Fitness
&
Enfermedades Crónicas

John Duperly MD, PhD

Director – Instituto de Medicina del Ejercicio - FSFB

Profesor Asociado Universidad de los Andes


Nalini
PINARELLO
movistar

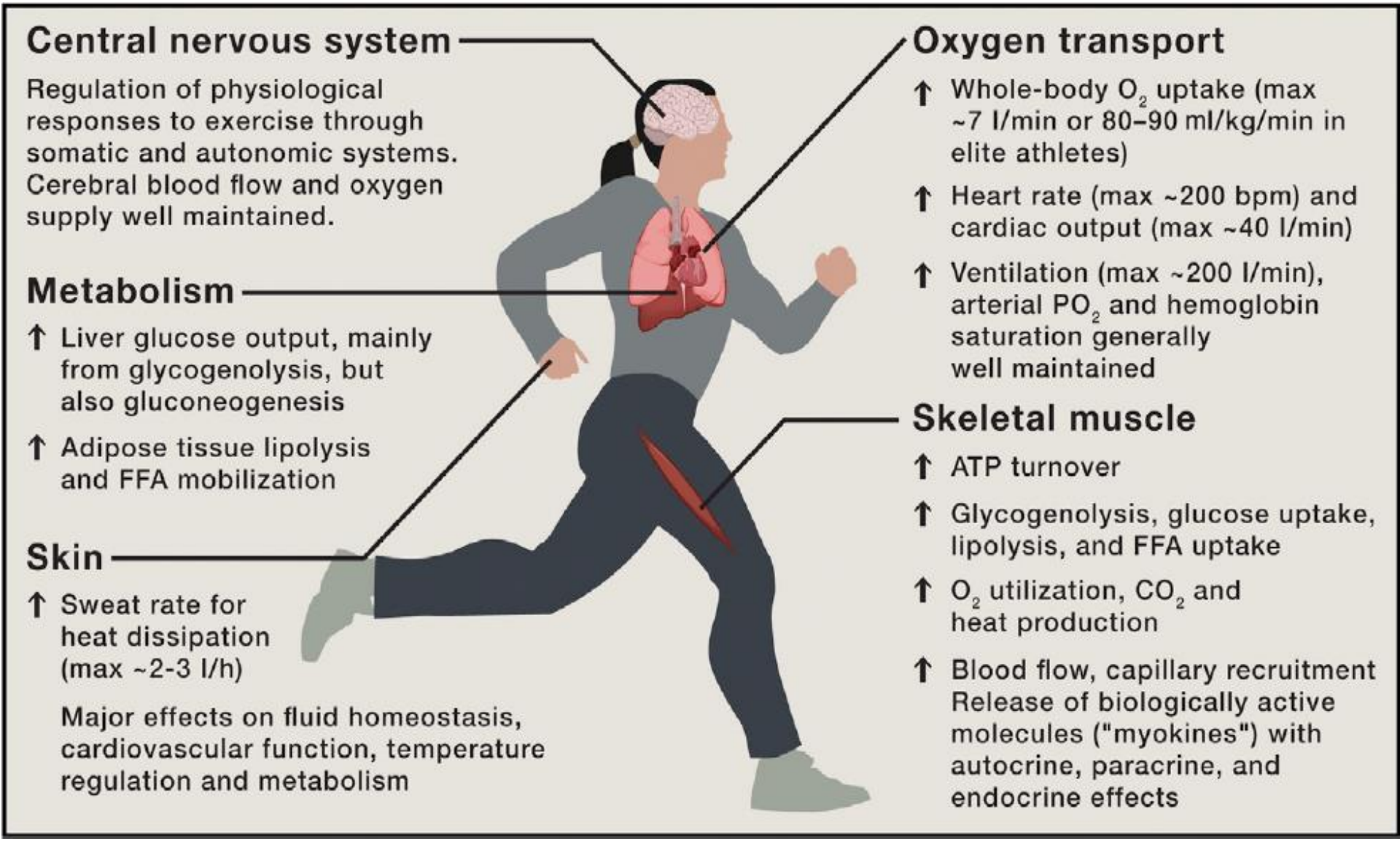

RUZ 2014
DEL CARIBE

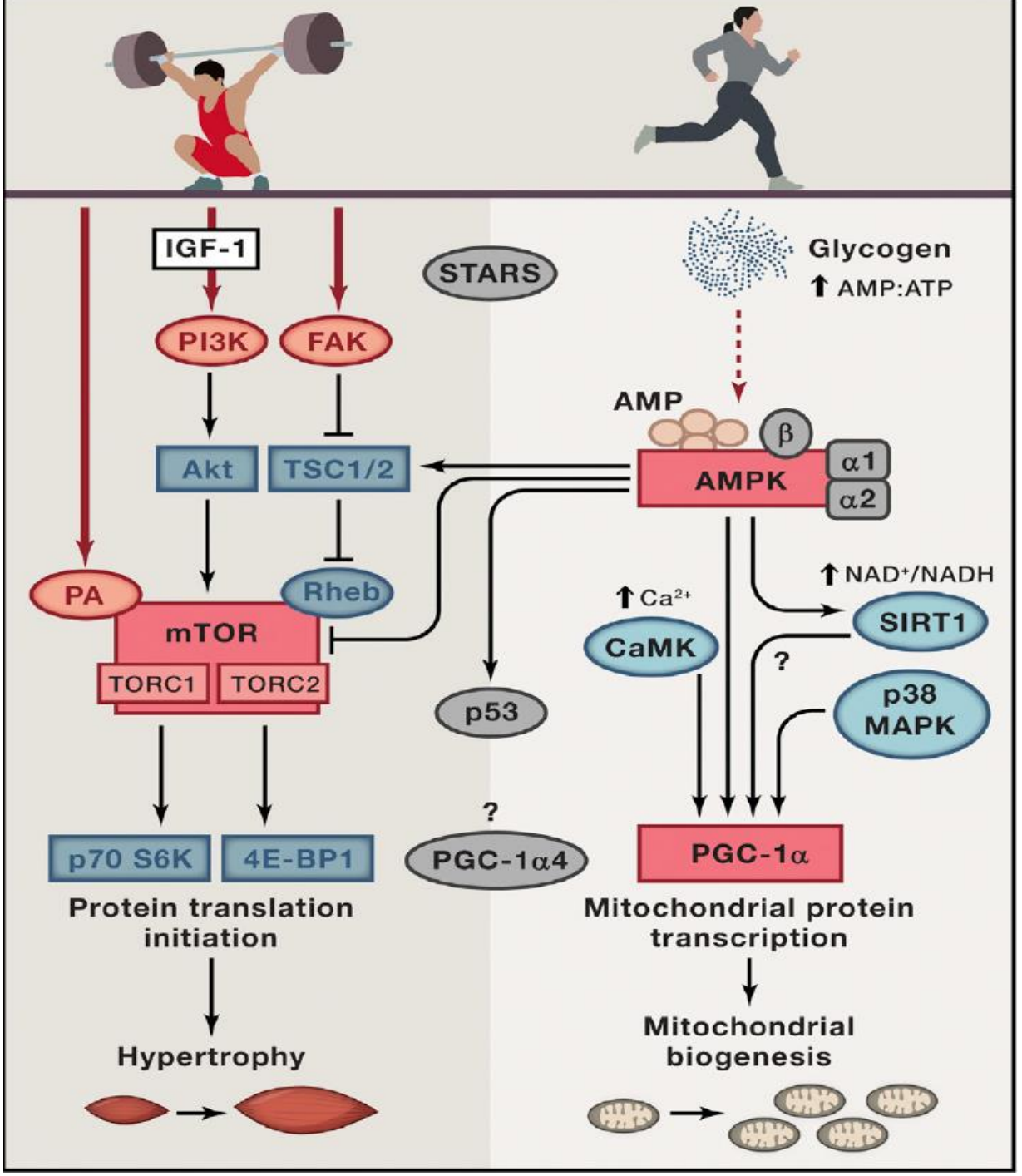

TORONTO 2015

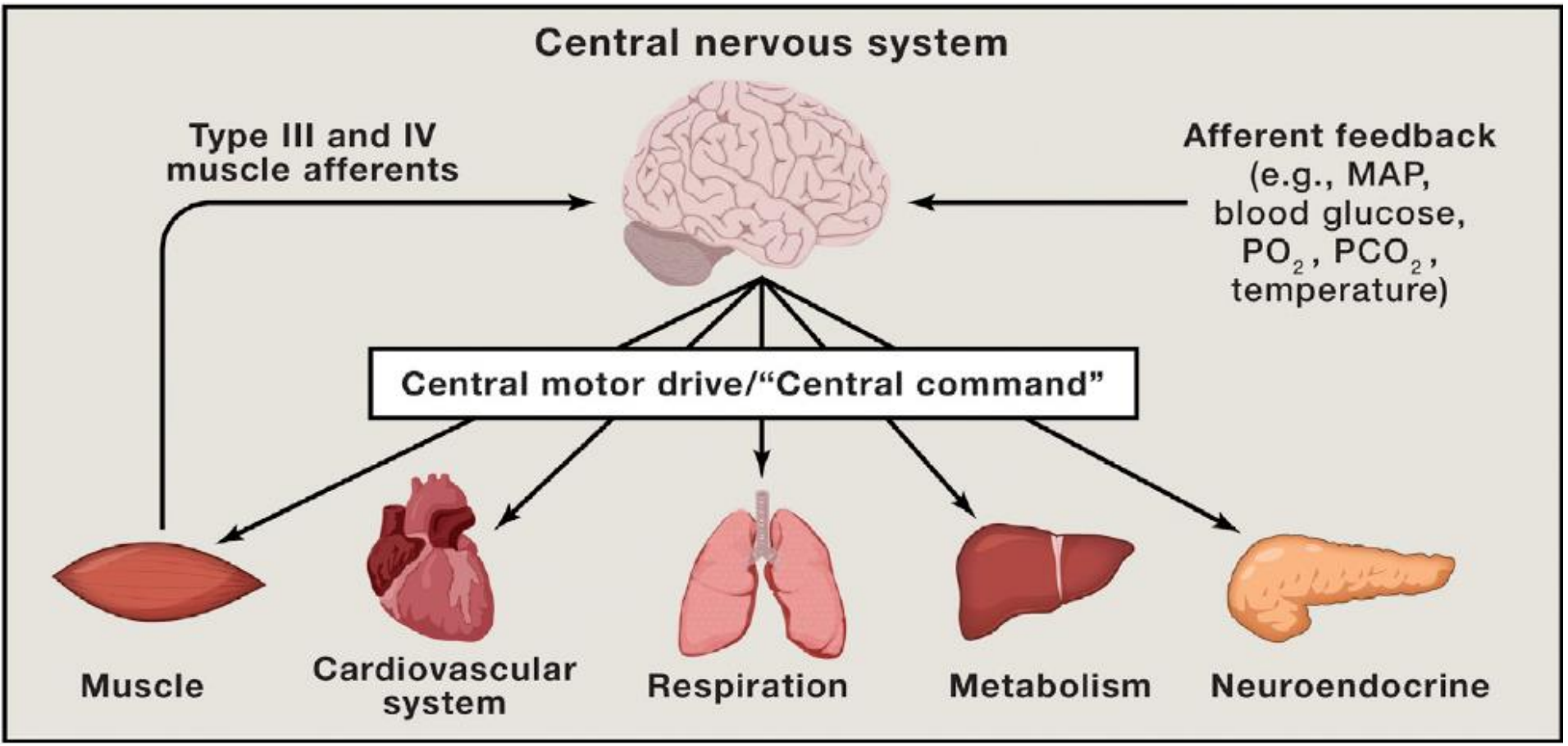

adidas
10

“Un agente hipolipemiante, antihipertensivo, inotrópico positivo, cronotrópico negativo, vasodilatador, diurético, anorexígeno, reductor de peso, catártico, hipoglicemiante, ansiolítico, hipnótico y con cualidades antidepresivas”

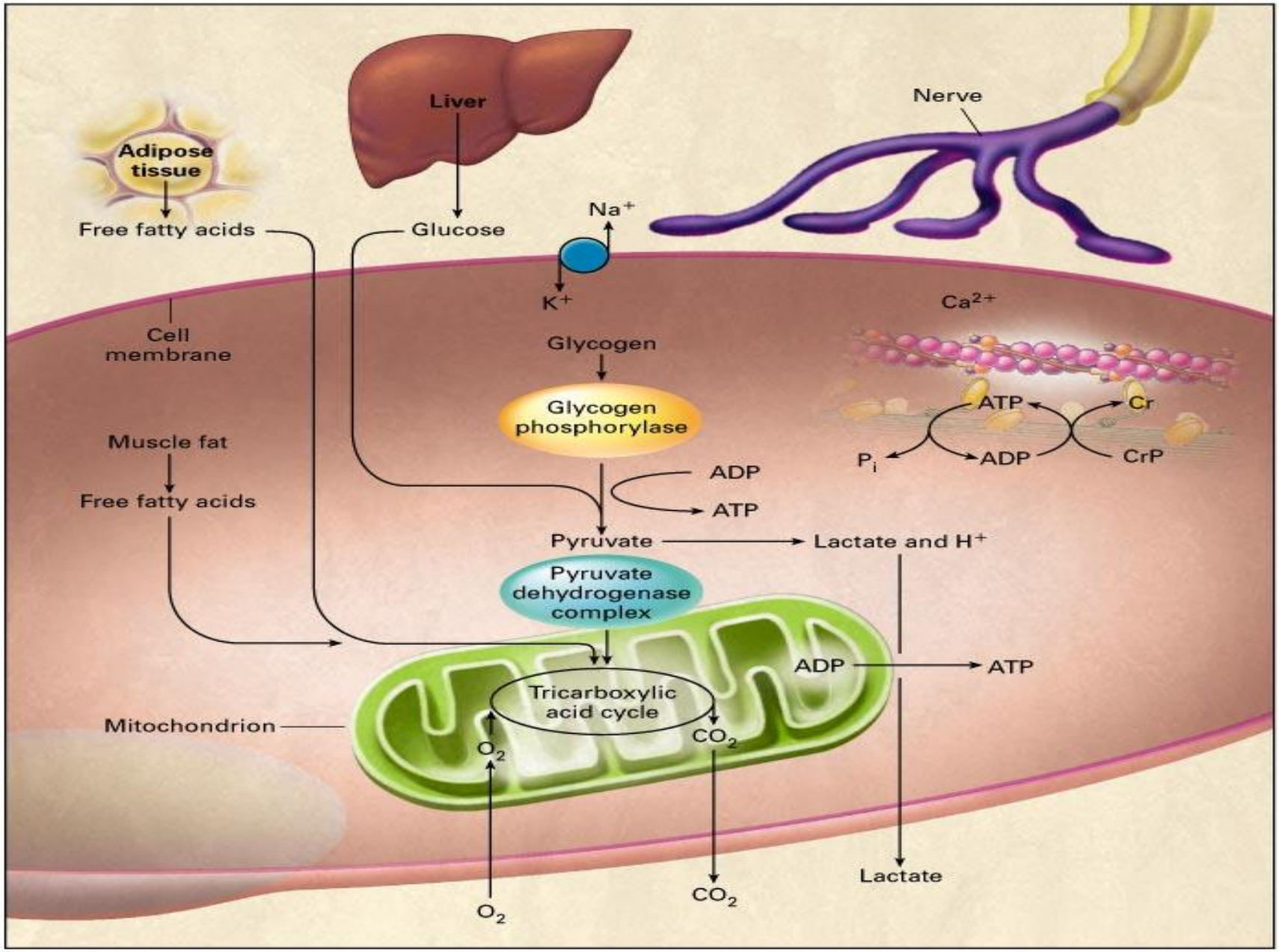
William C. Roberts - Editor in Chief
American Journal of Cardiology, 1984; 53: 261-262

