Sheffield Hallam University | Advanced Wellbeing Research Centre

Cancer, muscle and the potential role of Exercise

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Declarations

I have received research and speaker funding from

- Mars (UK)
- Gelita- Collagen Research Centre
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- Versus Arthritis
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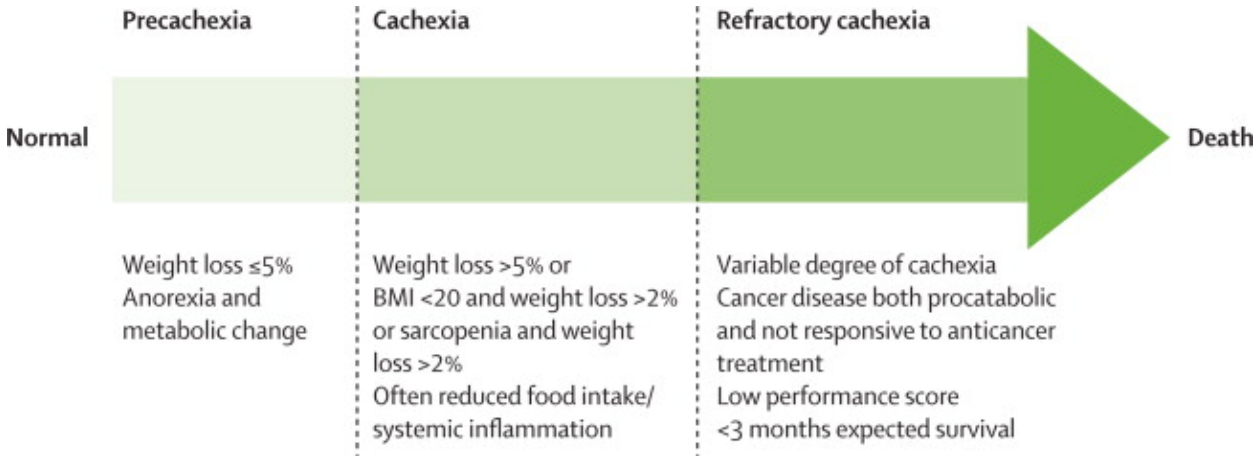
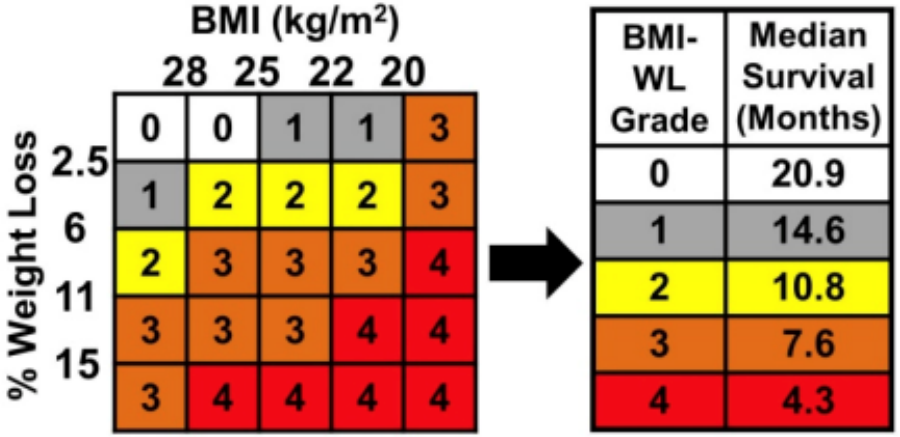
- BBSRC/MRC
- Research lead Strength for Life Programme.

Cancer and Skeletal Muscle

- Cancer-associated cachexia -loss of body weight with specific losses of skeletal muscle as well as adipose tissue.
- Driven by a reduced food intake and metabolic changes, including elevated energy expenditure, excess catabolism and inflammation.
- Not salvaged by nutritional intervention.
- Cachexia responsible for 20-30% of all cancer deaths alone.
- Loss of Muscle Mass and Strength= Reduced Independence, ADL performance, Chemotoxicity and Mortality.



