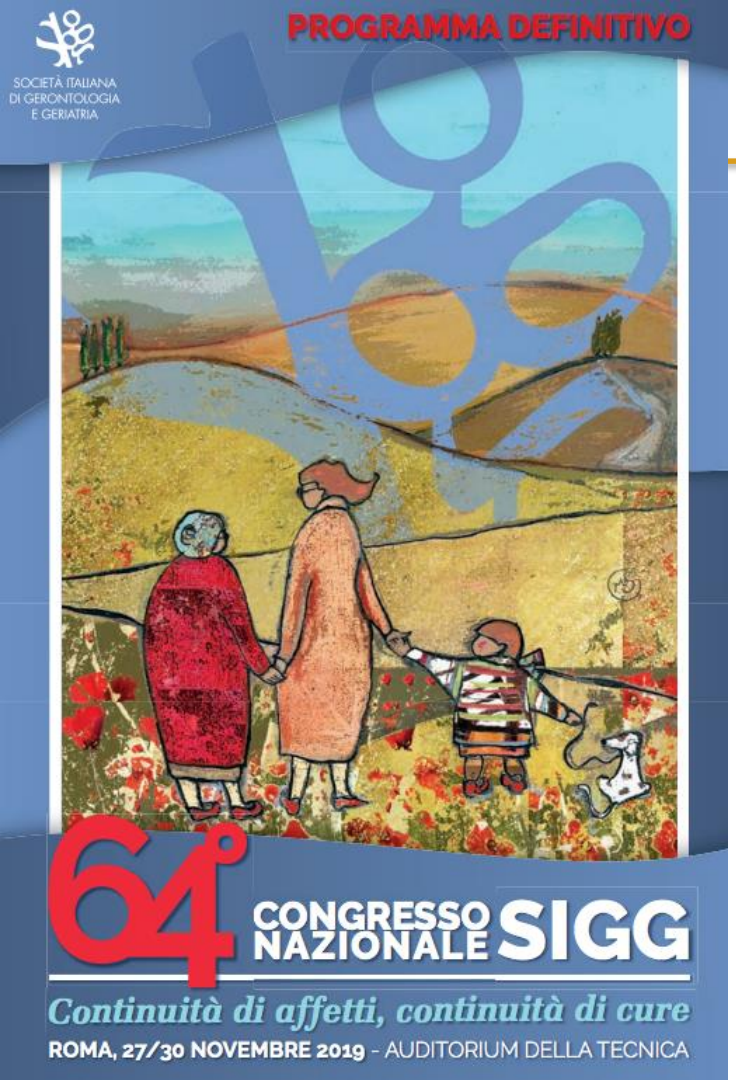

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PREVENZIONE E TRATTAMENTO DELLA SARCOPENIA: RUOLO DELL'ATTIVITÀ FISICA

Francesco Landi, MD, PhD

Catholic University,

Geriatric Center, Gemelli Hospital

Rome, Italy

Definitions

- Physical fitness: “a set of attributes that people have or achieve that relates to the ability to perform physical activity”.
- Physical activity: “bodily movement that is produced by the contraction of skeletal muscle and that substantially increases energy expenditure”.
- Physical exercise: subset of physical activity that involves “planned, structured, and repetitive bodily movement done to improve or maintain one or more components of physical fitness”.
- Physical inactivity: absence of physical activity.
- MET (metabolic equivalent): physiological measure expressing the energy cost of a given physical activity.

al., Public Health Rep 1985

Compr Physiol. 2012 April ; 2(2): 1143–1211. doi:10.1002/cphy.c110025.

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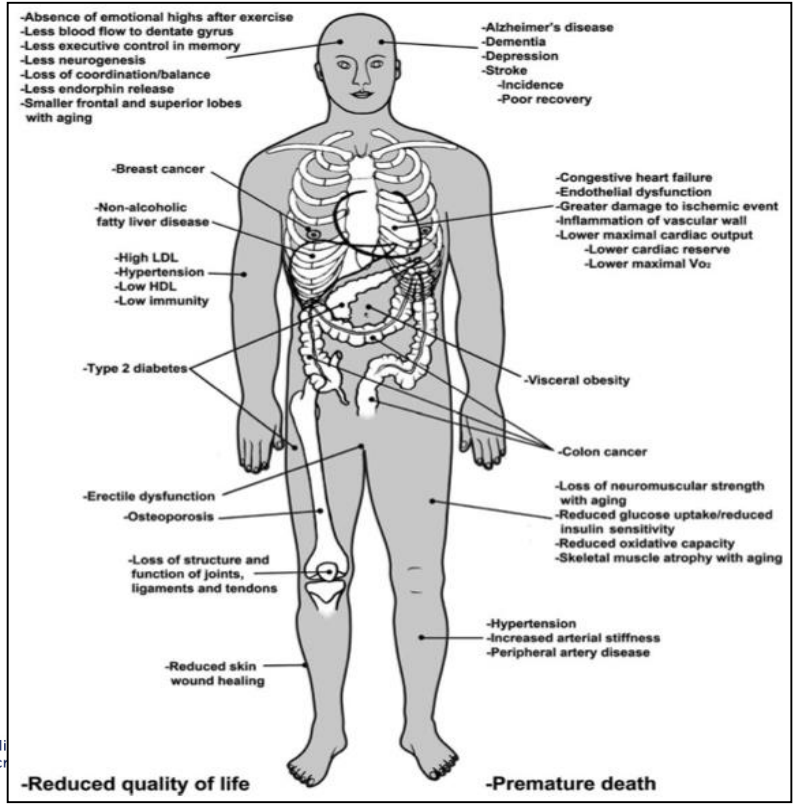
Lack of exercise is a major cause of chronic diseases

Frank W. Booth, Ph.D.[1], **Christian K. Roberts, Ph.D.**[2], and **Matthew J. Laye, Ph.D.**[3]



- Physical inactivity is the fourth leading risk factor for global mortality (6% of deaths globally) (WHO, 2009).
- Annual cost in lives lost due to inactivity ranges from 200,000 to 300,000 (Mokdad et al., JAMA 2000).
- In the US, annual medical costs due to inactivity and its consequences are estimated at $76 billion (Pratt et al., Phys Sportsmed 2000).

Physiological geroscience: targeting function to increase healthspan and achieve optimal longevity

Douglas R. Seals, Jamie N. Justice and Thomas J. LaRocca

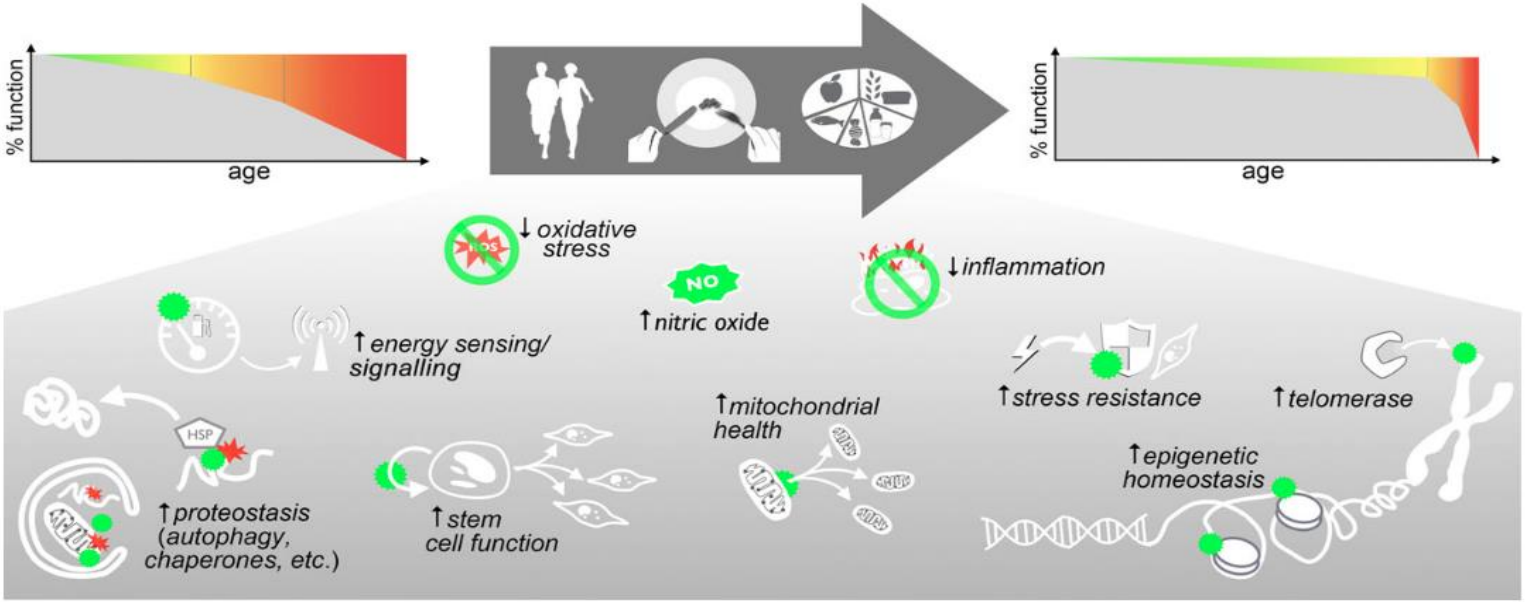


Figure 6. Lifestyle–behavioural strategies that increase function and potential underlying mechanisms
Regular physical activity, restricted energy intake and healthy diet composition enhance physiological function and healthspan, promoting optimal longevity. The molecular/biological mechanisms underlying these benefits may involve inhibiting or reversing several fundamental processes of ageing.

