Ά Καρδιολογική Κλινική ΑΧΕΠΑ

Φυσική δραστηριότητα στο πλαίσιο της πρωτοπαθούς πρόληψης

Βασίλειος Καμπερίδης **MD, MSc, PhD, FESC**

Καρδιολόγος

Ακαδημαϊκός Υπότροφος ΑΠΘ

Α' Καρδιολογική Κλινική Νοσοκομείο ΑΧΕΠΑ

Θεσσαλονίκη, 19/03/2019

Outline

- Κατευθυντήριες Οδηγίες
- Δημογραφικά
- Οφέλη της άσκησης
- Όρια στην άσκηση (χρόνος, ένταση, διάρκεια)
- Ακραία άσκηση – επιβλαβής

Outline

Ά Καρδιολογική Κλινική ΑΧΕΠΑ

- Κατευθυντήριες Οδηγίες
- Δημογραφικά
- Οφέλη της άσκησης
- Όρια στην άσκηση (χρόνος, ένταση, διάρκεια)
- Ακραία άσκηση – επιβλαβής

2016 European Guidelines on cardiovascular disease prevention in clinical practice

ιδιολογική Κλινική ΑΧΕΠΑ

Recommendations for physical activity

Recommendations	Class[a]	Level[b]	Ref[c]
It is recommended for healthy adults of all ages to perform at least 150 minutes a week of moderate intensity or 75 minutes a week of vigorous intensity aerobic PA or an equivalent combination thereof.	I	A	258–261
For additional benefits in healthy adults, a gradual increase in aerobic PA to 300 minutes a week of moderate intensity, or 150 minutes a week of vigorous intensity aerobic PA, or an equivalent combination thereof is recommended.	I	A	259, 260
Regular assessment and counselling on PA is recommended to promote the engagement and, if necessary, to support an increase in PA volume over time.[d]	I	B	262–264
PA is recommended in low-risk individuals without further assessment.	I	C	265, 266
Multiple sessions of PA should be considered, each lasting ≥10 minutes and evenly spread throughout the week, i.e. on 4–5 days a week and preferably every day of the week.	IIa	B	267, 268
Clinical evaluation, including exercise testing, should be considered for sedentary people with CV risk factors who intend to engage in vigorous PAs or sports.	IIa	C	265

2016 European Guidelines on cardiovascular disease prevention in clinical practice

ιδιολογική Κλινική ΑΧΕΠΑ

Table 10 Classification of physical activity intensity and examples of absolute and relative intensity levels

Absolute intensity			Relative intensity		
Intensity	**MET**	**Examples**	**%HRmax**	**RPE (Borg scale score)**	**Talk Test**
Light	1.1–2.9	Walking <4.7 km/h, light household work.	50–63	10–11	
Moderate	3–5.9	Walking briskly (4.8–6.5 km/h), slow cycling (15 km/h), painting/decorating, vacuuming, gardening (mowing lawn), golf (pulling clubs in trolley), tennis (doubles), ballroom dancing, water aerobics.	64–76	12–13	Breathing is faster but compatible with speaking full sentences.
Vigorous	≥6	Race-walking, jogging or running, bicycling >15 km/h, heavy gardening (continuous digging or hoeing), swimming laps, tennis (single).	77–93	14–16	Breathing very hard, incompatible with carrying on a conversation comfortably.

MET (metabolic equivalent) is estimated as the energy cost of a given activity divided by resting energy expenditure: 1 MET = 3.5 mL O_2 kg-1 min-1 oxygen consumption (VO_2).
RPE, rating of perceived exertion (20 value Borg score).
%HRmax, percentage of measured or estimated maximum heart rate (220-age).

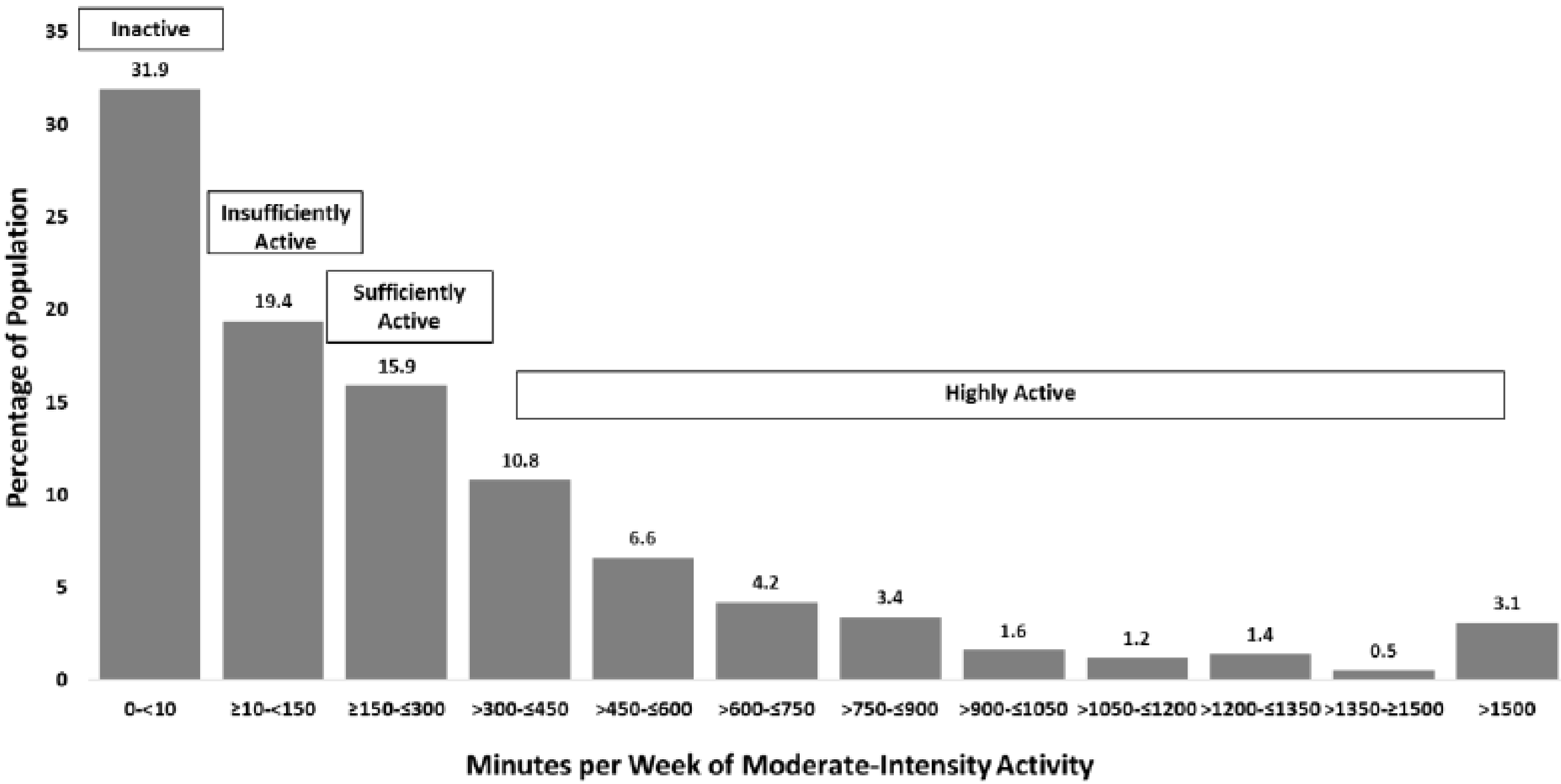
Outline

- Κατευθυντήριες Οδηγίες
- Δημογραφικά
- Οφέλη της άσκησης
- Όρια στην άσκηση (χρόνος, ένταση, διάρκεια)
- Ακραία άσκηση – επιβλαβής

Demographics

Ά Καρδιολογική Κλινική ΑΧΕΠΑ

Figure C-3. Distribution of Self-Reported Volume of Moderate-to-Vigorous Physical Activity, 150 Minutes per Week Increments, U.S. Adults, 2015



Source: Adapted from data found in the National Health Interview Survey, 2015.[29]

Marathon runners

Ά Καρδιολογική Κλινική ΑΧΕΠΑ

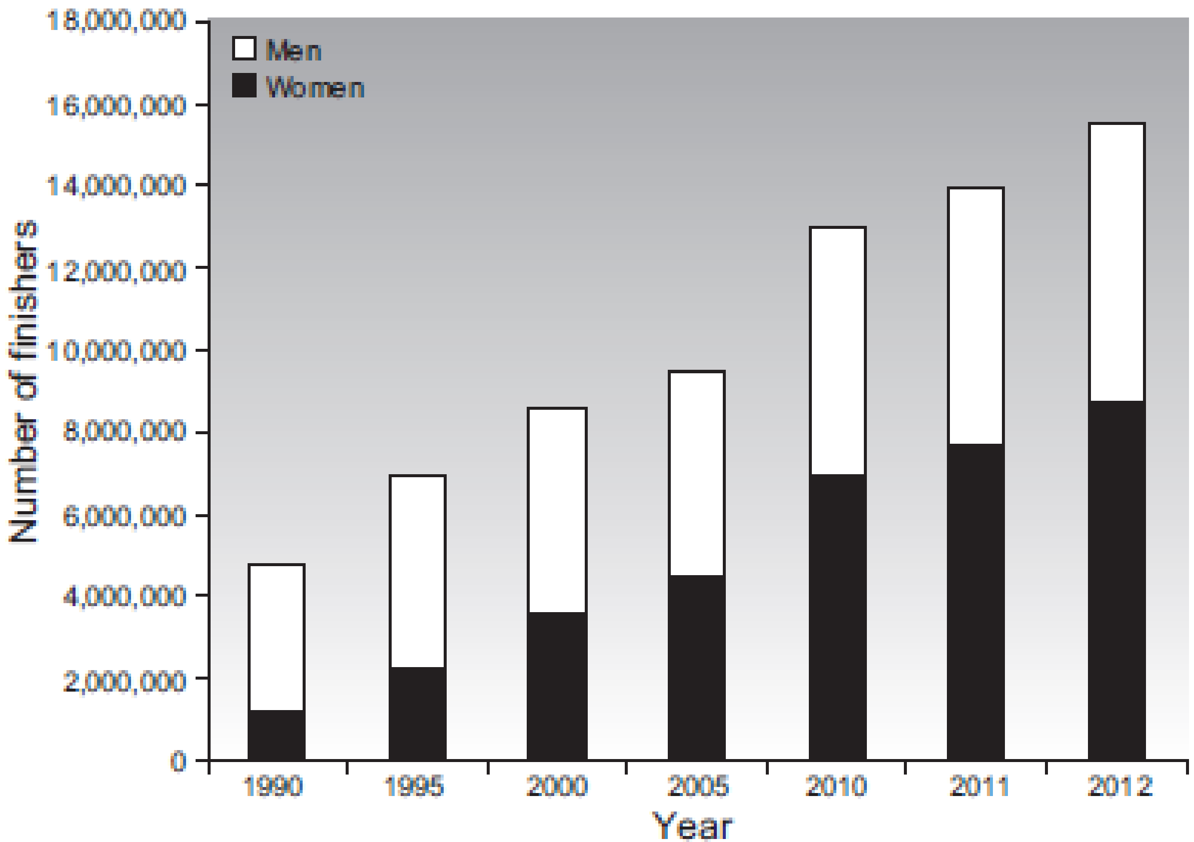


FIGURE 1. Trends in United States race finishers 1990–2012. (Data from Running USA.)

Outline

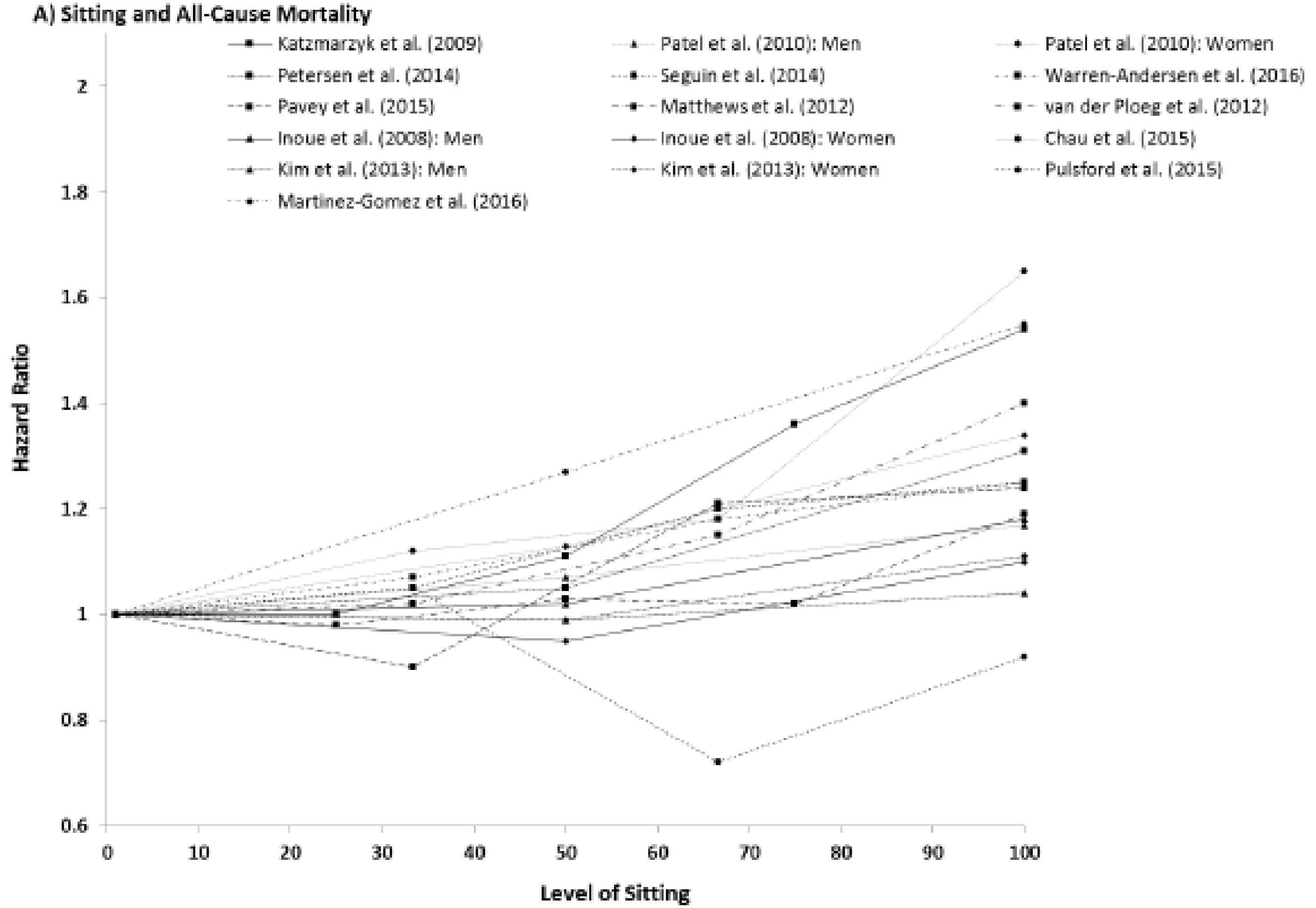
Ά Καρδιολογική Κλινική ΑΧΕΠΑ

- Κατευθυντήριες Οδηγίες
- Δημογραφικά
- Οφέλη της άσκησης
- Όρια στην άσκηση (χρόνος, ένταση, διάρκεια)
- Ακραία άσκηση – επιβλαβής