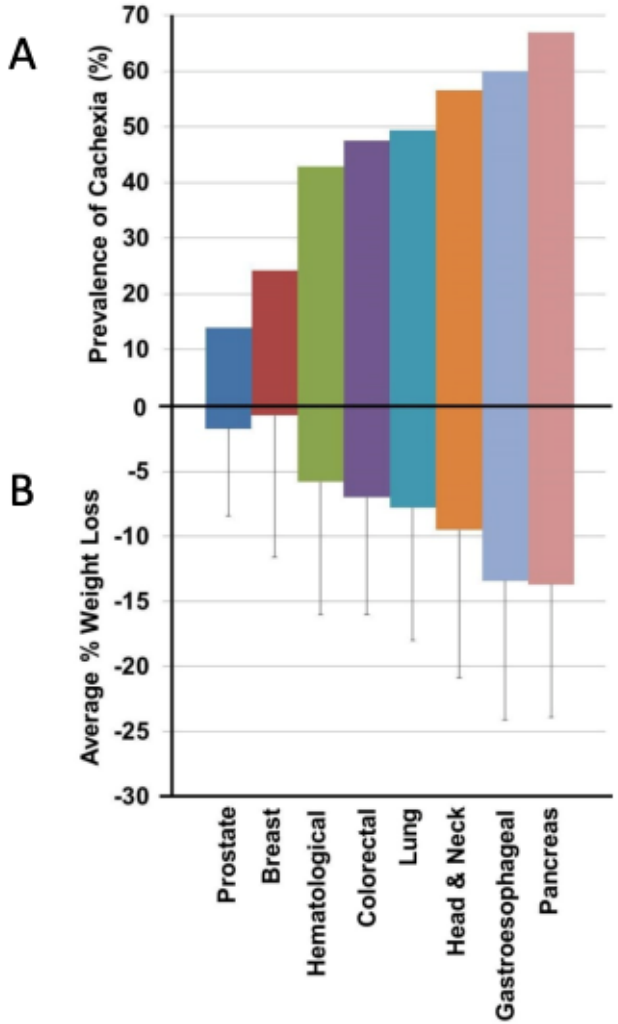
Fearon et al.,2011 Lancet

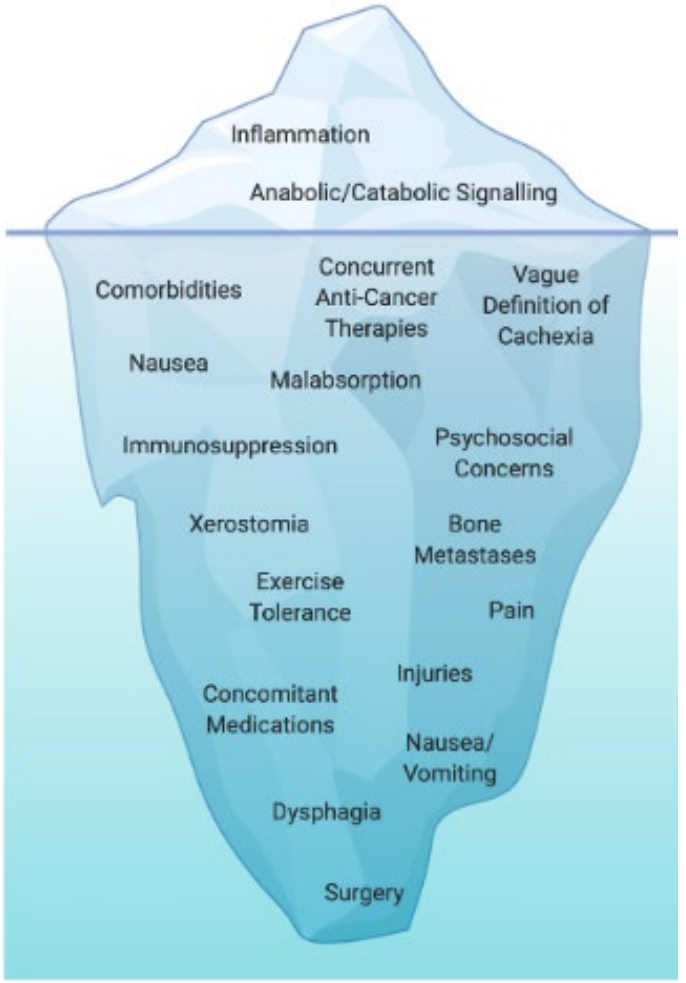


Martin et al., 2015

Cancer and Skeletal Muscle

Cachexia Prevalence





Challenges of Cachexia in Clinical Settings