Cell

Cell *153*, June 6, 2013

Leading Edge
Review

UNIVERSITÀ CATTOLICA del Sacro Cuore

The Hallmarks of Aging

Carlos López-Otín,[1] Maria A. Blasco,[2] Linda Partridge,[3,4] Manuel Serrano,[5,*] and Guido Kroemer[6,7,8,9,10]

REJUVENATION RESEARCH
Volume 18, Number 1, 2015

DOI: 10.1089/rej.2014.1623

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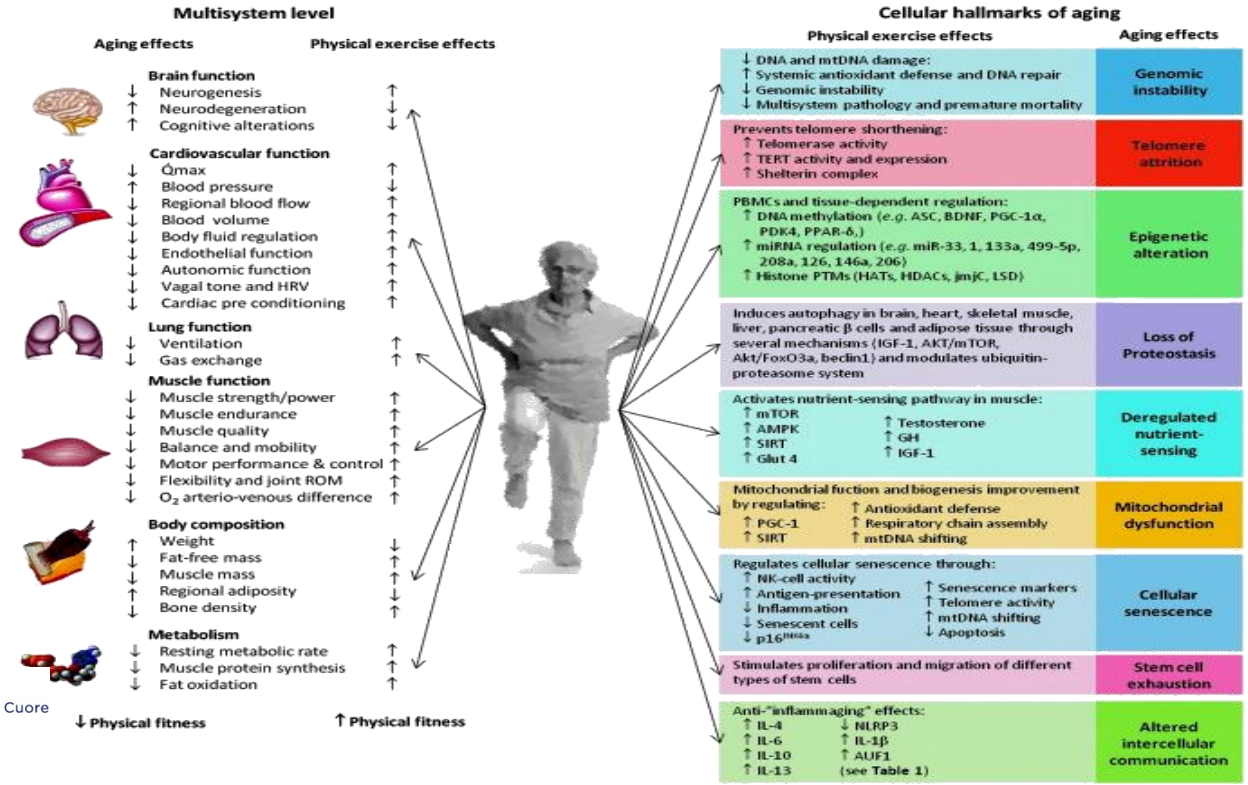
Exercise Attenuates the Major Hallmarks of Aging

Nuria Garatachea,[1–3,*] Helios Pareja-Galeano,[2,4,*] Fabian Sanchis-Gomar,[2] Alejandro Santos-Lozano,[2] Carmen Fiuza-Luces,[2,4] María Morán,[2,5] Enzo Emanuele,[6] Michael J. Joyner,[7,†] and Alejandro Lucia[2,4,†]



Ageing Research Reviews 37 (2017) 39–52

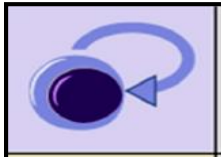
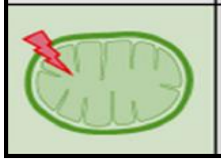
Contents lists available at ScienceDirect

Ageing Research Reviews

journal homepage: www.elsevier.com/locate/arr

Influence of anaerobic and aerobic exercise on age-related pathways in skeletal muscle

Ignacio Navas-Enamorado[a], Michel Bernier[a], Gloria Brea-Calvo[b], Rafael de Cabo[a,*]

	**STEM CELL EXHAUSTION**	**Increased proliferation and migration of some types of stem cells.**
	**LOSS OF PROTEOSTASIS**	**Induces autophagy in skeletal muscle through several mechanisms (IGF-1, AKT/mTOR) and modulates ubiquitin-proteasome system**
	**GENOMIC STABILITY**	**Reduced DNA and mtDNA damage:** **- Increases antioxidant defense and DNA repair** **- Reduces genomic instability** **- Reduces premature mortality**
	**CELLULAR SENESCENCE**	**Regulates cellular senescence through:** **- Increases NK-cell activity, senescence markers, telomere and activity.** **- Decreases inflammation senescent cells, and apoptosis.**
	**MITOCHONDRIAL DYSFUNCTION**	**Improvement in mitochondrial function and biogenesis:** **- Increases PGC-1α, SIRT, mtDNA shifting, antioxidant defense, respiratory chain assembly.**

Ageing Research Reviews 37 (2017) 39–52

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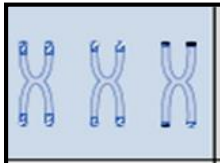
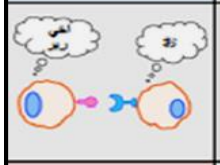
	**TELOMERE ATTRITION**	**Prevents telomere shortening:** - Increases telomerase activity - Increases TERT activity & expression - Increases shelterin complex
	**ALTERED INTERCELLULAR COMMUNICATION**	**"Inflammaging" counter effects:** - Increases IL-4, IL-6, IL-10, IL-13, AUF1 - Decreases NLRP3
	**EPIGENETIC ALTERATION**	**Regulation through:** - Increases DNA methylation - Increases miRNA regulation - Increases histone PTM's
	**DEREGULATED NUTRIENT-SENSING**	**Activates nutrient–sensing pathaways:** - Increases mTOR, AMPK, SIRT, Glut4, testosterone, GH and IGF-1

