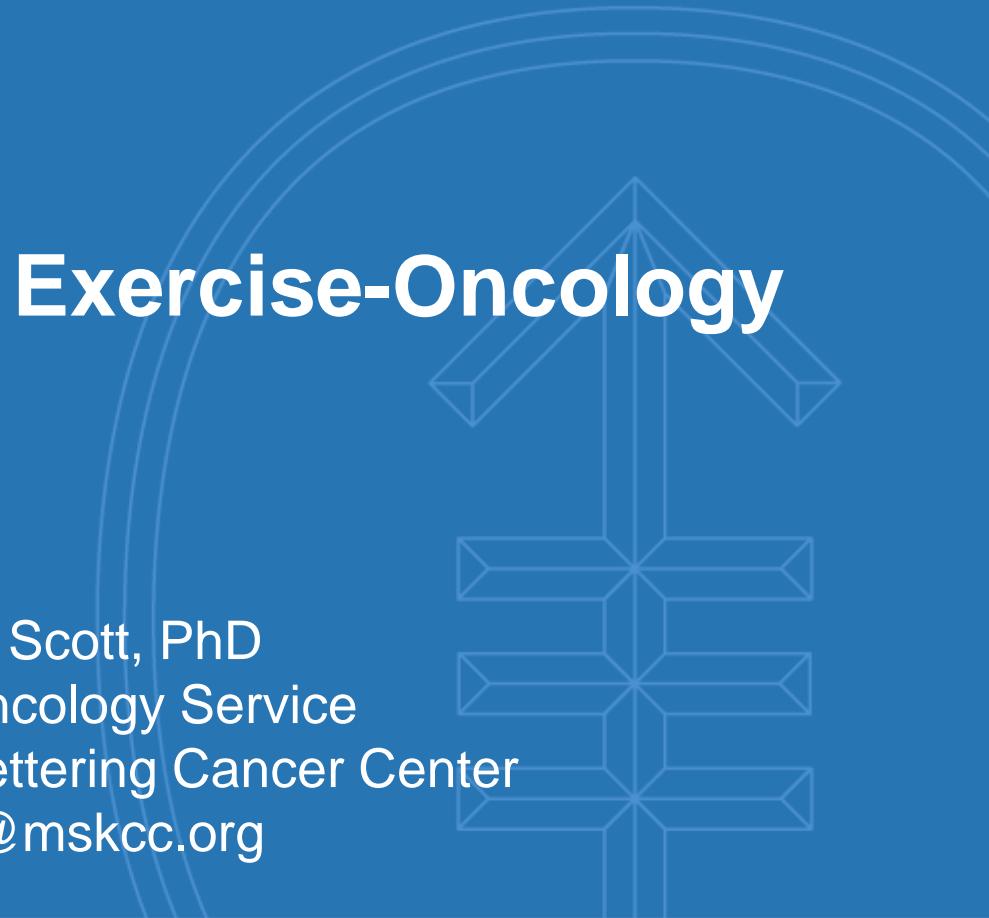




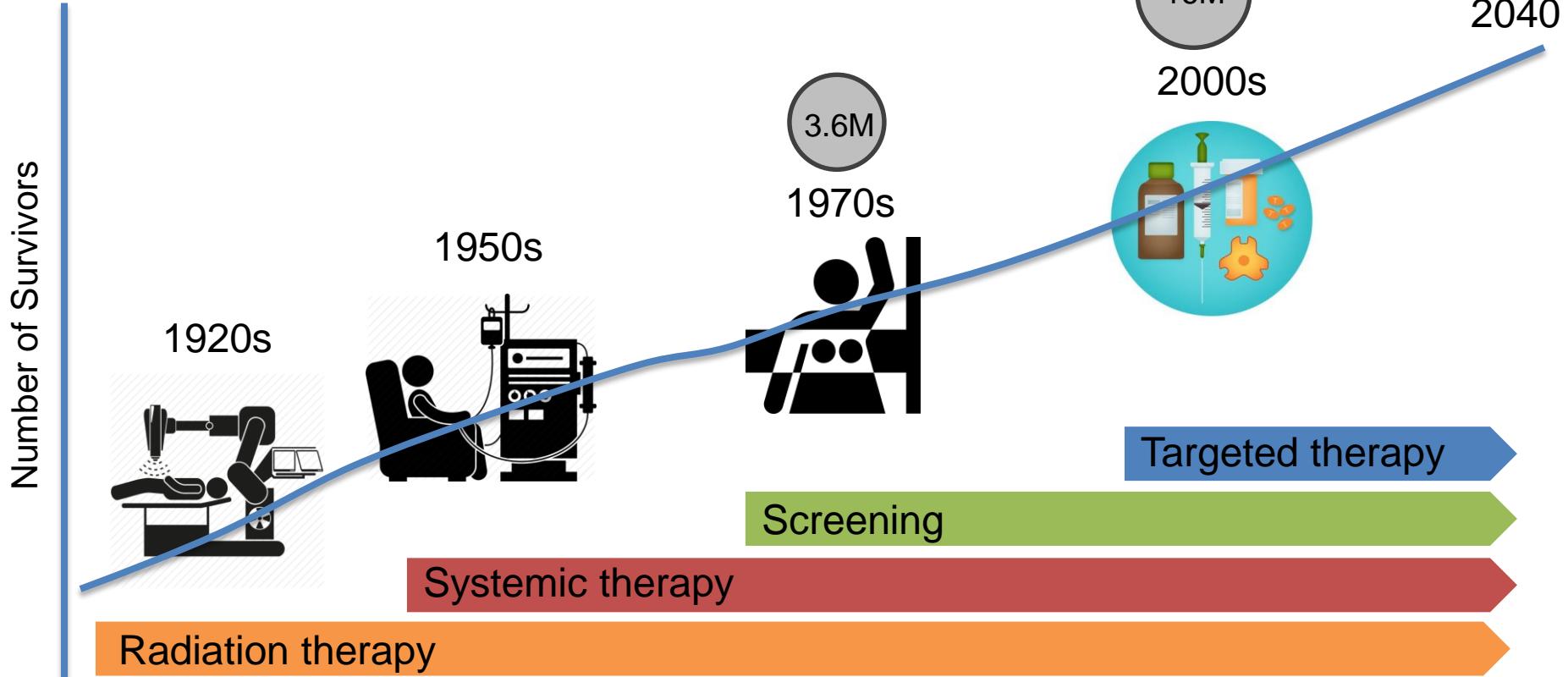
Memorial Sloan Kettering
Cancer Center™