Baracos et al., 2016
Fairman et al., 2022

Sarcopenia and Cachexia Rates in Different Cancers

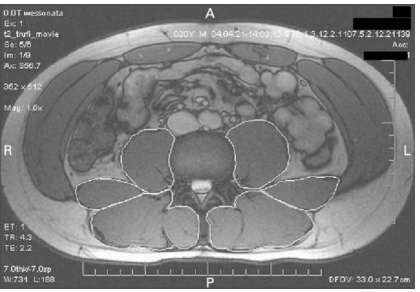
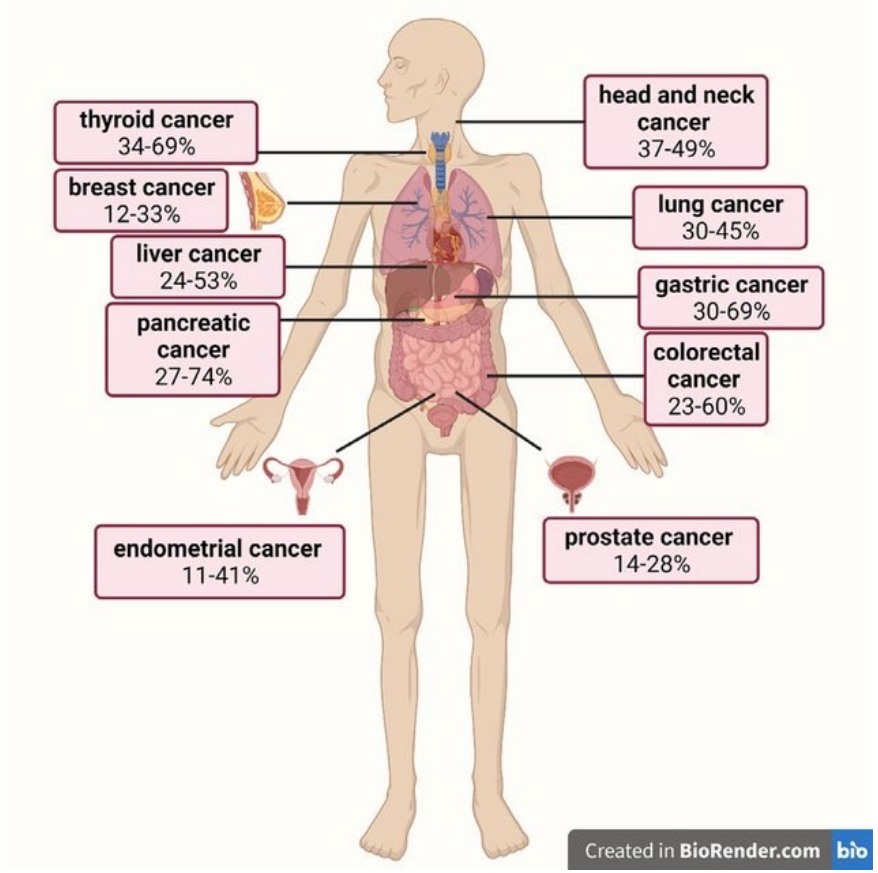
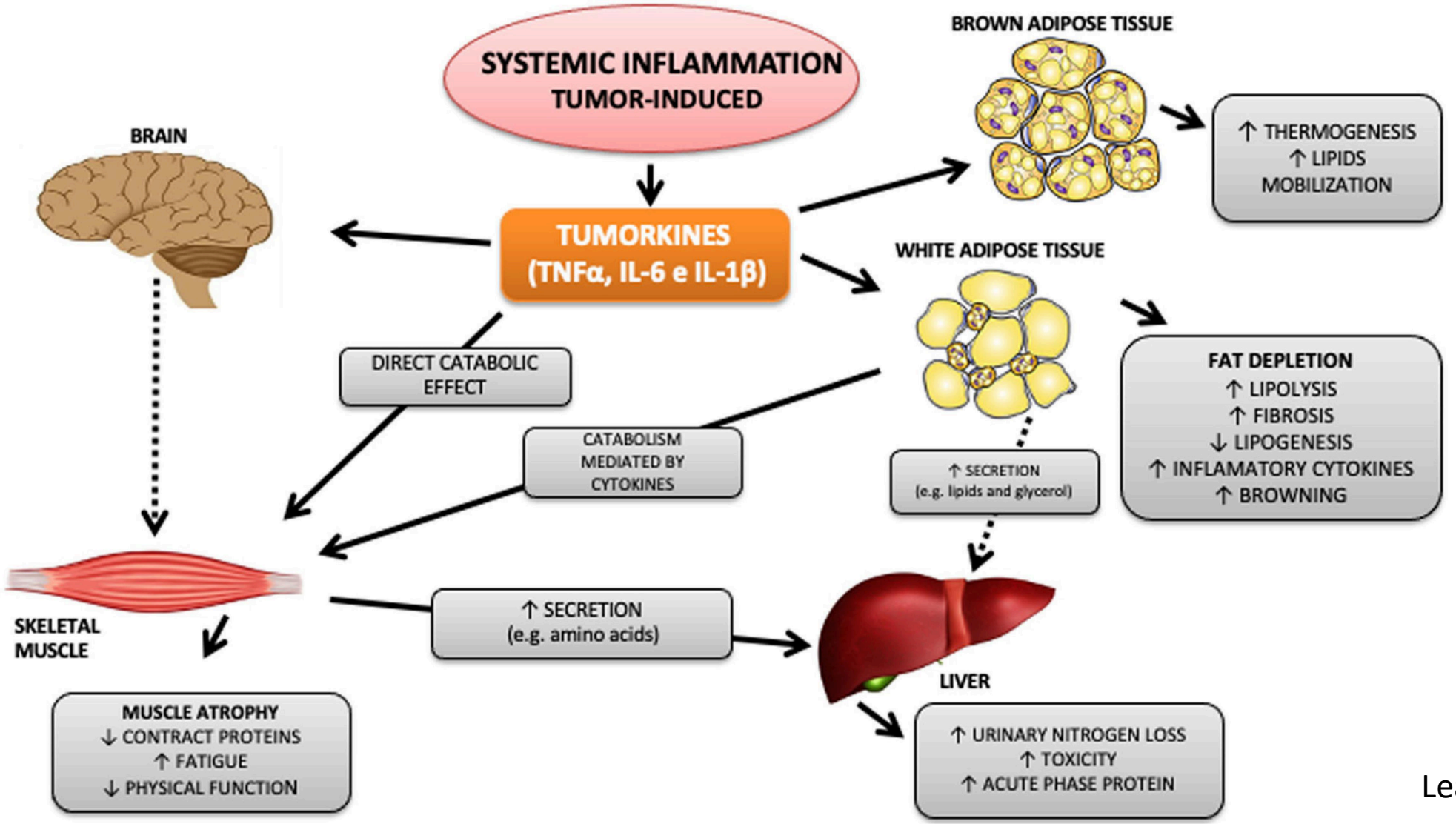