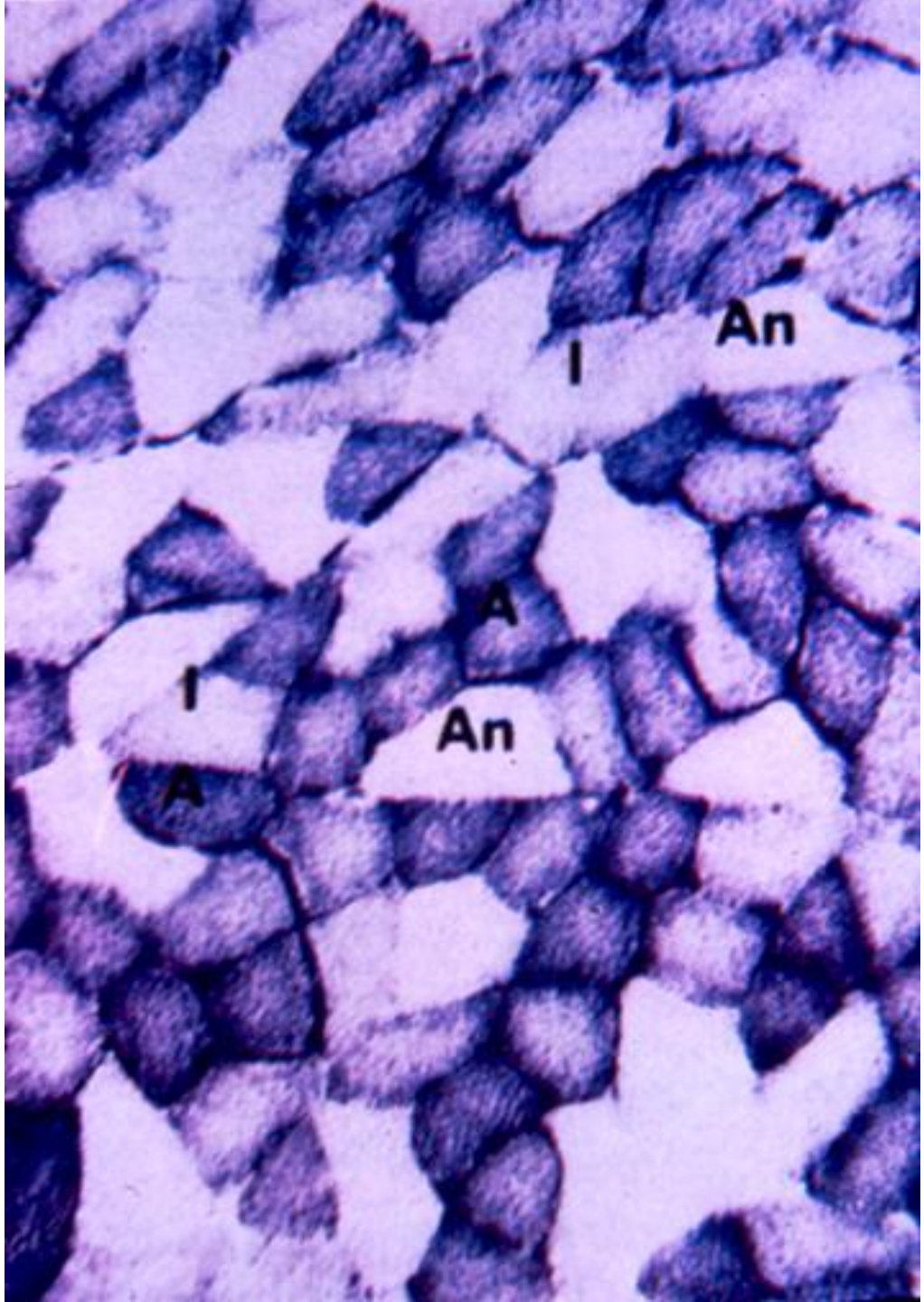

Central nervous system
Regulation of physiological responses to exercise through somatic and autonomic systems. Cerebral blood flow and oxygen supply well maintained.
Metabolism
↑ Liver glucose output, mainly from glycogenolysis, but also gluconeogenesis
↑ Adipose tissue lipolysis and FFA mobilization
Skin
↑ Sweat rate for heat dissipation (max ~2-3 l/h)
Major effects on fluid homeostasis, cardiovascular function, temperature regulation and metabolism
Oxygen transport
↑ Whole-body O_2 uptake (max ~7 l/min or 80–90 ml/kg/min in elite athletes)
↑ Heart rate (max ~200 bpm) and cardiac output (max ~40 l/min)
↑ Ventilation (max ~200 l/min), arterial PO_2 and hemoglobin saturation generally well maintained
Skeletal muscle
↑ ATP turnover
↑ Glycogenolysis, glucose uptake, lipolysis, and FFA uptake
↑ O_2 utilization, CO_2 and heat production
↑ Blood flow, capillary recruitment
Release of biologically active molecules ("myokines") with autocrine, paracrine, and endocrine effects


IGF-1
PI3K
FAK
Akt
TSC1/2
PA
Rheb
mTOR
TORC1
TORC2
p70 S6K
4E-BP1
Protein translation initiation
Hypertrophy
STARS
p53
?
PGC-1α4
Glycogen
↑ AMP:ATP
AMP
β
AMPK
α1
α2
↑ NAD+/NADH
↑ Ca2+
CaMK
SIRT1
?
p38 MAPK
PGC-1α
Mitochondrial protein transcription
Mitochondrial biogenesis


Central nervous system
Type III and IV muscle afferents
Afferent feedback (e.g., MAP, blood glucose, PO_2, PCO_2, temperature)
Central motor drive/"Central command"
Muscle
Cardiovascular system
Respiration
Metabolism
Neuroendocrine

Metabolismo Muscular

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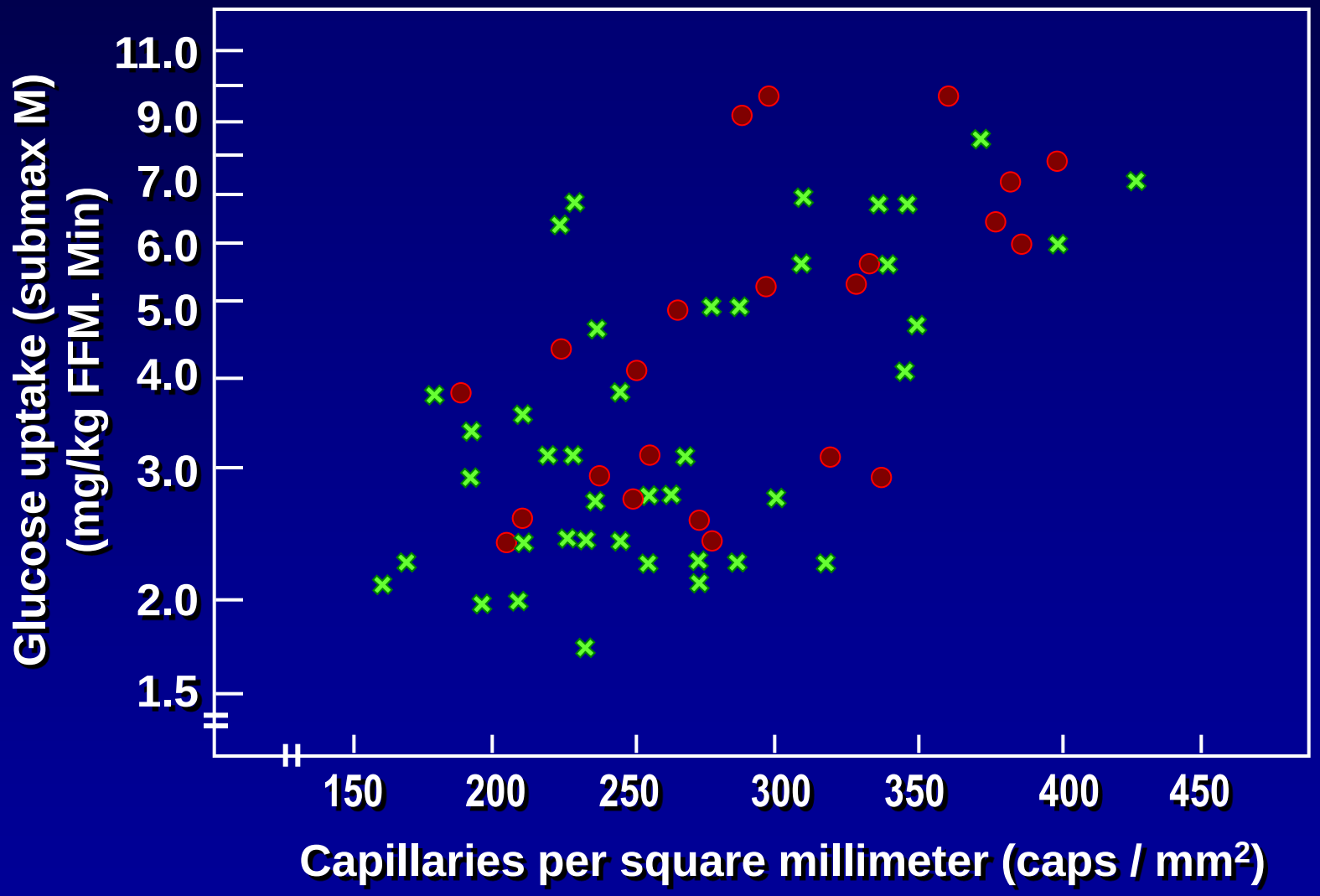
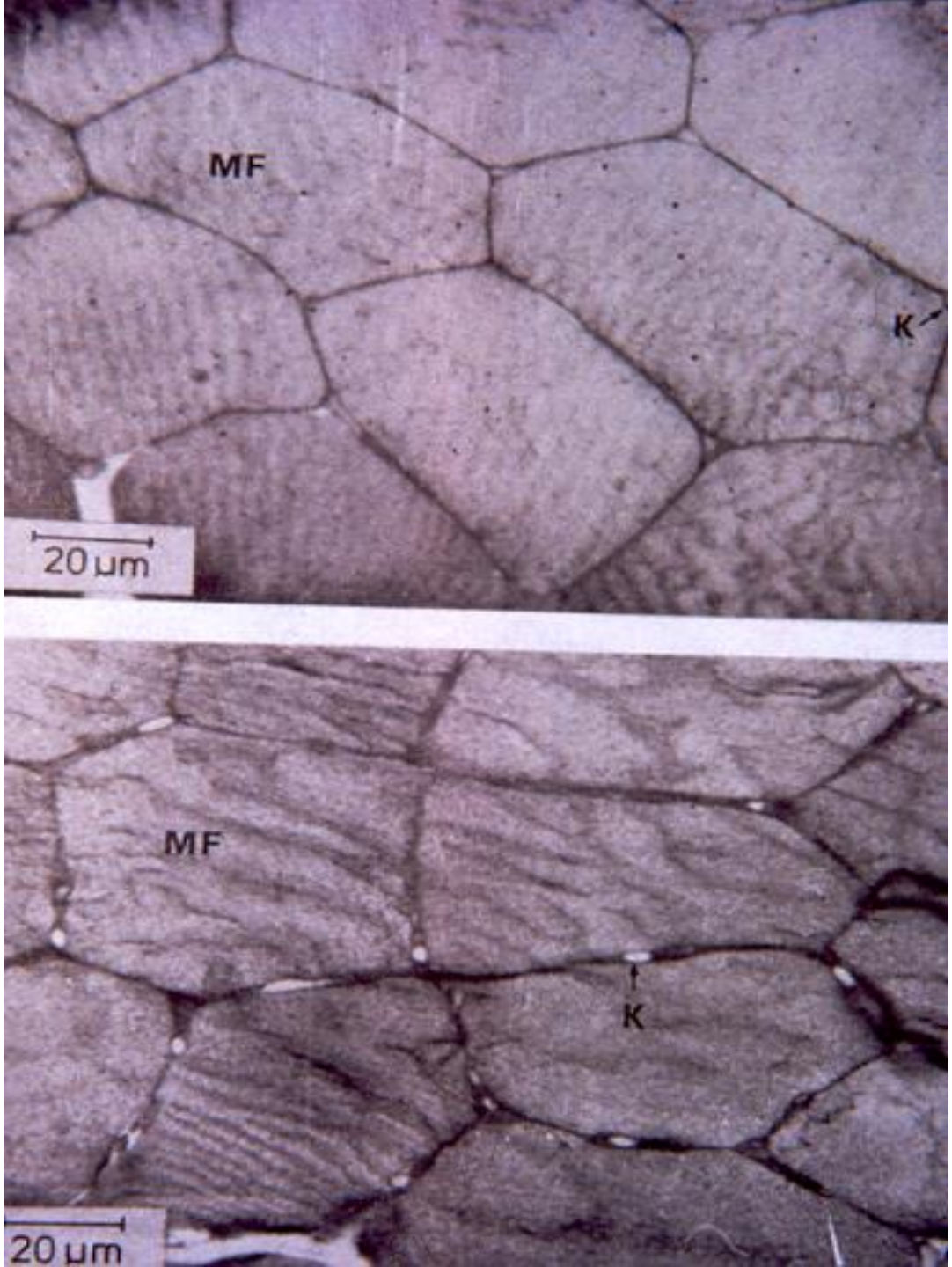
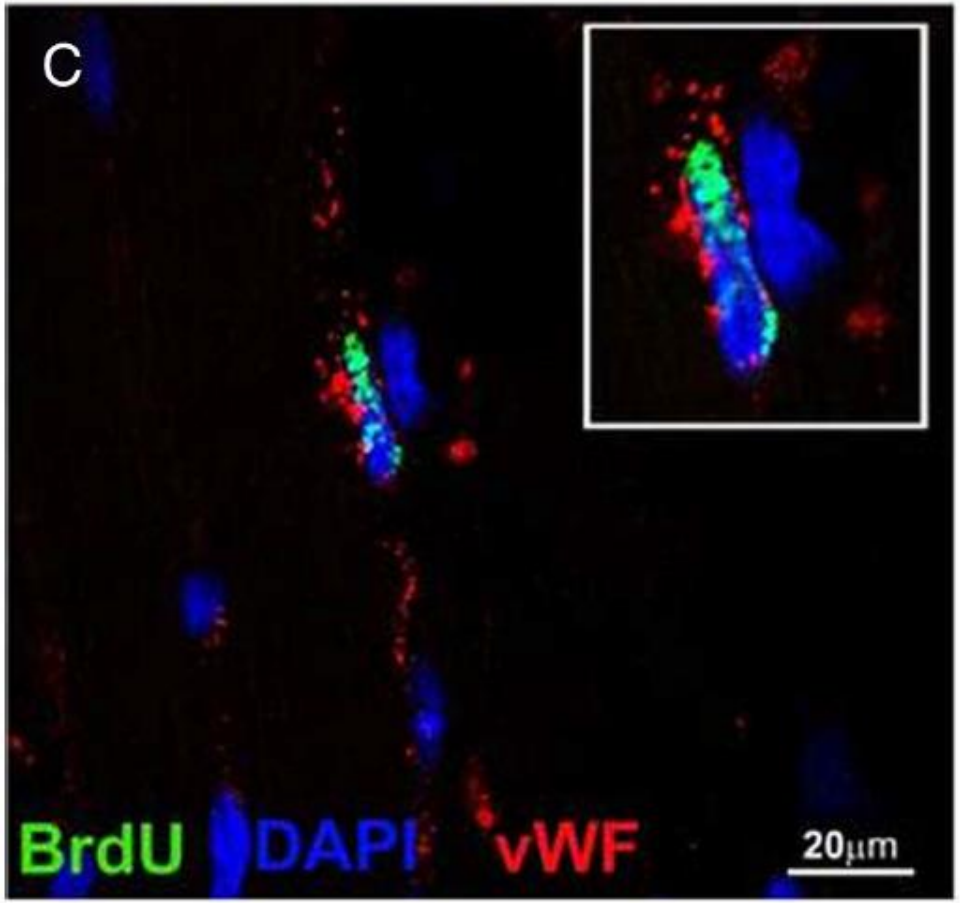
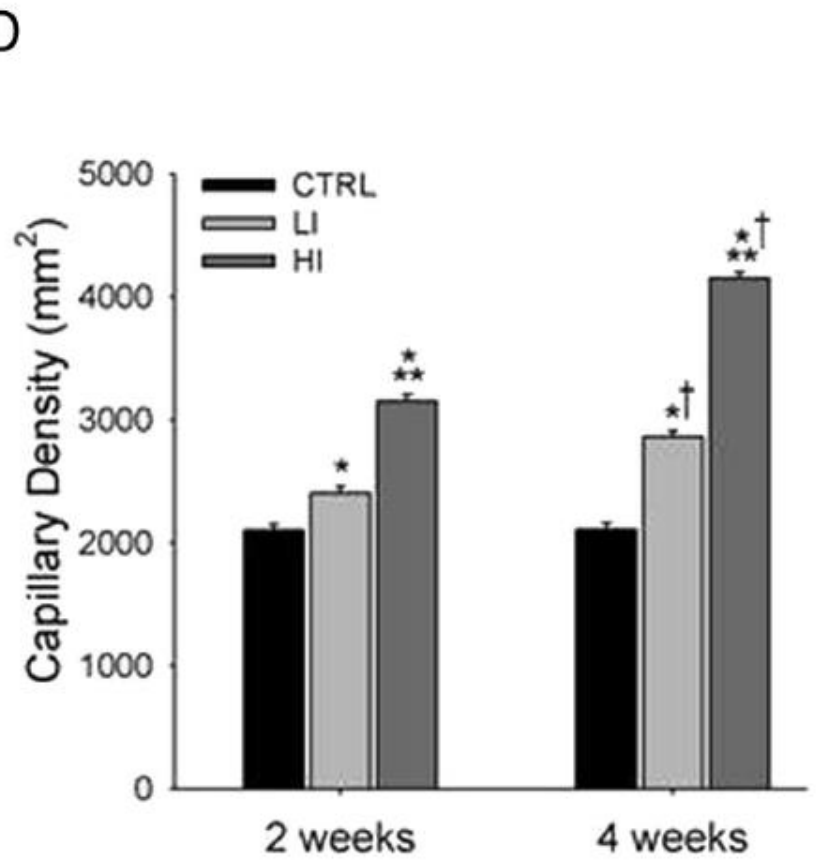