The Rationale for Exercise-Oncology

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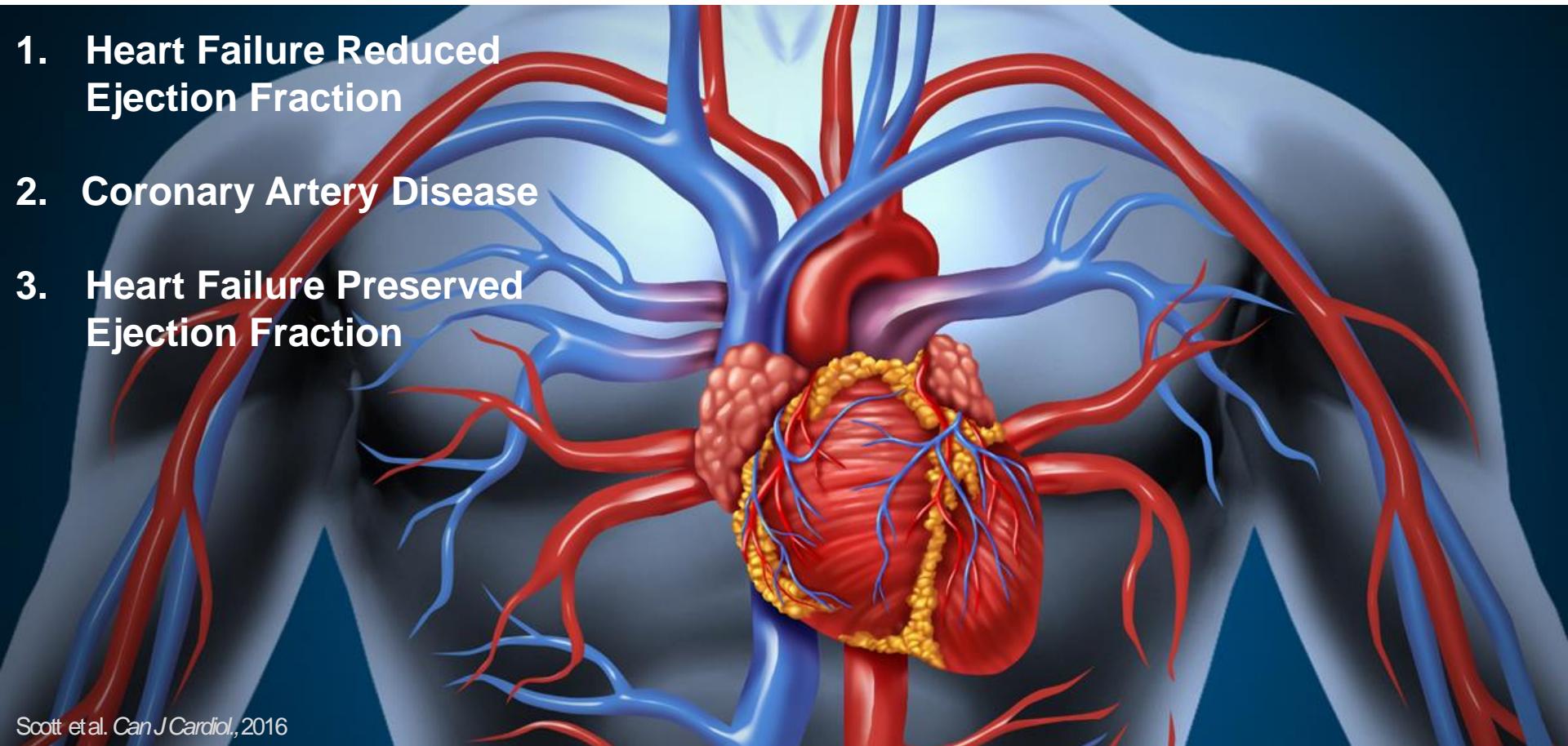