Καθιστική Ζωή

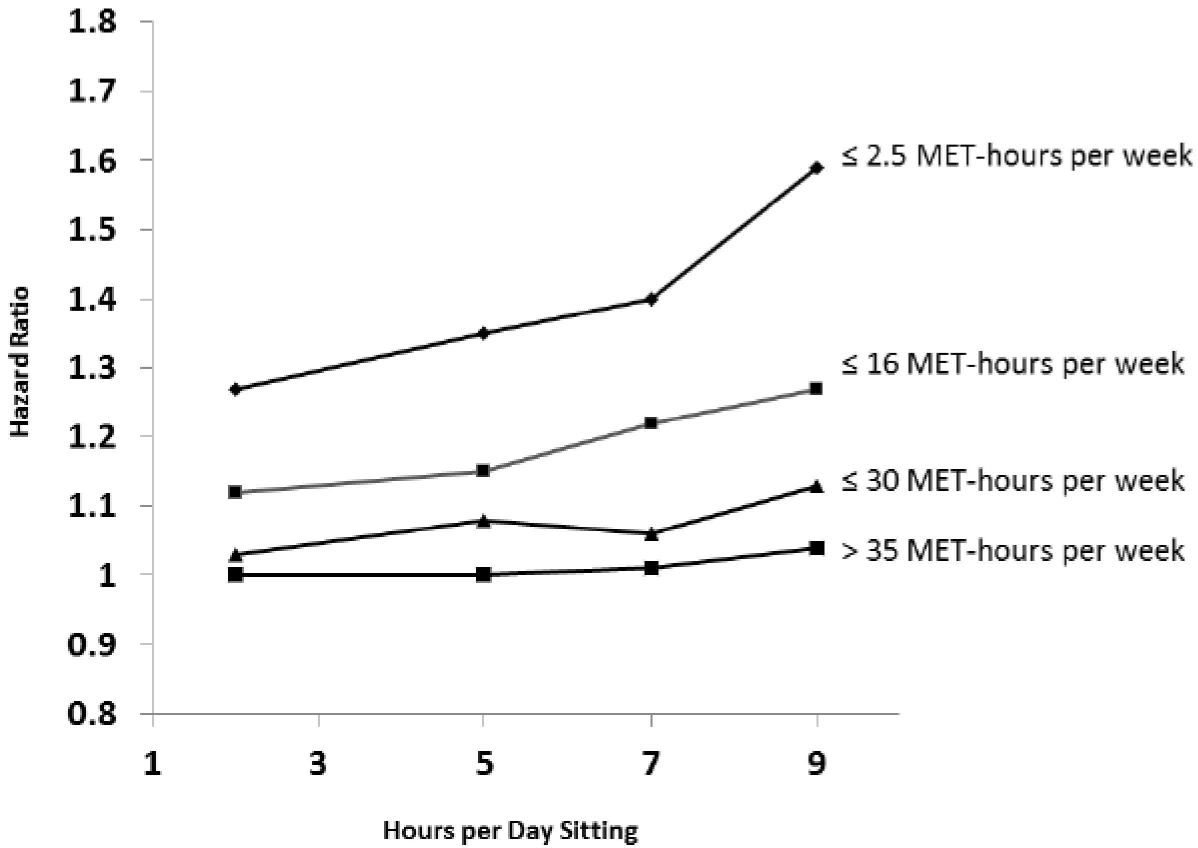
Ά Καρδιολογική Κλινική ΑΧΕΠΑ

Figure F2-1. Dose-Response Curves Showing Relationship Between Sedentary Behavior and All-Cause Mortality



Καθιστική Ζωή

Figure F2-2. Relationship Between Sitting and All-Cause Mortality, Stratified by Amount of Moderate-to-Vigorous Physical Activity



Οφέλη της άσκησης

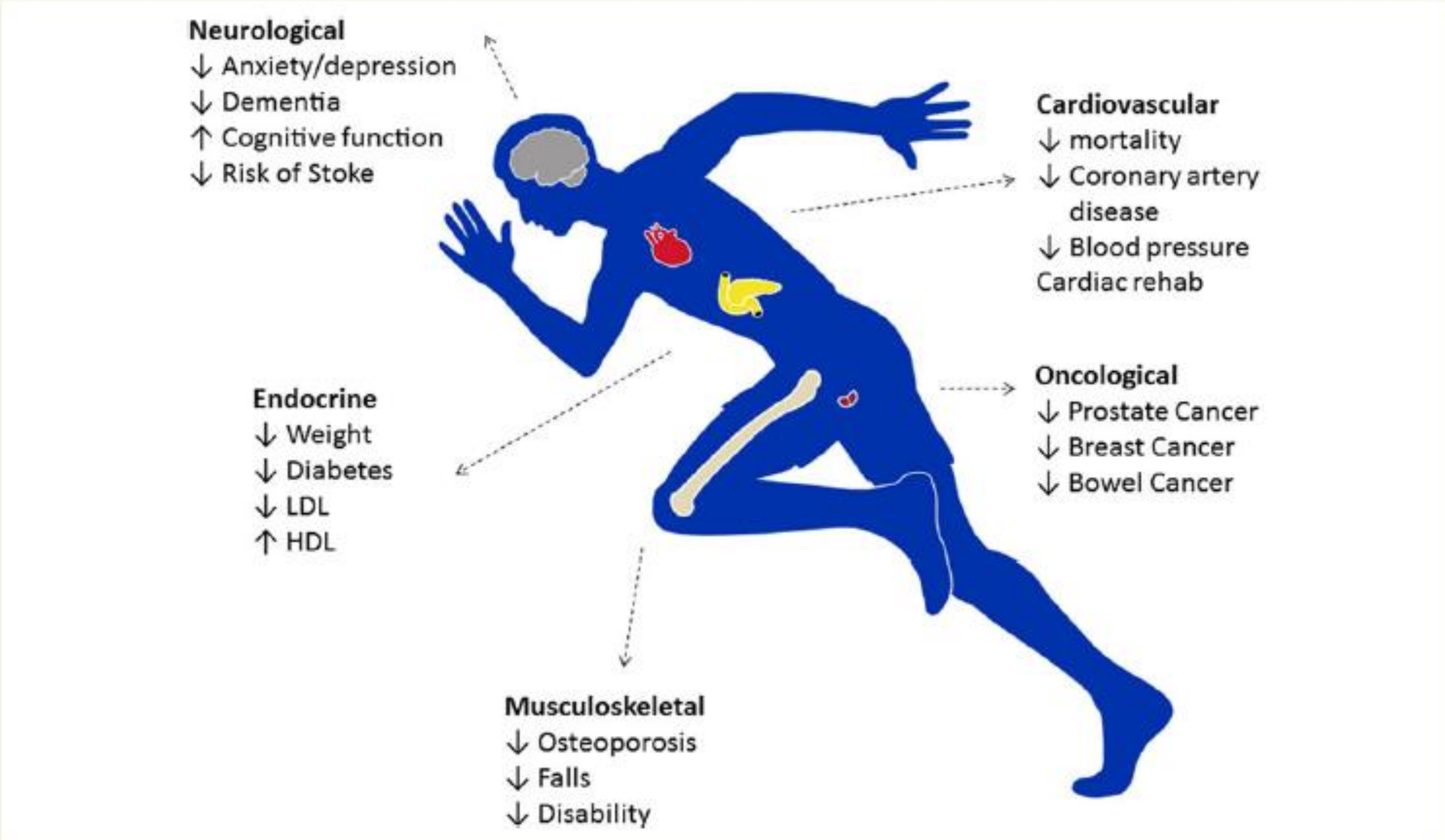


Figure 1 The benefits of exercise: HDL, high-density lipoprotein; LDL, low-density lipoprotein.

Reprint of: Promoting Physical Activity and Exercise

JACC Health Promotion Series

Ά Καρδιολογική Κλινική ΑΧΕΠΑ

FIGURE 1 **Benefits of PA/Exercise**

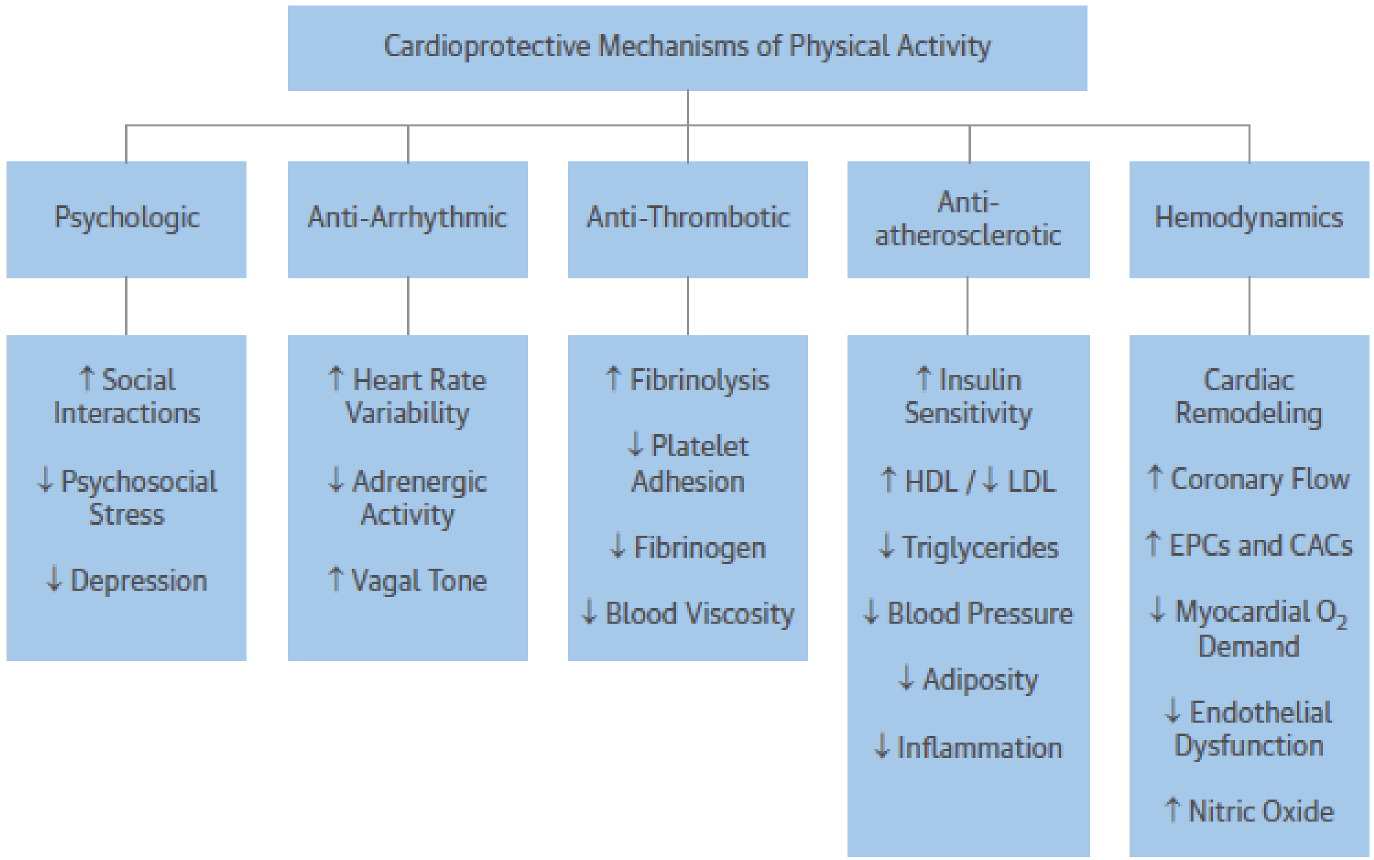


TABLE 1 Relationship Between PA, Exercise, and Fitness with Primary Prevention of CHD, CVD Risk Factors, and Mortality