Glucose uptake (submax M)
(mg/kg FFM. Min)
11.0
9.0
7.0
6.0
5.0
4.0
3.0
2.0
1.5
150
200
250
300
350
400
450
Capillaries per square millimeter (caps / mm²)

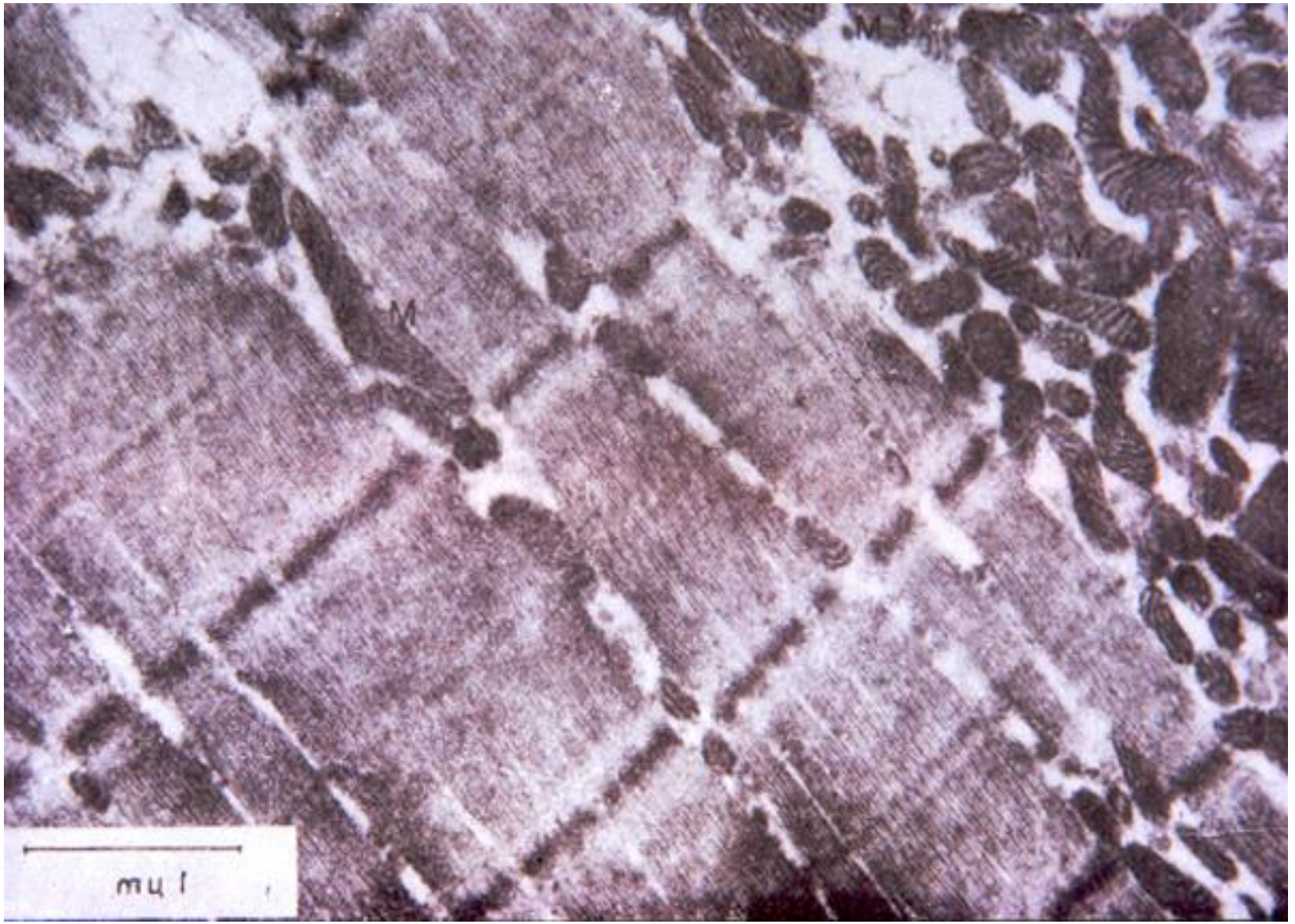

MF
K
20 µm
MF
K
20 µm

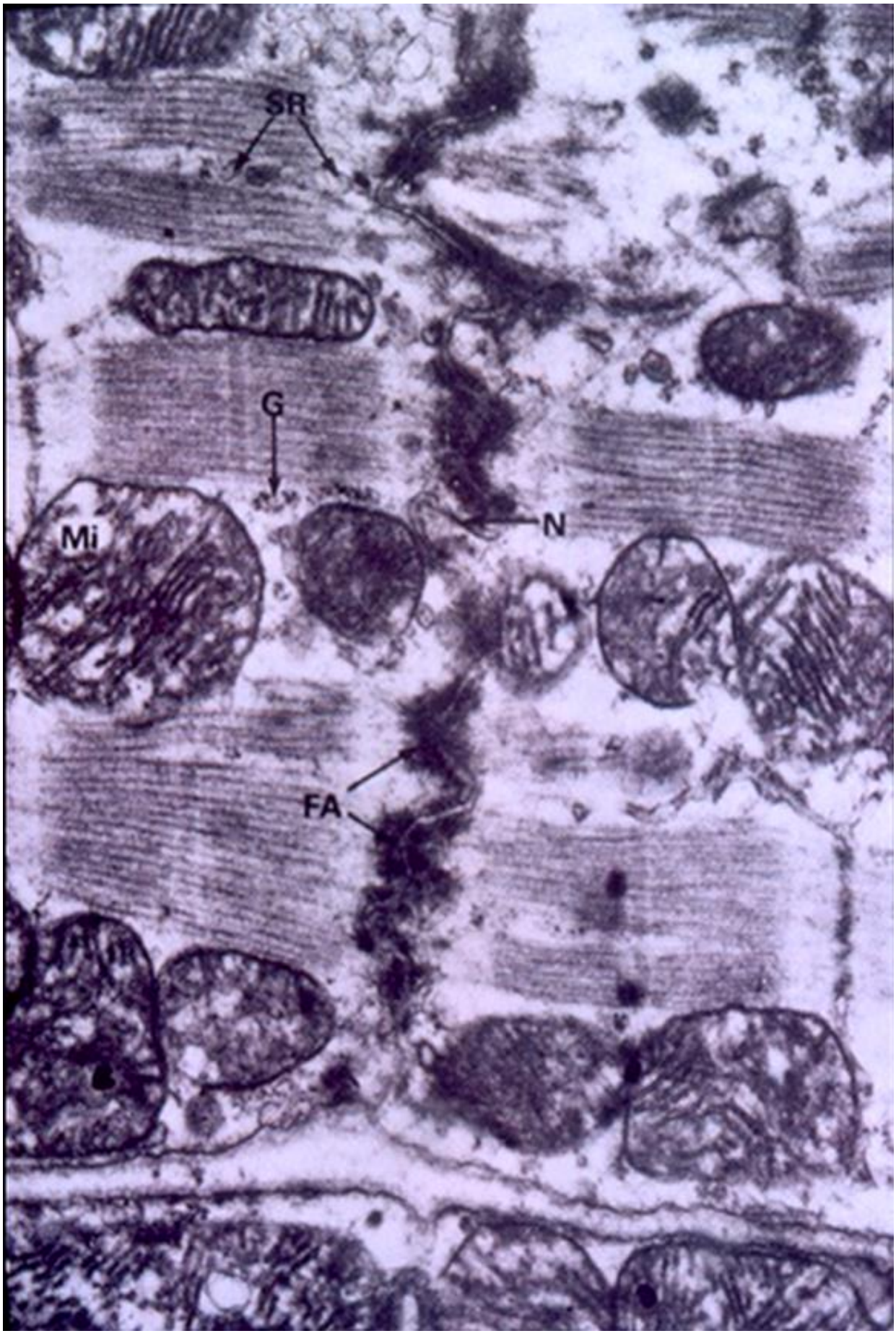
Basic science behind the cardiovascular benefits of exercise

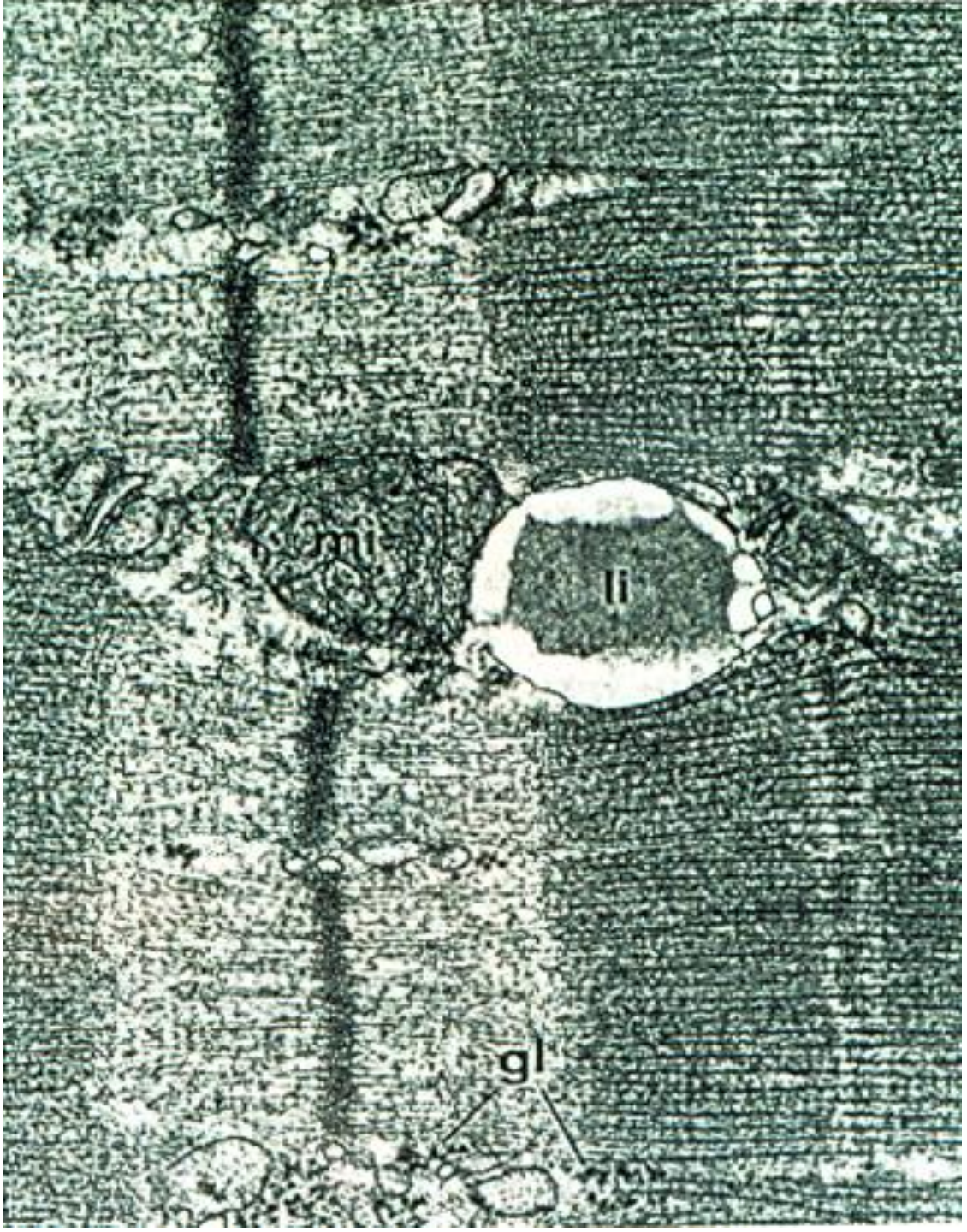


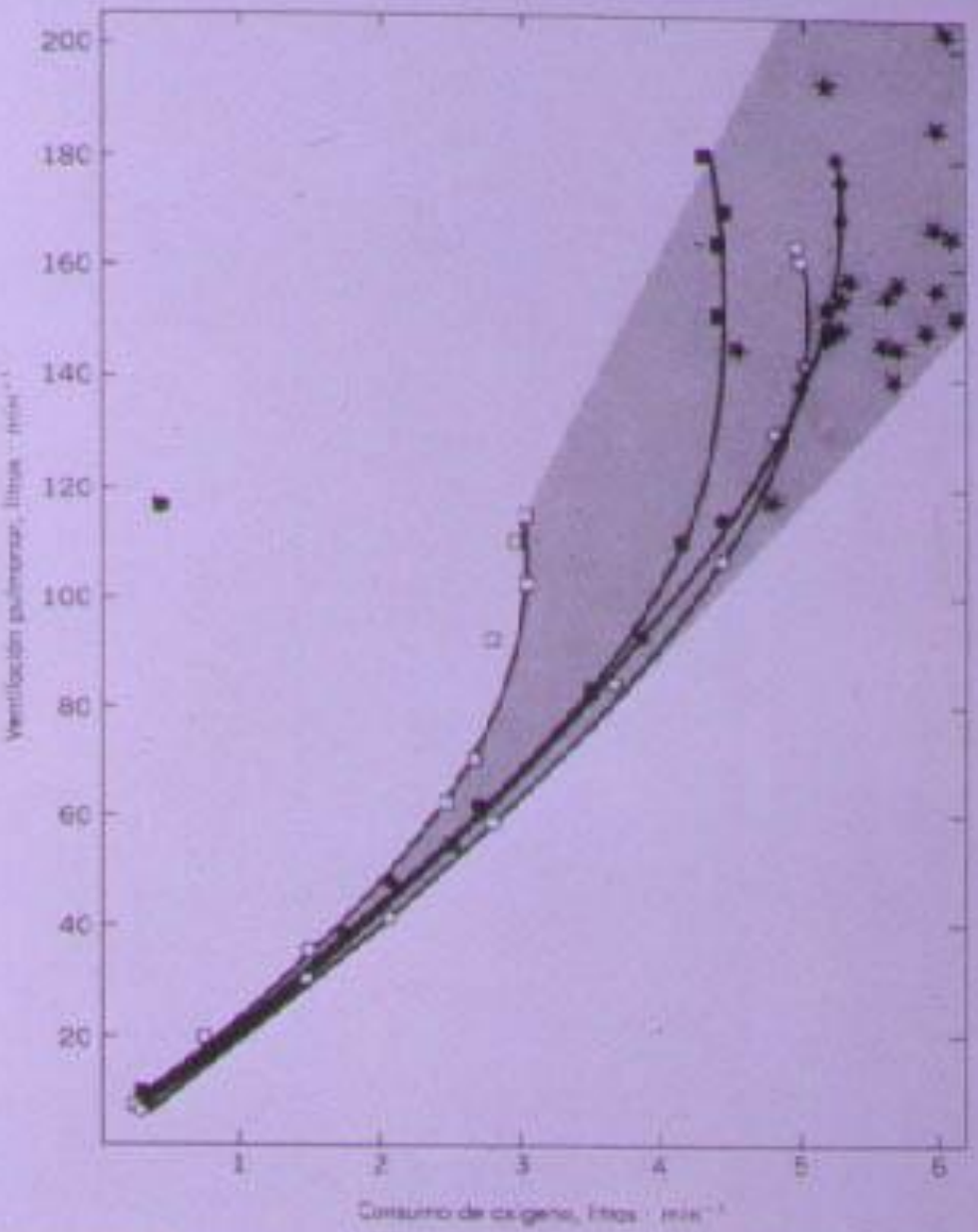


Wilson MG, *et al*. *Heart* 2015;**101**:758–765.