Increasing Number of Cancer Survivors



Treatment-Induced Cardiac Toxicity

1. Heart Failure Reduced Ejection Fraction
2. Coronary Artery Disease
3. Heart Failure Preserved Ejection Fraction



Cardiovascular Disease Among Cancer Survivors

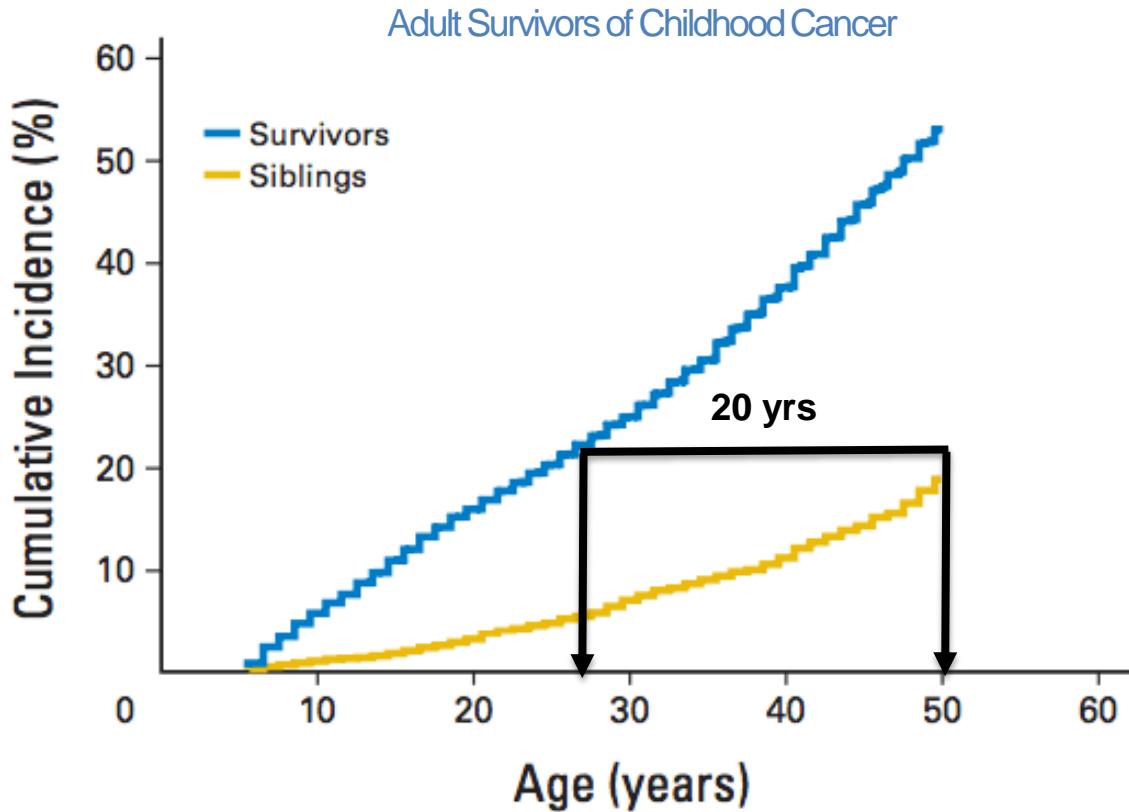
n=36,232 ≥ 2-year survivors of adult-onset cancer

Table 2. CVD Incidence Rates by Cancer Type for Cancer Survivors and Comparison Controls and Calculated Crude and Adjusted (age, sex, race/ethnicity, CVRFs, overweight/obesity, smoking history) IRR