First Author (Ref. #)	Subjects	Physical Activity/ Exercise Variables Measured	Results
Blair et al. (48)	10,224 men 3,120 women	Variables obtained from maxETT	Lower CV and cancer mortality were related to higher fitness levels Age-adjusted all-cause mortality: Men—least fit: 64/10,000 person-yrs Men—most fit: 18.6/10,000 person-yrs Women—least fit: 39.5/10,000 person-yrs Women—most fit: 8.5/10,000 person-yrs
Blair et al. (49)	5,341 men 7,080 women	Variables obtained from maxETT	Moderate fitness was protective against other CV risk factors Adjusted all-cause mortality: Men—low fitness: (RR: 1.52, 95% CI: 1.28-1.82) Women—low fitness: (RR: 2.10, 95% CI: 1.39-1.97)
Sandvik et al. (50)	1,960 men	Total work by bicycle ergometer	Higher levels of fitness were associated with lower mortality All-cause mortality: (RR: 0.54, 95% CI: 0.32-0.89) CV mortality: (RR: 0.41, 95% CI: 0.20-0.94)
Leon et al. (51)	12,138 men (MRFIT trial)	Self-reported leisure time PA	Moderate levels of leisure time physical activity were associated with 63% fewer fatal CHD events and sudden cardiac death compared with lower levels of leisure time PA.
Paffenbarger et al. (52)	10,269 men Harvard alumni	Habitual exercise, >4.5 METs	Moderately vigorous exercise was associated with a 23% reduction in all-cause and CV mortality (95% CI: 4-42%).
Sesso et al. (53)	12,516 men	Calories burned (kJ/week)	RR for CV events (CHD, MI, PCI, CABG, death) was reduced in men who burned more calories per week. Compared with men expending <2100 kJ/week, RR ranged from 0.90 to 0.81 for those expending >2,100-12,600 kJ/week.
Lee et al. (54)	7,307 men Harvard alumni	Self-reported PA	After controlling for confounding variables, total energy expenditure during physical exercise was more important than duration.
Lee et al. (55)	7,337 men Harvard alumni	Self-reported perceived level of exertion using Borg scale	Inverse relationship demonstrated between an individual's perceived level of exertion and risk of CHD: 0.86 (95% CI: 0.66-1.13) for "moderate" vs. 0.72 (95% CI: 0.52-1.00) for "intense."
Ekelund et al. (56)	4,276 men	Variables obtained from maxETT	Men with poor fitness had a higher risk of death RR of death from CV causes was 2.7 (95% CI: 1.4-5.1) for increment in HR >35 beats/min during stage 2 and 3.0 (95% CI: 1.5-5.0) for those with a decrement of 4.4 min in exercise time.
Kujala et al. (57)	7,295 men 7,977 women Finnish Twin Cohort	Self-reported PA	Odds ratio of death in "conditioning exercisers" was 0.57 (95% CI: 0.45-0.74) for all subjects and 0.44 (95% CI: 0.23-0.83) among the twin pairs discordant for death compared with sedentary subjects.
Manson et al. (58)	72,488 women Nurses' Health Study	Total PA, walking, vigorous exercise	Strong inverse relationship demonstrated between total PA, amount of walking, and vigorous activity with the risk for coronary events. Vigorous exercise resulted in 30%-40% reduction of coronary events. Women who became active later in life also showed a beneficial effect.
Manson et al. (59)	73,743 women Women's Health Initiative	Quintiles of METS derived from activity questionnaires	Women with higher levels of energy expenditure had fewer CHD events. Age-adjusted RR of coronary events with increasing quintiles of energy expenditure: 1.00, 0.73, 0.69, 0.68, and 0.47. Walking and vigorous exercise were similar with respect to risk reduction. Results did not vary according to race, age, or BMI.
Lee et al. (60)	39,372 women	Kcal/week burned, time spent walking, walking pace	The RR of CHD was inversely related to the number of kcal burned per week, the duration of walking and the pace of walking, although the time spent walking had greater impact than pace.
Mora et al. (61)	2,994 women	Variables obtained from maxETT	Low exercise capacity, low HR recovery, and failure to achieve target HR, but not ST-segment depression, were independently associated with all-cause and CV mortality.
Gulati et al. (62)	5,721 women	Variables obtained from maxETT	A nomogram to predicted exercise capacity (predicted MET = 14.7 − (0.13 × age) was used predict death. Subjects unable to achieve 85% of predicted MET value had twice the risk of death.
Wagner et al. (63)	9,758 men	Leisure-time net energy expenditure	Leisure time PA energy expenditure was associated with a lower risk of hard CHD events; by contrast, walking or cycling to work did not correlate with hard events.
Tanasescu et al. (64)	44,452 men	Total physical activity, rowing, running, weight- training, walking	Several forms of exercise were associated with reduced CHD risk. More intense exercise (MET level) and faster walking pace were associated with further reduced CHD risk reduction: Running for> 1 h/week—42% (RR: 0.58; 95% CI: 0.44-0.77) Weight training >30 min/week—23% (RR: 0.77; 95% CI: 0.61-0.98) Rowing >1 h/week—18% (RR: 0.82; 05% CI: 0.68-0.99) Walking briskly >0.5 h/day-18%/RR: 0.82; 05% CI: 0.68-0.99)
LaMonte et al. (65)	3,232 men 1,128 women	Variables obtained from maxETT	Favorable inverse associations between fitness and most CHD risk factors were demonstrated among men and women. Higher fitness significantly reduced the odds of clinically relevant risk factor values among men and women without CHD.

Ά Καρδιολογική Κλινική ΑΧΕΠΑ

JACC 2018

Physical Activity and Blood Pressure

Á Καρδιολογική Κλινική ΑΧΕΠΑ

Figure F5-3. Inverse Relationship Between Incident Hypertension and Leisure-Time Physical Activity, by MET-Hours per Week Among Adults with Normal Blood Pressure

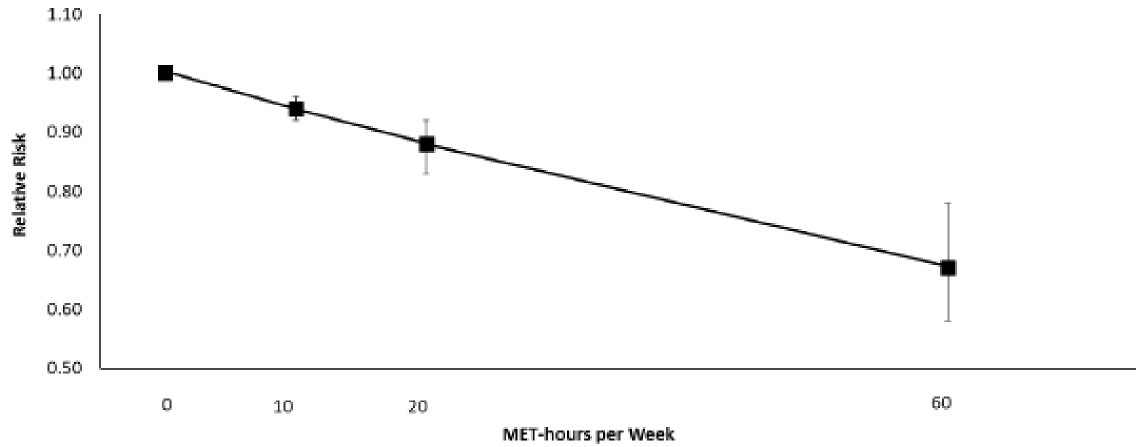
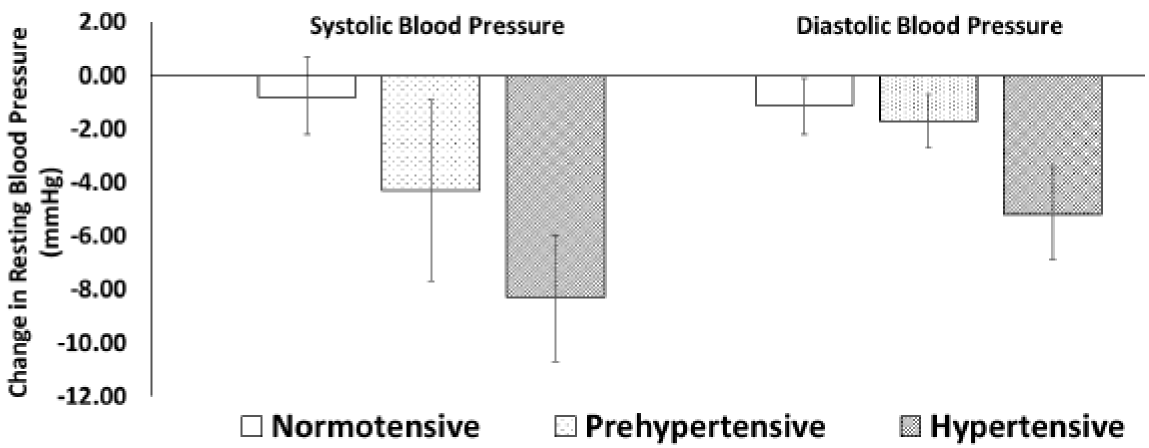


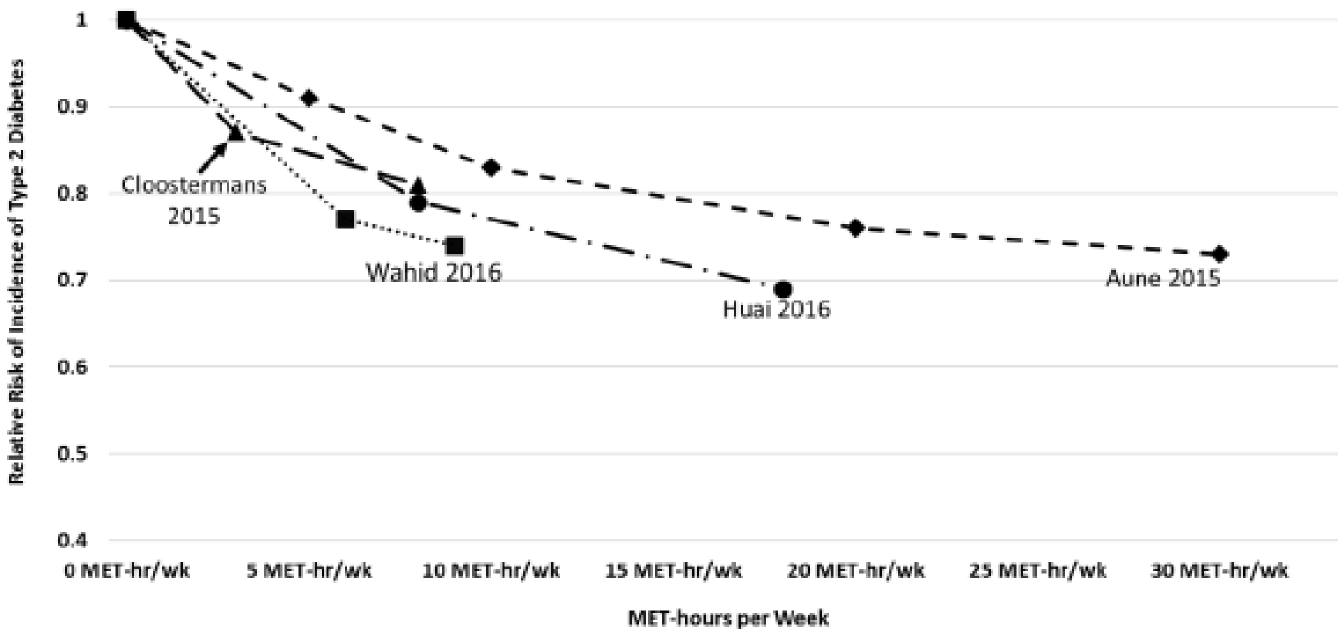
Figure F5-4. Blood Pressure Response to 16 Weeks of Aerobic Exercise Training



Physical Activity and Diabetes

Ά Καρδιολογική Κλινική ΑΧΕΠΑ

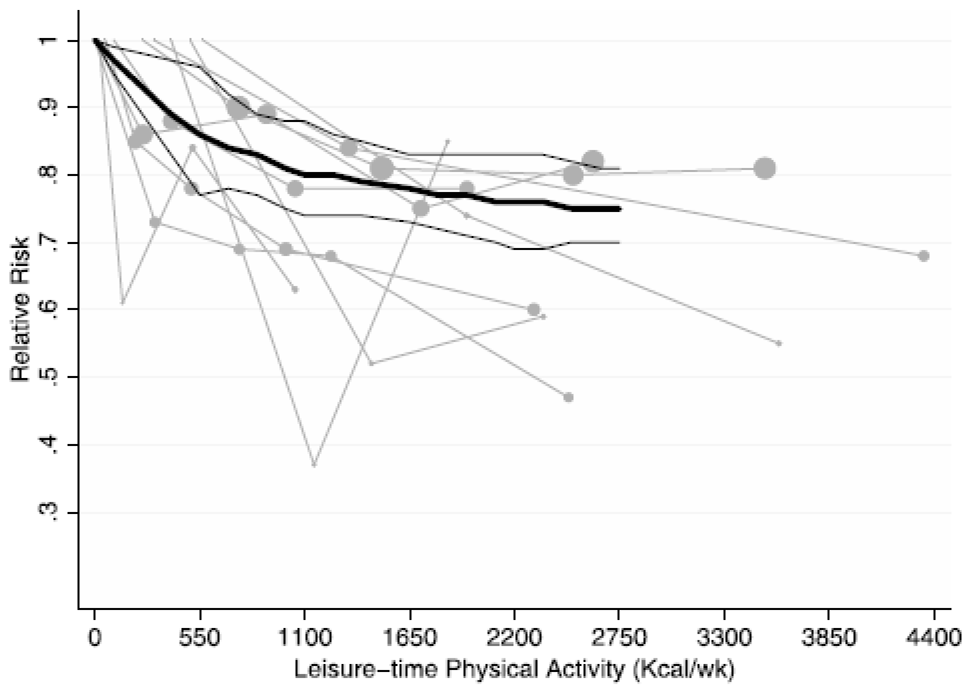
Figure F5-5. Dose-response Curves for Moderate-to-Vigorous Physical Activity and Relative Risk of Type 2 Diabetes



Physical Activity and CAD

Ά Καρδιολογική Κλινική ΑΧΕΠΑ

Figure F6-5. Plot with Spline and 95% Confidence Intervals of Relative Risk of Coronary Heart Disease by Kilocalories per Week of Leisure-time Physical Activity



Note: Individual study results are plotted with grey lines; the thick black line shows the trend line for both sexes combined from a random spline-fit model and the thinner black lines show the 95% CI for the trend.
Source: Sattelmair et al., 2011,[23] Dose response between physical Activity and Risk of Coronary Heart Disease, a Meta-Analysis, Circulation, 124: 789-795. https://doi.org/10.1161/CIRCULATIONAHA.110.010710

Cardiac structure and function and leisure-time physical activity in the elderly: The Atherosclerosis Risk in Communities Study