M
M
M
mμ l


SR
G
Mi
N
FA


mi
li
gl

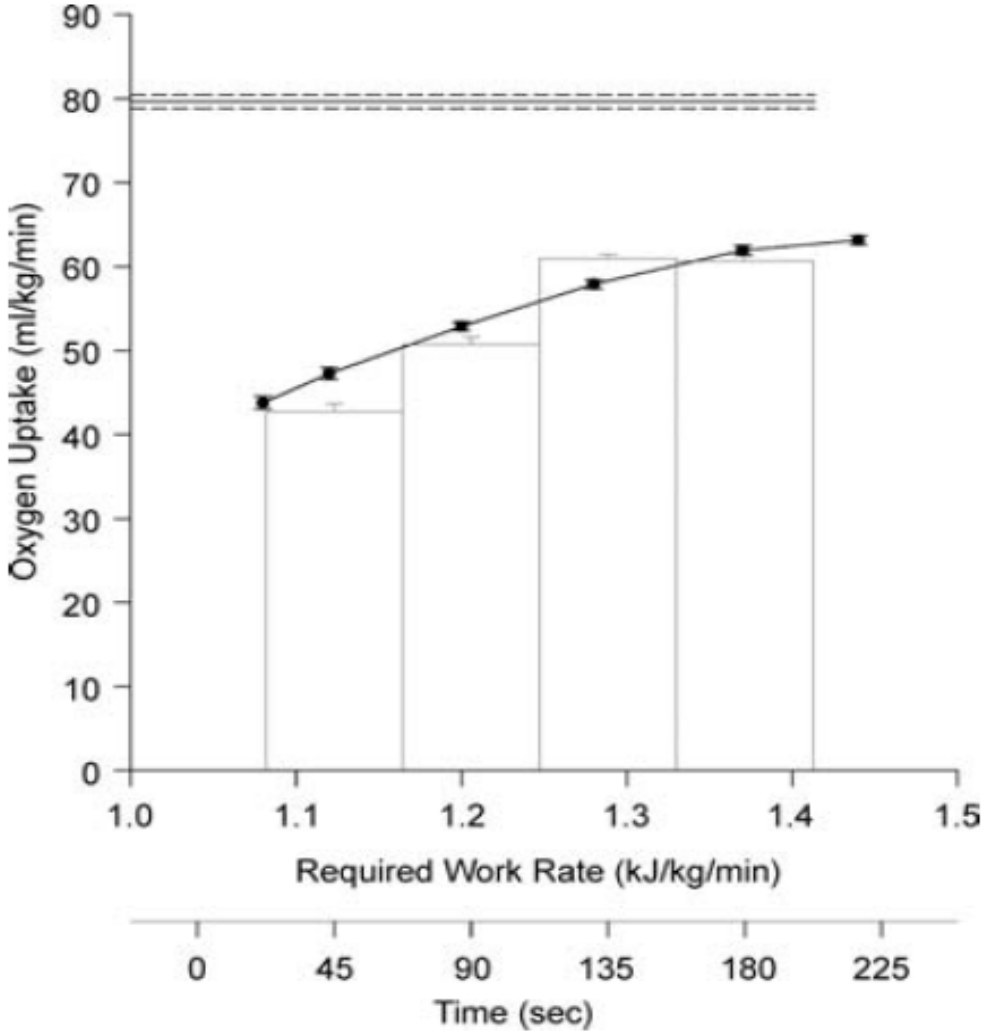

Ventilacion Pulmonar L / min
200
180
160
140
120
100
80
60
40
20
1
2
3
4
5
6
Consumo de Oxígeno L / min

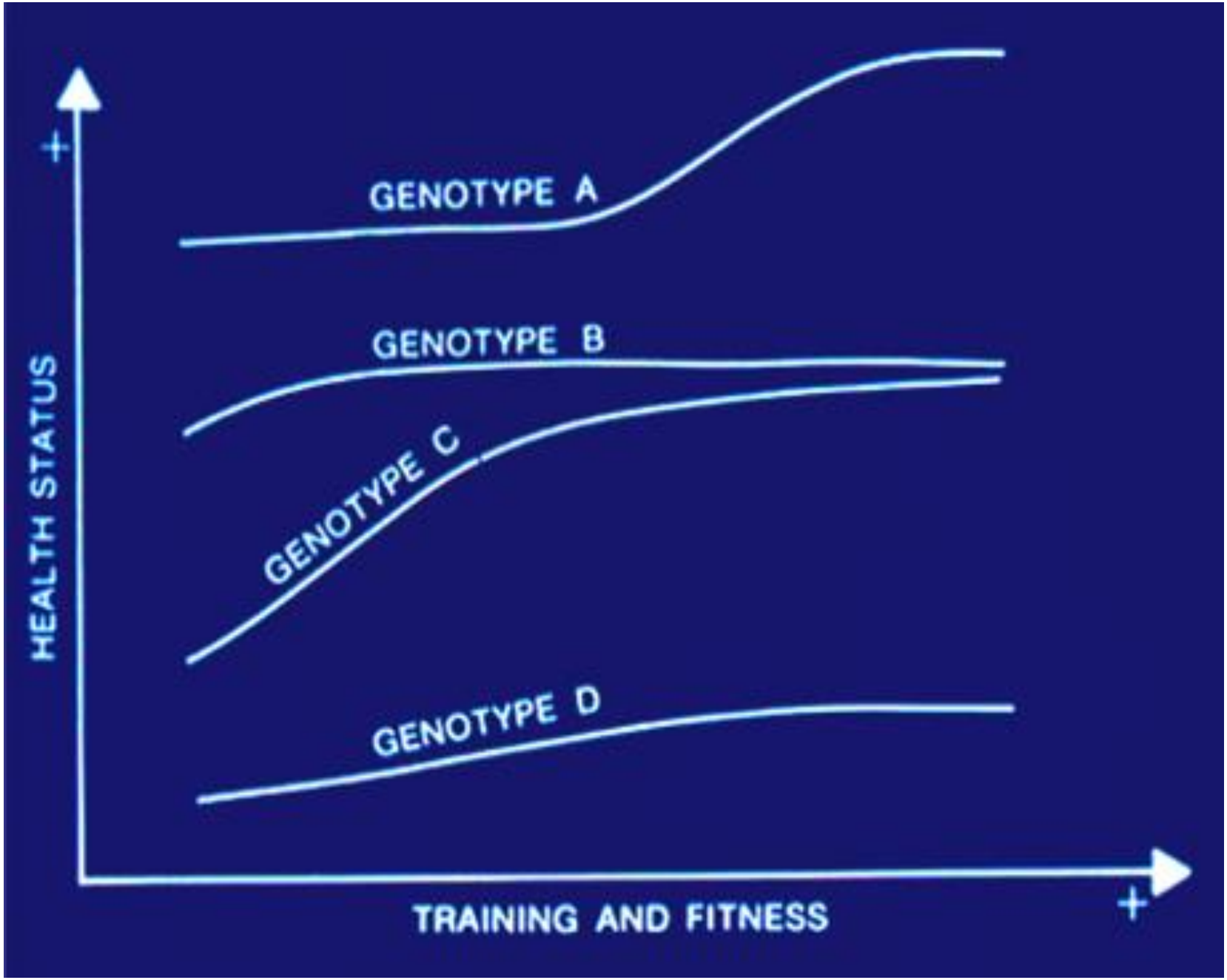
J Physiol 586.1 (2008) pp 25–34

TOPICAL REVIEW

$\dot{V}_{O_2,max}$: what do we know, and what do we still need to know?

Benjamin D. Levine




HEALTH STATUS
+
GENOTYPE A
GENOTYPE B
GENOTYPE C
GENOTYPE D
TRAINING AND FITNESS
+

Respuesta Fisiológica al Ejercicio Principios Básicos

- ESPECIFICIDAD
- SOBRECARGA
- REVERSIBILIDAD
- VALORES INICIALES / BASALES
- RESPUESTA BIOLOGICA INDIVIDUAL

Med Sci Sports Exerc 1995; 27: i-vii

REVIEW Open Access

Genes to predict VO_{2max} trainability: a systematic review

Camilla J. Williams[1], Mark G. Williams[2], Nir Eynon[3*], Kevin J. Ashton[4], Jonathan P. Little[5], Ulrik Wisloff[1,6] and Jeff S. Coombes[1]

97 genes posibles predictores de la "entrenabilidad" del VO2max

Conclusion: Ninety-seven genes have been identified as possible predictors of VO_{2max} trainability. To verify the strength of these findings and to identify if there are more genetic variants and/or mediators, further tightly-controlled studies that measure a range of biomarkers across ethnicities are required.

“Una obligación en atención primaria:

prescribir actividad fisica a todo patiente para reducir el riesgo de enfermedades crónicas”

Mayo Clin Proc. 2002 Feb;77(2):165-73.

Contribution of risk factors to achieving the 25 × 25 non-communicable disease mortality reduction target: a modelling study

Cardiovascular & Respiratory Disease, Cáncer, Diabetes

37 million premature deaths in 15 years

Risk Factors:

Physical Inactivity
Tobacco
Malnutrition
Alcohol

THE LANCET May 3; 2014

US Endocrinology

Volume 9 • Issue 1 • Summer 2013 • Extract

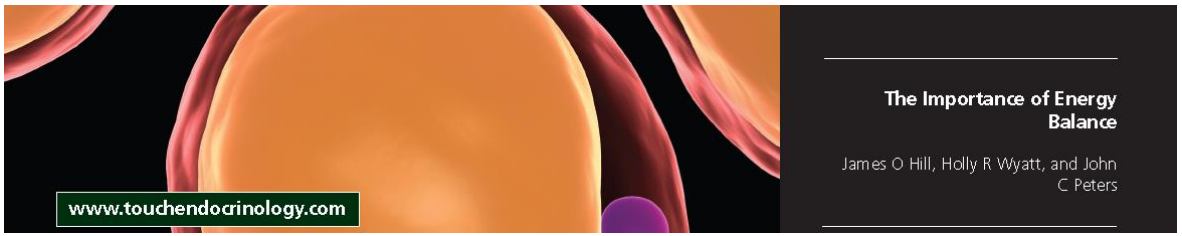
What is Causing the Worldwide Rise in Body Weight?

Robin P Shook, PhD,[1] Steven N Blair, PED,[2] John Duperly, MD, PhD,[3] Gregory A Hand, PhD, MPH,[4] Sandra M Matsudo, MD, PhD[5] and Joanne L Slavin, PhD, RD[6]

The Importance of Energy Balance

James O Hill, PhD, Holly R Wyatt, MD and John C Peters, PhD

Anschutz Health & Wellness Center, University of Colorado, Aurora, CO



Physical Inactivity

↓

Visceral fat accumulation

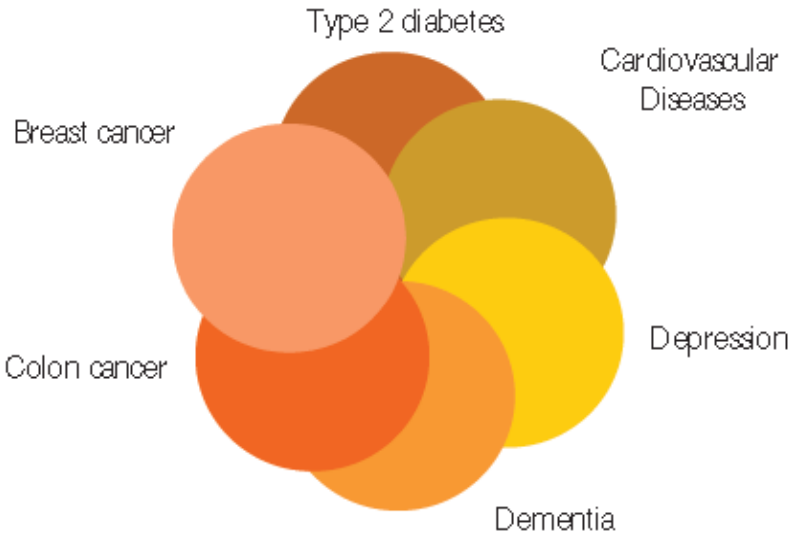
↓

Chronic Systemic Inflammation

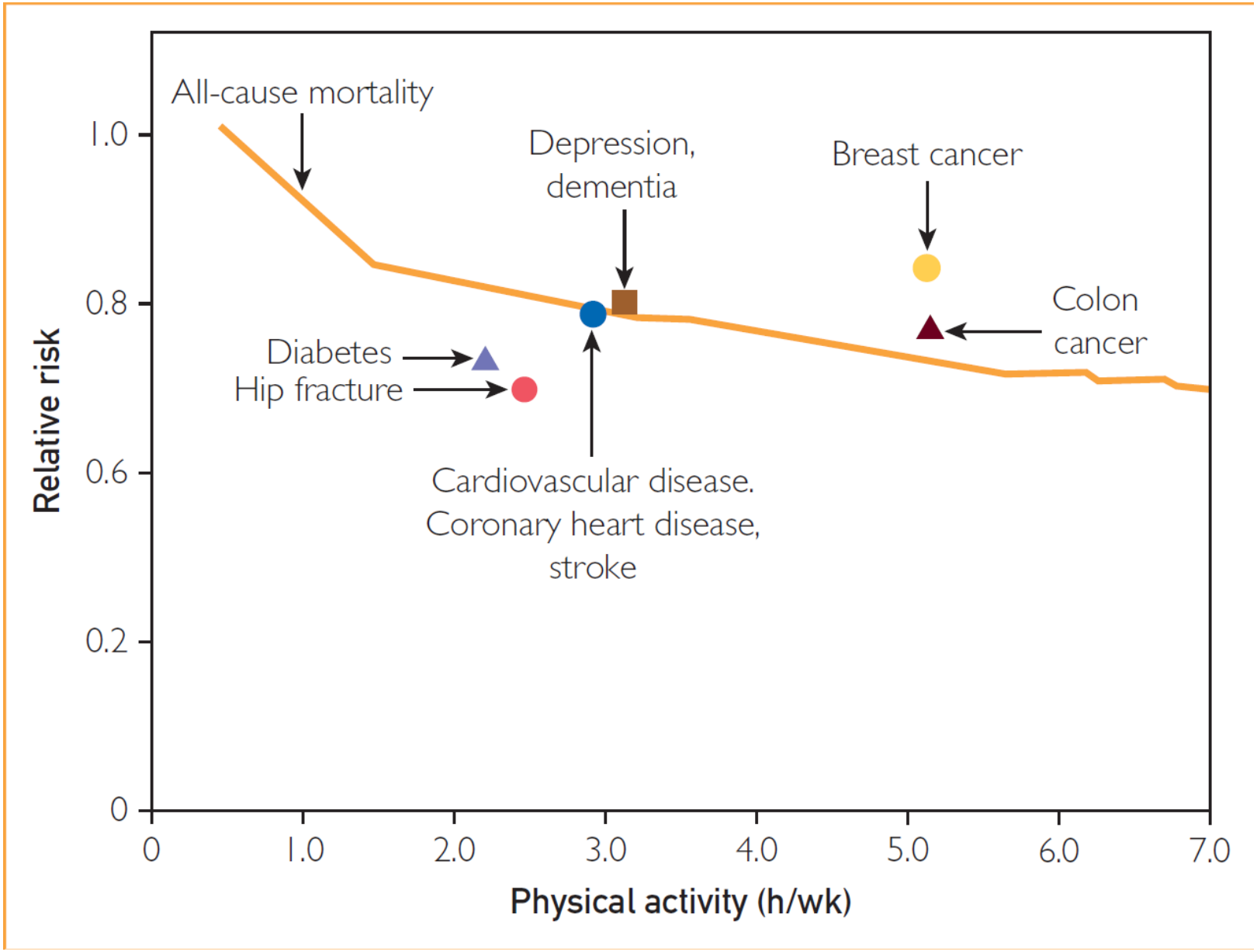
↓

Insulin Resistance, Atherosclerosis, Neurodegeneration, Tumour growth

↓



Physical Activity Promotion in the Health Care System



Ilkka M. Vuori, MD, PhD; Carl J. Lavie, MD; and Steven N. Blair, PED Mayo Clin Proc. 2013;88(12):1446-1461