Fig. 1. (Colour online) Summary of studies reporting sarcopenia in a variety of cancers compared with healthy controls. For cancer populations sarcopenia defined by computed tomography scan using Prado *et al.*[38] values of 38·5 cm^2/m^2 for females and 52·4 cm^2/m^2 for males; Mourtzakis *et al.*[45] values of 38·9 cm^2/m^2 for females and 55·4 cm^2/m^2 for males. Reference ranges for healthy population based on appendicular lean mass as assessed by dual-energy X-ray absorptiometry of <5·45 kg/m^2 for females and <7·26 kg/m^2 for males.

Ryan et al., 2016 Proc Nutr Soc

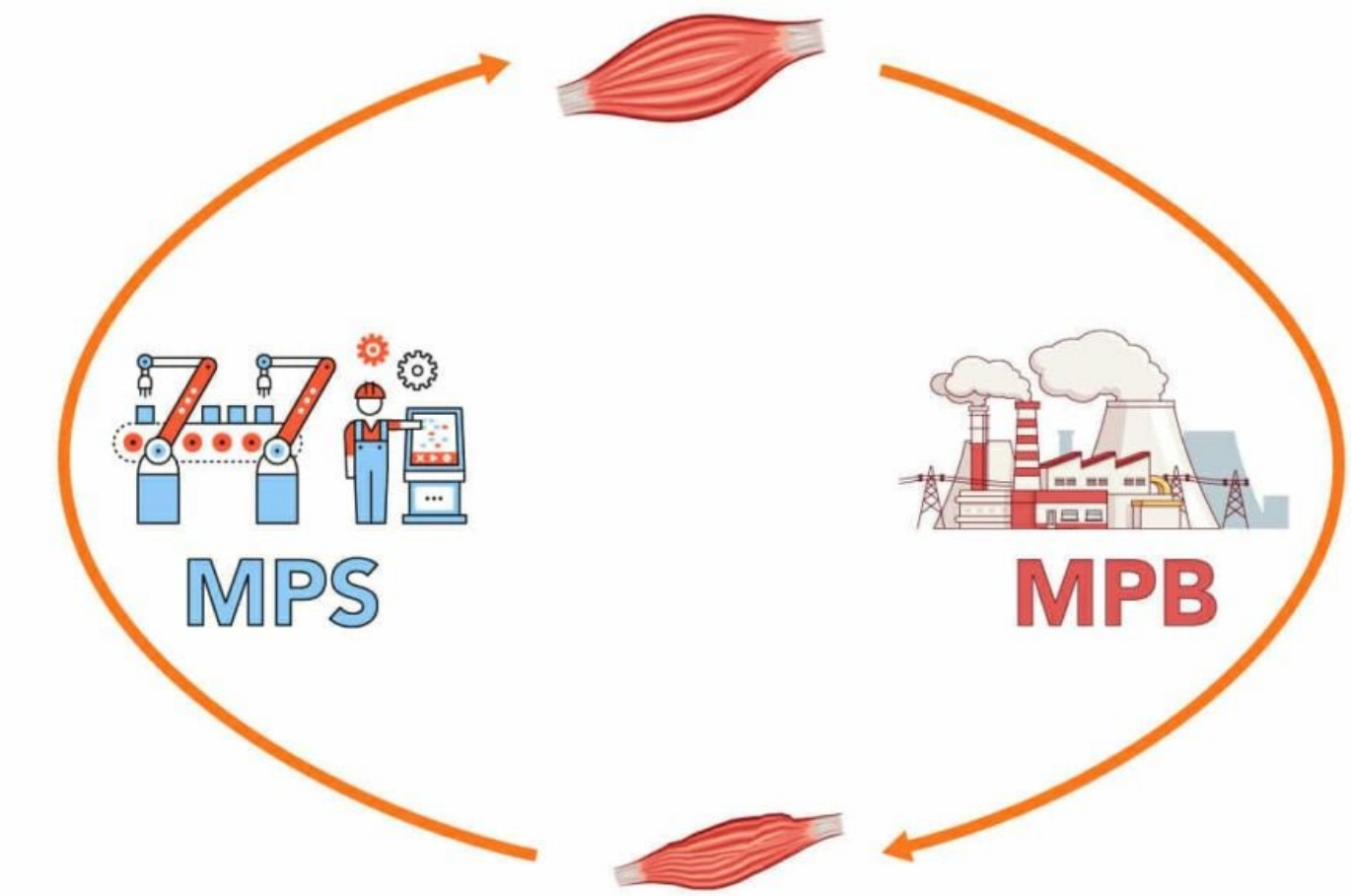


Kottorou et al., 2021 Translational Oncology



Leal et al., 2020

Control of Muscle Mass



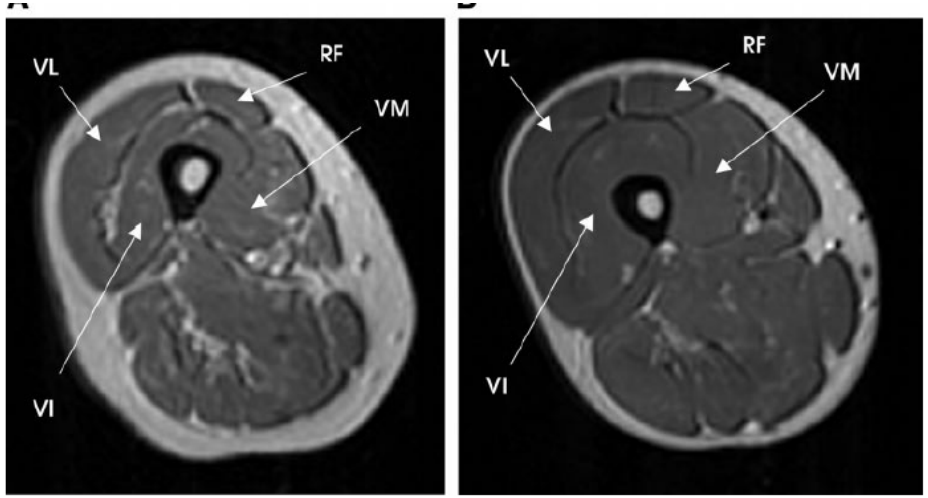
Loss of Muscle Mass in Cancer

Pro-Catabolic- Increased Protein Breakdown

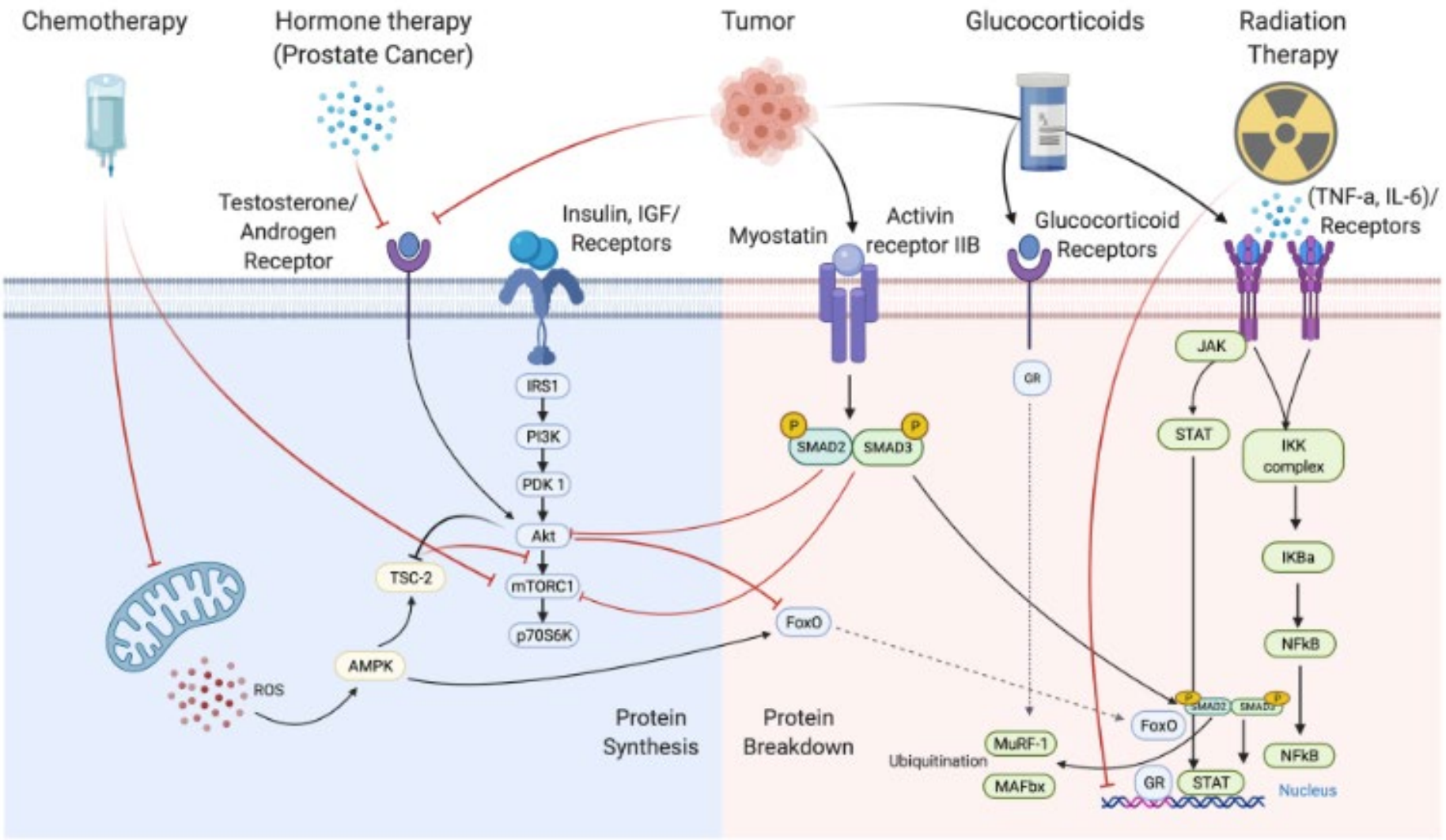
- Increase in Fat Infiltration
- Systemic Inflammation
- Oxidative Stress
- Endothelial Dysfunction

Anti-Anabolic- Decreased Synthesis

- Impaired Anabolism
- Decrease in Anabolic Hormones (IGF-1,GH,Oestrogen, Testosterone)



Both cancer and its treatments are detrimental to muscle



Fairman et al., 2022 JCSM

Sarcopenia in Cancer Patients

LITERATURE REVIEW

Sarcopenia in Cancer Patients

Andree Kurniawan

CONCLUSIONS

Patients with cancer are the population at risk to develop sarcopenia before and after chemotherapy. The loss of muscle mass that happens during chemotherapy will make a poor prognosis. Sarcopenia can worse chemotherapy toxicity. Sarcopenia diagnosis needs evaluation of muscle mass and muscle strength or physical performance. Physical activity exercise is the best strategy for sarcopenia in cancer patients. The combination of adequate energy and protein with vitamin D supplementation is important.