Ά Καρδιολογική Κλινική ΑΧΕΠΑ

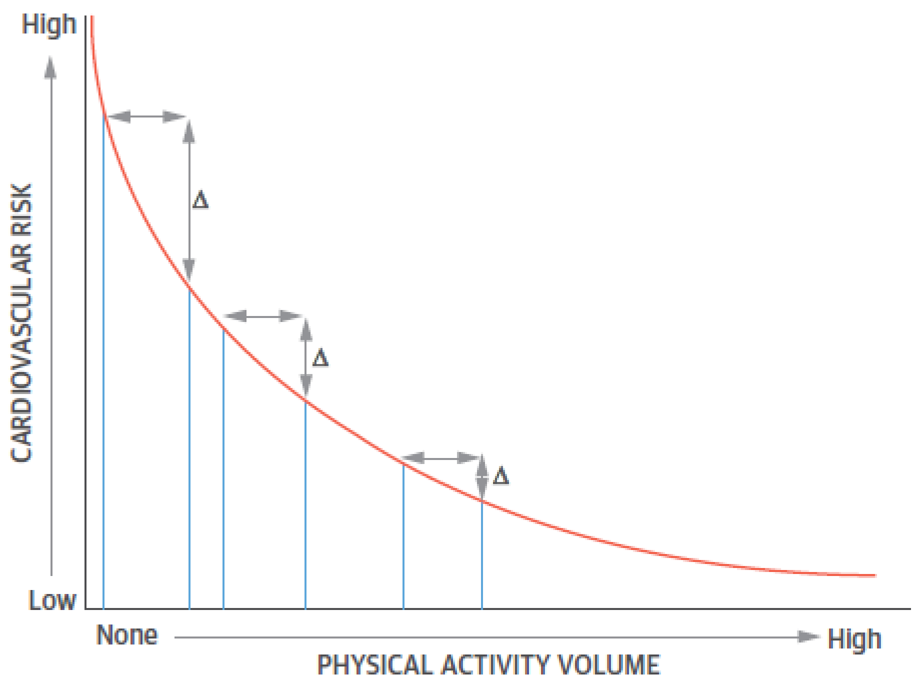
Table 2 Cardiac structure and function by physical activity level at Visit 5 (2011–2013), ARIC

	Poor activity *n* = 1300	Intermediate activity *n* = 839	Ideal activity *n* = 2203	P-value*
LV EDVi (mL/m^2)	42.5 (41.9, 43.0)	42.4 (41.8, 43.0)	43.4 (43.0, 43.8)	0.002
RV EDAi (cm^2/m^2)	10.4 (10.2, 10.5)	10.3 (10.2, 10.5)	10.6 (10.5, 10.7)	0.009
LAVi (mL/m^2)	25.1 (24.7, 25.6)	24.5 (23.9, 25.0)	25.2 (24.8, 25.5)	0.67
LVMi (g/m^2)	78.5 (77.5, 79.4)	76.7 (75.5, 77.9)	75.9 (75.2, 76.6)	<0.001
RWT (cm)	0.43 (0.42, 0.43)	0.43 (0.43, 0.43)	0.42 (0.42, 0.43)	0.02
LV hypertrophy (%)	12.1 (10.4, 13.9)	8.7 (6.8, 10.6)	7.5 (6.3, 8.6)	<0.001
LV geometry (%)				
Normal	49.8 (47.0, 52.6)	51.4 (48.0, 54.7)	53.7 (51.5, 55.8)	0.03
Concentric remodelling	40.4 (37.7, 43.1)	40.2 (36.9, 43.5)	38.0 (35.9, 40.1)	0.16
Concentric hypertrophy	6.3 (4.9, 7.7)	5.0 (3.5, 6.5)	4.3 (3.5, 5.1)	0.02
Eccentric hypertrophy	3.7 (2.6, 4.8)	3.4 (2.1, 4.7)	4.0 (3.2, 4.8)	0.60
LV EF (%)	65.6 (65.3, 66.0)	65.8 (65.5, 66.2)	66.1 (65.9, 66.3)	0.03
Longitudinal LV strain (%)	−17.9 (−18.0, −17.8)	−18.1 (−18.2, −17.9)	−18.3 (−18.4, −18.2)	<0.001
RV FAC	0.52 (0.52, 0.53)	0.52 (0.52, 0.53)	0.53 (0.53, 0.53)	0.007
TAPSV (cm/s)	12.0 (11.8, 12.1)	12.0 (11.8, 12.2)	12.0 (11.9, 12.1)	0.43
E/A ratio	0.83 (0.82, 0.85)	0.84 (0.82, 0.85)	0.86 (0.85, 0.87)	0.005
Lateral E/E′ ratio	10.4 (10.2, 10.5)	10.0 (9.7, 10.2)	9.8 (9.6, 9.9)	<0.001
LV diastolic function, *n* (%)				
Normal	31.5 (28.6, 34.5)	34.9 (31.4, 38.5)	39.8 (37.6, 42.1)	<0.001
Mild	31.9 (29.1, 34.7)	32.2 (28.9, 35.6)	28.7 (26.6, 30.8)	0.06
Moderate	36.3 (33.3, 39.3)	32.7 (29.3, 36.1)	31.4 (29.3, 33.5)	0.01

Physical Activity and Cardiovascular Risk

Ά Καρδιολογική Κλινική ΑΧΕΠΑ

FIGURE 1 **The Curvilinear Relationship Between Physical Activity and Cardiovascular Risk**



A similar increase in physical activity yields different risk reductions across the activity spectrum. Physical inactivity is associated with the highest risk, whereas high aerobic exercise volumes are associated with the lowest risk (26).

JACC 2016

Leisure-Time Running Reduces All-Cause and Cardiovascular Mortality Risk

55,137 adults

18 to 100 years of age (mean age 44 years).

mean follow-up of 15 years,

- 3,413 all-cause deaths occurred
- 1,217 cardiovascular deaths occurred.

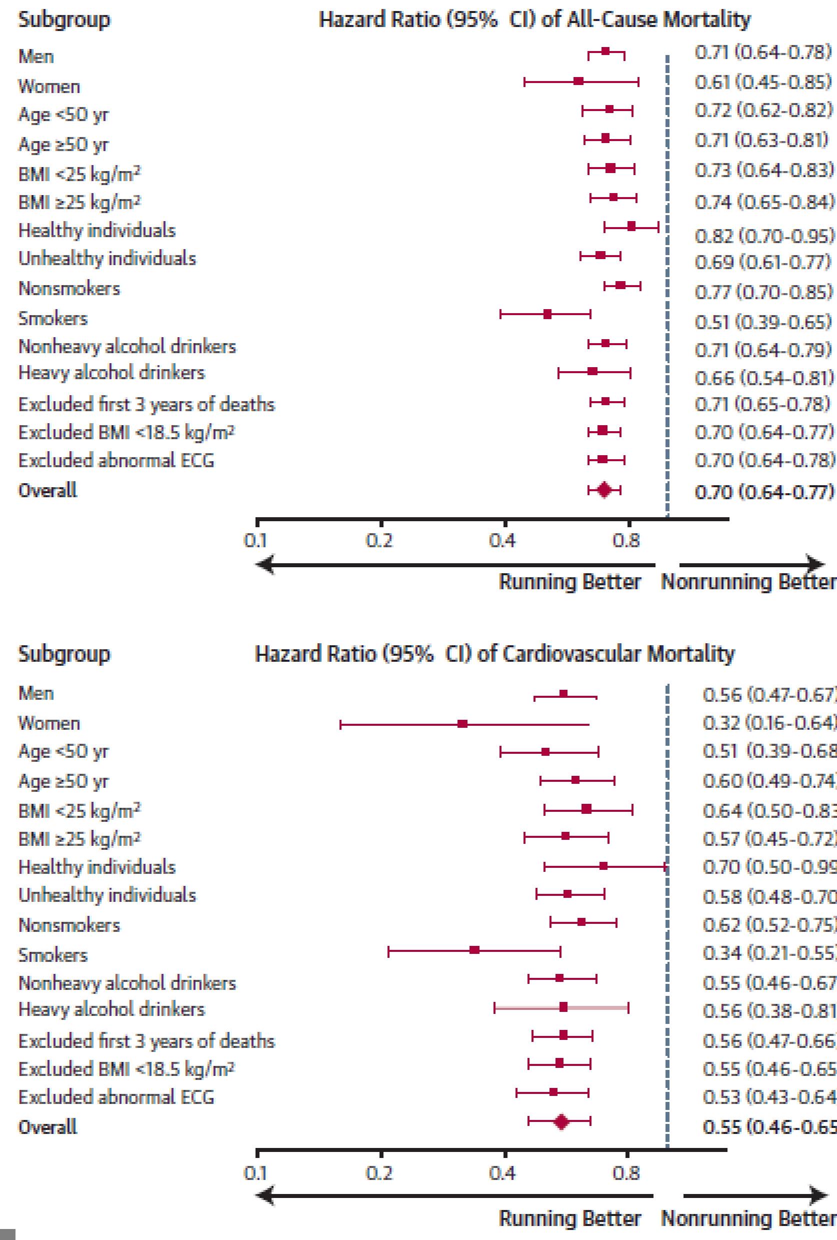


FIGURE 1 HRs of All-Cause and Cardiovascular Mortality by Subgroup

JACC 2014

Leisure-Time Running Reduces All-Cause and Cardiovascular Mortality Risk

Ά Καρδιολογική Κλινική ΑΧΕΠΑ

TABLE 2 HRs, PAFs, and Estimated Decreased Life Expectancy by Running and Other Mortality Predictors

	All-Cause Mortality*			Cardiovascular Mortality*		
Mortality Predictor	HR (95% CI)	PAF, %†	Decreased Life Expectancy, yrs‡	HR (95% CI)	PAF, %†	Decreased Life Expectancy, yrs‡
Nonrunner	1.24 (1.13-1.37)	16	3.0	1.40 (1.18-1.66)	25	4.1
Current smoker	1.67 (1.54-1.80)	11	7.0	1.69 (1.49-1.92)	12	6.3
Overweight or obesity	1.16 (1.08-1.25)	8	2.0	1.43 (1.26-1.63)	20	4.4
Parental CVD	1.20 (1.12-1.29)	7	2.5	1.38 (1.23-1.54)	13	3.9
Abnormal ECG	1.55 (1.42-1.70)	7	6.0	2.43 (2.14-2.77)	17	10.7
Hypertension	1.46 (1.36-1.57)	15	5.2	1.94 (1.72-2.18)	28	8.0
Diabetes	1.36 (1.23-1.51)	3	4.2	1.53 (1.31-1.79)	6	5.1
Hypercholesterolemia	1.06 (0.98-1.13)	2	0.7	1.32 (1.18-1.48)	10	3.4

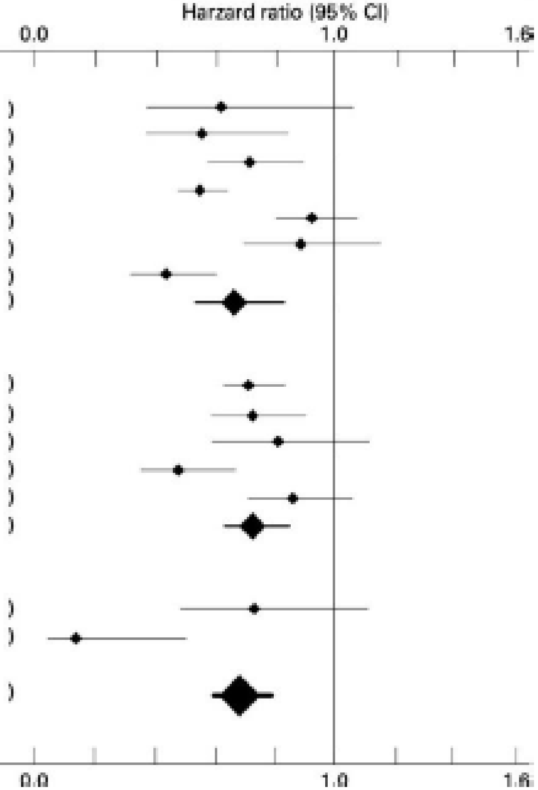
JACC 2014

Physical Activity and Mortality

Ά Καρδιολογική Κλινική ΑΧΕΠΑ

Figure F6-1. The Association Between Walking and All-Cause Mortality in Men and Women

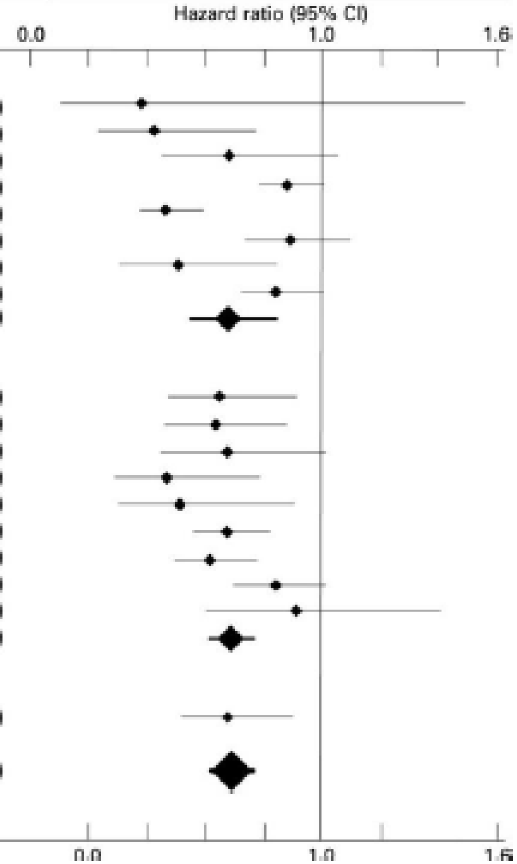
	Authors (year)	Exposure	Sample size	Hazard ratio (95% CI)
Male				
1	Wannamethee *et al* (1998)[11]	Walking > 1 hour/day	4311	0.62 (0.37 to 1.05)
2	Hakim *et al* (1998)[12]	Walking > 3.2 km/day	707	0.55 (0.37 to 0.83)
3	Bijnen *et al* (1998)[13]	Walking > 1 hour/week	802	0.71 (0.58 to 0.88)
4	Davey Smith *et al* (2000)[19]	Brisk walking	6702	0.55 (0.48 to 0.63)
5	Fujita *et al* (2004)[24]	Walking > 1 hour/day	20 004	0.92 (0.80 to 1.06)
6a	Schnohr *et al* (2007)[26]	Walking > 2 hours/day	3204	0.89 (0.69 to 1.14)
6b	Schnohr *et al* (2007)[26]	Brisk walking	3204	0.43 (0.32 to 0.59)
	Subtotal		38 934	0.66 (0.53 to 0.83)
Female				
1	Gregg *et al* (2003)[23]	Walking > 898 kcal/week	9518	0.71 (0.62 to 0.82)
2	Fujita *et al* (2004)[24]	Walking > 1 hour/day	21 159	0.72 (0.59 to 0.89)
3a	Schnohr *et al* (2007)[26]	Walking > 2 hours/day	4104	0.81 (0.59 to 1.10)
3b	Schnohr *et al* (2007)[26]	Brisk walking	4104	0.48 (0.35 to 0.66)
4	Matthew *et al* (2007)[27]	Walking > 10 MET-hours/day	67 143	0.86 (0.71 to 1.05)
	Subtotal		106 028	0.72 (0.62 to 0.84)
Male and female				
1	LaCroix *et al* (1996)[10]	Walking > 4 hours/week	1645	0.73 (0.48 to 1.10)
2	Stessman *et al* (2000)[18]	Walking > 4 hours/week	456	0.14 (0.04 to 0.50)
	Total		147 063	0.68 (0.59 to 0.78)
	Test for heterogeneity			$\chi^2(13) = 31.35, p < 0.001$
	Test for overall effect			$\chi^2(1) = 57.86, p < 0.001$