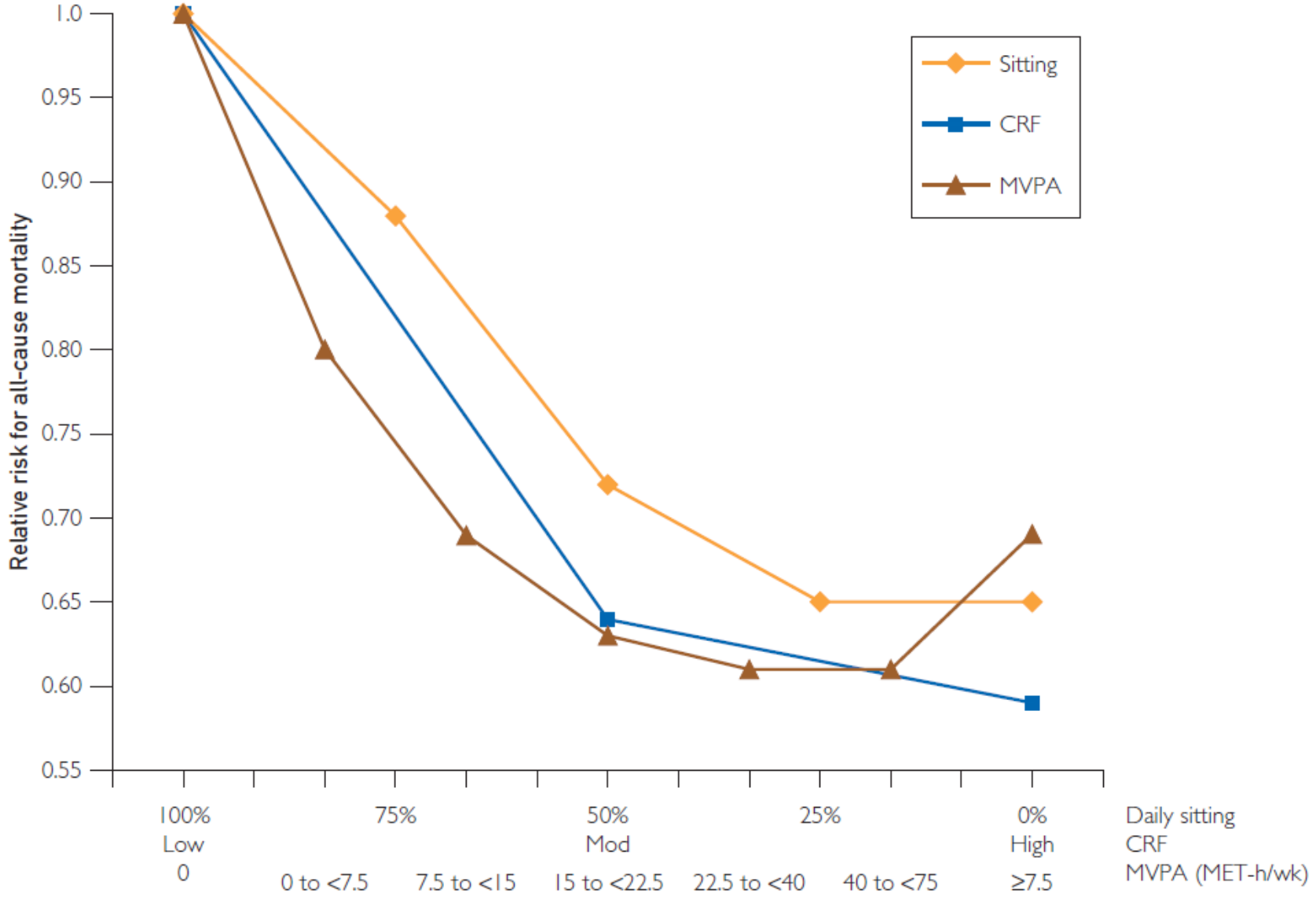
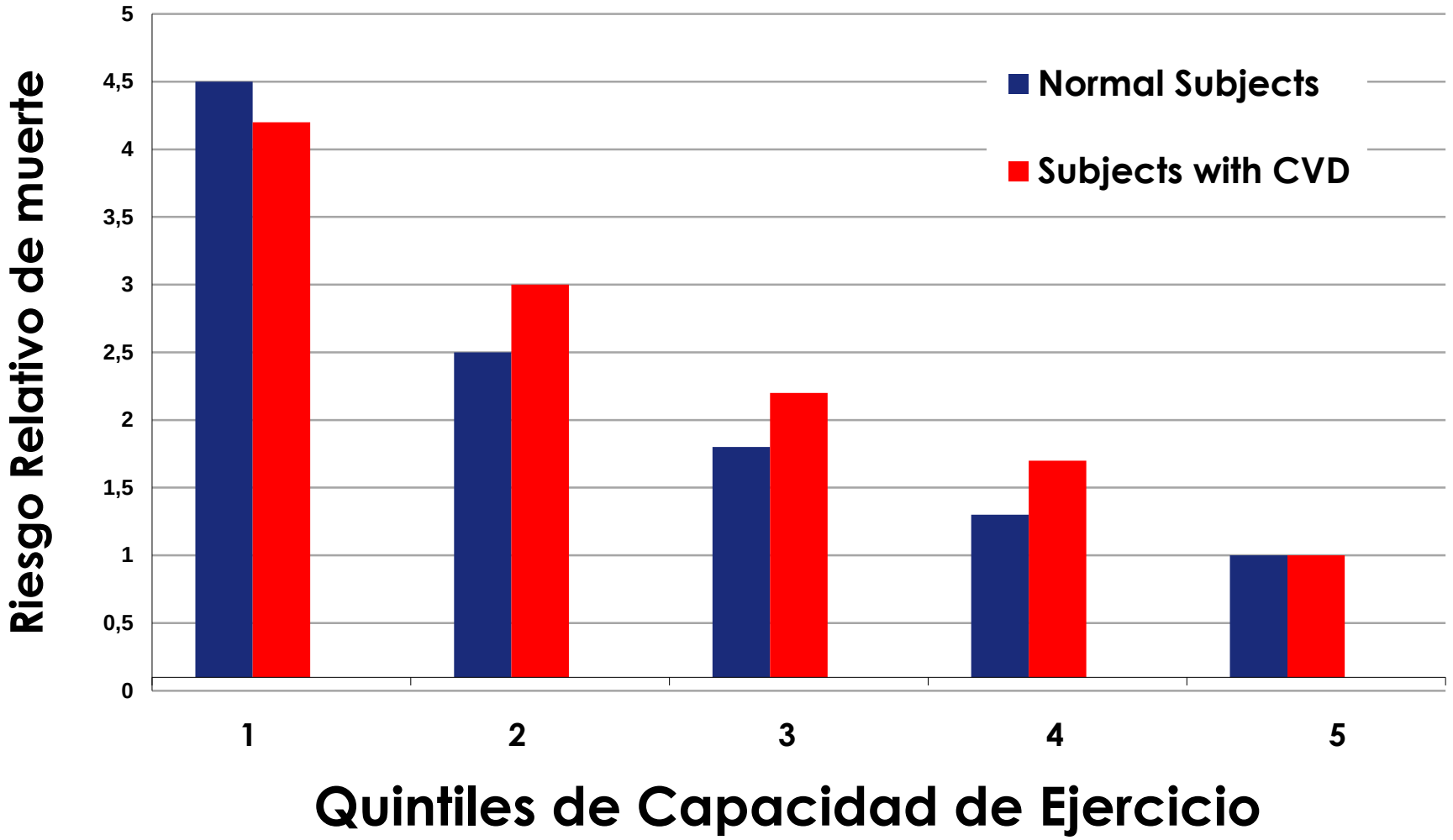


FIGURE 2. Relative risks for all-cause mortality associated with daily sitting among 17,103 men and women followed up for a mean of 12.0 years,[15] cardiorespiratory fitness (CRF) from a meta-analysis of 102,980 participants from 33 published studies,[25] and moderate to vigorous physical activity (MVPA) among 661,137 men and women from 6 cohort studies followed up for a median of 14.2 years.[21] Relative risks are from models that include a variety of covariates as described in the original studies.