frontiers in Physiology

REVIEW
published: 19 May 2017
doi: 10.3389/fphys.2017.00319

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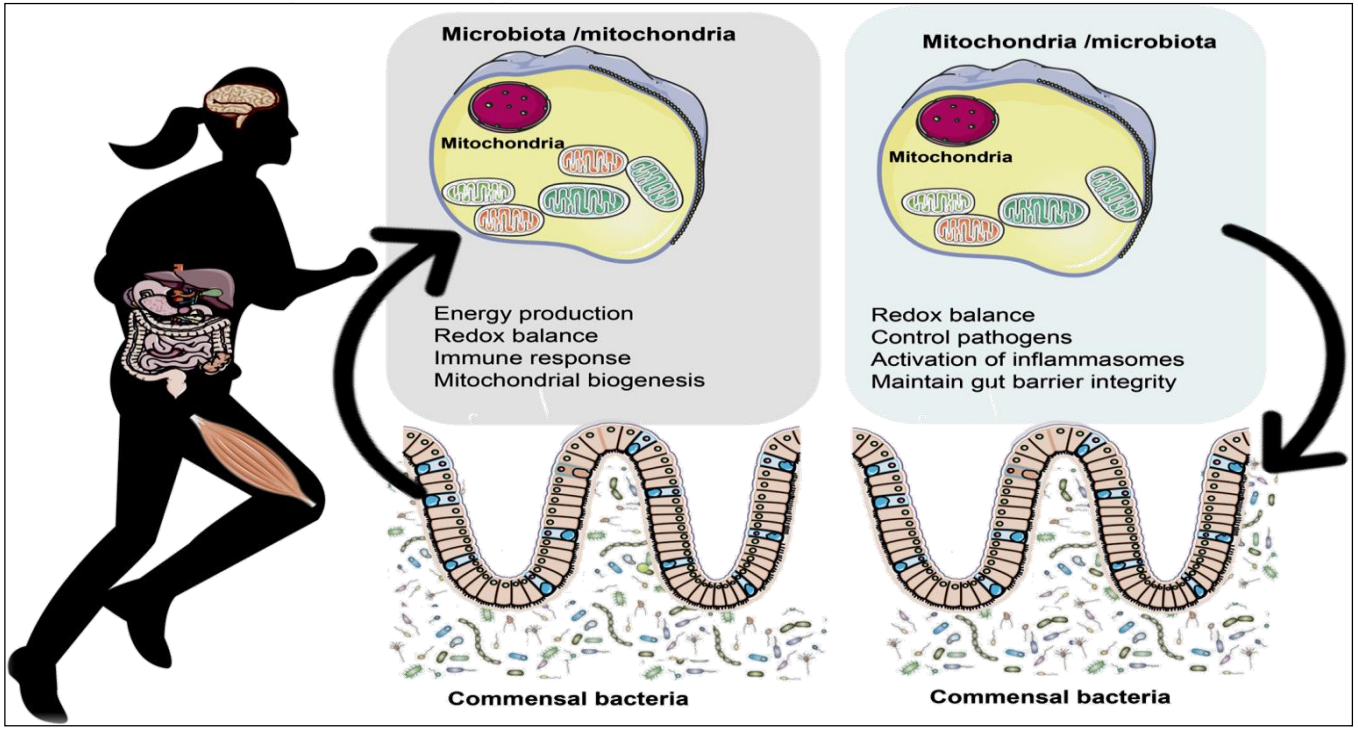
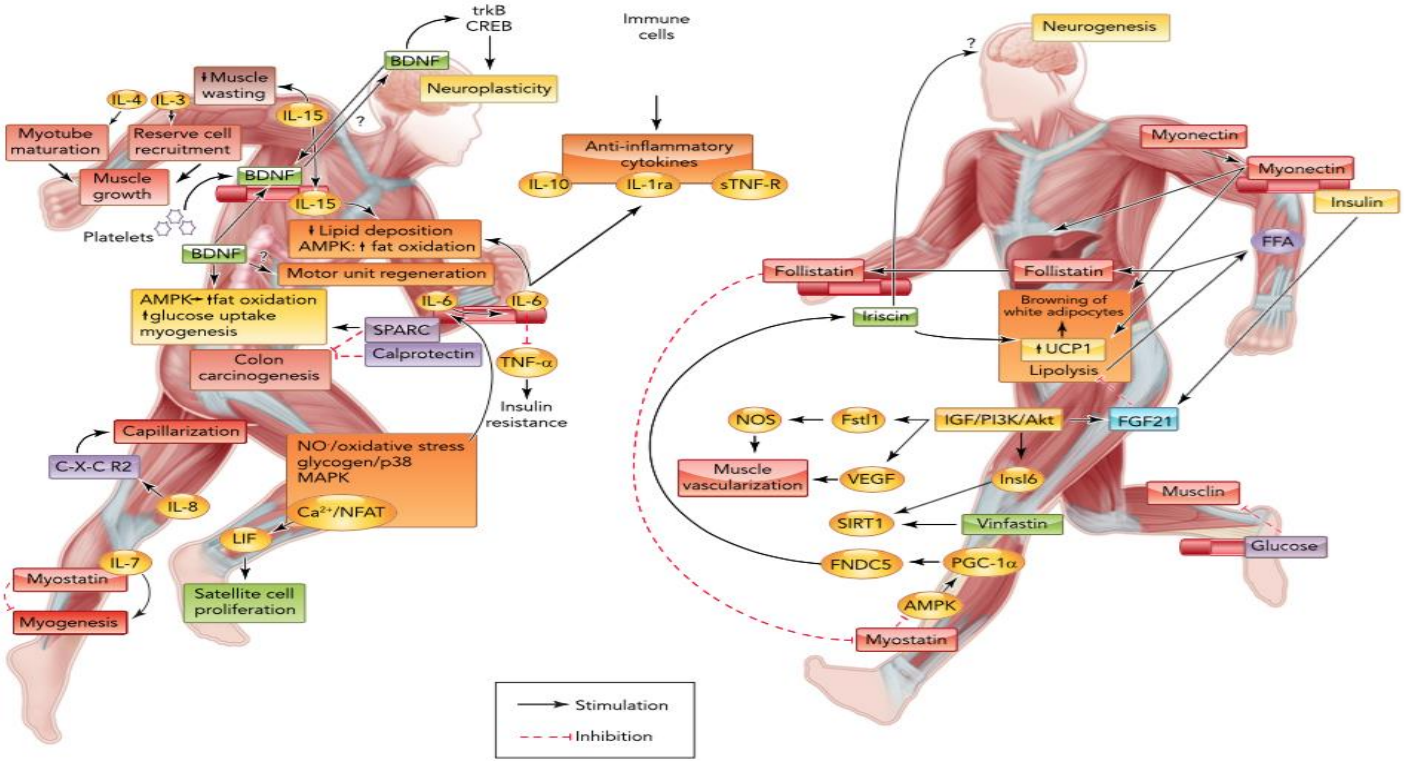
The Crosstalk between the Gut Microbiota and Mitochondria during Exercise



PHYSIOLOGY 28: 330–358, 2013; doi:10.1152/physiol.00019.2013

Exercise is the Real Polypill

Carmen Fiuza-Luces,[1,2]
Nuria Garatachea,[3]



World Health Organization

RECOMMENDED LEVELS OF PHYSICAL ACTIVITY FOR HEALTH

UNIVERSITÀ CATTOLICA del Sacro Cuore

5–17 years old

For children and young people of this age group physical activity includes play, games, sports, transportation, recreation, physical education or planned exercise, in the context of family, school, and community activities.
In order to improve cardiorespiratory and muscular fitness, bone health, cardiovascular and metabolic health biomarkers and reduced symptoms of anxiety and depression, the following are recommended:

1. Children and young people aged 5–17 years old should accumulate at least 60 minutes of moderate- to vigorous-intensity physical activity daily.
2. Physical activity of amounts greater than 60 minutes daily will provide additional health benefits.
3. Most of daily physical activity should be aerobic. Vigorous-intensity activities should be incorporated, including those that strengthen muscle and bone, at least 3 times per week.

18–64 years old

For adults of this age group, physical activity includes recreational or leisure-time physical activity, transportation (e.g walking or cycling), occupational (i.e. work), household chores, play, games, sports or planned exercise, in the context of daily, family, and community activities.
In order to improve cardiorespiratory and muscular fitness, bone health and reduce the risk of NCDs and depression the following are recommended:

1. Adults aged 18–64 years should do at least 150 minutes of moderate-intensity aerobic physical activity throughout the week, **or** do at least 75 minutes of vigorous-intensity aerobic physical activity throughout the week, **or** an equivalent combination of moderate- and vigorous-intensity activity.
2. Aerobic activity should be performed in bouts of at least 10 minutes duration.
3. For additional health benefits, adults should increase their moderate-intensity aerobic physical activity to 300 minutes per week, **or** engage in 150 minutes of vigorous-intensity aerobic physical activity per week, **or** an equivalent combination of moderate- and vigorous-intensity activity.
4. Muscle-strengthening activities should be done involving major muscle groups on 2 or more days a week.

RECOMMENDED LEVELS OF PHYSICAL ACTIVITY FOR HEALTH

65 years old and above

For adults of this age group, physical activity includes recreational or leisure-time physical activity, transportation (e.g walking or cycling), occupational (if the person is still engaged in work), household chores, play, games, sports or planned exercise, in the context of daily, family, and community activities.
In order to improve cardiorespiratory and muscular fitness, bone and functional health, and reduce the risk of NCDs, depression and cognitive decline, the following are recommended:

1. Adults aged 65 years and above should do at least 150 minutes of moderate-intensity aerobic physical activity throughout the week, **or** do at least 75 minutes of vigorous-intensity aerobic physical activity throughout the week, **or** an equivalent combination of moderate- and vigorous-intensity activity.
2. Aerobic activity should be performed in bouts of at least 10 minutes duration.
3. For additional health benefits, adults aged 65 years and above should increase their moderate-intensity aerobic physical activity to 300 minutes per week, **or** engage in 150 minutes of vigorous-intensity aerobic physical activity per week, **or** an equivalent combination of moderate- and vigorous-intensity activity.
4. Adults of this age group with poor mobility should perform physical activity to enhance balance and prevent falls on 3 or more days per week.
5. Muscle-strengthening activities should be done involving major muscle groups, on 2 or more days a week.
6. When adults of this age group cannot do the recommended amounts of physical activity due to health conditions, they should be as physically active as their abilities and conditions allow.