Physical Activity and Cardiovascular Mortality

Figure F6-4. The Association Between Walking and Cardiovascular Mortality Risk in Men and Women

	Authors (year)	Exposure	Sample size	Hazard ratio (95% CI)
Male				
1	Hakim *et al* (1998)[12]	Walking > 3.2 km/day	707	0.39 (0.10 to 1.49)
2	Hakim *et al* (1999)[14]	Walking > 2.5 km/day	2678	0.43 (0.24 to 0.77)
3	Bijnen *et al* (1998)[13]	Walking > 1 hour/week	802	0.69 (0.45 to 1.05)
4	Sesso *et al* (2000)[17]	Walking > 10 km/week	12 516	0.88 (0.78 to 1.00)
5	Davey Smith *et al* (2000)[19]	Brisk walking	6702	0.47 (0.37 to 0.59)
6a	Tanasescu *et al* (2002)[22]	Walking > 3.5 hours/week	44 452	0.90 (0.73 to 1.10)
6b	Tanasescu *et al* (2002)[22]	Brisk walking	44 452	0.51 (0.31 to 0.84)
7	Noda *et al* (2005)[25]	Walking > 1 hour/day	31 023	0.85 (0.72 to 1.00)
	Subtotal		143 332	0.68 (0.55 to 0.85)
Female				
1a	Manson *et al* (1999)[15]	Walking > 3 hours/week	72 488	0.65 (0.47 to 0.91)
1b	Manson *et al* (1999)[15]	Brisk walking	72 488	0.64 (0.47 to 0.88)
2	Sesso *et al* (1999)[16]	Walking > 10 km/week	1564	0.67 (0.45 to 1.01)
3a	Lee *et al* (2001)[20]	Walking > 2 hours/week	39 372	0.48 (0.29 to 0.78)
3b	Lee *et al* (2001)[20]	Brisk walking	39 372	0.52 (0.30 to 0.90)
4	Manson *et al* (2002)[21]	Walking > 3 hours/week	73 743	0.68 (0.56 to 0.82)
5	Gregg *et al* (2003)[23]	Walking > 898 kcal/week	9518	0.62 (0.49 to 0.78)
6	Noda *et al* (2005)[25]	Walking > 1 hour/day	42 242	0.84 (0.70 to 1.02)
7	Matthew *et al* (2007)[27]	Walking > 10 MET-hour/day	67 143	0.92 (0.60 to 1.40)
	Subtotal		417 930	0.69 (0.61 to 0.77)
Male and female				
1	LaCroix *et al* (1996)[10]	Walking > 4 hours/week	1645	0.68 (0.52 to 0.90)
	Total		562 907	0.69 (0.61 to 0.77)
	Test for heterogeneity			$\chi^2(17) = 42.91, p < 0.001$
	Test for overall effect			$\chi^2(1) = 47.68, p < 0.001$

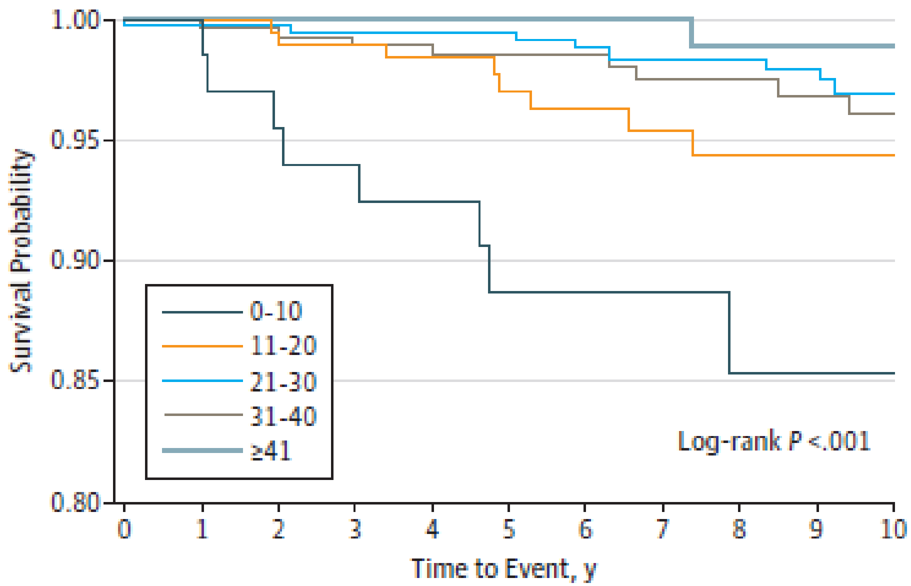


Original Investigation | Nutrition, Obesity, and Exercise

Association Between Push-up Exercise Capacity and Future Cardiovascular Events Among Active Adult Men

ιολογική Κλινική ΑΧΕΠΑ

Figure. Kaplan-Meier Curves for the Cumulative Risk of Cardiovascular Disease Outcome in 5 Push-up Categories



No. at risk

0-10	75	68	63	60	53	39	32	28	26	23	17
11-20	200	200	186	184	172	139	118	96	89	78	63
21-30	389	386	382	375	368	310	275	238	227	202	155
31-40	285	283	276	271	267	232	208	179	169	148	120
≥41	155	153	151	149	147	129	112	99	92	86	63

Minimal Amount of Exercise to Prolong Life

To Walk, to Run, or Just Mix It Up?*

Ά Καρδιολογική Κλινική ΑΧΕΠΑ

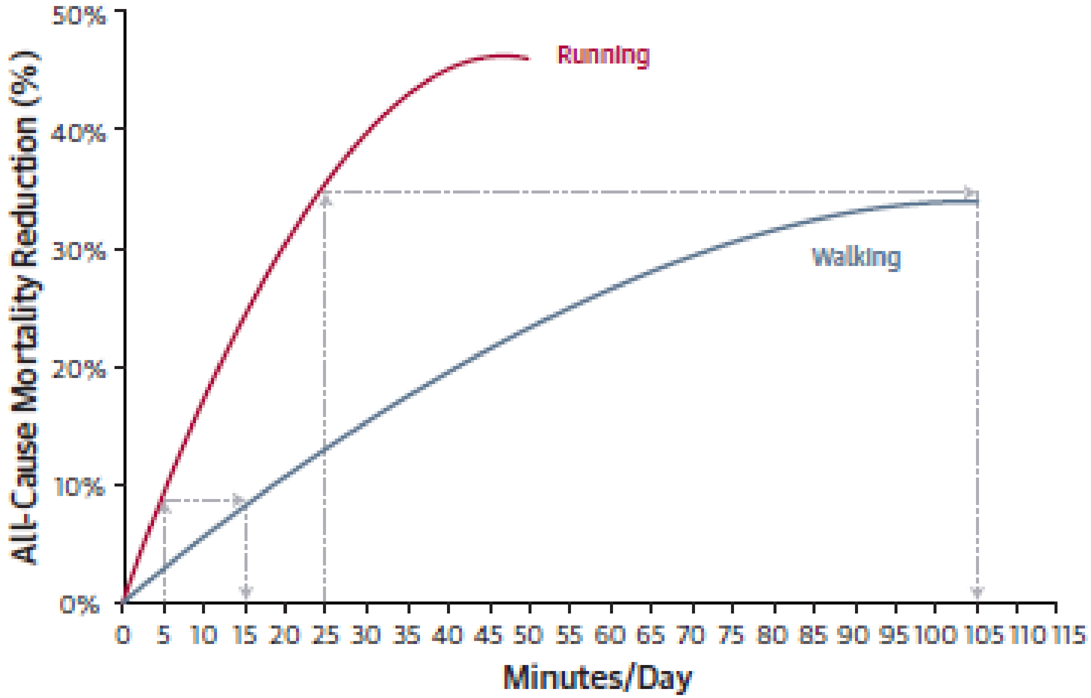


FIGURE 1 **Comparison of Benefits Between Walking and Running**

A 5-min run generates the same benefits as a 15-min walk, and a 25-min run is equivalent to a 105-min walk.

JACC 2014

"Add 10 Min for Your Health"

The New Japanese Recommendation for Physical Activity Based on Dose-Response Analysis

increment of 1 MET-h/week,
which is equivalent to 2 to 3 min of MVPA per day,
results in a 0.8% reduction of the average relative risk (RR)

a low dose of >3 METs activities → 3.2% reduction of the RR

(2 to 3 min x 4 = 10 min, so 0.8% x 4 = 3.2%),

which is promising from a public health perspective.

Outline

- Κατευθυντήριες Οδηγίες
- Δημογραφικά
- Οφέλη της άσκησης
- Όρια στην άσκηση (χρόνος, ένταση, διάρκεια)
- Ακραία άσκηση – επιβλαβής

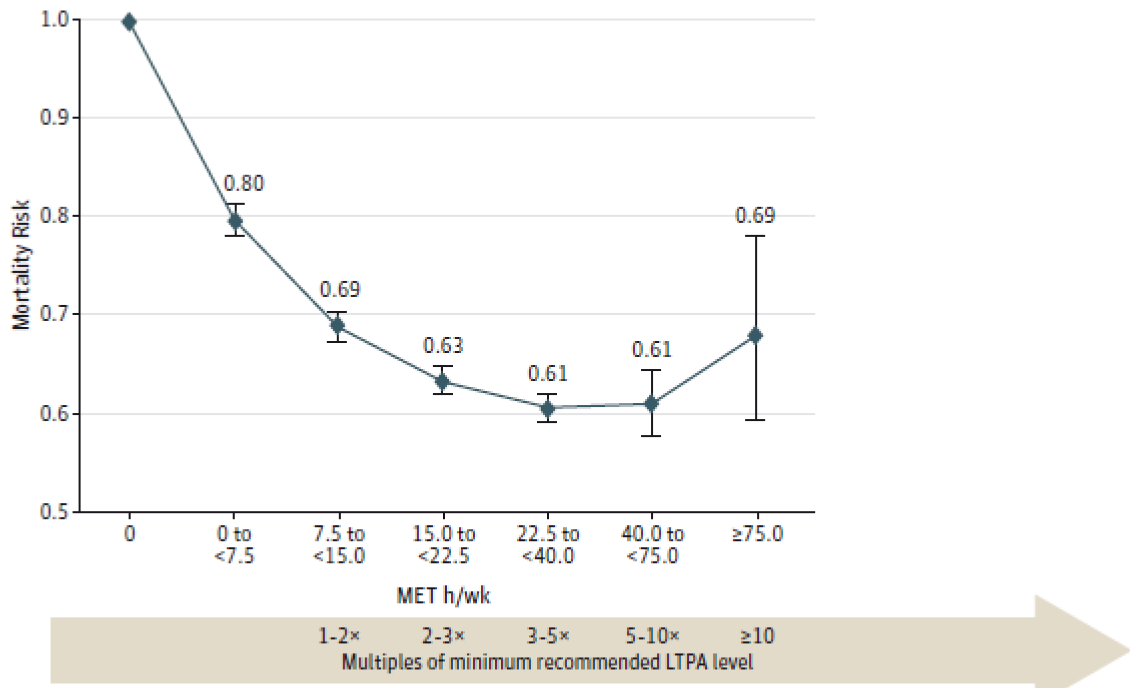
Leisure Time Physical Activity and Mortality
A Detailed Pooled Analysis of the Dose-Response Relationship

λογική Κλινική ΑΧΕΠΑ

Table 1. Descriptive Characteristics of 661 137 Study Participants

Characteristic	No. of Participants	LTPA Level, MET h/wk, No. (%)[a] 0	0.1 to <7.5	7.5 to <15.0	15.0 to <22.5	22.5 to <40.0	40.0 to <75.0	≥75.0
Participants	661 137	52 848 (8.0)	172 203 (26.1)	170 563 (25.8)	118 169 (17.9)	124 446 (18.8)	18 831 (2.9)	4077 (0.6)
Deaths	116 686	11 523 (9.9)	33 511 (28.7)	28 957 (24.8)	19 979 (17.1)	21 114 (18.1)	1390 (1.2)	212 (0.2)
CVD deaths, No. (%)		3238 (12.8)	7952 (31.4)	6316 (24.9)	3293 (13.0)	4044 (15.9)	457 (1.8)	69 (0.3)
HR (95% CI)[a]		1.00	0.80 (0.77-0.84)	0.67 (0.65-0.70)	0.59 (0.57-0.63)	0.58 (0.56-0.61)	0.61 (0.55-0.67)	0.71 (0.56-0.91)

Figure. Hazard Ratios (HRs) and 95% CIs for Leisure Time Moderate- to Vigorous-Intensity Physical Activity and Mortality

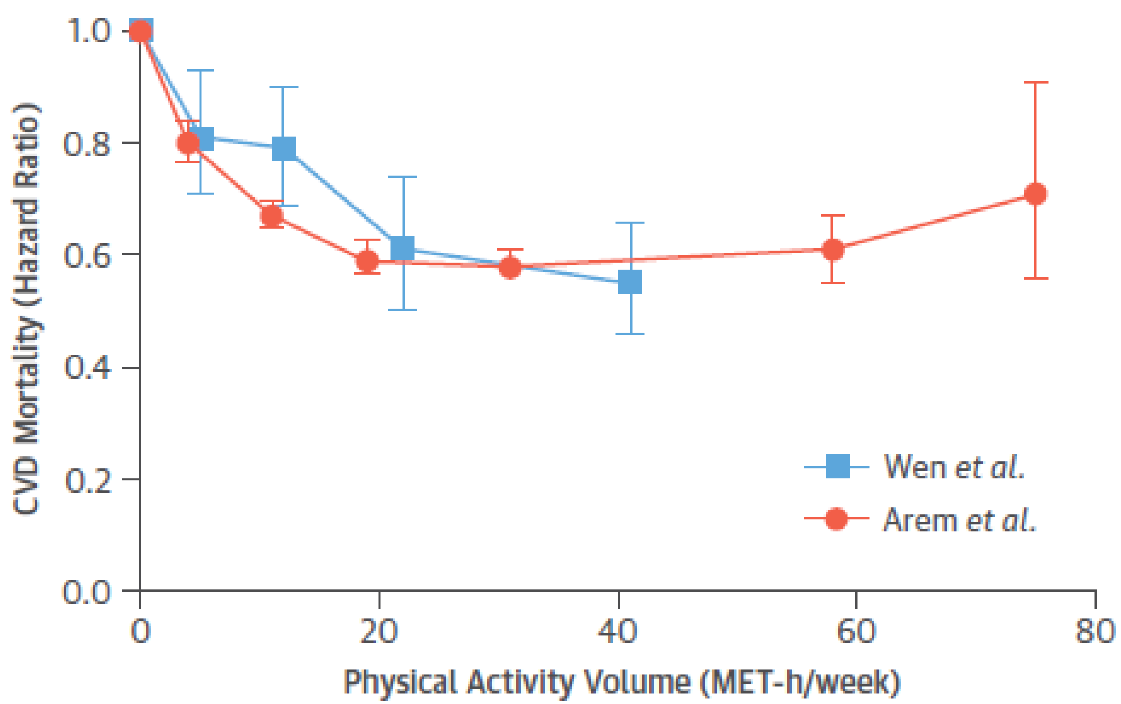


JAMA 2015

The Amount of Exercise to Reduce Cardiovascular Events

Ά Καρδιολογική Κλινική ΑΧΕΠΑ

FIGURE 2 The Dose-Response Curve of Physical Activity and Cardiovascular Mortality