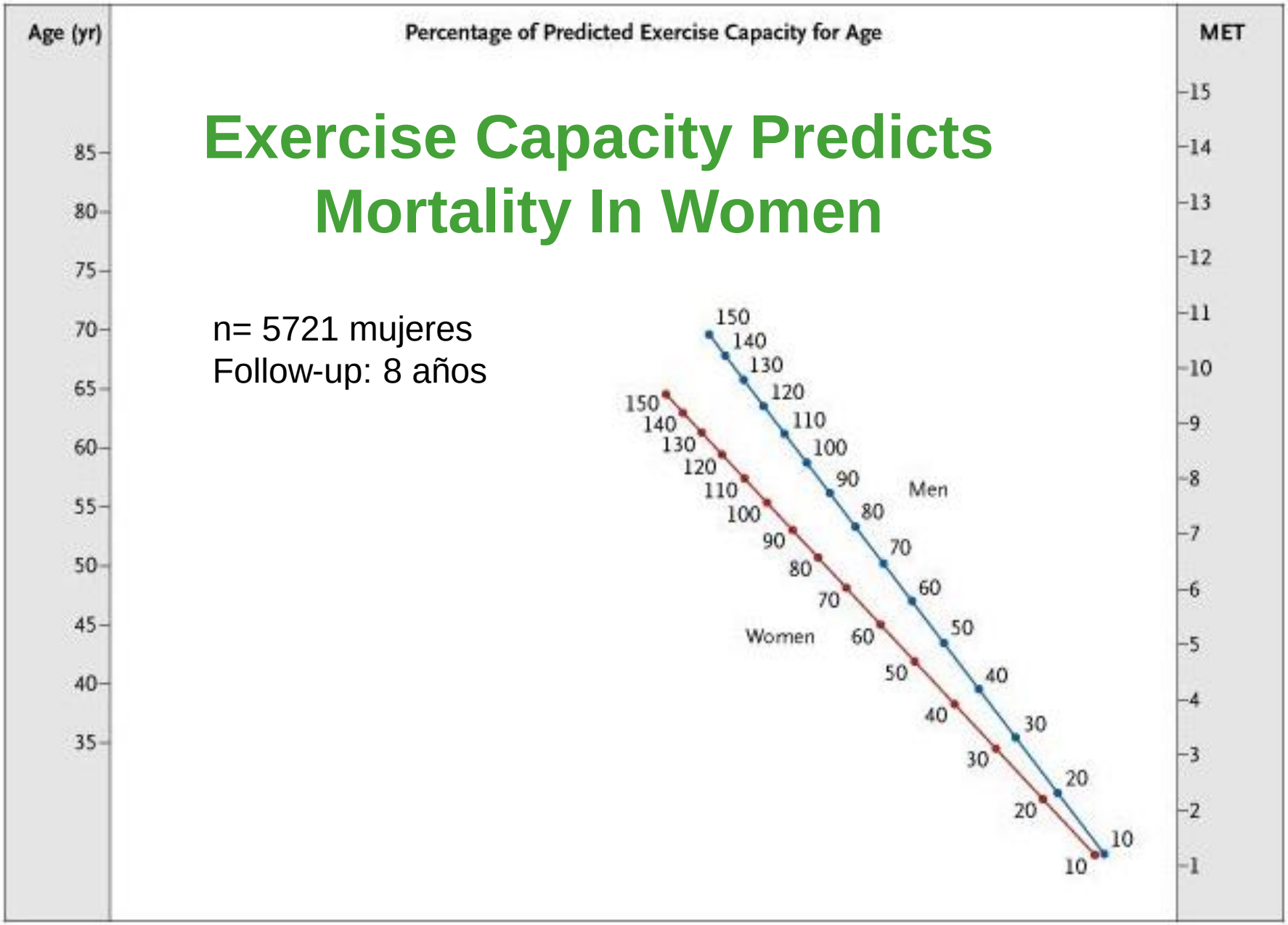
MORTALIDAD Y CAPACIDAD DE EJERCICIO



N Engl J. Med, Vol. 346, No. 11 - March 14, 2002

Exercise Capacity Predicts Mortality In Women

n= 5721 mujeres
Follow-up: 8 años



Martha Gulati, et al N Engl J Med 2005;353: 468-75

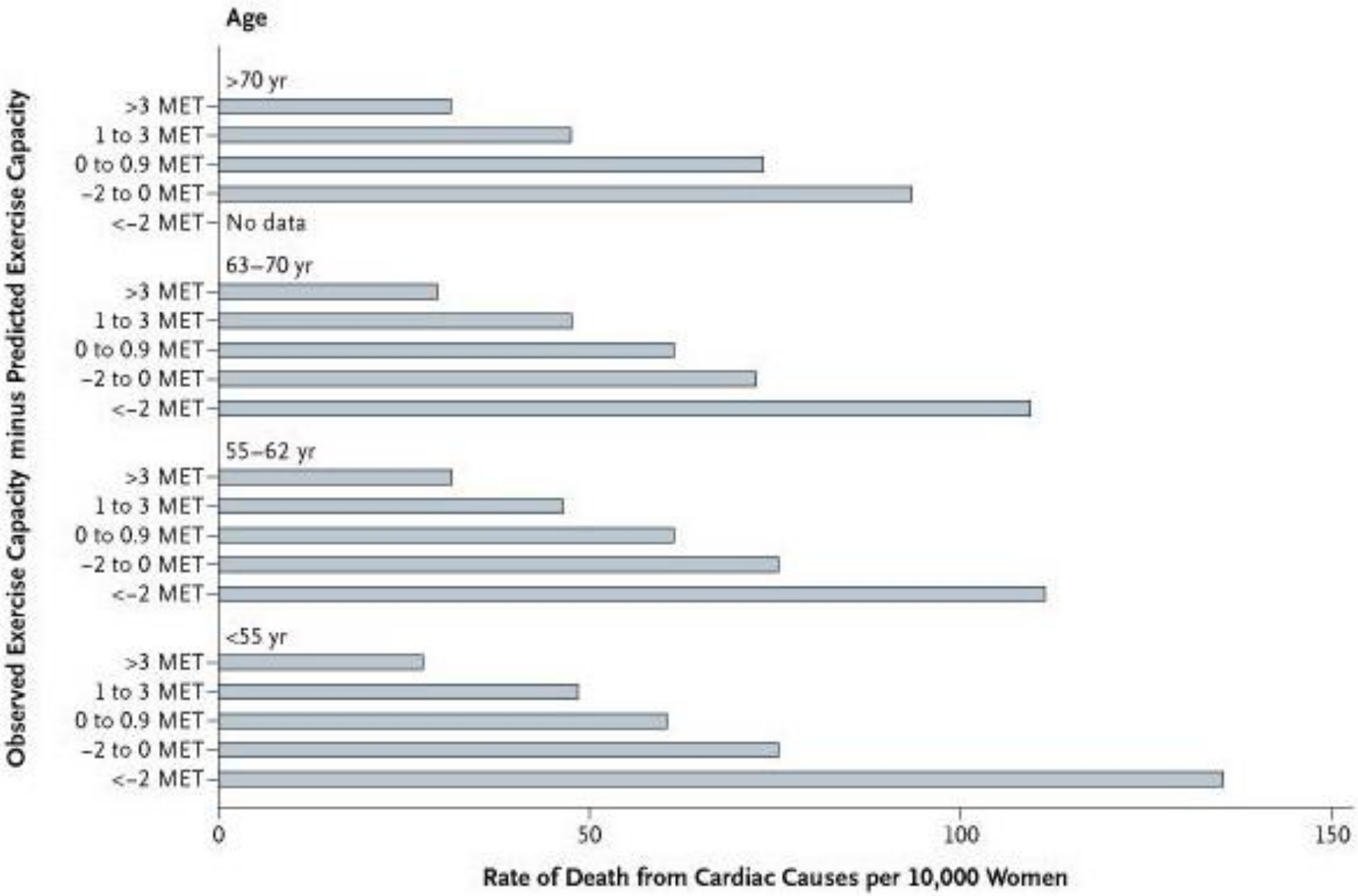
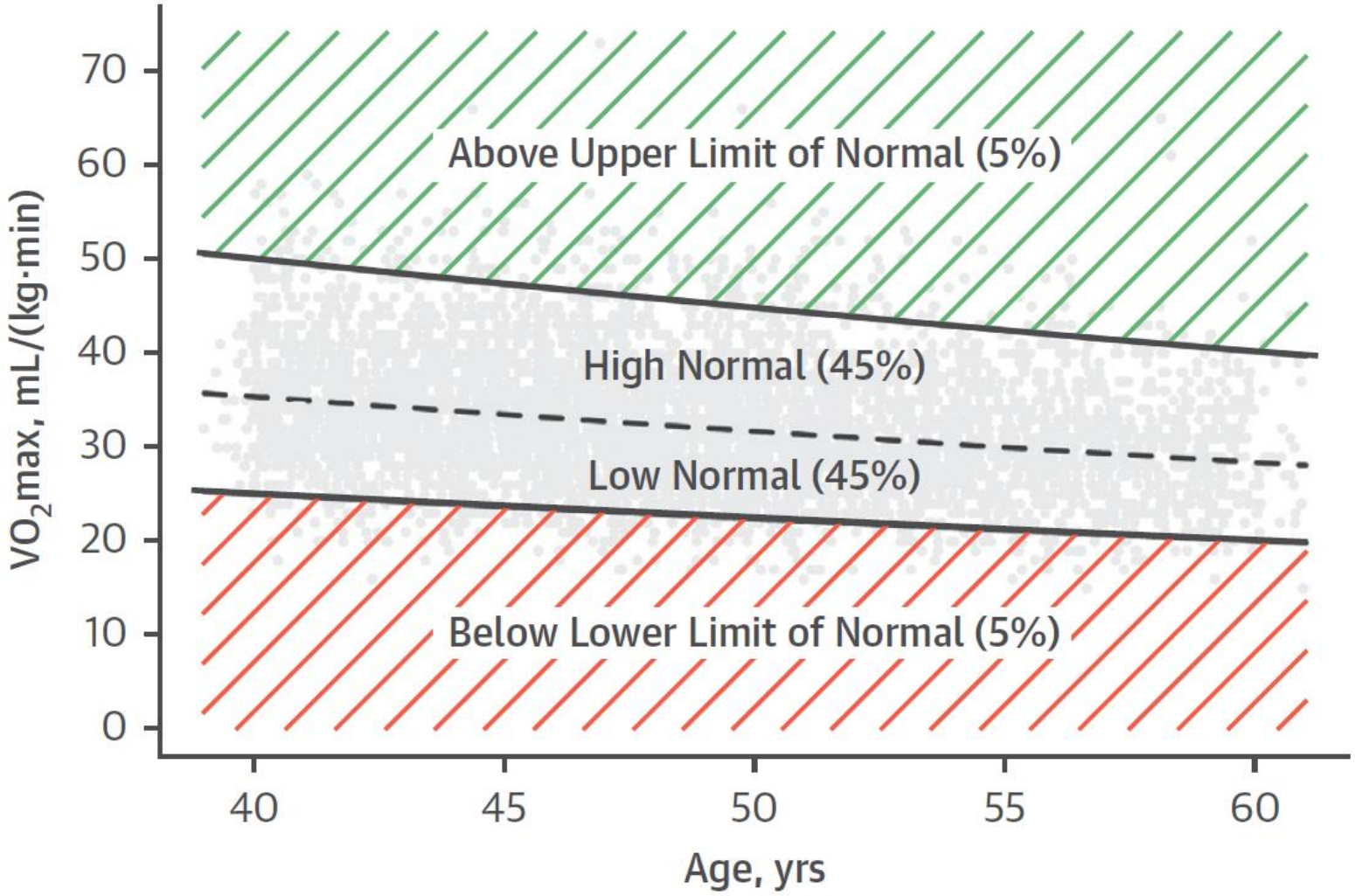

Age
>70 yr
>3 MET
1 to 3 MET
0 to 0.9 MET
−2 to 0 MET
<−2 MET
No data
63–70 yr
>3 MET
1 to 3 MET
0 to 0.9 MET
−2 to 0 MET
<−2 MET
55–62 yr
>3 MET
1 to 3 MET
0 to 0.9 MET
−2 to 0 MET
<−2 MET
<55 yr
>3 MET
1 to 3 MET
0 to 0.9 MET
−2 to 0 MET
<−2 MET
Observed Exercise Capacity minus Predicted Exercise Capacity
0
50
100
150
Rate of Death from Cardiac Causes per 10,000 Women

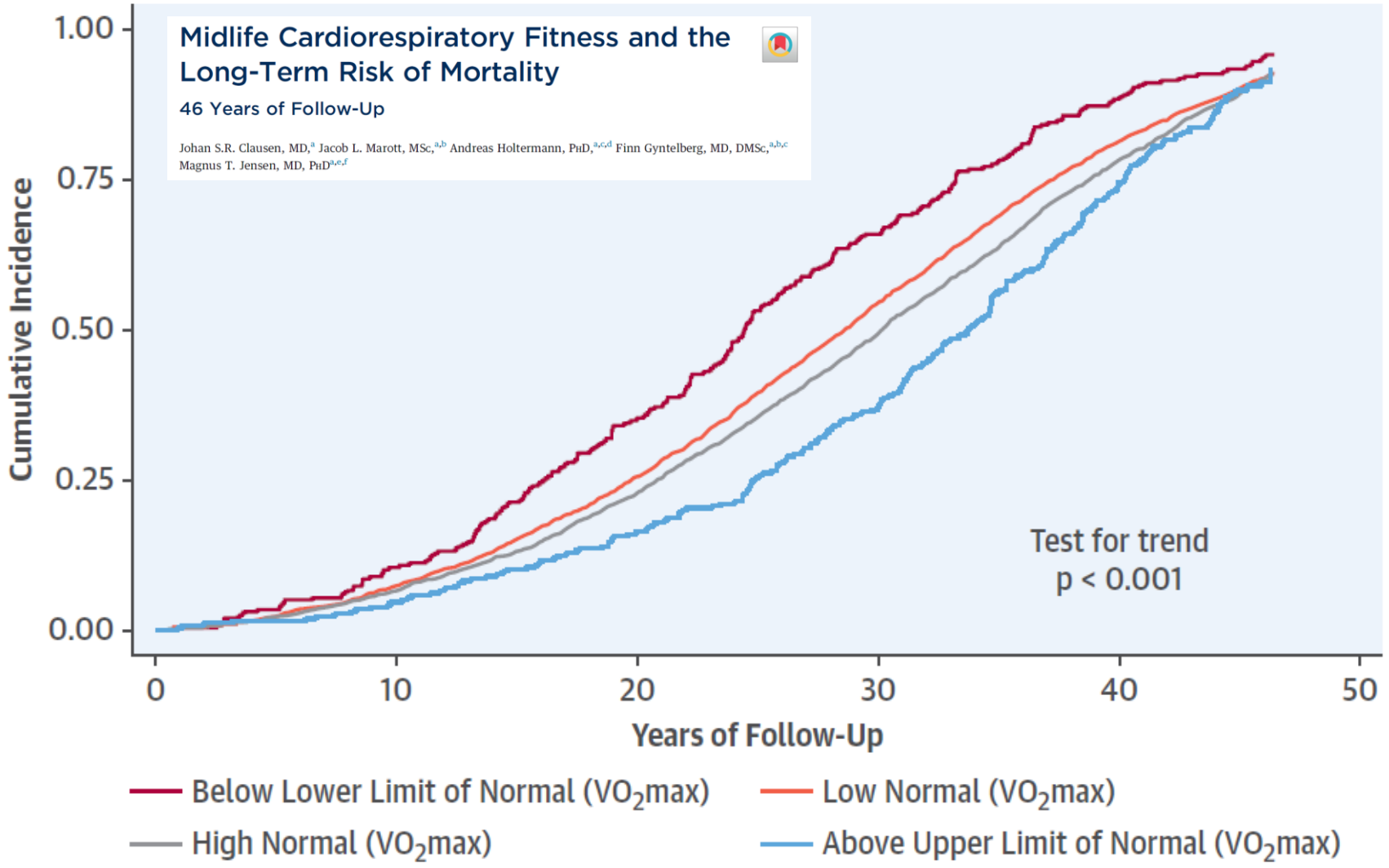
FIGURE 2 Distribution of CRF (Vo_2max) According to Age in 5,107 Middle-Aged, Employed Men Without CVD

JACC VOL. 72, NO. 9, 2018
AUGUST 28, 2018:987–95



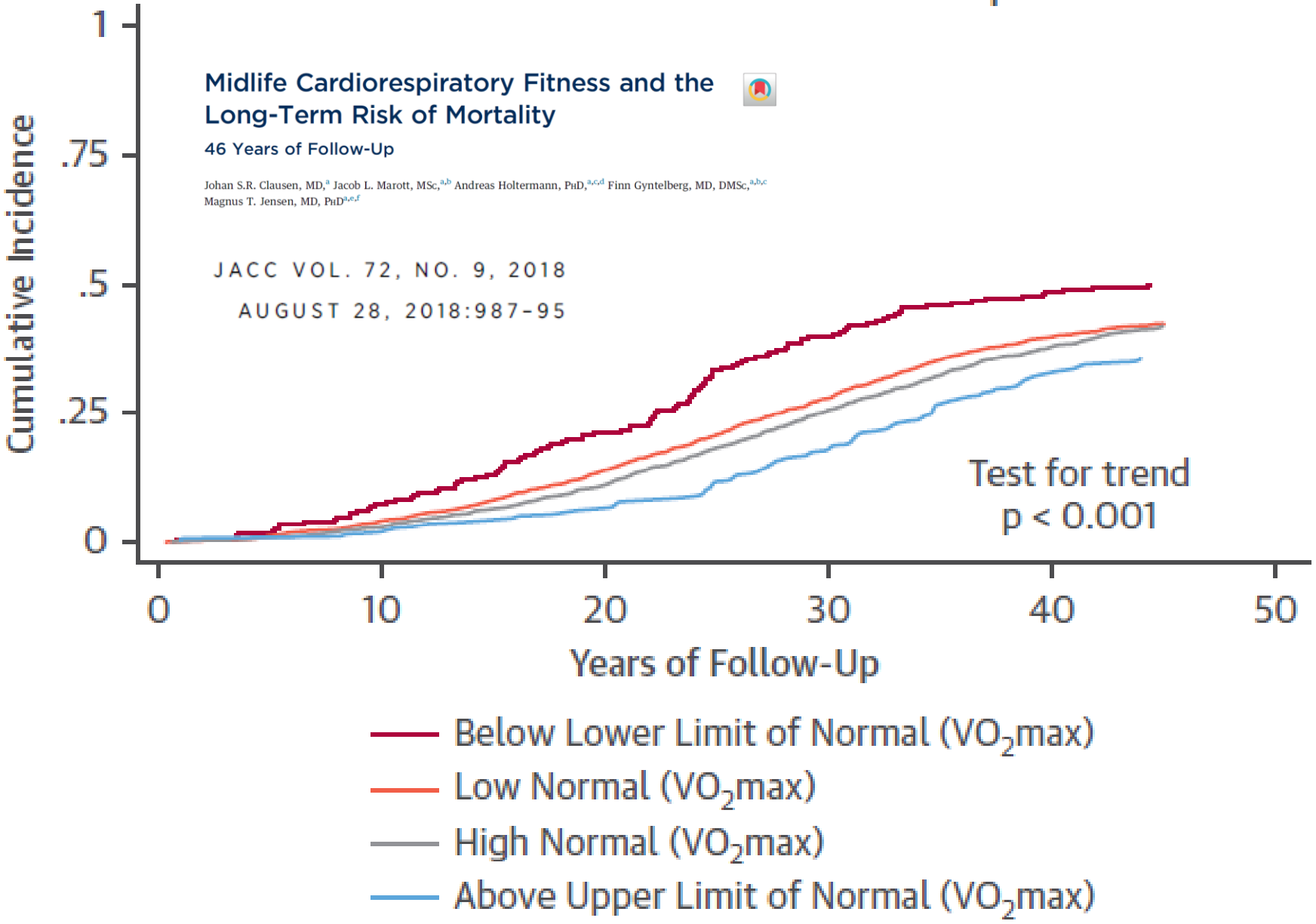
CONCLUSIONS CRF was significantly related to longevity over the course of 4 decades in middle-aged, employed men free of CVD. The benefits of higher midlife CRF extend well into the later part of life. (J Am Coll Cardiol 2018;72:987–95)

5,107 Men Free of Cardiovascular Disease at Inclusion Followed up to 46 Years



Clausen, J.S.R. et al. J Am Coll Cardiol. 2018;72(9):987-95.