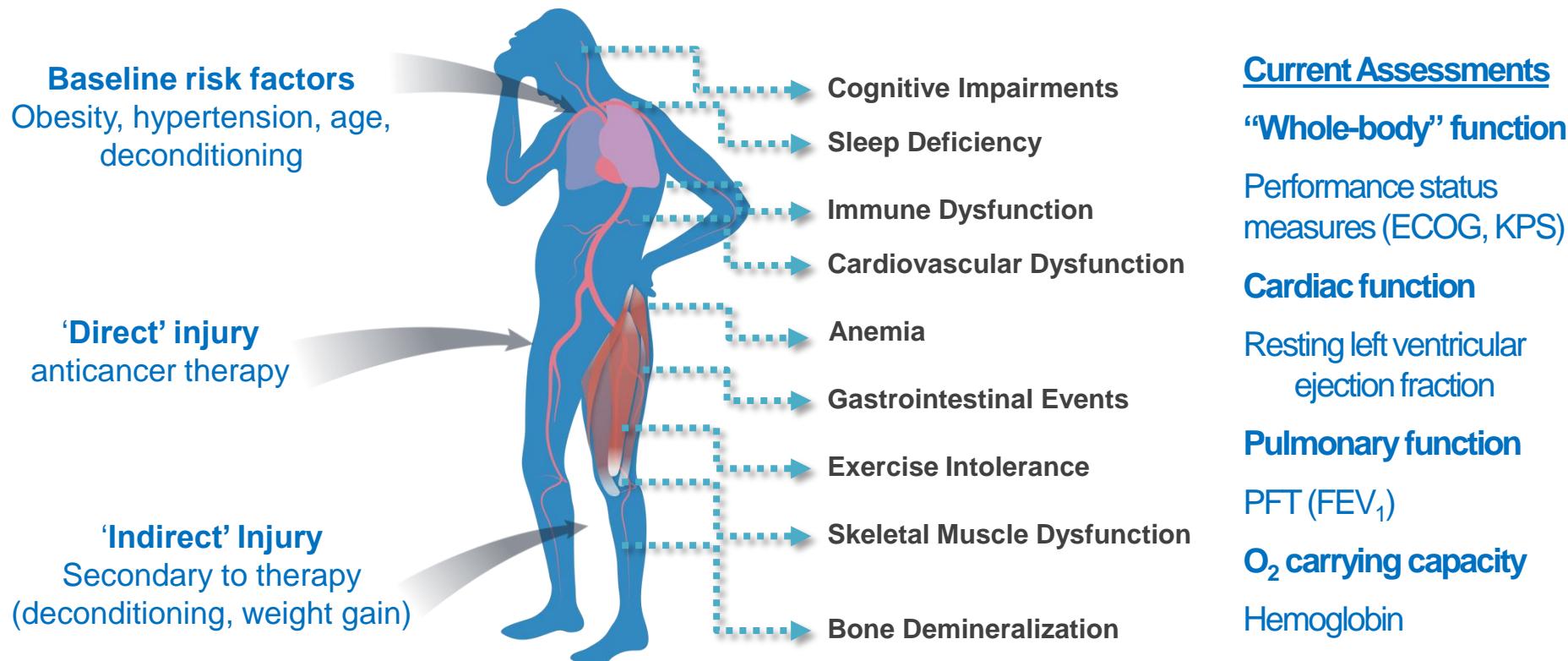
Cancer Type	Cancer Survivors			Comparison Cohort			Crude IRR			Adjusted IRR		
	No. With CVD	No. of Person-Years	Incidence Rate*	No. With CVD	No. of Person-Years	Incidence Rate*	IRR	95% CI	P	IRR	95% CI	P
Overall	5,026	162,487.13	30.93	9,795	339,438.42	28.55	1.07	1.04 to 1.11	< .01	1.02	0.99 to 1.06	.17
Bladder	88	2,087.05	42.16	224	5,033.33	44.55	0.96	0.75 to 1.22	.73	0.82	0.63 to 1.07	.14
Breast	1,287	49,136.35	26.19	2,196	100,738.05	21.80	1.20	1.12 to 1.29	< .01	1.13	1.06 to 1.22	< .01†
Chronic lymphocytic leukemia	92	2,152.52	42.74	168	4,610.00	35.97	1.19	0.92 to 1.53	.18	1.13	0.87 to 1.47	.34
Colon	345	10,667.78	32.34	444	36,360.00	12.16	1.26	1.16 to 1.36	.75	0.93	0.82 to 1.06	.30
Kidney	156	4,356.44	35.81	284	10,454.74	27.16	1.32	1.08 to 1.60	.01	1.24	1.02 to 1.51	.03
Lung and bronchus	218	3,437.07	63.43	478	15,702.53	37.55	1.69	1.44 to 1.98	< .01	1.58	1.30 to 1.90	< .01†
Melanoma	245	9,770.25	25.08	543	24,121.00	22.74	0.94	0.81 to 1.09	.42	0.94	0.80 to 1.09	.40
Multiple myeloma	90	1,356.70	66.34	157	4,214.76	35.24	1.81	1.39 to 2.34	< .01	1.70	1.31 to 2.21	< .01†
Non-Hodgkin lymphoma	256	6,490.77	39.44	437	15,247.46	28.66	1.38	1.18 to 1.61	< .01	1.41	1.20 to 1.65	< .01†
Ovary	77	3,234.80	23.80	135	7,921.00	17.10	1.39	1.05 to 1.84	.02	1.41	1.06 to 1.88	.02
Prostate	1,774	51,008.24	34.78	3,520	94,072.00	37.87	0.93	0.88 to 0.99	.02	0.89	0.84 to 0.95	< .01†
Rectum/rectosigmoid	145	5,390.93	26.90	304	11,577.31	20.26	1.02	0.84 to 1.25	.82	0.94	0.77 to 1.15	.55
Thyroid	66	5,192.31	12.71	151	10,041.90	15.23	0.83	0.62 to 1.11	.22	0.82	0.61 to 1.10	.19
Uterus	187	8,205.92	22.07	197	10,041.90	19.50	0.93	0.72 to 1.14	.68	0.98	0.81 to 1.17	.79

Breast
Lung
Multiple Myeloma
Kidney
Ovary
Non Hodgkin Lymphoma

Accelerated CVD Phenotype



Cancer Therapy: A “Multiple-Hit”



Current Assessments

“Whole-body” function

Performance status
measures (ECOG, KPS)

Cardiac function

Resting left ventricular
ejection fraction

Pulmonary function

PFT (FEV₁)