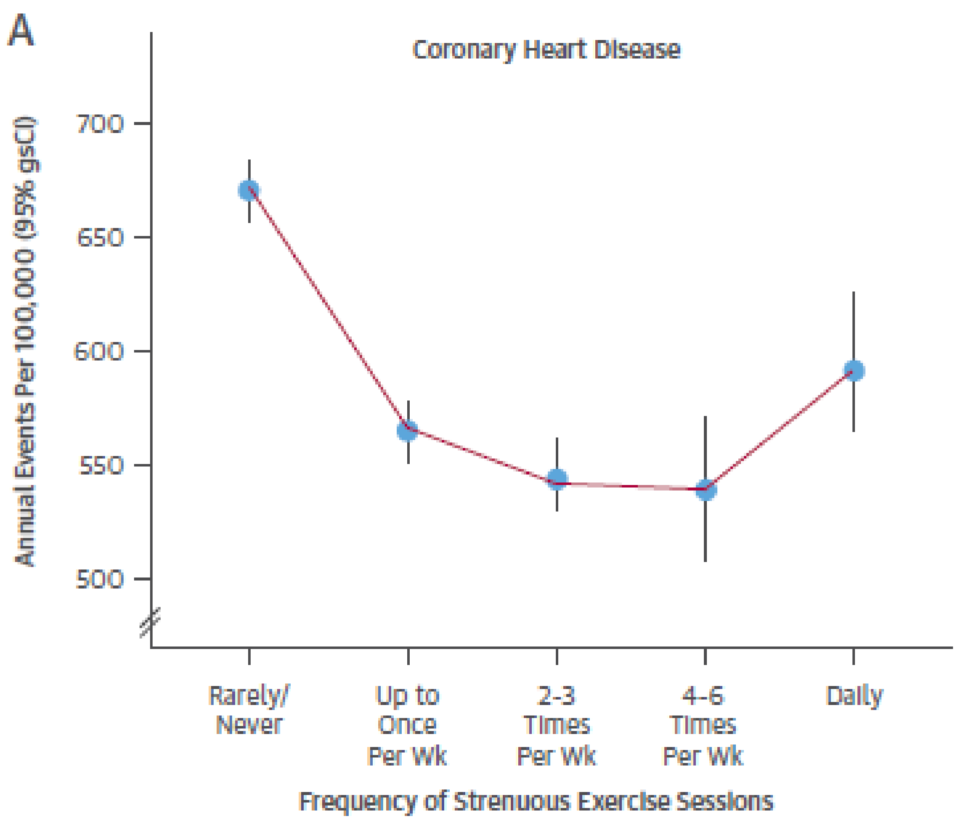
On the basis of data from the studies of Wen et al. (35) **(blue squares)** and Arem et al. (36) **(orange circles)**. The average exercise volume (MET-h/week) was calculated for the ranges of physical activity that were provided in the study by Arem et al. (36). The maximal risk reduction for cardiovascular mortality was found at an exercise volume of 41 MET-h/week. CVD = cardiovascular disease; MET = metabolic equivalent of task score.

REPLY: Exercise and Mortality Reduction

Recurring Reverse J- or U-Curves

Ά Καρδιολογική Κλινική ΑΧΕΠΑ

FIGURE 1 Coronary Heart Disease Was Reduced by Regular Strenuous Physical Activity



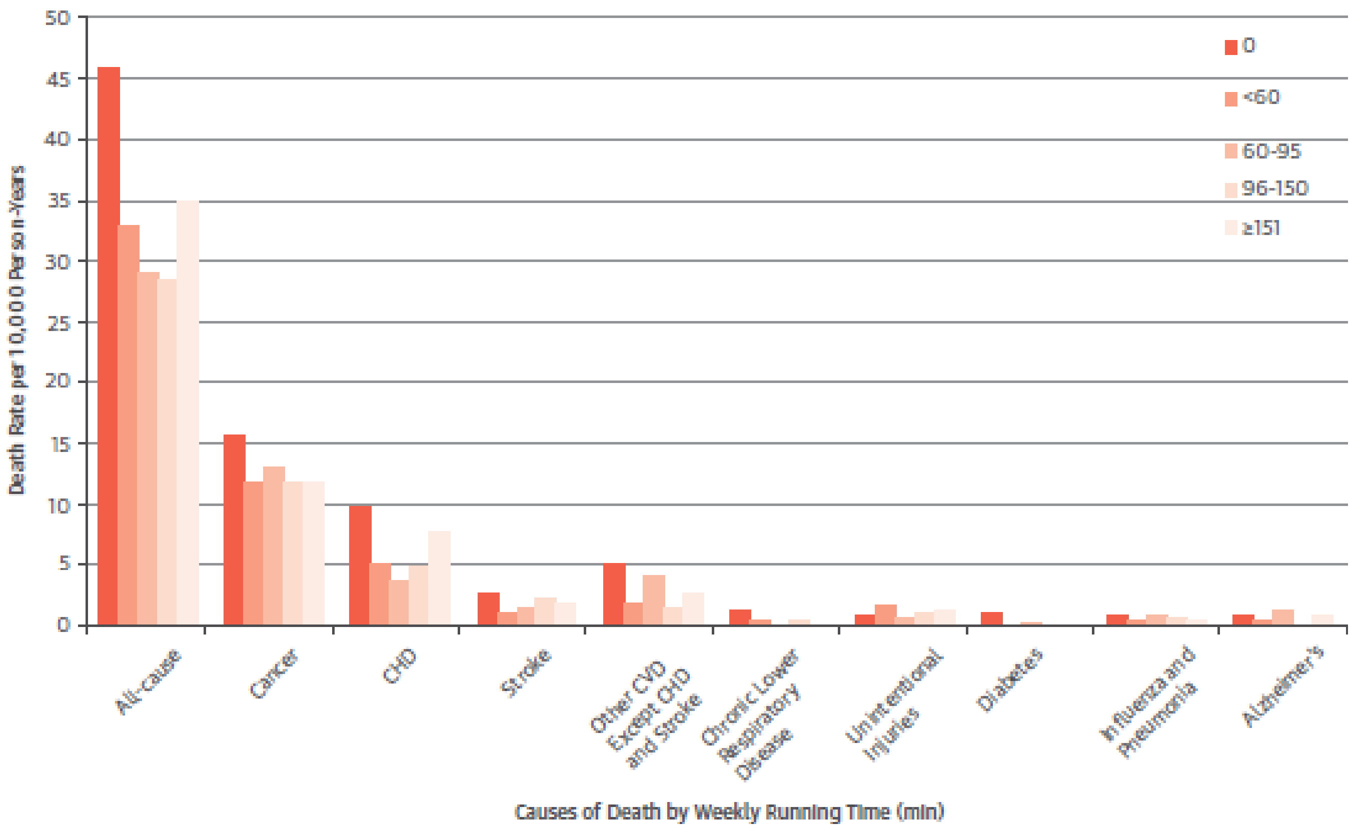
JACC 2015

Optimal Dose of Running for Longevity

Is More Better or Worse?*

Ά Καρδιολογική Κλινική ΑΧΕΠΑ

FIGURE 1 Death Rates for Major Causes of Death by Weekly Running Time



Participants were classified into 5 groups: nonrunners and 4 quartiles of weekly running time in minutes. Death rates were adjusted for baseline age, sex, and examination year. CHD = coronary heart disease; CVD = cardiovascular disease.

JACC 2015

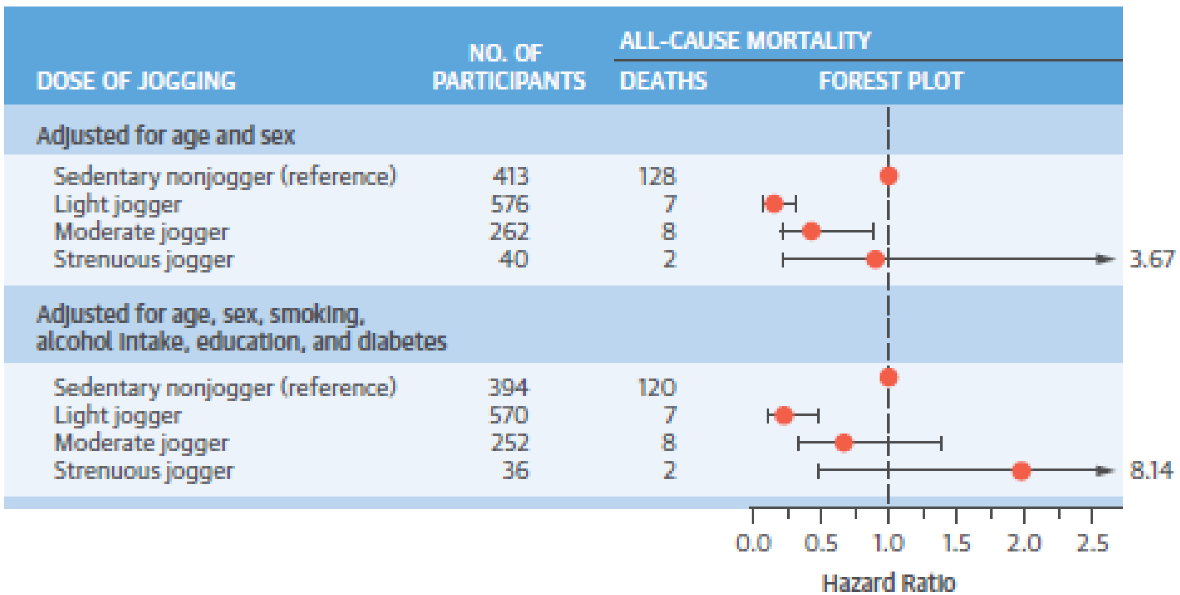
Dose of Jogging and Long-Term Mortality

The Copenhagen City Heart Study

TABLE 1 Joggers Categorized as Light Joggers, Moderate Joggers, or Strenuous Joggers on the Basis of Self-Reported Pace, Quantity, and Frequency of Jogging

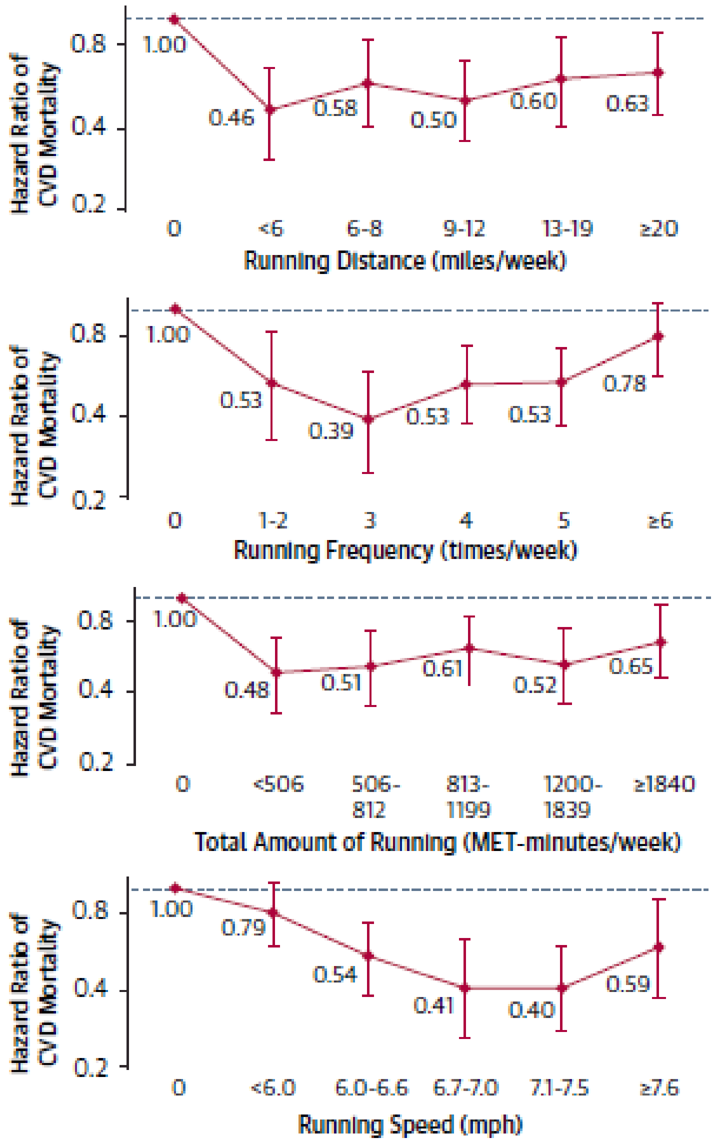
	Jogging Pace								
	Slow			Average			Fast		
	<2.5 h/week	2.5–4 h/week	>4 h/week	<2.5 h/week	2.5–4 h/week	>4 h/week	<2.5 h/week	2.5–4 h/week	>4 h/week
Frequency of jogging									
≤3 times/week	Light	Moderate	Moderate	Light	Moderate	Moderate	Moderate	Moderate	Strenuous
>3 times/week	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Strenuous	Strenuous

CENTRAL ILLUSTRATION Dose of Jogging and Long-Term Mortality



HRs of All-Cause and Cardiovascular Mortality by Running Distance, Frequency, Total Amount, and Speed