Midlife Cardiorespiratory Fitness (VO_2max) & Cardiovascular Mortality
5107 Men free of CVD at Inclusion Followed up to 45 Years



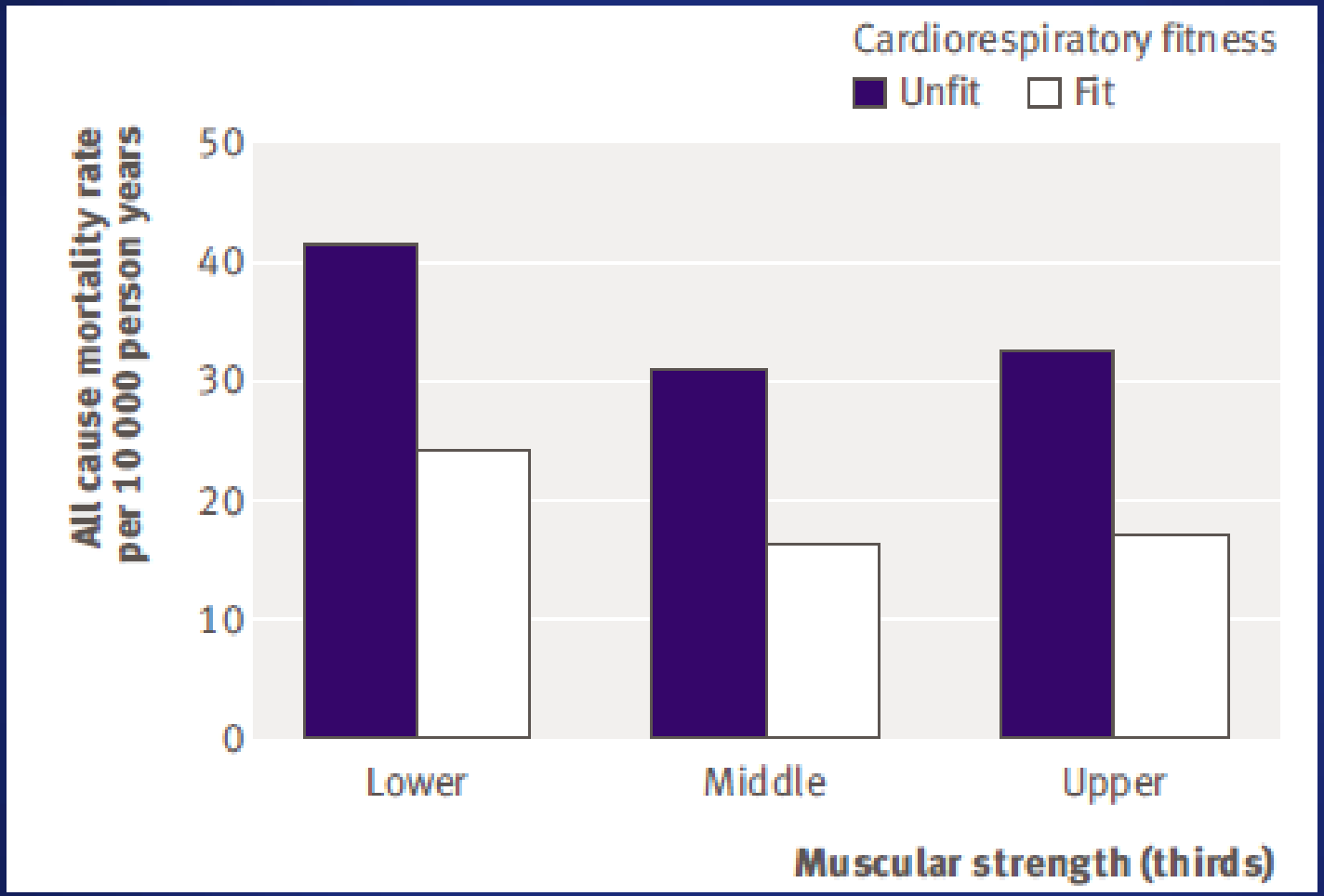
BMJ

RESEARCH

Association between muscular strength and mortality in men: prospective cohort study

Jonatan R Ruiz, research associate,[1,2] Xuemei Sui, research associate,[3] Felipe Lobelo, research associate,[3] James R Morrow Jr, professor,[4] Allen W Jackson, professor,[4] Michael Sjöström, associate professor,[1] Steven N Blair, professor[3,4]

BMJ 2008;337;439-



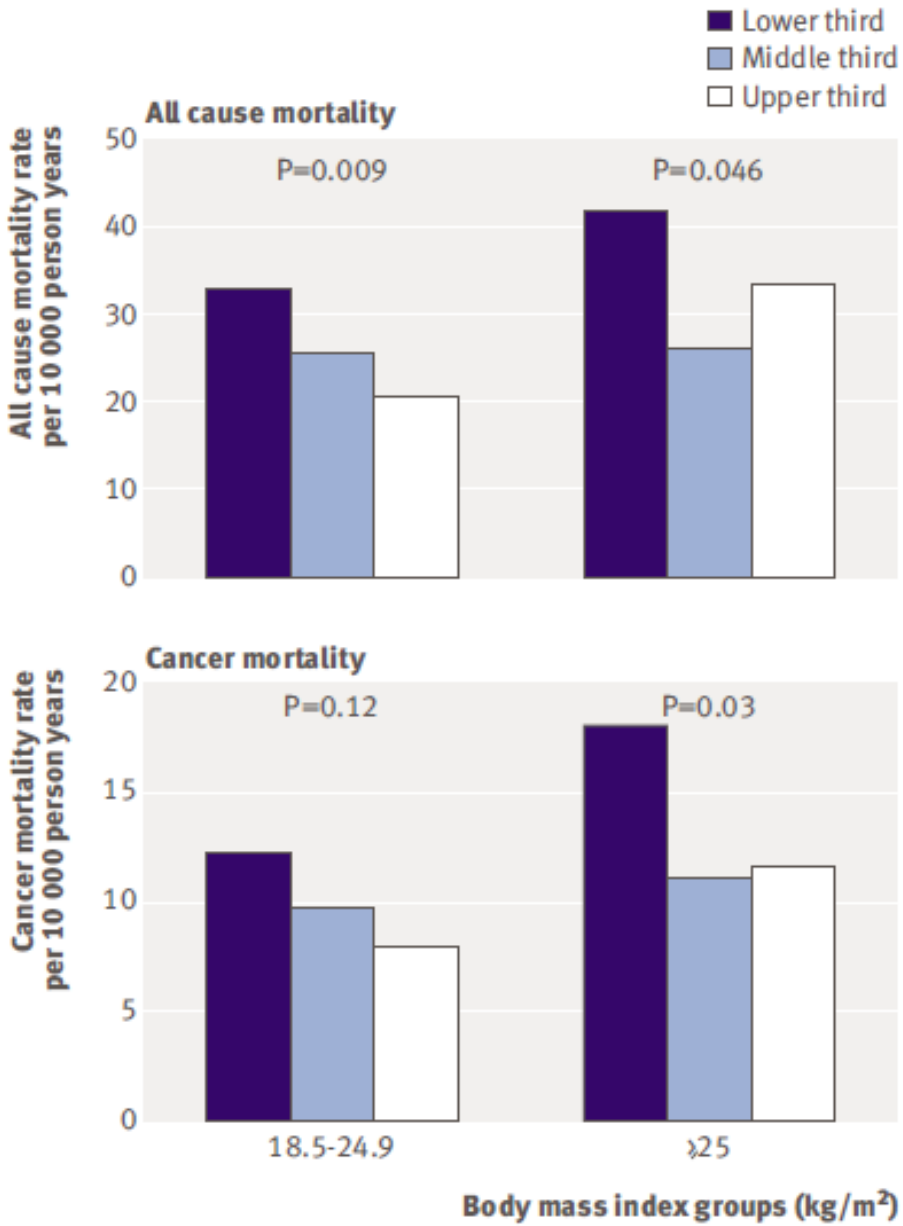
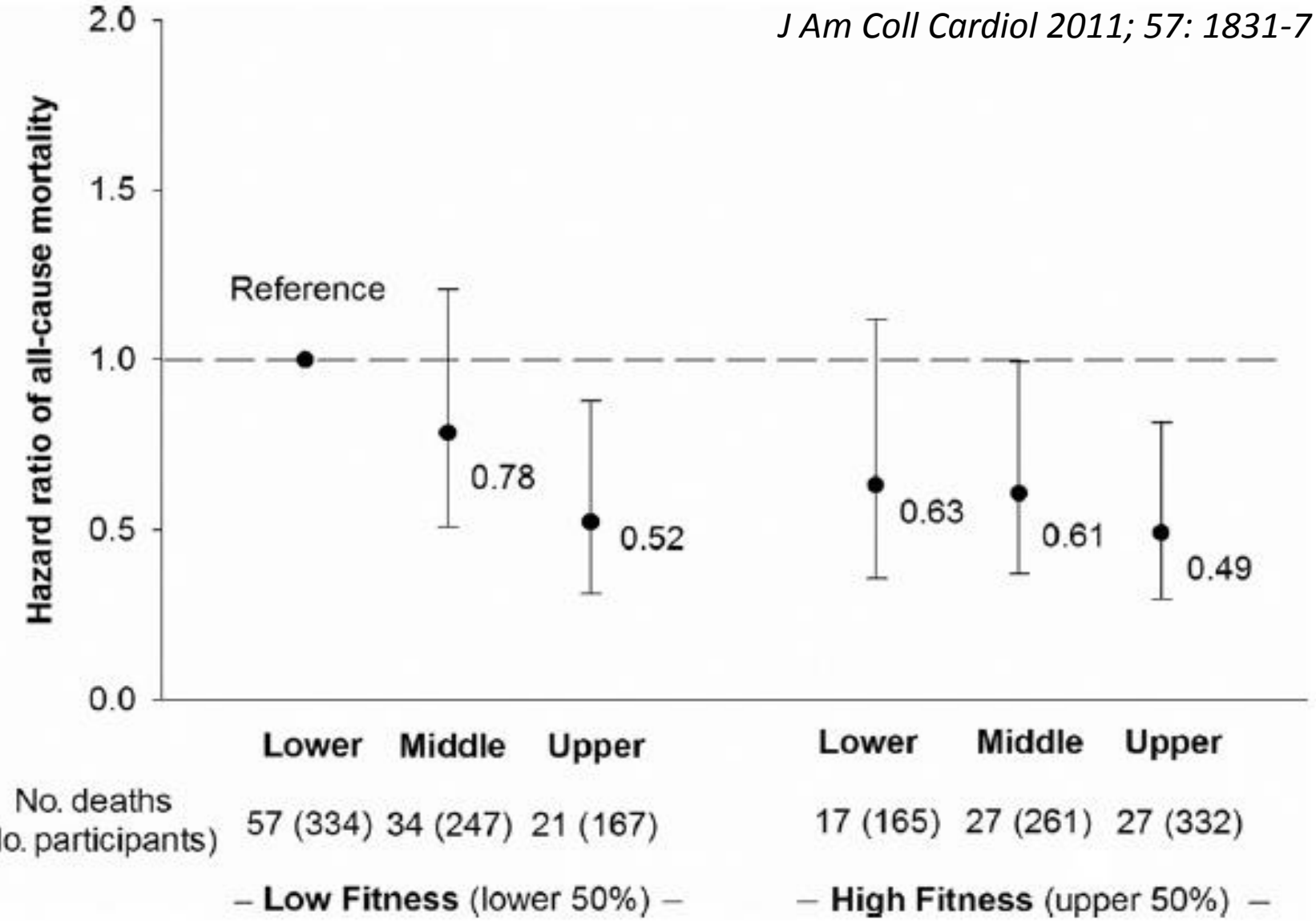


Fig 2| Age adjusted death rates per 10 000 person years by thirds of muscular strength and body mass index groups

BMJ 2008; 337:349

Fuerza Muscular y Mortalidad:
Un estudio prospectivo en hombres hipertensos

J Am Coll Cardiol 2011; 57: 1831-7

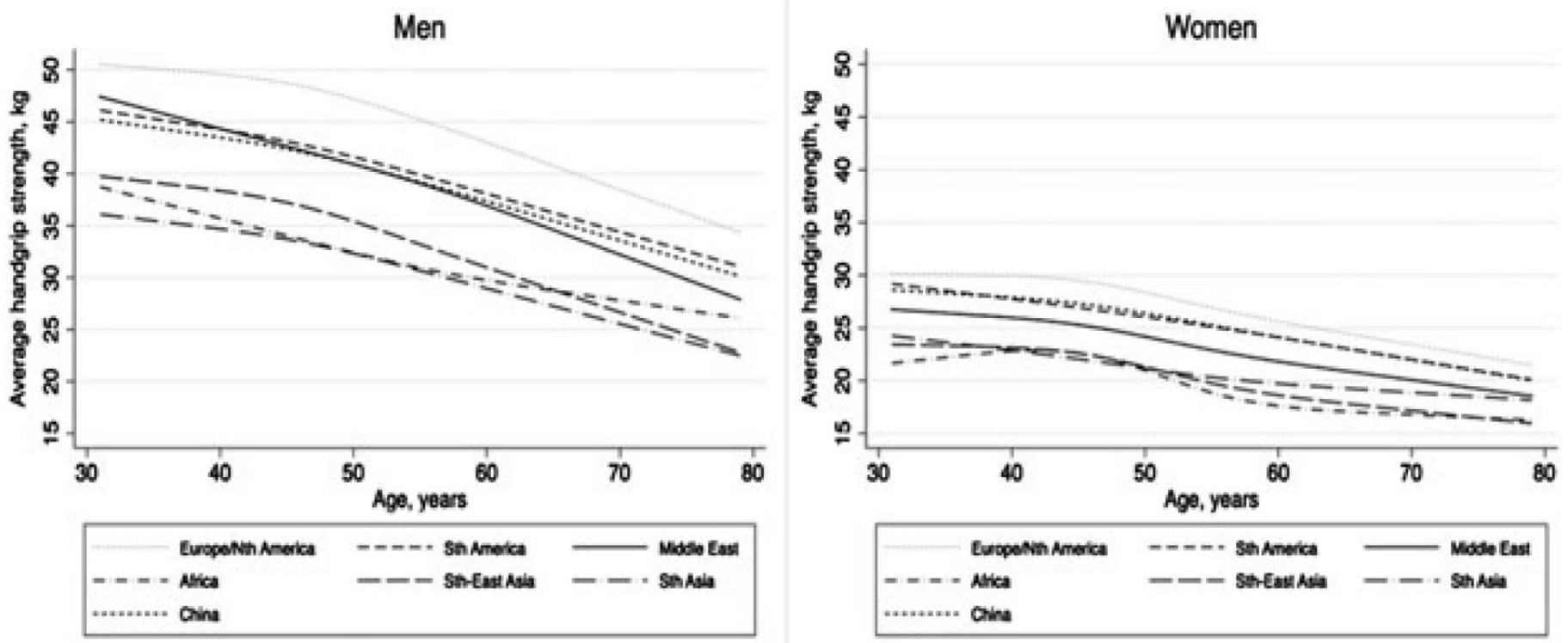


Reference ranges of handgrip strength from 125,462 healthy adults in 21 countries: a prospective urban rural epidemiologic (PURE) study

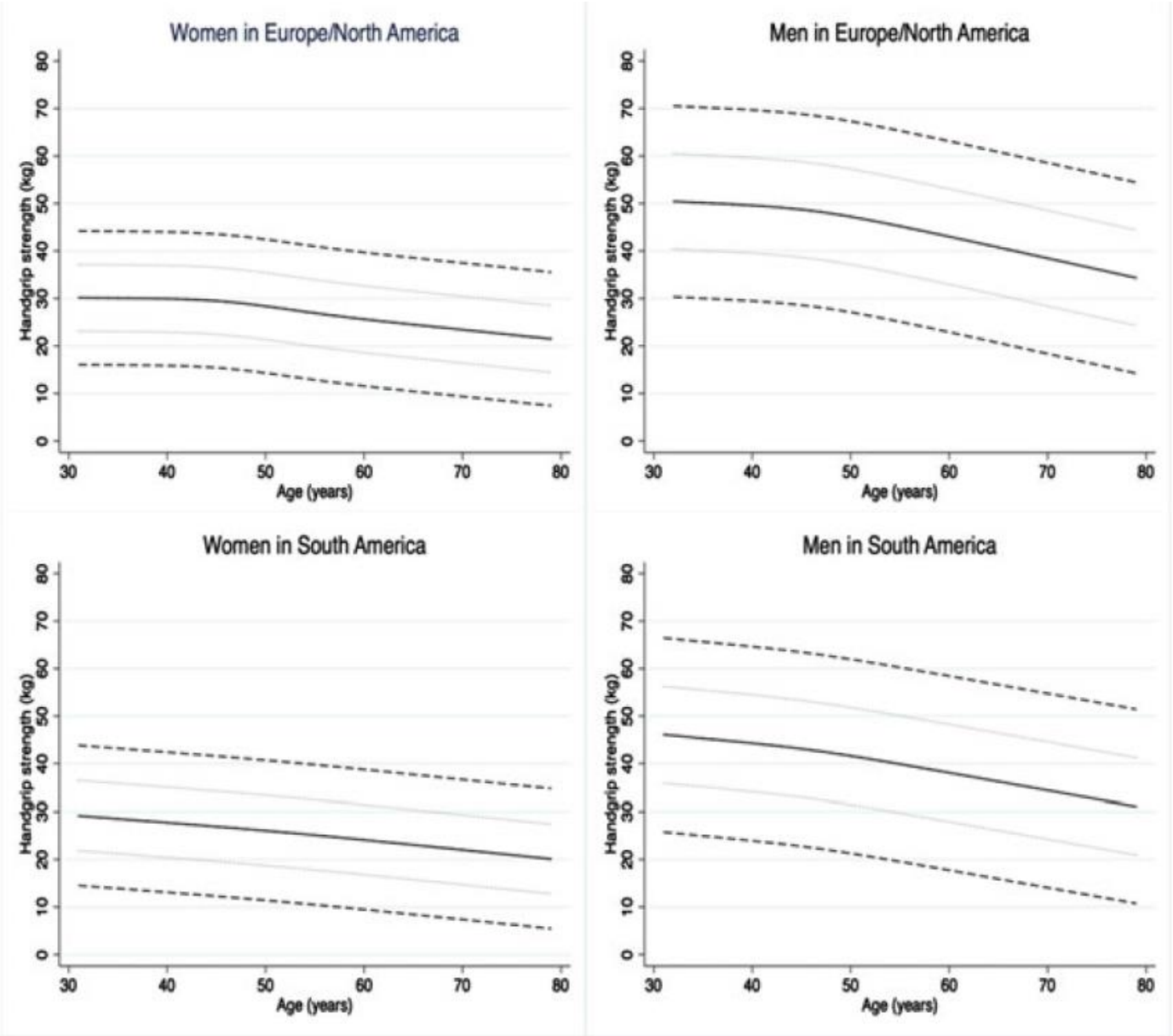
Table 1. Participant characteristics stratified by geographic region. Displayed are median (25^{th}–75^{th} percentile) values, mean ± standard deviation values, or column percentages

