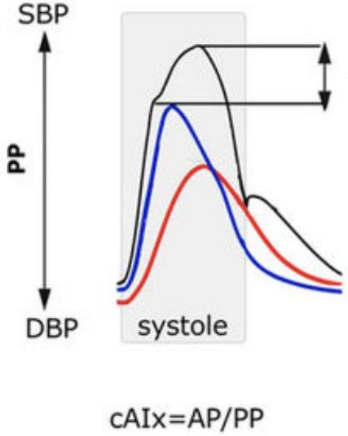
- p16 (biomarker of aging)
- Immune biomarkers
- Inflammation biomarkers
- CBC

Delivery and Transport

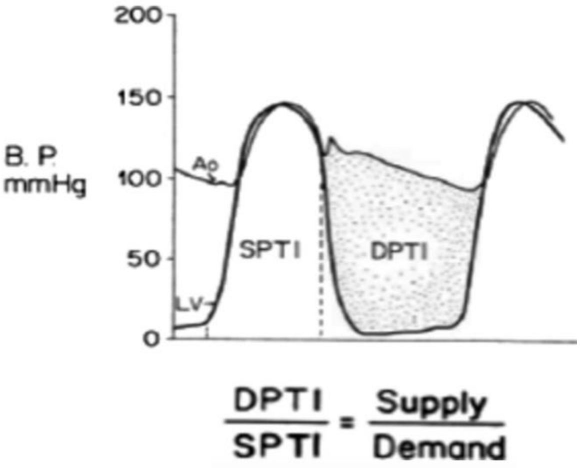
Arterial Stiffness (PWV)



Augmentation Index



Buckberg Index



Results (n=20)

Demographics	Mean (SD)
Age (yr)	58 (9.6)
Height (cm)	166 (8)
Weight (kg)	75 (15)
Stage	20% I 50% II 30% III
Hormone Receptor	80% Pos
HER2	35% Pos
Surgery	75% Lumpectomy 25% Mastectomy
Chemotherapy	70% Yes
Radiation	80% Yes
Chemo + Rad	55%

(n=20)

Parameter	Pre	Post	Change	P-value
Weight (kg)	75.2 (15)	76.5 (14.5)	1.3	0.19
%BF	40.7 (7)	39.4 (7)	-1.3	0.06
RHR (bpm)	**66 (8)**	**62 (8)**	**-4**	**$p<0.01$**
Systolic BP (mmHg)	128 (14)	127 (14)	-1	0.36
Diastolic BP (mmHg)	79 (7)	78 (8)	-1	0.4
PWV (m/s)	7.7 (1)	7.9 (1.8)	0.2	0.68
AIx @ 75	25.8 (13)	22 (13)	-3.8	0.17
Buckberg Index (%)	**146 (26)**	**153 (27)**	**7**	**$p<0.01$**
VO_{2peak} (ml/kg/min)	21.8 (5)	22 (5)	0.2	0.46
Max HR (bpm)	157 (16)	155 (15)	-2	0.75
Max Wattage	**118 (26)**	**133 (27)**	**15**	**$p<0.0001$**
Lactate	**6.1 (1.6)**	**7.4 (2.3)**	**1.3**	**$p<0.01$**
TTE	**9:37**	**10:36**	**1:00**	**$p<0.0001$**

Something Interesting to Think About:

	C (6)	D (23)
Age	63	59
Race	White	
Body Fat	41	
Meno Status	Post	
BC Stage	2	1
BC Tumor	ER+/HER2-	ER+/HER2+
Chemo	None	Taxol, Herceptin
Radiation	None	
Delta PWV	1.05	-0.3
Delta Buckberg	-3	-4.5
Delta TTE	1:39	0:15
Delta VO_2	6.8	-3.3
Delta Watts	25	3
Delta 6MWT	126	18

Takeaways

While exercise can be beneficial, *one size does not fit all*

Impact of exercise on specific physiology of BCS still TBD

Means/averages can mask very important **clinical** implications

Optimal **patient-centered care** must recognize the outliers
and
adapt training/care programs

Recommendations for Future Research

- What are the **vulnerable components** of the O_2 cascade driving VO_2 impairments?
- Can a specific (exercise) **intervention** help?
  - **Prehab** before cancer therapy?
  - **Minimize** CVD development?
- Long-term cardiovascular **surveillance**

Recommendations for Future Research Cont.

- Characterize CV profiles pre-treatment
- Impact of specific therapies on these profiles
- Efficacy of preventative strategies to protect CV components

Long term

- **Risk stratify** patients at clinical baseline → **personalized** interventions
  - Oncologic and exercise related

Recommendations for Future Research Cont.

- Continuation of exploration of different types of modes, intensity, frequency, and duration of exercise training (Lab based experiments)
- Longitudinal trials examining long term prognosis (Recurrence, survival, health care costs)
- Start looking at scalable interventions (i.e., Home-based, community-based, Tele-health, etc…)

Our challenge is to make exercise prescription a regular part of cancer care and monitor specific cardiovascular outcomes long term to improve patients' lives.

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THANK YOU

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