Vol. 4, 818-825, November 2012
http://dx.doi.org/10.1016/j.pmrj.2012.09.582

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The Exercise Prescription: A Tool to Improve Physical Activity

Edward M. Phillips, MD, Mary A. Kennedy, MS

	Subjective Measures		Physiological/Relative Measures		Absolute Measure
Intensity	"Talk Test"	Perceived Exertion (10-Point Scale)	% HRR	Maximal HR (%)	METs
Light	Able to talk and/or sing	<3	<40	<64	<3
Moderate	Able to talk but not sing	3-4	40-60	64-76	3-6
Vigorous/hard	Difficulty talking	≥5	>60	>76	>6

Reprinted with permission from Jonas and Phillips [29].
Note: See Chapter 8 addendum for details on how to calculate measures of intensity.
HRR = heart rate reserve; METs = metabolic equivalent units (1 MET = 3.5 mL × $kg^{-1} \times min^{-1}$); = oxygen uptake reserve.

November 10, 2015, Vol 314, No. 18

JAMA®
The Journal of the American Medical Association

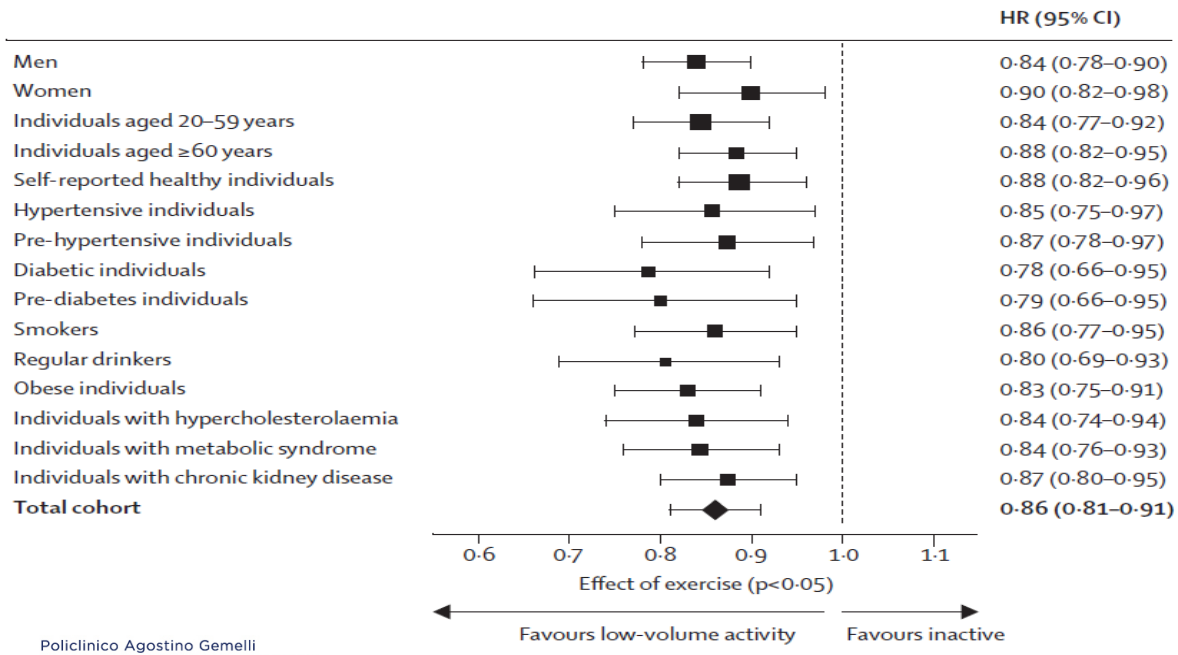
Exercise Is Medicine At Any Dose?

Thijs M. H. Eijsvogels, Paul D. Thompson

Minimum amount of physical activity for reduced mortality and extended life expectancy: a prospective cohort study

Chi Pang Wen, Jackson Pui Man Wai*, Min Kuang Tsai, Yi Chen Yang, Ting Yuan David Cheng, Meng-Chih Lee, Hui Ting Chan, Chwen Keng Tsao, Shan Pou Tsai, Xifeng Wu*

THE LANCET
Vol 378 October 1, 2011



n=416,175 individuals
Average follow-up: 8.05 years

15 min a day or 90 min a week of light-to-moderate intensity exercise (3.75–7.49 MET-h) reduce the risk for all-cause mortality by 14% (+3 yrs of life)

Every additional 15 min of daily exercise beyond the minimum amount of 15 min a day further reduce all-cause mortality by 4%

JAMA®
The Journal of the American Medical Association

Exercise Is Medicine At Any Dose?

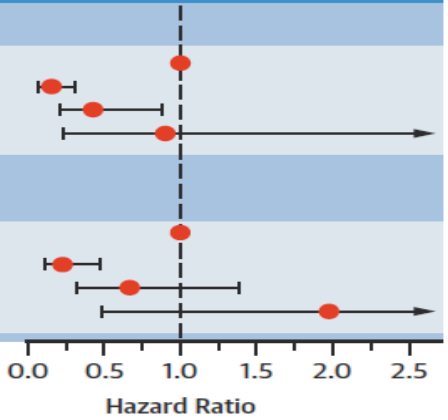
Thijs M. H. Eijsvogels, Paul D. Thompson

There is no known upper limit for moderate-intensity physical activity in healthy individuals, but doses more than 100 minutes a day do not appear to be associated with additional reductions in mortality rates.[5] For vigorous physical activity, low doses are related to large benefits, whereas doses up to 10 times the recommended physical activity levels are not associated with further reductions in mortality rates[5-7]. Some studies suggest an attenuation of health benefits at higher physical activity doses, but methodological flaws may limit the validity of these observations.[1,4] No dose of vigorous physical activity is associated with higher mortality rates than physical inactivity. Physical activity is one of the best modifiable factors for the prevention of noncommunicable diseases and mortality, so it is important for clinicians to keep emphasizing that exercise is medicine.

How much exercise is too much?

CENTRAL ILLUSTRATION **Dose of Jogging and Long-Term Mortality**

DOSE OF JOGGING	NO. OF PARTICIPANTS	ALL-CAUSE MORTALITY DEATHS	FOREST PLOT
Adjusted for age and sex			
Sedentary nonjogger (reference)	413	128	
Light jogger	576	7	
Moderate jogger	262	8	
Strenuous jogger	40	2	3.67
Adjusted for age, sex, smoking, alcohol intake, education, and diabetes			
Sedentary nonjogger (reference)	394	120	
Light jogger	570	7	
Moderate jogger	252	8	
Strenuous jogger	36	2	8.14



Schnohr, P. et al. J Am Coll Cardiol. 2015; 65(5):411–9.

Forest plot indicating all-cause mortality in light, moderate, and strenuous joggers compared with sedentary nonjoggers.

Effect of Structured Physical Activity on Prevention of Major Mobility Disability in Older Adults
The LIFE Study Randomized Clinical Trial

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Marco Pahor, MD; Jack M. Guralnik, MD, PHD; Walter T. Ambrosius, PhD; Steven Blair, PED; Denise E. Bonds, MD; Timothy S. Church, MD, PhD, Mark A. Espeland, PhD; Roger A. Fielding, PhD; Thomas M. Gill, MD; Erik J. Groessl, PhD; Abby C. King, PhD; Stephen B. Kritchevsky, PhD; Todd M. Manini, PhD; Mary M. McDermott, MD; Michael E. Miller, PhD; Anne B. Newman, MD, MPH; W Jack Rejeski, PhD; Kaycee M. Sink, MD, MAS; Jeff D. Williamson, MD, MHS; for the LIFE study investigators

OBJECTIVE To test the hypothesis that a long-term structured physical activity program is more effective than a health education program (also referred to as a successful aging program) in reducing the risk of major mobility disability.

DESIGN, SETTING, AND PARTICIPANTS The Lifestyle Interventions and Independence for Elders (LIFE) study was a multicenter, randomized trial that enrolled participants between February 2010 and December 2011, who participated for an average of 2.6 years. Follow-up ended in December 2013. Outcome assessors were blinded to the intervention assignment. Participants were recruited from urban, suburban, and rural communities at 8 centers throughout the United States. We randomized a volunteer sample of 1635 sedentary men and women aged 70 to 89 years who had physical limitations, defined as a score on the Short Physical Performance Battery of 9 or below, but were able to walk 400 m.