	Europe/North America		South America		Middle East		Africa
Characteristic	Women	Men	Women	Men	Women	Men	Women
N	9362	7221	12,163	7704	4241	3901	3022
Age, years	51 (44–58)	52 (44–59)	50 (43–58)	50 (43–59)	45 (39–52)	46 (40–53)	49 (41–57)
Rural location	29	30	41	49	43	39	53
Education							
Primary	22	18	58	61	59	35	71
Secondary	28	28	26	22	30	38	28
Post-secondary	50	54	16	17	11	27	1
Employed	68	74	60	70	46	83	10
Physical activity							
Low	8	10	10	15	24	28	16
Medium	39	34	35	29	54	36	38
High	53	56	55	56	22	36	46
Tobacco use							
Former	27	35	16	30	<1	12	2
Current	14	23	19	25	<1	30	22
Never	59	42	65	45	99	58	76
Alcohol use							
Former	5	7	6	12	0	2	3
Current	60	72	33	62	0	1	19
Never	35	21	61	26	100	97	78
Daily caloric intake, kcal	1941 (1513–2481)	2379 (1852–3004)	2026 (1561–2562)	2216 (1723–2824)	2099 (1622–2677)	2332 (1879–2887)	1848 (1337–2646)
Percentage of caloric intake from protein	16.5 ± 2.8	16.3 ± 2.7	16.9 ± 3.5	16.4 ± 3.4	17.1 ± 2.4	17.2 ± 2.2	13.6 ± 3.0
Height, cm	161 ± 7.2	175 ± 7.8	156 ± 7.0	169 ± 7.6	156 ± 6.2	170 ± 6.9	157 ± 6.6
Weight, kg	72 ± 15	85 ± 15	69 ± 15	78 ± 17	71 ± 15	78 ± 15	70 ± 20
Waist circumference, cm	85 ± 13	95 ± 12	89 ± 13	94 ± 12	89 ± 13	91 ± 12	85 ± 15
Body-mass index, kg/m^2	27.7 ± 6.04	27.7 ± 5.60	28.2 ± 5.85	27.5 ± 5.04	29.3 ± 5.76	27.0 ± 4.82	28.3 ± 7.69

Journal of Cachexia, Sarcopenia and Muscle 2016; **7**: 535–546



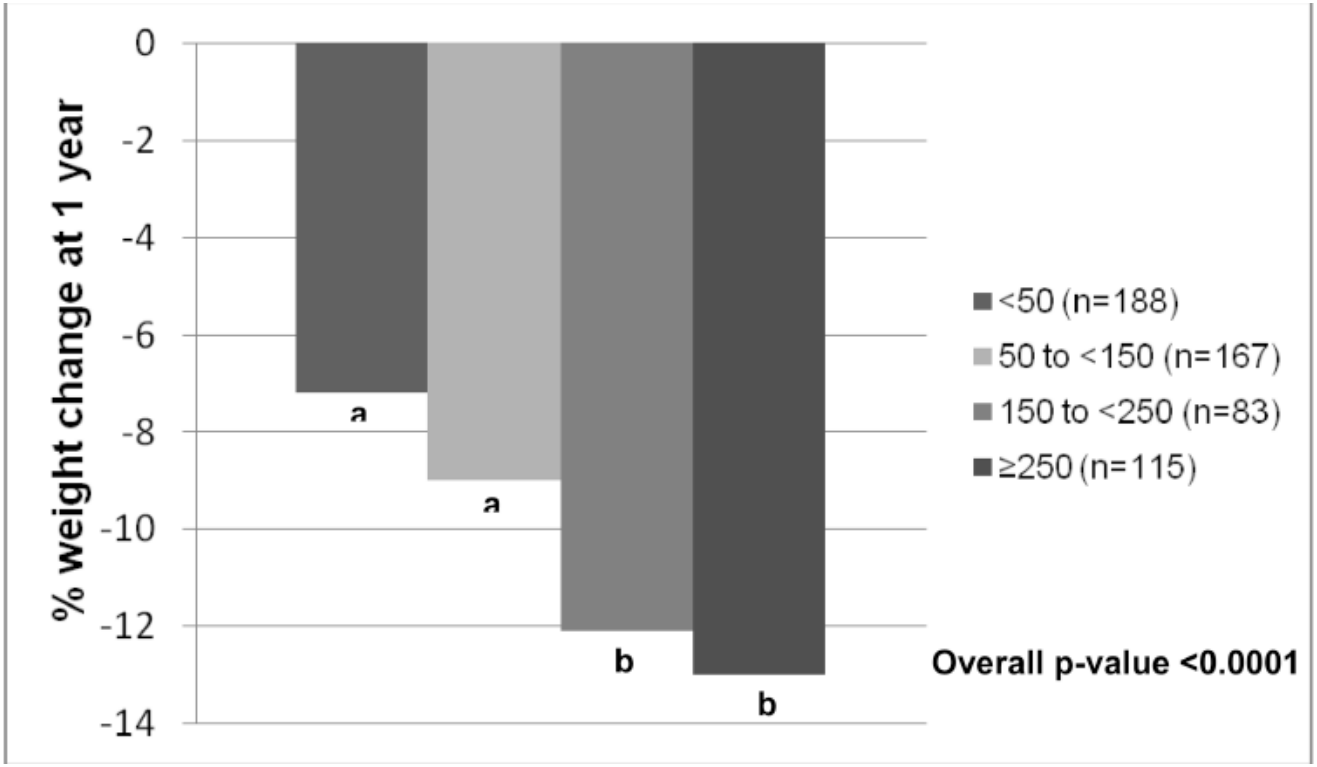
Journal of Cachexia, Sarcopenia and Muscle 2016; **7**: 535–546



Journal of Cachexia, Sarcopenia and Muscle 2016; **7**: 535–546

Objectively-assessed physical activity and weight loss maintenance among individuals enrolled in a lifestyle intervention

Perdida de Peso a 1 año



Obesity (Silver Spring). 2017 November ; 25(11): 1903–1909.

Hipertension & Ejercicio

Endothelial Regulation

Arterial Compliance

Autonomic Balance

Salt Excretion

Insulin Resistance

Muscle Mass / Body Fat

Circulation
JOURNAL OF THE AMERICAN HEART ASSOCIATION

Ejercicio & Ateroesclerosis

- Regulación Endotelial
- Resistencia a la Insulina
- Regulaciòn autonòmica (TA y FC)
- SIMPATICO (TA y FC—
- LDL pequeñas, HDL 2, TG
- Inflamación crónica
- Hemostasis favorable (?)

Circulation 2001,103: 327-334

Midlife cardiovascular fitness and dementia

A 44-year longitudinal population study in women

Una aptitud fisica (fitness) alto a edad media se asoció con menor riesgo de demencia y un retardo en la aparición de demencia entre 5 -10 años

Conclusions

Among Swedish women, a high cardiovascular fitness in midlife was associated with a decreased risk of subsequent dementia. Promotion of a high cardiovascular fitness may be included in strategies to mitigate or prevent dementia. Findings are not causal, and future research needs to

Original Article

Fat or Fit: The Joint Effects of Physical Activity, Weight Gain, and Body Size on Breast Cancer Risk

Lauren E. McCullough, MSPH[1]; Sybil M. Eng, PhD, MPH[2]; Patrick T. Bradshaw, PhD[1]; Rebecca J. Cleveland, PhD[3]; Susan L. Teitelbaum, PhD[4]; Alfred I. Neugut, MD, PhD[2,5]; and Marilie D. Gammon, PhD[1]

CA Seno & Actividad Fisica: Meta-analysis

31 studies with 63,786 cases
Combined relative risk (RR) with 95 % CI of breast cancer was 0.88 (0.85-0.91).
The inverse association was consistent among all subgroups analyses.

Stronger association [0.72] was found for subjects with BMI <25 kg/m(2), premenopausal women [0.77], and estrogen and progesterone receptor-negative breast cancer [0.80].

Dose-response analysis suggest that the risk of breast cancer decreased by 5 % for every 2 h/week increment in moderate + vigorous recreational activity (p< 0.001).

Physical activity could significantly reduce the risk of breast cancer!

Breast Cancer Res Treat. 2013 Feb;137(3):869-82.

Asociación entre Actividad Física y Mortalidad en CA Colorectal: Meta-analysis

5,299 pacientes AF pre dx

6,348 pacientes AF post dx

Seguimiento: 3.8 a 11.9 anos

- AF antes del dx: RR 0.75 ($p < 0.001$) para mortalidad por CA colorectal vs. sedentarios.
- AF alta vs baja antes del dx: RR 0.70 ($p = 0.002$)
- AF post dx RR of 0.74 ($p = 0.02$) para mortalidad por CA colorectal vs .sedentarios.
- AF alta vs baja post dx RR of 0.65 ($p = 0.01$).

In conclusion, both prediagnosis and postdiagnosis PA were associated with reduced colorectal cancer-specific mortality and all-cause mortality.

Int J Cancer. 2013 Oct 15;133(8):1905-13.

Exercise interventions on health-related quality of life for people with cancer during active treatment.

56 trials with 4826 participants randomized :
exercise (n = 2286) vs. comparison (n = 1985)

CONCLUSIONS: This systematic review indicates that exercise may have beneficial effects at varying follow-up periods on HRQoL and certain HRQoL domains including physical functioning, role function, social functioning, and fatigue.

Positive effects of exercise interventions are more pronounced with **moderate- or vigorous-intensity** versus mild-intensity exercise programs.

Cochrane Database Syst Rev. 2012 Aug 15;8:CD008465

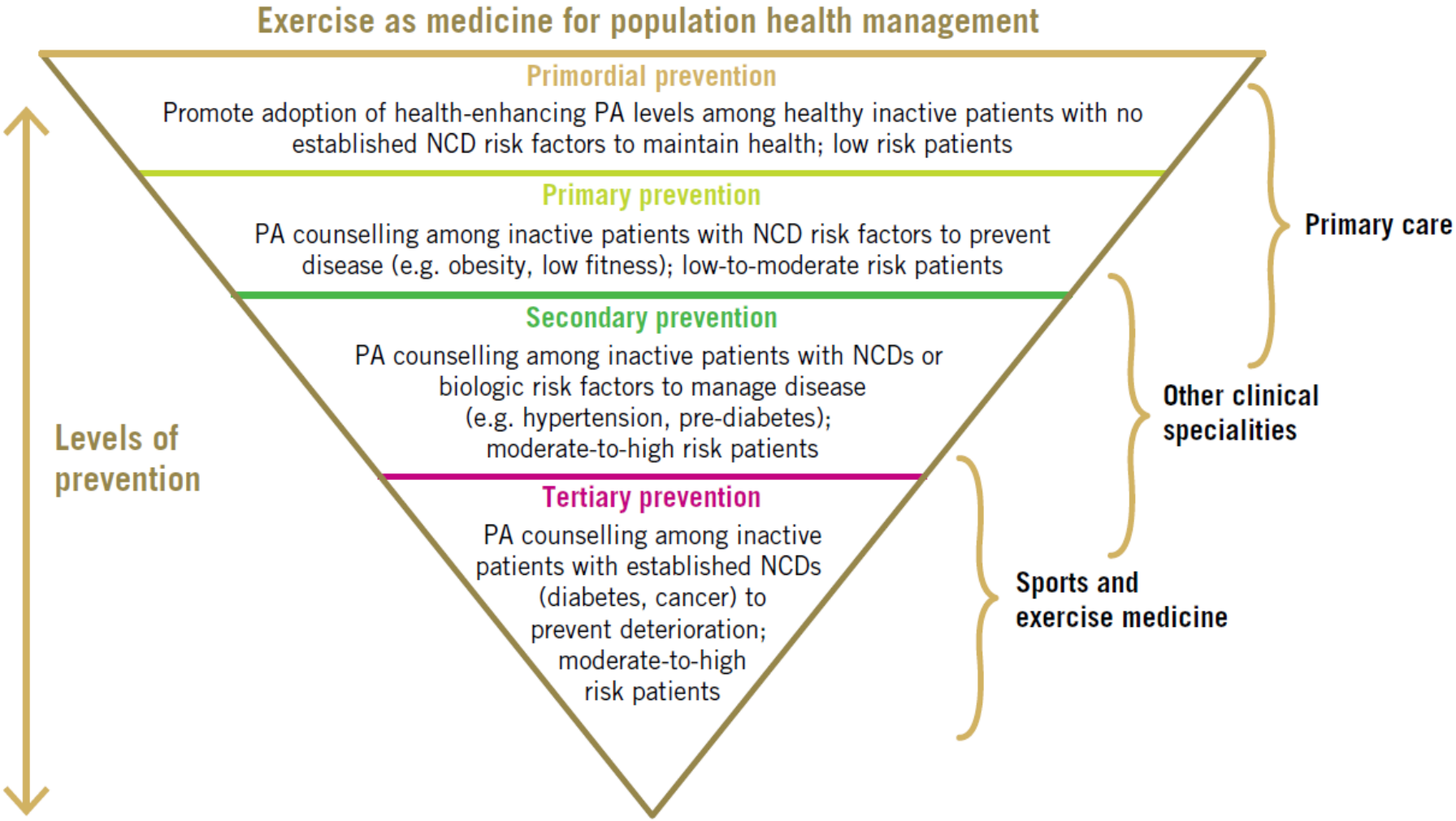


Figure 1: Suggested physician roles for implementation of physical activity counseling in health systems. PA=physical activity, NCDs=non-communicable chronic diseases.

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Prescripción del ejercicio

Una guía para recomendar actividad física a cada paciente

John Duperly, MD, PhD
Felipe Lobelo, MD, PhD

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LEO

John Duperly es director del Centro Regional de Exercise is Medicine® (EIM®) América Latina. Es especialista en Medicina Interna y PhD en Medicina del Deporte, miembro institucional de la Fundación Santa Fe de Bogotá y profesor asociado de la Facultad de Medicina de la Universidad de Los Andes. Es representante del Presidente de la República de Colombia ante el Consejo Nacional del Deporte, la Recreación, la Actividad Física y el Aprovechamiento del Tiempo Libre.

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AHA SCIENTIFIC STATEMENT

Routine Assessment and Promotion of Physical Activity in Healthcare Settings

A Scientific Statement From the American Heart Association

adult patients. It also adds concrete recommendations for healthcare systems, clinical and community care providers, fitness professionals, the technology industry, and other stakeholders in order to catalyze increased adoption of physical activity assessment and promotion in healthcare settings and to contribute to meeting the American Heart Association's 2020 Impact Goals.

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