D

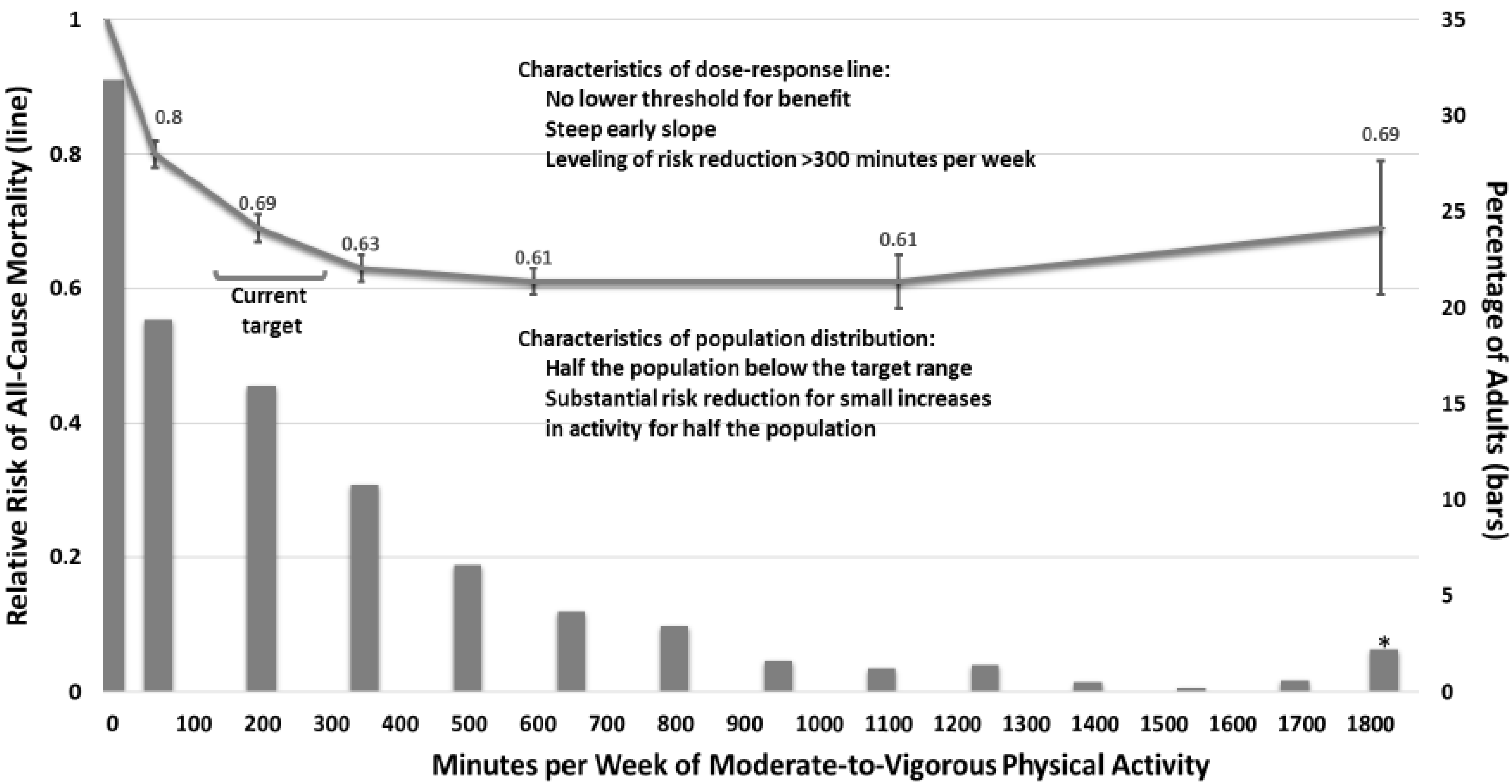


JACC 2014

2018 Physical Activity Guidelines

ΚΕΠΑ

Figure D-1. Risk of All-Cause Mortality and Self-Reported Physical Activity, by Minutes of Moderate-to-Vigorous Physical Activity per Week



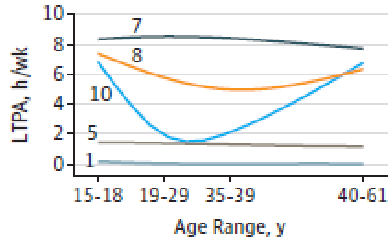
Note: *Includes all adults reporting greater than 1800 minutes per week of moderate-to-vigorous physical activity.
Source: Adapted from data found in Arem et al., 2015[2] and National Center for Health Statistics, 2015.[3]

LTPA life course patterns

Figure 1. Leisure-Time Physical Activity (LTPA) Trajectories and Respective Hazard Ratios (HRs) for All-
and Cardiovascular Disease (CVD)-Related Mortality Among Maintainers, Increasers, and Decreasers

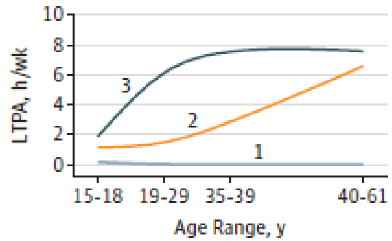
A Maintainers

Trajectory, No.	HR (95% CI) All-Cause Mortality	HR (95% CI) CVD-Related Mortality
7	0.71 (0.68-0.73)	0.66 (0.62-0.70)
8	0.66 (0.63-0.68)	0.58 (0.54-0.63)
10	0.64 (0.60-0.68)	0.58 (0.53-0.64)
5	0.84 (0.81-0.87)	0.82 (0.77-0.88)
1	1 [Reference]	1 [Reference]



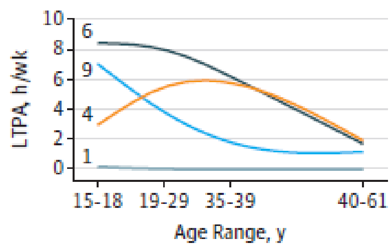
B Increasers

Trajectory, No.	HR (95% CI) All-Cause Mortality	HR (95% CI) CVD-Related Mortality
3	0.68 (0.65-0.72)	0.58 (0.53-0.64)
2	0.65 (0.62-0.68)	0.57 (0.53-0.61)
1	1 [Reference]	1 [Reference]



C Decreasers

Trajectory, No.	HR (95% CI) All-Cause Mortality	HR (95% CI) CVD-Related Mortality
6	0.96 (0.92-1.00)	0.96 (0.90-1.03)
4	0.92 (0.88-0.96)	0.88 (0.81-0.92)
9	0.86 (0.83-0.90)	0.86 (0.81-0.92)
1	1 [Reference]	1 [Reference]



Ά Καρδιολογική Κλινική ΑΧΕΠΑ

JAMA open 2019

Cardiac structure and function and leisure-time physical activity in the elderly: The Atherosclerosis Risk in Communities Study

Ά Καρδιολογική Κλινική ΑΧΕΠΑ

	Poor activity $n = 1300$	Intermediate activity $n = 839$	Ideal activity $n = 2203$
Age (years)	76.1 ± 5.1	75.8 ± 5.1	75.2 ± 4.9

Table 3 Cardiac structure and function by change in physical activity over 18 years (1995–2013), ARIC

	(Reference Group) Persistently poor activity $n = 627$	Decreased activity $n = 894$	Increased activity $n = 1134$	Persistently active $n = 1494$
LV EDVi (mL/m²)	42.4 (41.7, 43.1)	42.5 (41.9, 43.1)	42.9 (42.3, 43.4)	43.4 (43.0, 43.9)*
RV EDAi (cm²/m²)	10.3 (10.1, 10.5)	10.4 (10.3, 10.6)	10.4 (10.3, 10.5)	10.7 (10.5, 10.8)*
LAVi (mL/m²)	24.8 (24.2, 25.5)	25.0 (24.4, 25.5)	25.0 (24.5, 25.5)	25.2 (24.8, 25.6)
LVMi (g/m²)	78.7 (77.4, 80.1)	78.1 (77.0, 79.2)	76.0 (75.0, 77.0)*	75.8 (74.9, 76.7)*
LV hypertrophy (%)	11.6 (9.1, 14.0)	12.1 (10.0, 14.2)	6.3 (4.9, 7.7)**	8.1 (6.7, 9.5)*
LV EF (%)	65.7 (65.3, 66.2)	65.7 (65.4, 66.1)	66.2 (65.9, 66.5)	65.9 (65.6, 66.2)
Longitudinal LV strain (%)	−17.9 (−18.1, −17.7)	−18.0 (−18.1, −17.8)	−18.3 (−18.4, −18.2)*	−18.3 (−18.4, −18.1)*
RV FAC	0.53 (0.52, 0.53)	0.52 (0.52, 0.53)	0.53 (0.53, 0.54)	0.53 (0.52, 0.53)
TAPSV (cm/s)	11.9 (11.7, 12.1)	12.0 (11.8, 12.2)	12.0 (11.8, 12.1)	12.1 (11.9, 12.2)
E/A ratio	0.84 (0.82, 0.86)	0.83 (0.82, 0.85)	0.85 (0.83, 0.86)	0.86 (0.84, 0.87)
Lateral E/E′ ratio	10.4 (10.1, 10.6)	10.1 (9.9, 10.3)	9.9 (9.7, 10.1)*	9.8 (9.7, 10.0)**
LV diastolic function, *n* (%)				
Normal	32.2 (28.1, 36.4)	34.4 (30.8, 38.0)	37.8 (34.8, 40.9)*	37.9 (35.2, 40.6)*
Mild	32.3 (28.4, 36.3)	31.1 (27.8, 34.4)	29.8 (26.9, 32.8)	29.7 (27.2, 32.3)
Moderate	35.2 (31.0, 39.5)	34.2 (30.7, 37.7)	32.4 (29.5, 35.3)	32.4 (29.9, 34.9)

Outline

Ά Καρδιολογική Κλινική ΑΧΕΠΑ

- Κατευθυντήριες Οδηγίες
- Δημογραφικά
- Οφέλη της άσκησης
- Όρια στην άσκηση (χρόνος, ένταση, διάρκεια)
- Ακραία άσκηση – επιβλαβής

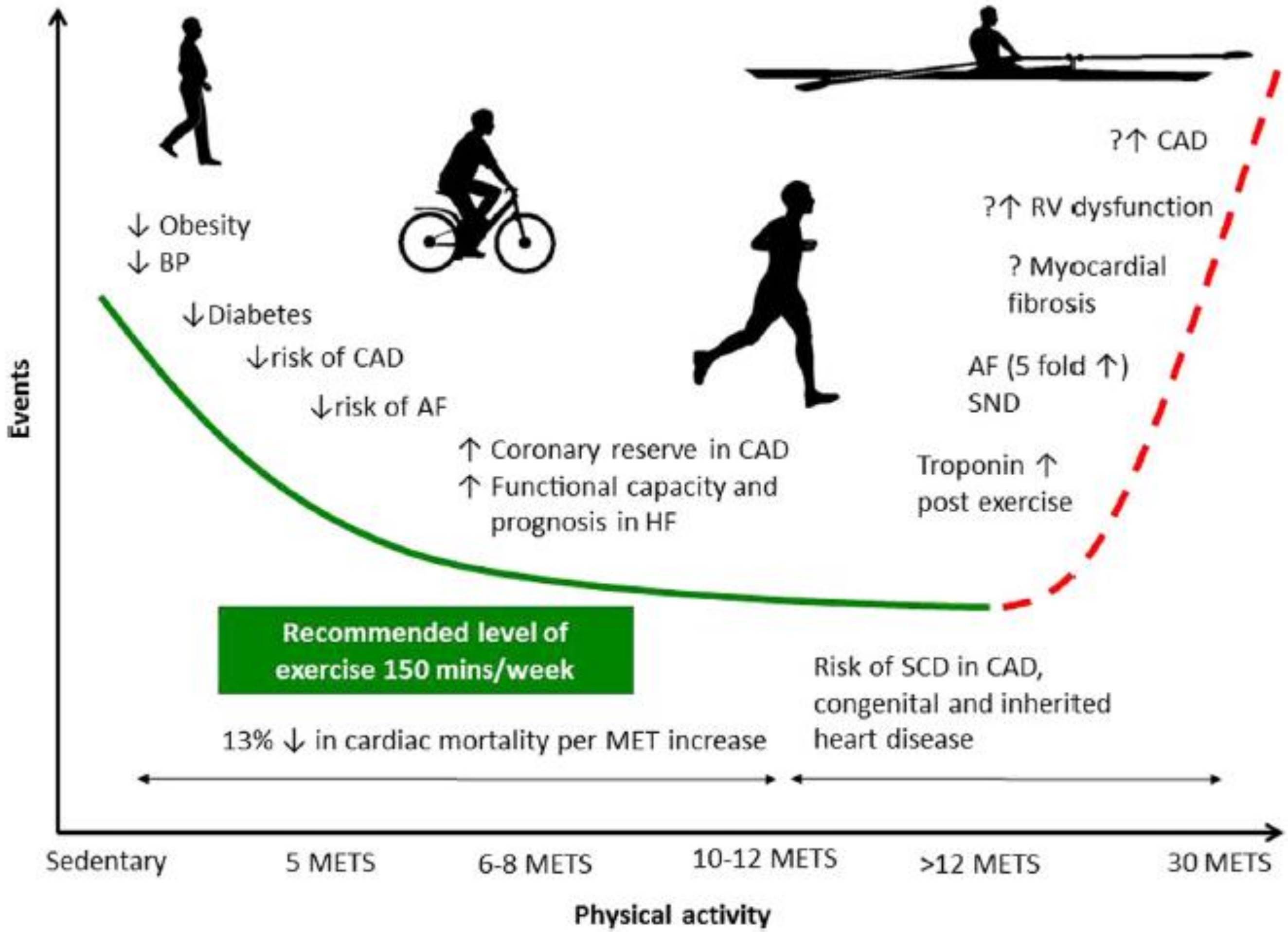
The Limits of Cardiac Performance: Can Too Much Exercise Damage the Heart?

Prashant Rao, MD, MRCP,[a] Adolph M. Hutter Jr, MD,[b] Aaron L. Baggish, MD[b]

ρδιολογική Κλινική ΑΧΕΠΑ

- High levels of exercise may have the capacity to damage the heart.
- The most convincing example of an overuse pathologic cardiac phenotype is atrial fibrillation.
- Other possible manifestations of an exercise-related cardiac injury include myocardial fibrosis and coronary artery calcification.
- In the absence of prospective outcomes data, the cause-and-effect relationship between high levels of exercise and cardiac morbidity and mortality remains uncertain.