Effect of Structured Physical Activity on Prevention of Major Mobility Disability in Older Adults
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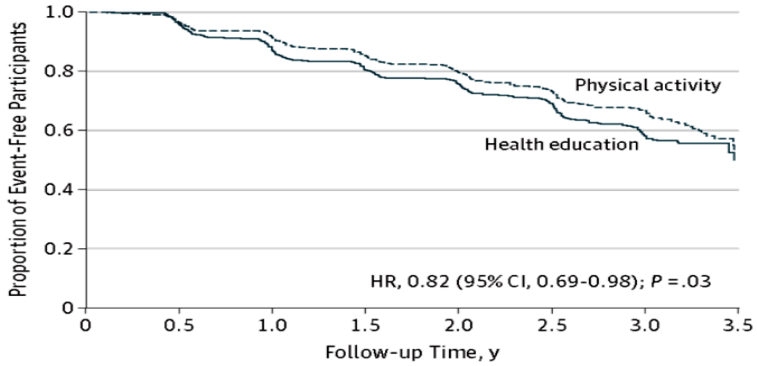

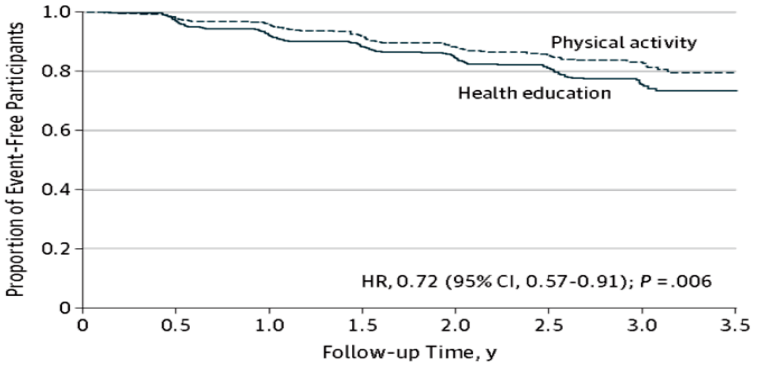

No. at risk															
Physical activity	818	758	706	646	559	378	182	11	818	761	726	673	579	393	188	12
Health education	817	765	680	617	540	358	162	13	817	762	707	655	567	371	178	10
Events																
Physical activity	0	29	67	115	155	197	224	246	0	18	32	64	88	104	113	120
Health education	0	33	105	155	190	232	277	286	0	25	64	91	118	138	158	162

Effect of Structured Physical Activity on Prevention of Major Mobility Disability in Older Adults
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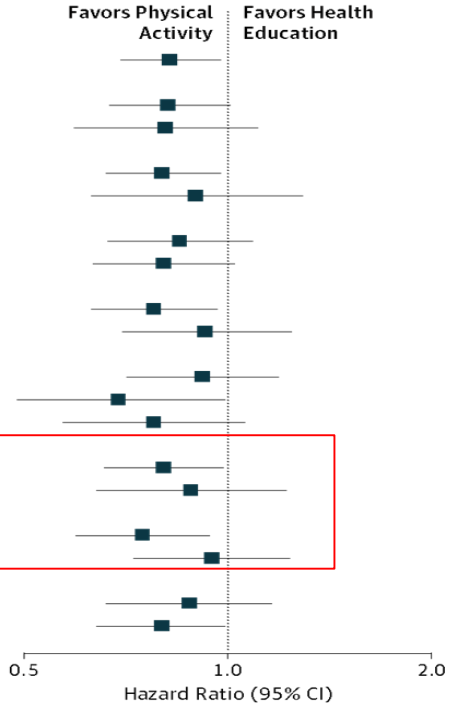
Marco Pahor, MD; Jack M. Guralnik, MD, PHD; Walter T. Ambrosius, PhD; Steven Blair, PED; Denise E. Bonds, MD; Timothy S. Church, MD, PhD, Mark A. Espeland, PhD; Roger A. Fielding, PhD; Thomas M. Gill, MD; Erik J. Groessl, PhD; Abby C. King, PhD; Stephen B. Kritchevsky, PhD; Todd M. Manini, PhD; Mary M. McDermott, MD; Michael E. Miller, PhD; Anne B. Newman, MD, MPH; W Jack Rejeski, PhD; Kaycee M. Sink, MD, MAS; Jeff D. Williamson, MD, MHS; for the LIFE study investigators

Subgroup	Physical Activity Events, No.	Physical Activity Total Participants	Health Education Events, No.	Health Education Total Participants	Hazard Ratio (95% CI)	Interaction *P* Value
Overall	246	818	290	817	0.82 (0.69-0.98)	
Sex						
Women	171	547	204	551	0.82 (0.67-1.01)	.95
Men	75	271	86	266	0.81 (0.59-1.11)	
Ethnicity/race						
Non-Hispanic white	182	604	234	635	0.80 (0.66-0.98)	.58
Other	64	211	56	180	0.90 (0.63-1.29)	
Age, y						
70-79	123	477	138	455	0.85 (0.67-1.09)	.76
≥80	123	341	152	362	0.81 (0.63-1.03)	
History of CVD						
No CVD	155	582	187	563	0.78 (0.63-0.97)	.34
CVD	91	236	103	254	0.93 (0.70-1.24)	
History of diabetes						
None	114	406	126	414	0.92 (0.71-1.19)	.41
Impaired fasting glucose	59	192	68	165	0.69 (0.49-0.99)	
Diabetes	73	220	96	238	0.78 (0.57-1.06)	
Gait speed						
<0.8 m/s	173	485	210	508	0.81 (0.66-0.99)	.63
≥0.8 m/s	73	333	80	309	0.88 (0.64-1.22)	
SPPB						
<8	135	353	177	378	0.75 (0.60-0.94)	.19
8 or 9	111	465	113	439	0.95 (0.73-1.23)	
3MSE (post hoc)						
<90	95	261	108	261	0.88 (0.66-1.16)	.58
≥90	151	557	182	556	0.80 (0.64-0.99)	



PLOS ONE

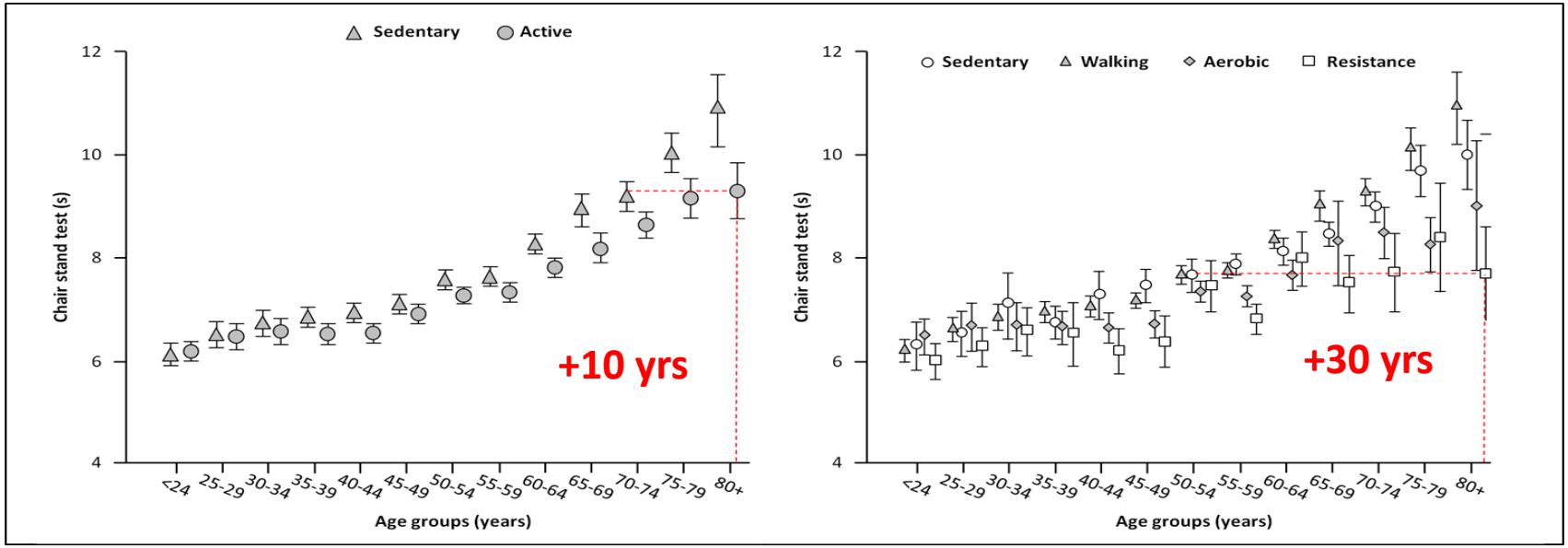
RESEARCH ARTICLE

Impact of habitual physical activity and type of exercise on physical performance across ages in community-living people

Francesco Landi, Riccardo Calvani*, Anna Picca, Matteo Tosato, Anna Maria Martone, Emanuela D'Angelo, Elisabetta Serafini, Roberto Bernabei, Emanuele Marzetti

Department of Geriatrics, Neurosciences and Orthopedics, Teaching Hospital "Agostino Gemelli", Catholic University of the Sacred Heart, Rome, Italy