Sarcopenia associated with chemotherapy and targeted agents for cancer therapy

Mellar P. Davis[1], Rajiv Panikkar[2]

Summary

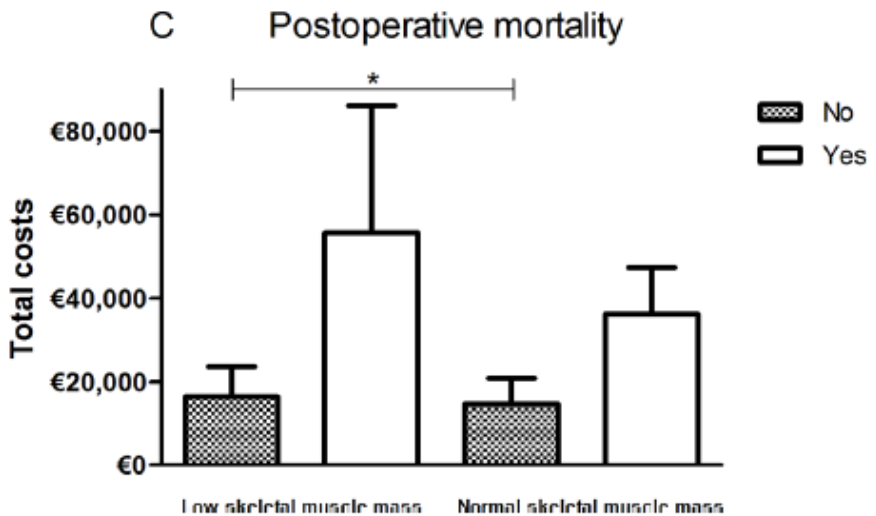
Sarcopenia is present at the beginning of chemotherapy in a subgroup of patients, and worsens or develops during neoadjuvant chemotherapy or palliative chemotherapy. Clinical outcomes are adversely influenced by the presence of sarcopenia prior to treatment or with the development of sarcopenia during therapy. Certain targeted agents cause sarcopenia while others may prevent or reverse sarcopenia. To treat and prevent sarcopenia, patients need adequate protein intake and resistance exercises. Patients should be

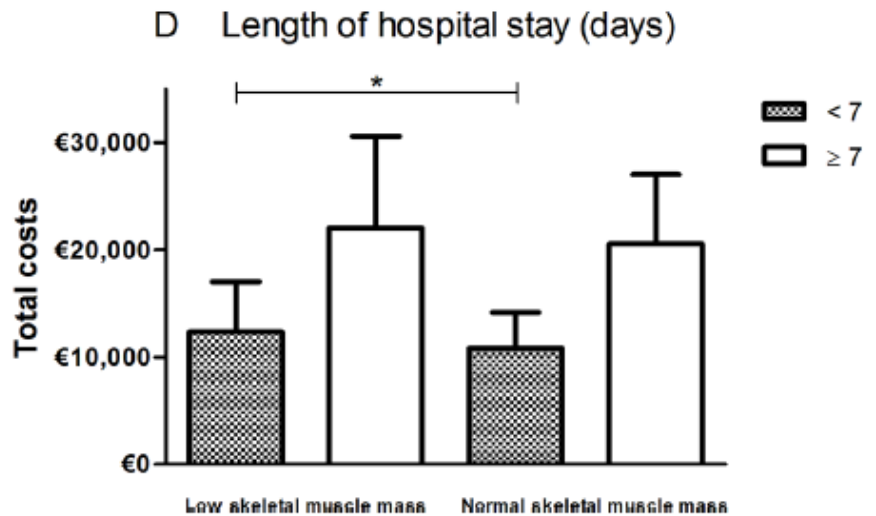
RESEARCH ARTICLE

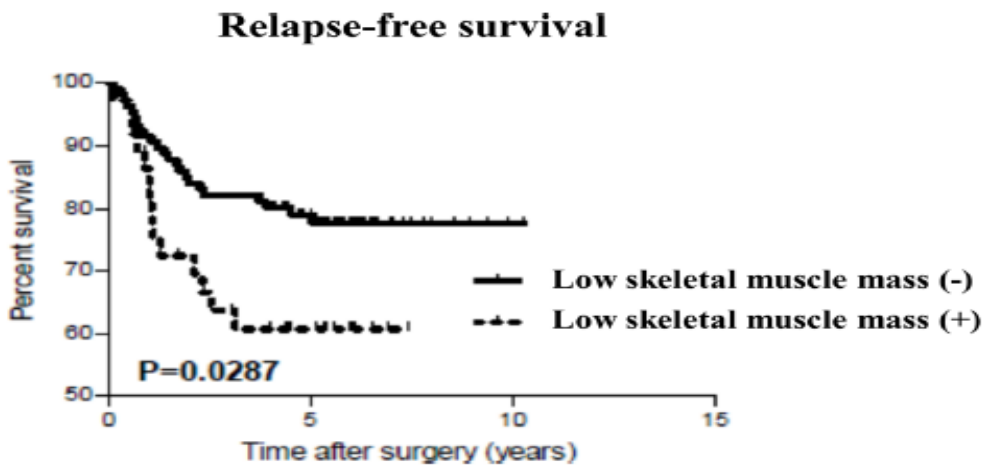
Low skeletal muscle mass is associated with increased hospital expenditure in patients undergoing cancer surgery of the alimentary tract