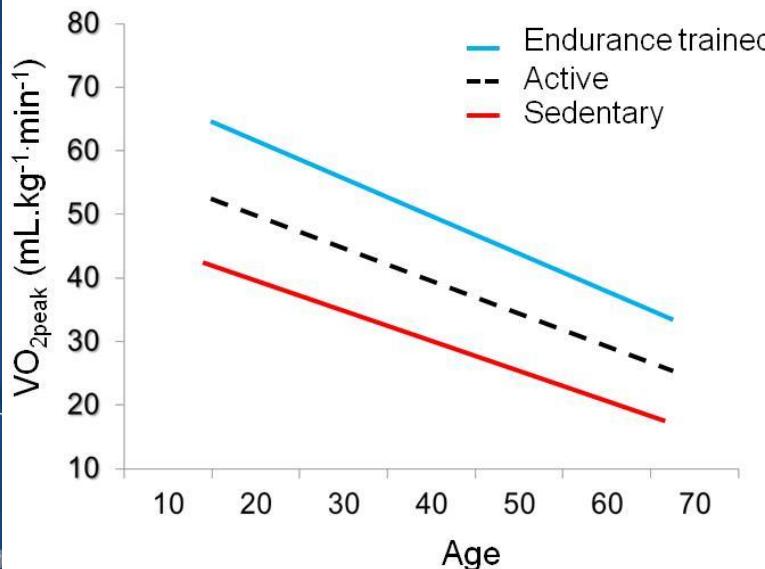
O₂ carrying capacity

Hemoglobin

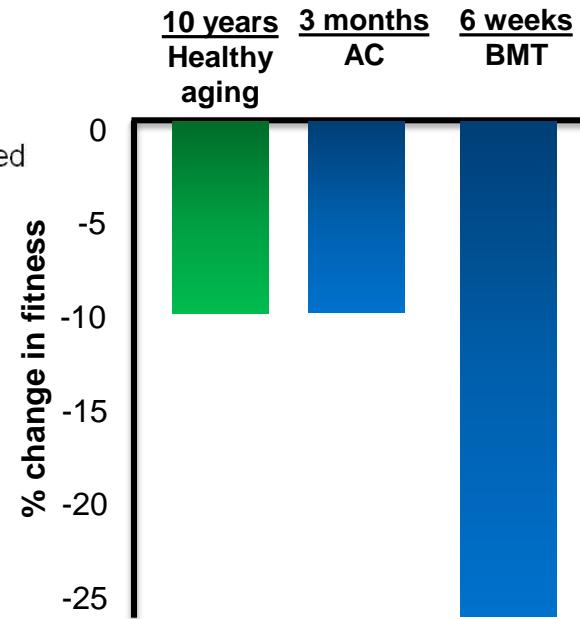
Multisystem Toxicity Assessment

Symptom limited cardiopulmonary exercise test

Cardiorespiratory fitness ($\text{VO}_{2\text{peak}} - \text{mL}\cdot\text{kg}^{-1}\text{min}^{-1}$)



Cardiopulmonary exercise test

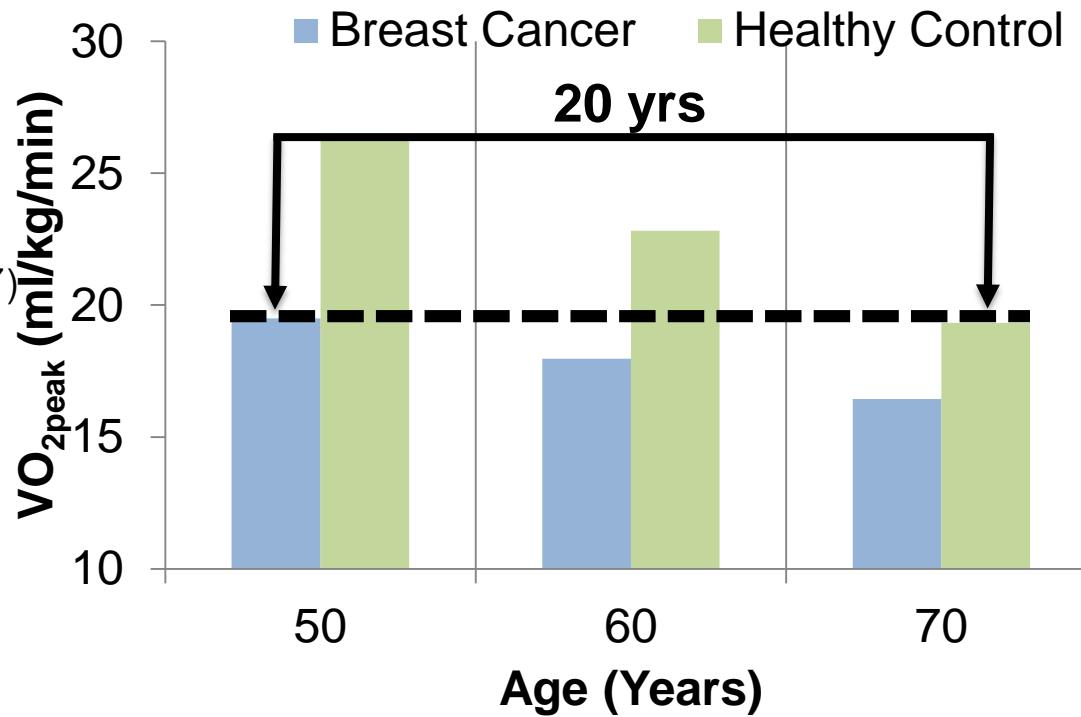


- ‘Accelerated’ CV / physiological aging

Persistent Multisystem Toxicity

$\text{VO}_{2\text{peak}}$ assessed in:

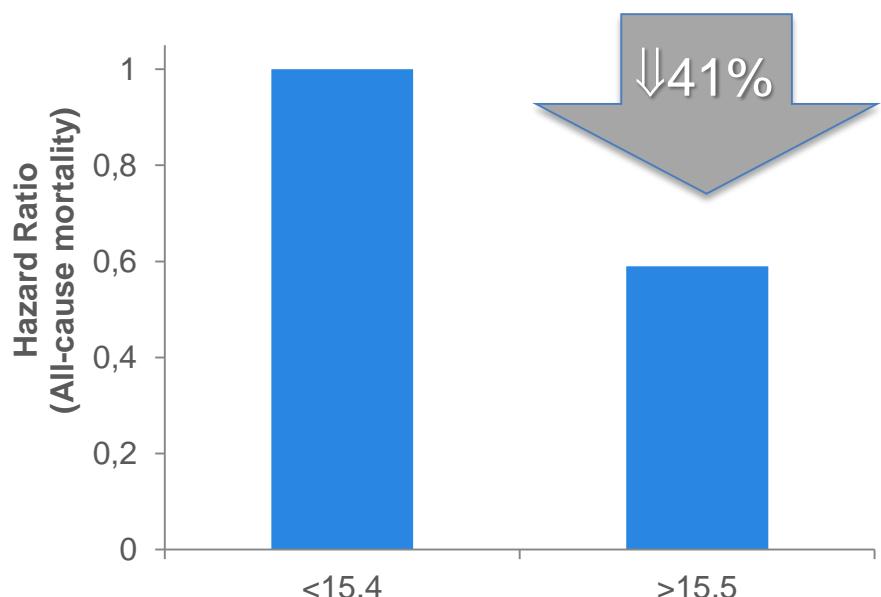
1. Breast cancer survivors
(n=140; ~3 yrs post-therapy)
2. Healthy age-matched controls (n=107)



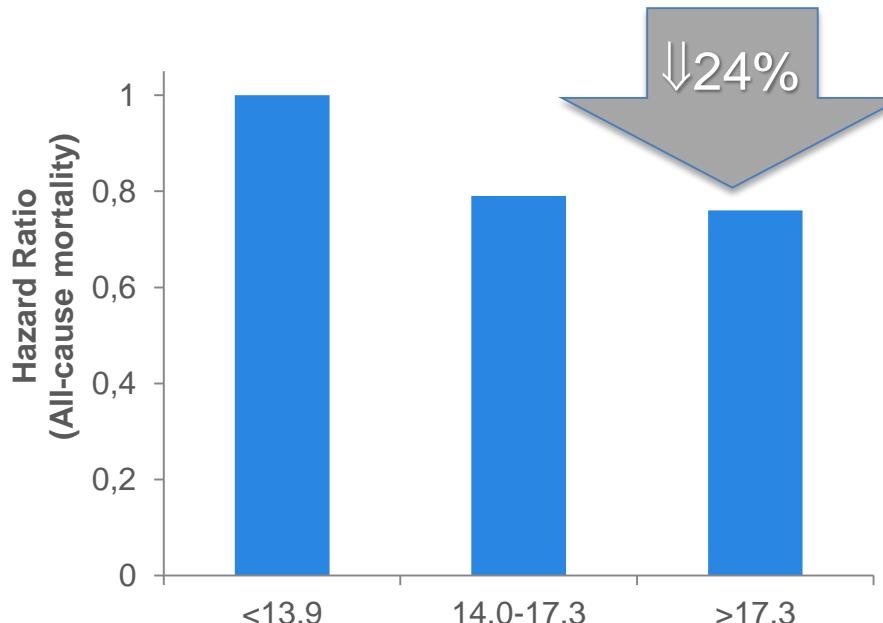
- $\text{VO}_{2\text{peak}}$ does not recover post treatment

Prognostic Importance of VO₂peak

- Metastatic BC
- (n=52; median follow-up 122 months)