Active versus sedentary

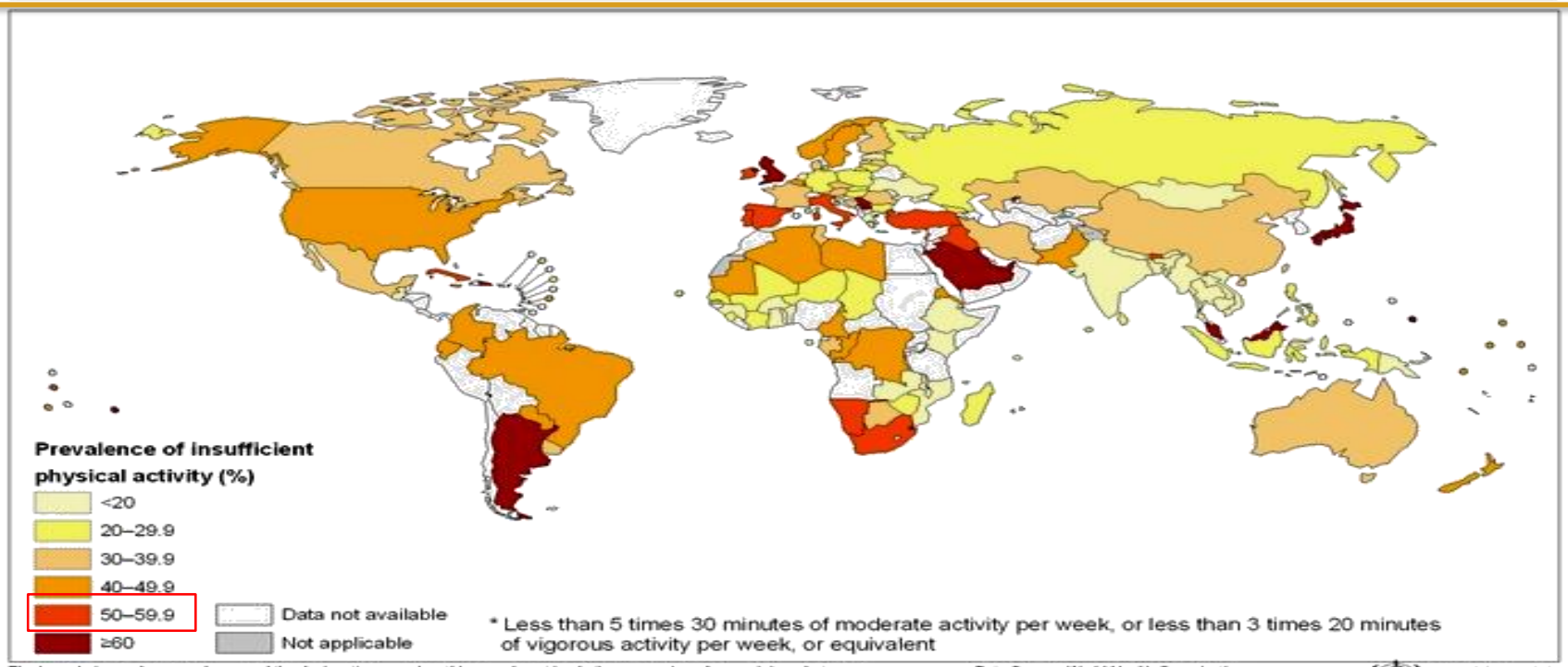


n=6,242

Age: 54.4 ± 15.2 yrs (range: 18-98 yrs)

Women: 3,552 (57%)

Prevalence of insufficient physical activity*, ages 15+, age standardized
Both sexes, 2008



The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted lines on maps represent approximate border lines for which there may not yet be full agreement.

Data Source: World Health Organization
Map Production: Public Health Information and Geographic Information Systems (GIS)
World Health Organization

World Health Organization

Barriers to participation in physical activity and exercise among middle-aged and elderly individuals

Maria Justine[1], PhD, PT, *Azliyana Azizan*[1], BPT, *Vaharli Hassan*[2], BPT, *Zoolfaiz Salleh*[1], BPT, *Haidzir Manaf*[1], BSc, PT

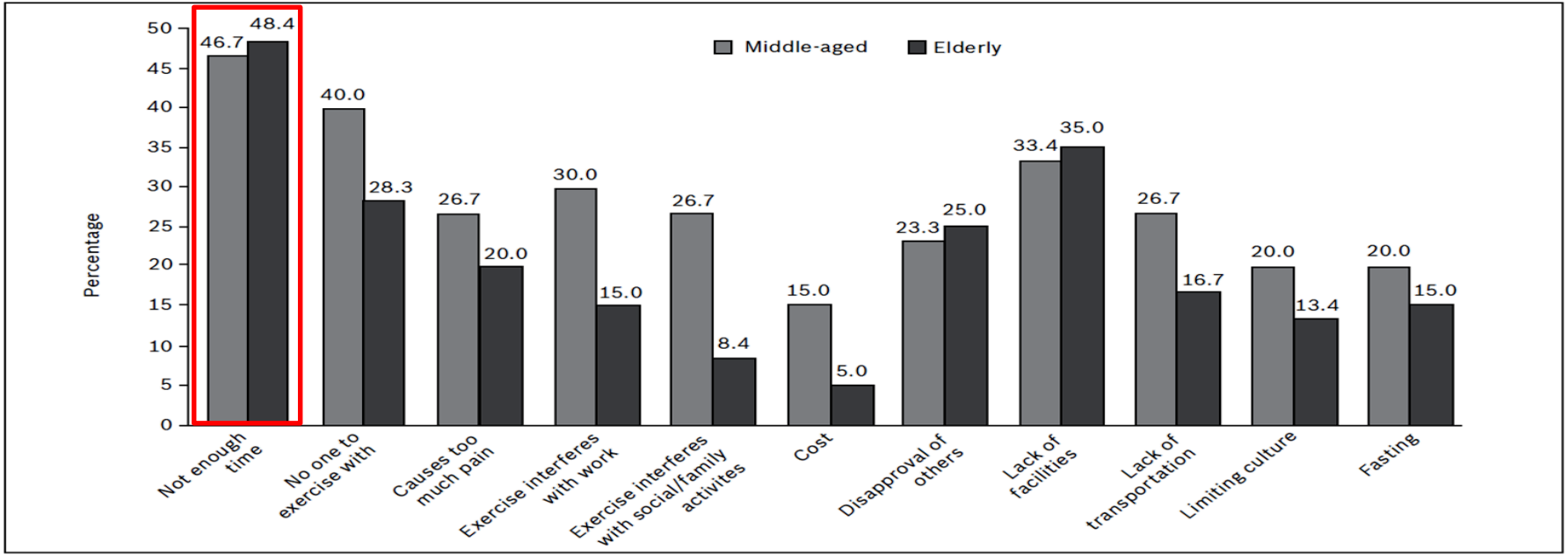


Fig. 1 Graph shows the external barriers to participation in physical activity among middle-aged (n = 60) and elderly (n = 60) respondents.

Barriers to participation in physical activity and exercise among middle-aged and elderly individuals

Maria Justine[1], PhD, PT, *Azliyana Azizan*[1], BPT, *Vaharli Hassan*[2], BPT, *Zoolfaiz Salleh*[1], BPT, *Haidzir Manaf*[1], BSc, PT