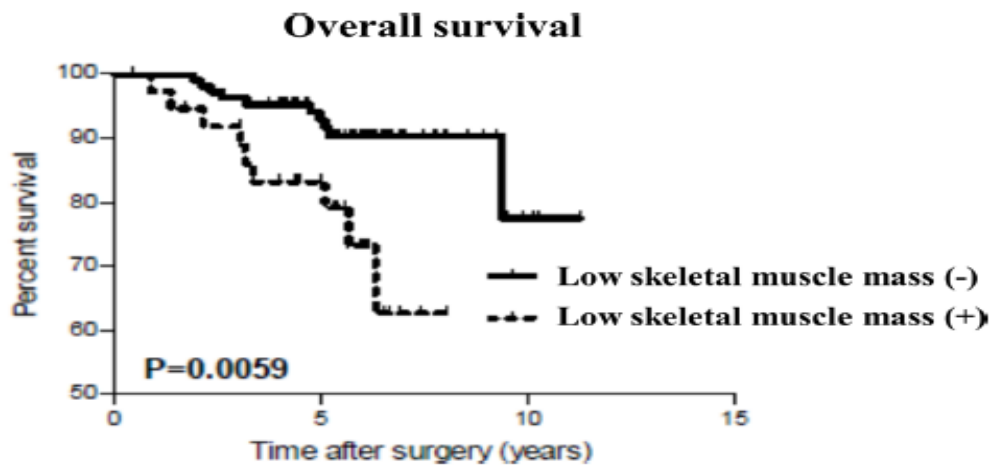
RESEARCH ARTICLE

Skeletal muscle loss is an independent negative prognostic factor in patients with advanced lower rectal cancer treated with neoadjuvant chemoradiotherapy