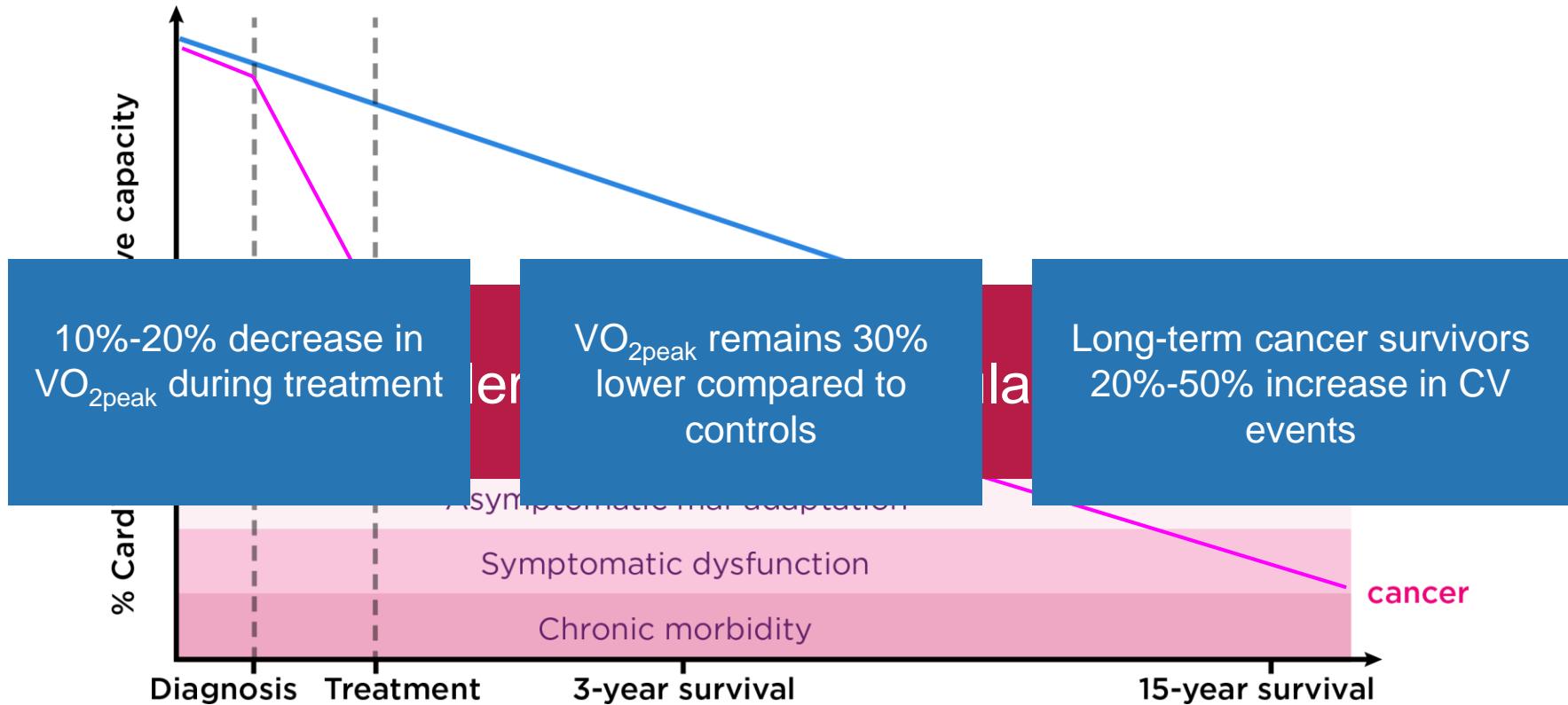


- NSCLC
- (n=398; median follow-up 31 months)