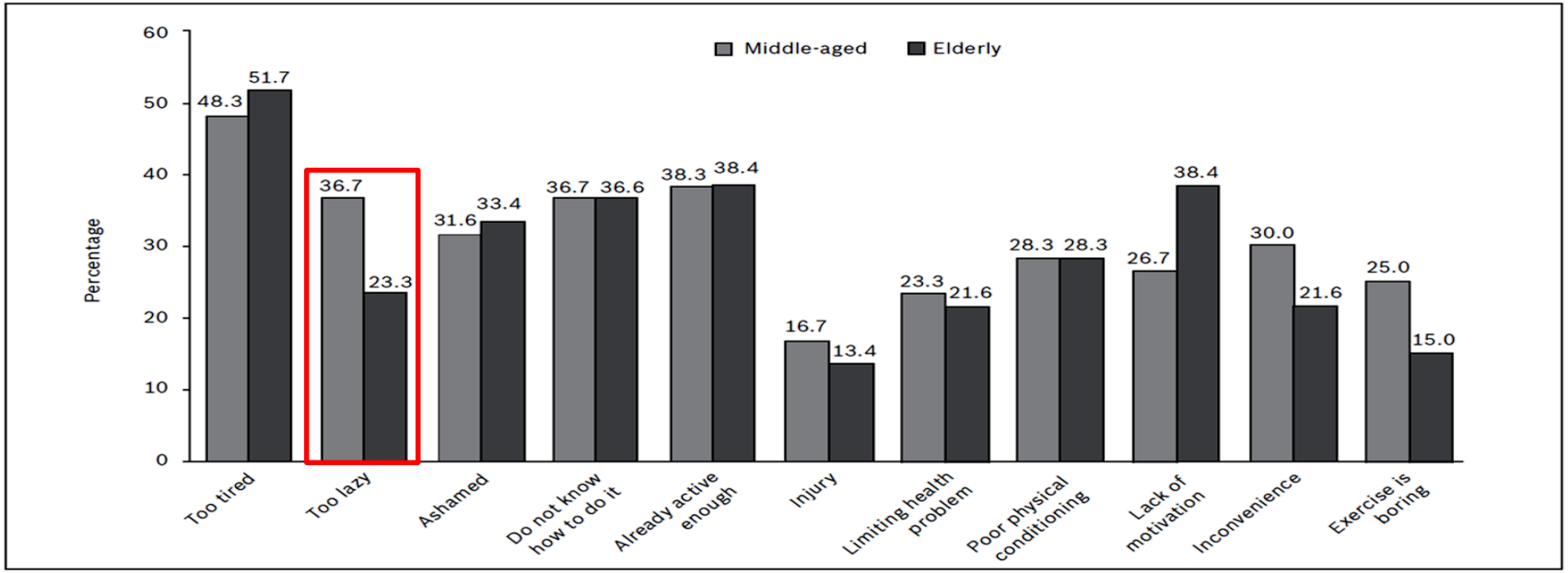
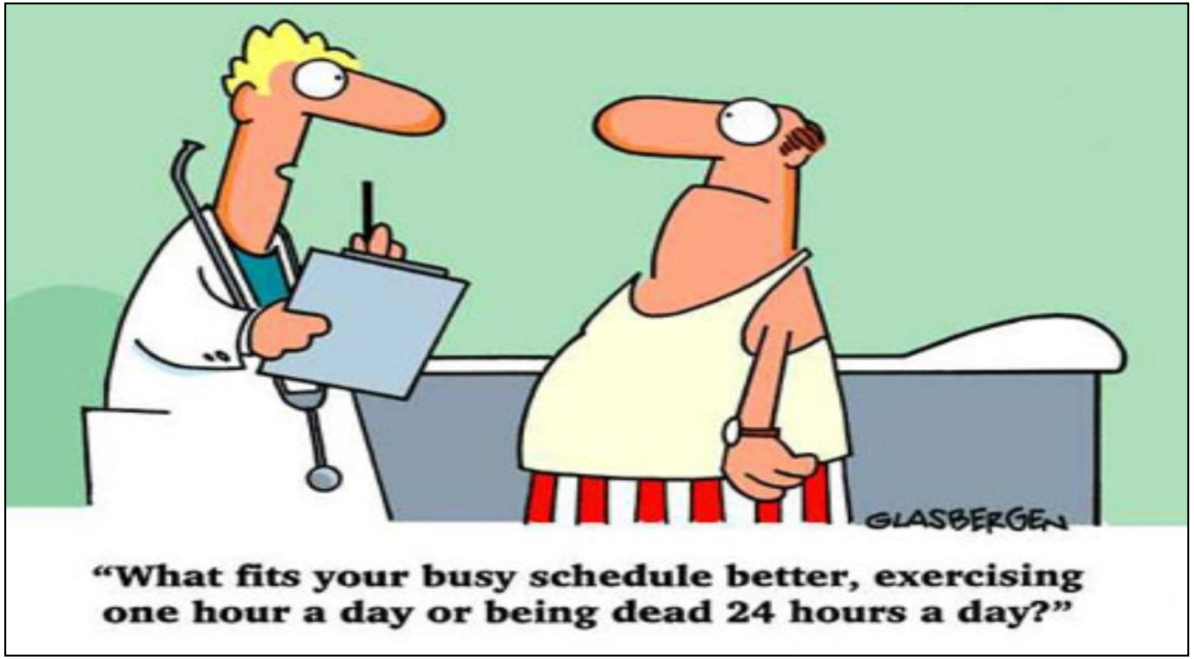


Fig. 2 Graph shows internal barriers to participation in physical activity among middle-aged (n = 60) and elderly (n = 60) respondents.

Lack of time is the major barrier to participating in physical activity regardless of age



Poor adherence to exercise prevents long-term benefits

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Up to 50% of individuals who begin an exercise program stop within the first 6 months.

Appl. Physiol. Nutr. Metab. 42: 384–390 (2017) dx.doi.org/10.1139/apnm-2016-0413

NRC Research Press

ARTICLE

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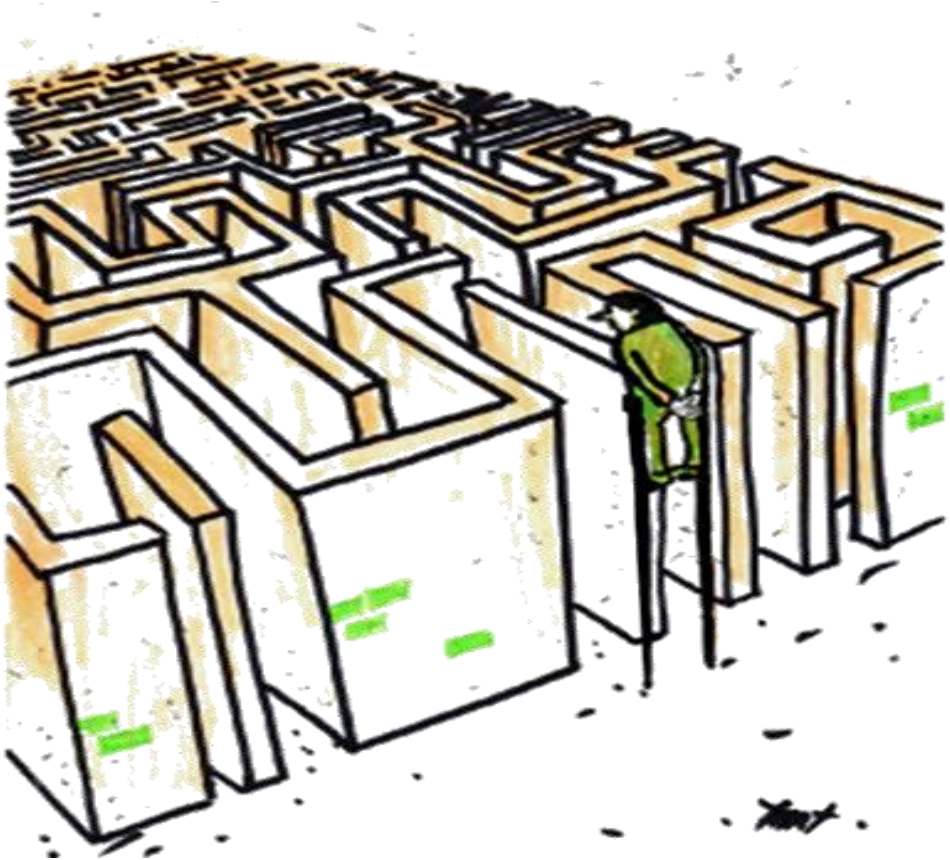
Health care provider confidence and exercise prescription practices of Exercise is Medicine Canada workshop attendees

Myles W. O'Brien, Christopher A. Shields, Paul I. Oh, and Jonathon R. Fowles

Table 3. Reporting and rating barriers that prevent patient physical activity and exercise counselling.

	Physicians		Allied health professionals		Exercise professionals	
Variable	%	Rating/4	%	Rating/4	%	Rating/4
Patients not interested in exercise[a]	92.9*	2.77*	92.6*	2.73*	73.9	2.11
Lack of guidance/resources in exercise for those with chronic disease[b]	90.3*	2.65**	77.8	2.46*	65.2	1.73
Lack of time[c]	95.6**	2.62**	88.9*	2.11‡	69.6	1.75
Patients prefer medication management[d]	80.5**	2.38*	88.9**	2.51*	47.8	1.73
Lack of exercise education in medical school[e]	89.4*	2.29**	75.9*	2.28**	26.1	1.29
Personal knowledge[f]	80.5*	2.04*	81.5*	2.00*	56.5	1.38
Other lifestyle changes more important[g]	75.2	1.96	81.5	2.26**	60.9	1.57
Lack of evidence for effectiveness of exercise[h]	68.1	1.38	72.2	1.71	52.2	1.25

Is there a way out?