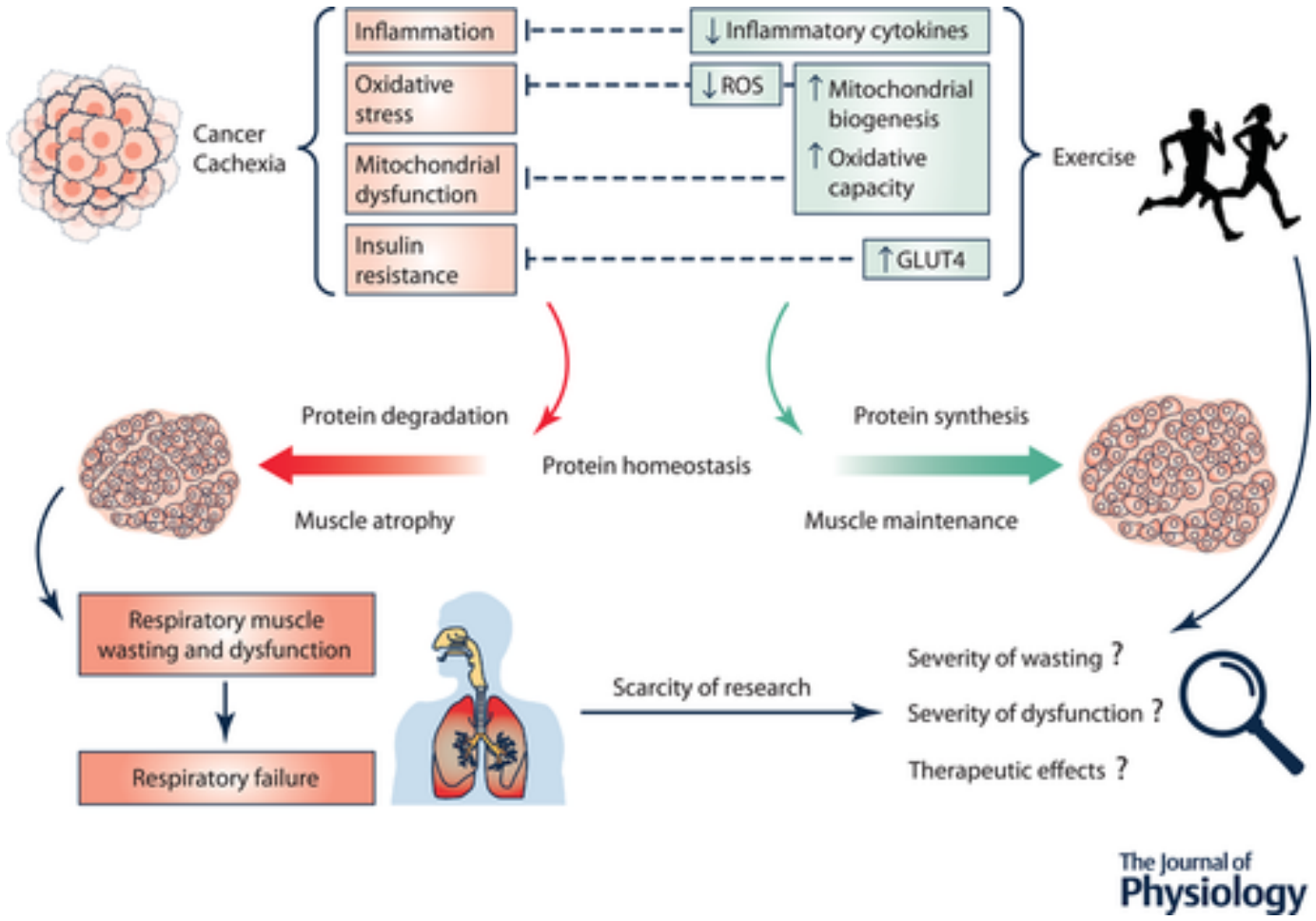








The case for exercise in cachexia



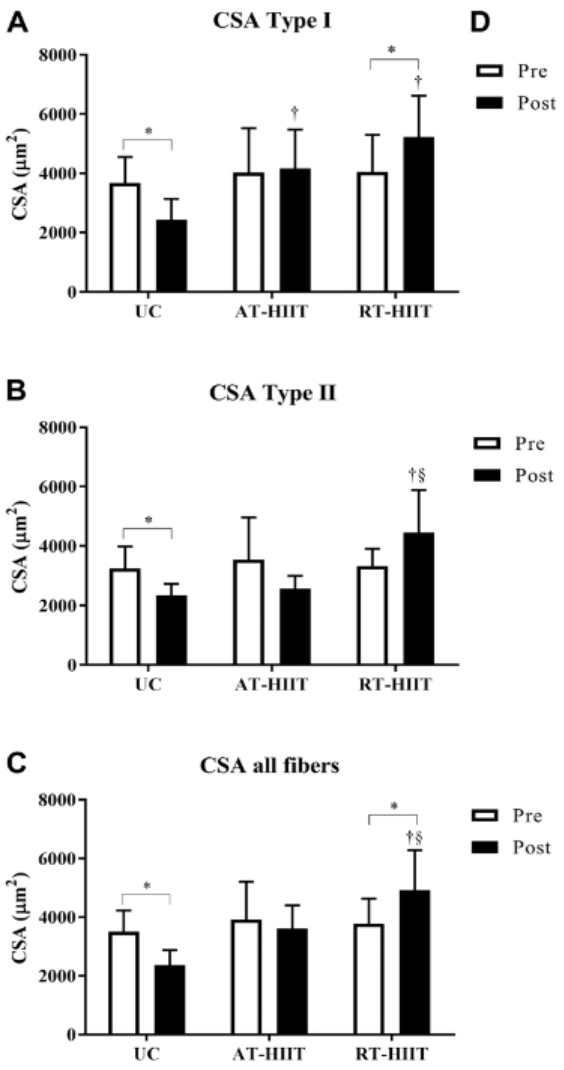
Murphy et al., 2022 J Physiol

The case for resistance exercise during treatment

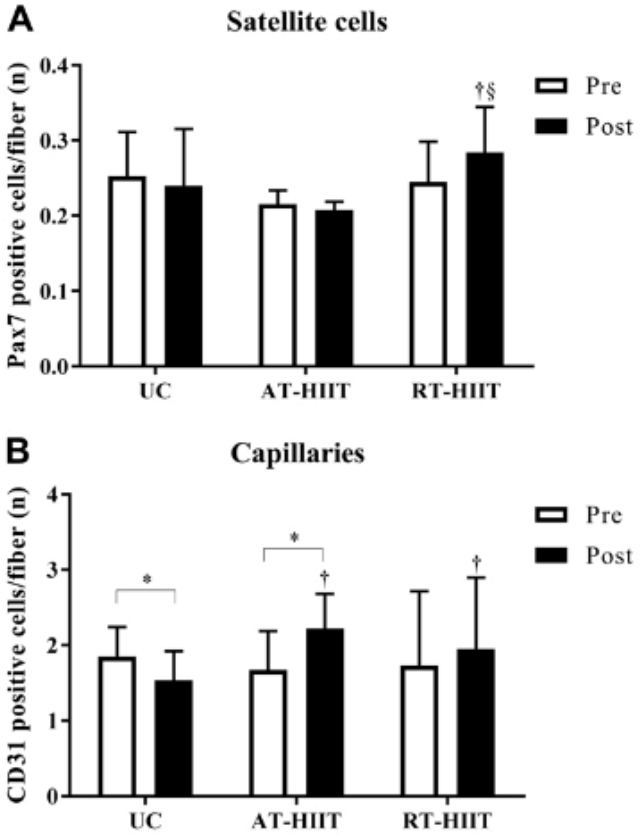
- Chemotherapy results in greater loss of muscle mass from lower limb than upper (25% vs 16%- Klassen et al. 2017)
- ~2x greater loss of muscle mass in cytotoxic chemotherapy c.f. to molecular therapy (Kakinuma et al., 2018)
- Pharmacological intervention can improve muscle mass but DOES NOT improve physical function (Advani et al., 2018)
- Cachectic patients still gain muscle strength with PRE (Grote et al., 2013- Head and Neck)
- Improvements in Physical Function (Kamel et al., 2020- Pancreatic)

Exercise Training alongside Chemotherapy preserves muscle mass, capillarization and aerobic capacity of muscle