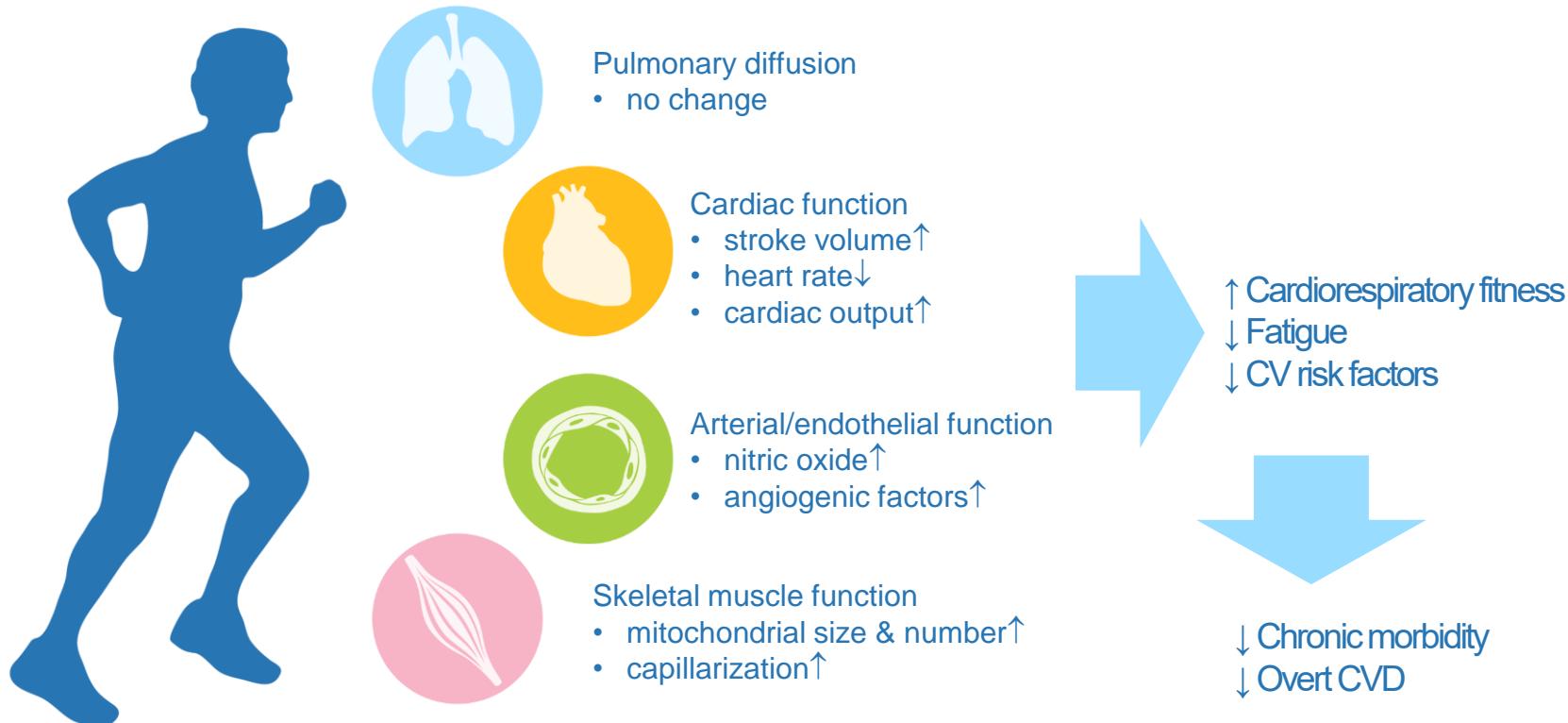


- VO₂peak *independent predictor of survival*

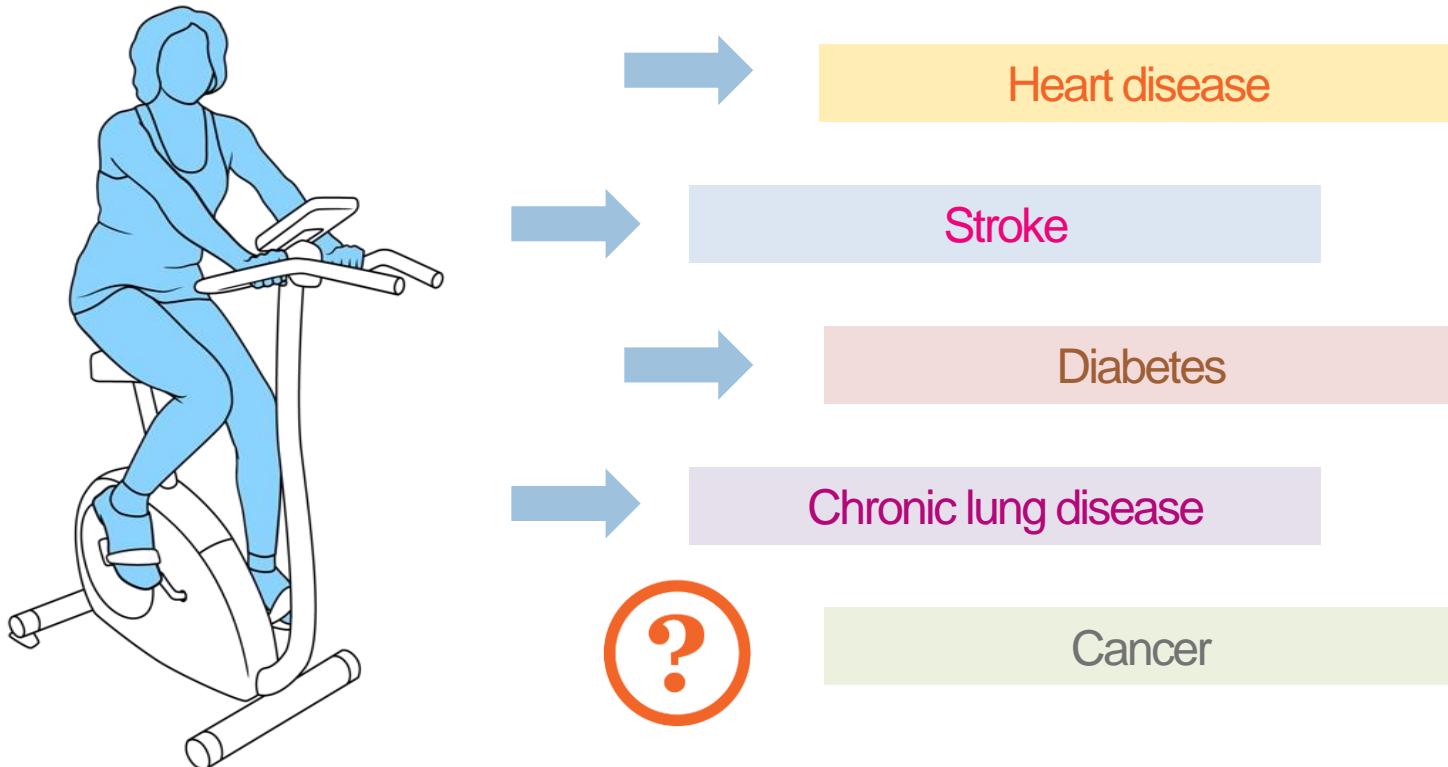
Multi-system Decline



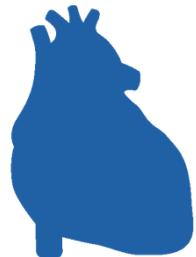
Exercise Training to Off-Set the Multiple-Hit



Exercise: Standard of Care in Chronic Disease



Major Exercise-Oncology Objectives



Cardiovascular side-effects

Effects on prevention & treatment of cancer therapy-induced side-effects



Cancer treatment

Effects on cancer incidence & progression

Acknowledgements

MSK Exercise-Oncology Team





Memorial Sloan Kettering
Cancer Center™

The Rationale for Exercise-Oncology

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