Special Article

Mayo Clin Proc. 2002;77:165-173

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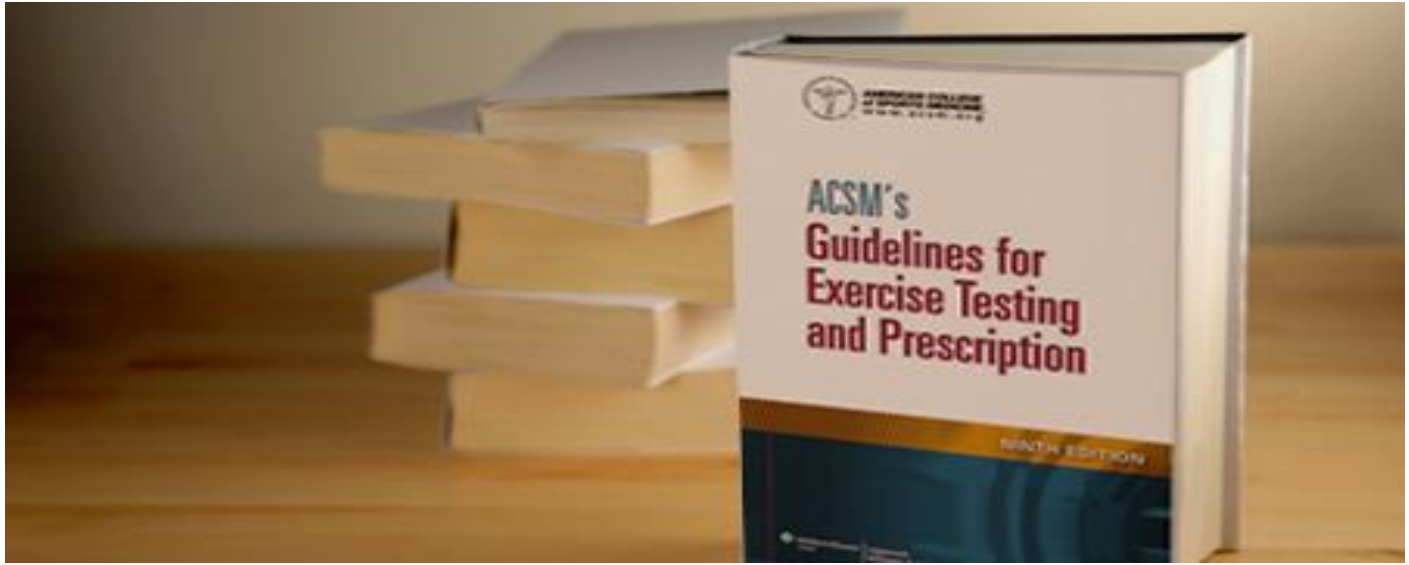
An Obligation for Primary Care Physicians to Prescribe Physical Activity to Sedentary Patients to Reduce the Risk of Chronic Health Conditions

MANU V. CHAKRAVARTHY, MD, PHD; MICHAEL J. JOYNER, MD; AND FRANK W. BOOTH, PHD



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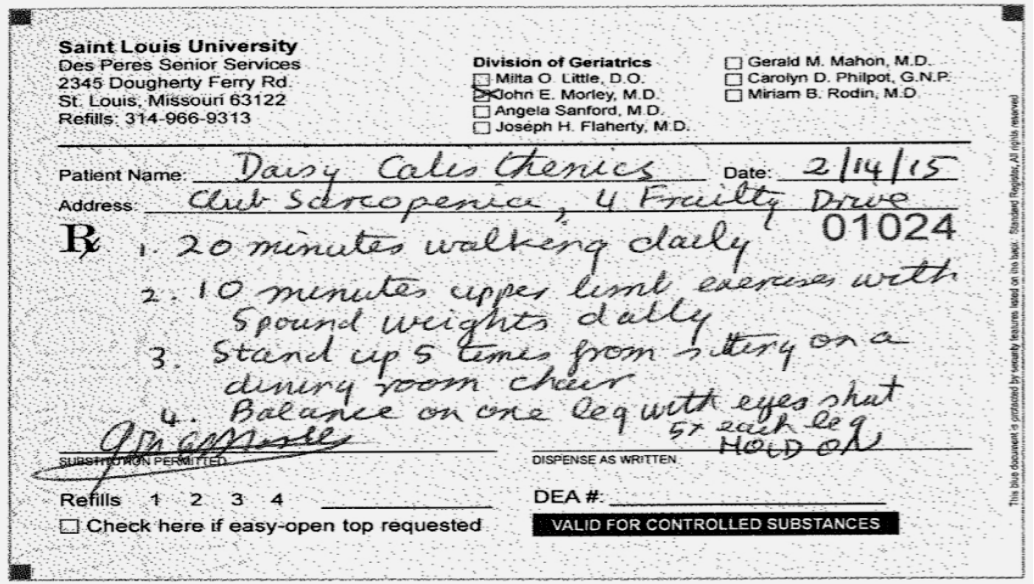
Editorial

Exercise: The Ultimate Medicine

John E. Morley MB, BCh *



Saint Louis University
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Division of Geriatrics
☐ Milta O. Little, D.O.
☒ John E. Morley, M.D.
☐ Angela Sanford, M.D.
☐ Joseph H. Flaherty, M.D.
☐ Gerald M. Mahon, M.D.
☐ Carolyn D. Philpot, G.N.P.
☐ Miriam B. Rodin, M.D.

Patient Name: Daisy Calisthenics Date: 2/14/15
Address: Club Sarcopenia, 4 Frailty Drive 01024

℞
1. 20 minutes walking daily
2. 10 minutes upper limb exercises with 5 pound weights daily
3. Stand up 5 times from sitting on a dining room chair
4. Balance on one leg with eyes shut 5x each leg HOLD ON

JM Morley
SUBSTITUTION PERMITTED
DISPENSE AS WRITTEN

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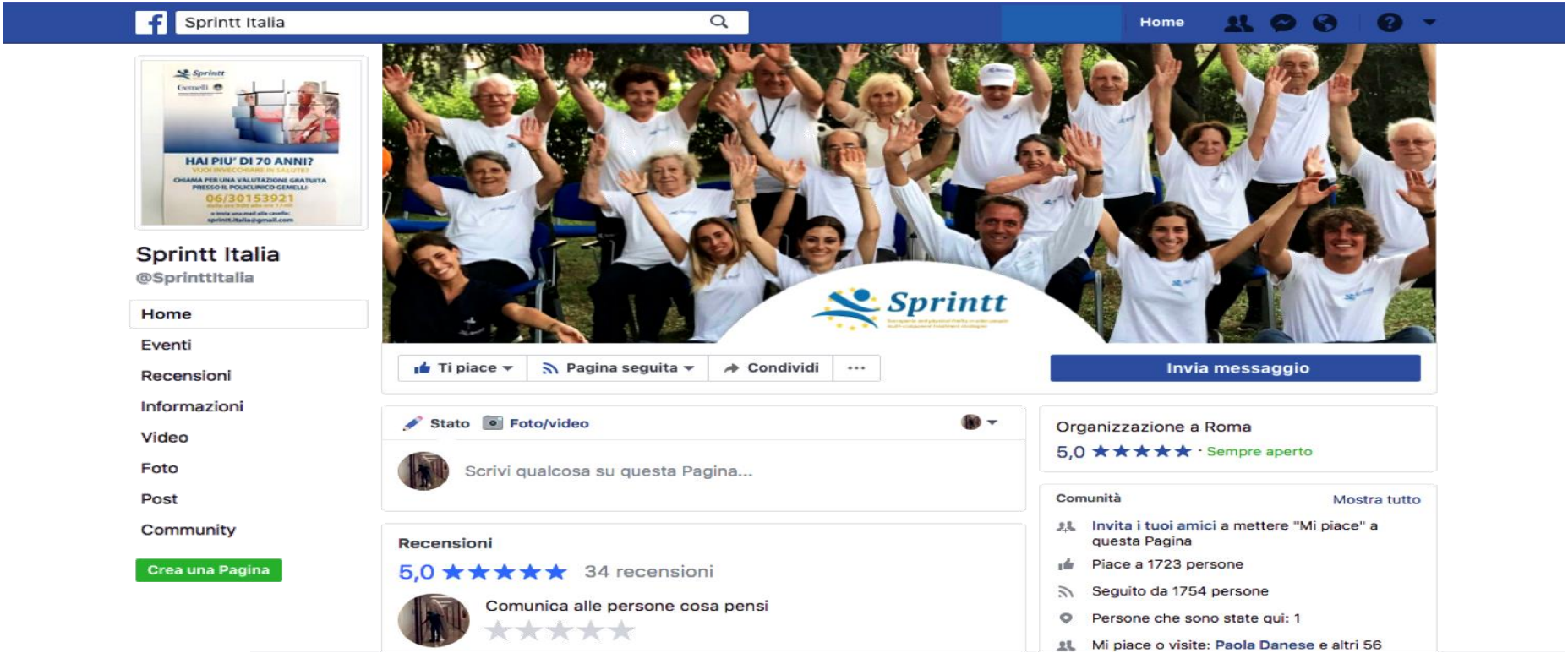

Is there a way out?

Is there a way out?

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@LONGEVITY_RUN

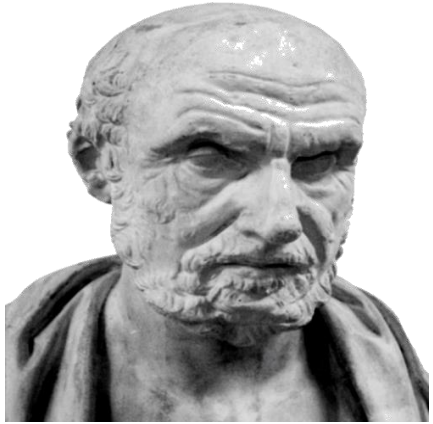
Instagram

LONGEVITY RUN

Is there a way out?

1:48:35

Is there a way out?



Hippocrates - 460 BC – 375 BC

"If we could give every individual the right amount of nourishment and exercise, not too little and not too much, we would have found the safest way to health"