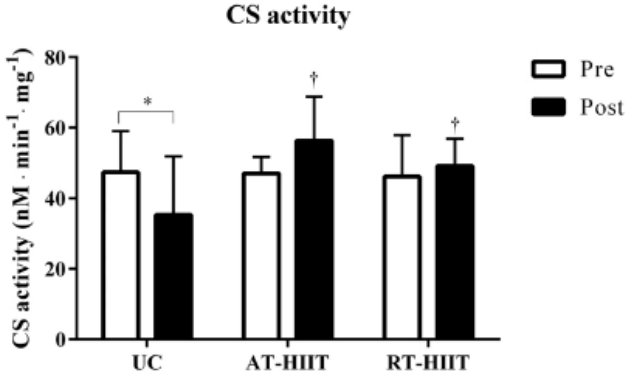
Muscle Size



Adaptability



Mitochondria Activity

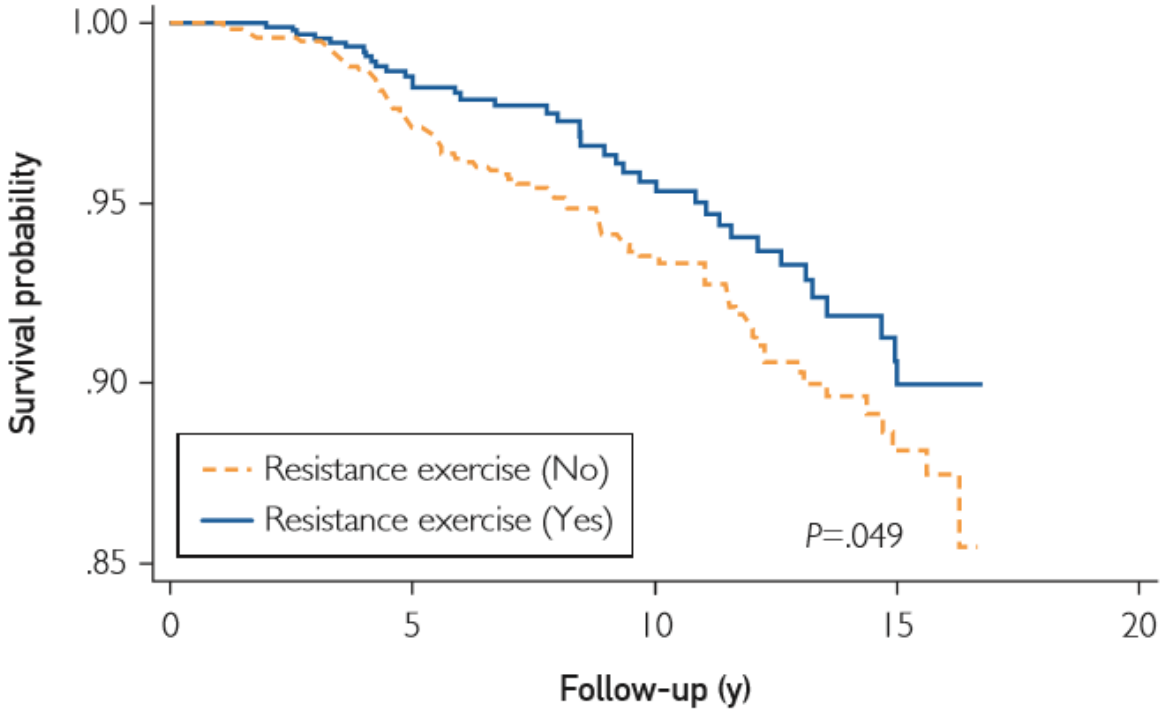


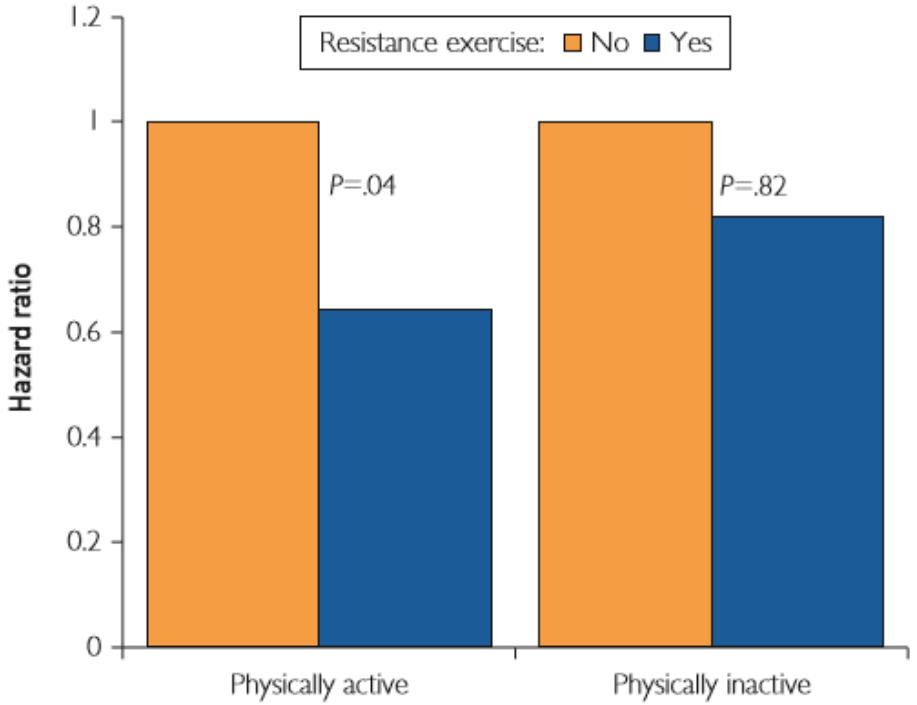
Exercise training during chemotherapy preserves skeletal muscle fiber area, capillarization, and mitochondrial content in patients with breast cancer

Sara Mijwel, Daniele A. Cardinale, Jessica Norrbom, Mark Chapman, Niklas Ivarsson, Yvonne Wengström, Carl Johan Sundberg, Helene Rundqvist

First published: 11 May 2018 | https://doi.org/10.1096/fj.201700968R | Citations: 16

Resistance Training and Cancer Survivors



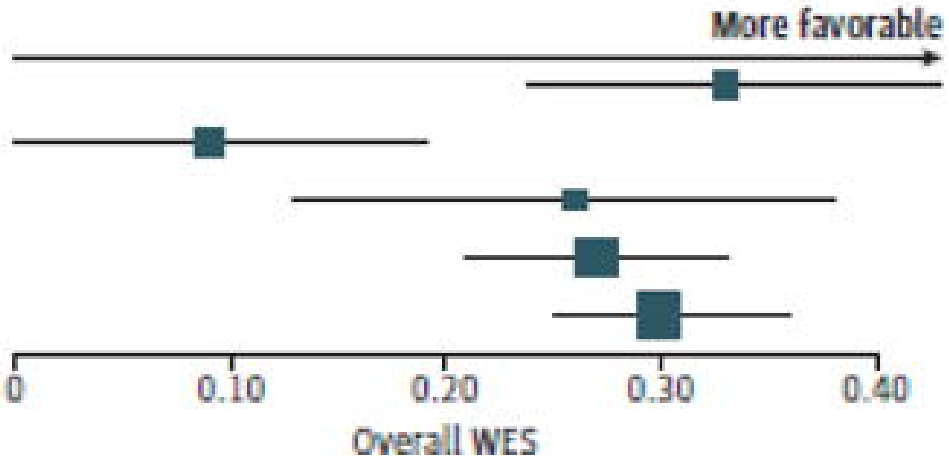


The Effect of Resistance Exercise on All-Cause Mortality in Cancer Survivors

Justin P. Hardee MS [a], Ryan R. Porter MS [a], Xuemei Sui MD, MPH, PhD [a], Edward Archer PhD [c], I-Min Lee MD, ScD [d, e], Carl J. Lavie MD [f, g], Steven N. Blair PED [a, b]

Effects of Exercise on Cancer Related Fatigue

Intervention	No. of Effect Sizes	WES	SE	(95% CI)
All	127	0.33	0.05	(0.24-0.43)
Pharmaceutical	14	0.09	0.05	(0.00-0.19)
Exercise plus psychological	10	0.26	0.07	(0.13-0.38)
Psychological	34	0.27	0.05	(0.21-0.33)
Exercise	69	0.30	0.03	(0.25-0.36)



WES=Weight Effect Size

Mustian et al., 2017

Holistic Benefits of PA in cancer patients

- Increase in muscle mass and strength- lower chemotoxicity
- Increase in physical function and ease of ADL's
- Increased length of survival
- Improved QoL even in palliative Care
- Psychological benefits- lower Depression/Anxiety
- Lower Cancer related Fatigue
- Lower BMI
- Lower number of metastases
- Improved aerobic capacity and cardiorespiratory fitnes
- No evidence of increased risk of Lymphoedema with RT.

Barriers to Exercise in Cancer patients

- Physical barriers include Cancer Related Fatigue, painful muscle and joints, balance issues, Lymphoedema and Shortness of breath.
- Treatment effects on Heart, Lungs, Bone and Peripheral Neuropathy.
- Psychosocial barriers include Low Self Esteem, Confidence, Body image concerns and fear of recurrence.
- Nutritional/Energy Balance
- Safety
- Knowledge and Experience in prescribing exercise from HCP
- Patient preference.

Future Directions/Challenges

- Combination of Resistance Exercise and Pharmacological Interventions.
- Optimisation of Resistance Training Stimulus including patient preference.
- Role of multimorbidities and Medication.
- Lab measures of Muscle Mass, Strength and Function.
- Timing of interventions
- Control groups
- Nutritional Supplementation
- Identification of patient groups

Acknowledgements

Loughborough University

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Canon Medical

LIVINGCARE bringing health to you

Sheffield United F.C. 1889

British Cycling

Sport England

Gilead Creating Possible

Pfizer

UK active More people More active More often

National Centre for Sport & Exercise Medicine Working for Health & Wellbeing

move more

Centre for Sport, Exercise & Osteoarthritis Research Versus Arthritis

UKRI Innovate UK

NHS Sheffield Teaching Hospitals NHS Foundation Trust

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