The U-shaped relationship between exercise and cardiac morbidity



Can exercise damage a previously normal heart?

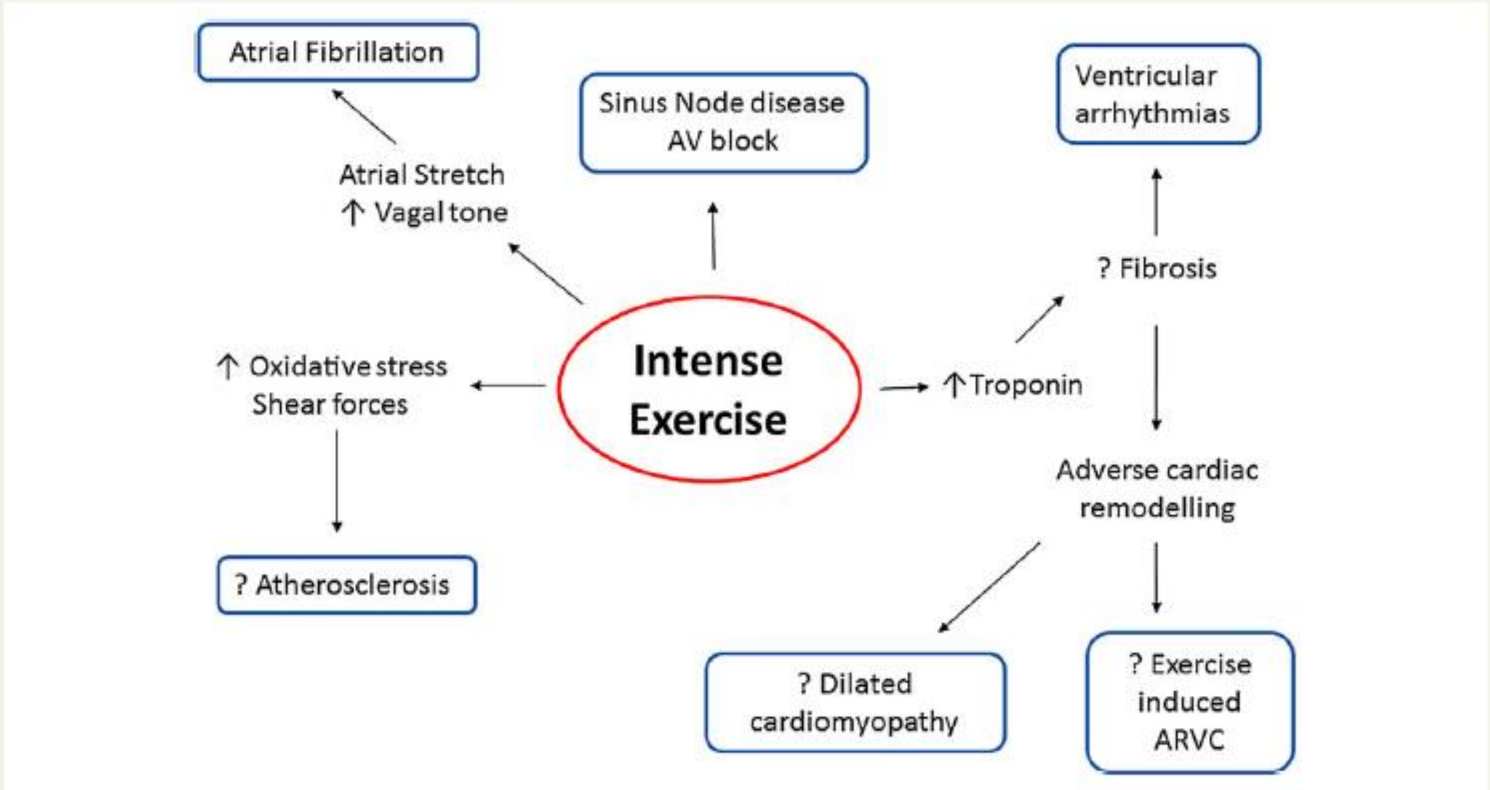


Figure 6 Speculated mechanisms for the detrimental effects of exercise. ARVC, arrhythmogenic right ventricular cardiomyopathy; AV, atrioventricular; DCM, dilated cardiomyopathy.

Electrical, structural, and functional changes observed in the athlete's heart. .

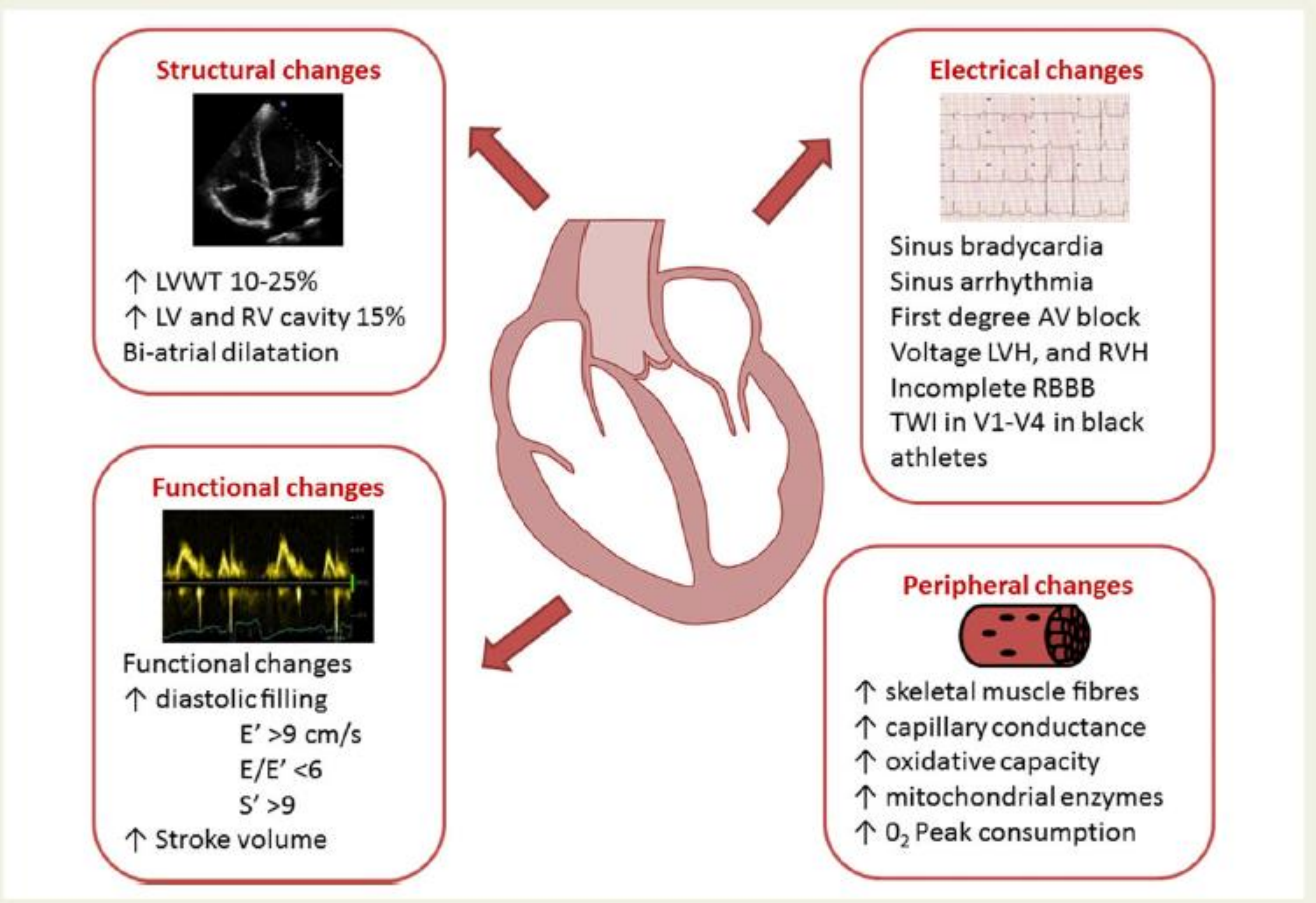


Figure 2 Cardiovascular and peripheral adaptation to exercise in athletes. AV, atrioventricular; LV, left ventricular; LVH, left ventricular hypertrophy; LVWT, left ventricular wall thickness; RV, right ventricle; RVH, right ventricular hypertrophy; TWI, T-wave inversion.

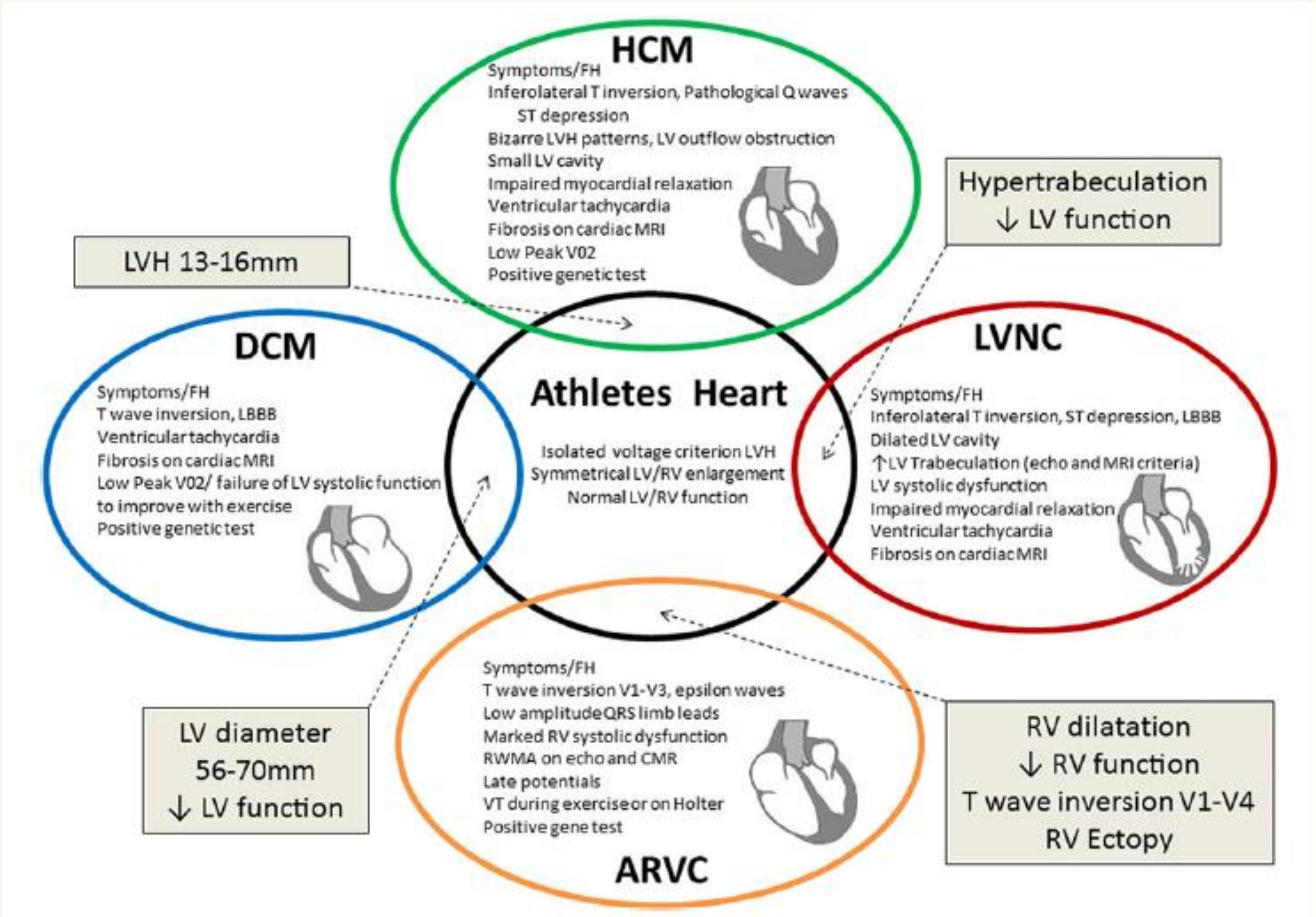


Figure 5 Differentiating features between physiological cardiac changes and cardiomyopathy in athletes. ARVC, arrhythmogenic right ventricular cardiomyopathy; CMR, cardiac magnetic resonance; DCM, dilated cardiomyopathy; FH, family history; HCM, hypertrophic cardiomyopathy; LV, left ventricle; LVH, left ventricular hypertrophy; LVNC, left ventricular non-compaction; RV, right ventricle; RWMA, regional wall motion abnormalities; VT, ventricular tachycardia.

EHJ 2015

Exercise-Induced Cardiac Troponin Elevation

Evidence, Mechanisms, and Implications

Ά Καρδιολογική Κλινική ΑΧΕΠΑ

Table 1 Recent Studies Examining Post-Exercise cTn Levels

Activity First Author (Ref. #)	Distance	Number of Participants	Troponin Isoform Measured	cTn Diagnostic Threshold	Prevalence of Positive cTn Observed
Walking					
Eijsvogels et al. (48)	30–50 km (4 consecutive days)	103	cTnI	>0.01 ug/ml	18%
				>0.2 ug/ml	6%
Running					
Lippi et al. (45)	HM	17	cTnT	0.03 ng/ml	0%
Jassal et al. (49)	HM	61 (HM)	cTnT	"Detectable"	HM: 30.6% immediately after race; 45.9% at 1 h after
	FM	68 (FM)			FM: 35.7% immediately after race; 52.8% at 1 h after
Mingels et al. (36)	FM	85	hs-cTnT	>99th percentile	86%
			cTnI	>99th percentile	45%
Fortescue et al. (37)	FM	482	cTnT	>0.01 ng/ml	68%
Mousavi et al. (38)	FM	14	cTnT	>0.01 ng/ml	100%
Middleton et al. (2)	FM	9	cTnT	>0.01 ug/ml	100%
Scott et al. (50)	160 km	25	cTnT	>0.01 ug/ml	20%
Giannitsis et al. (51)	216 km	10	hs-cTnT	>99th percentile	50%
Cycling					
Serrano-Ostariz et al. (52)	206 km	91	cTnI	>0.04	43%
Triathlon					
La Gerche et al. (53)	IM	26	cTnI	>0.16 ng/ml	58%

JACC 2010

Troponin in Marathon runners

Ά Καρδιολογική Κλινική ΑΧΕΠΑ

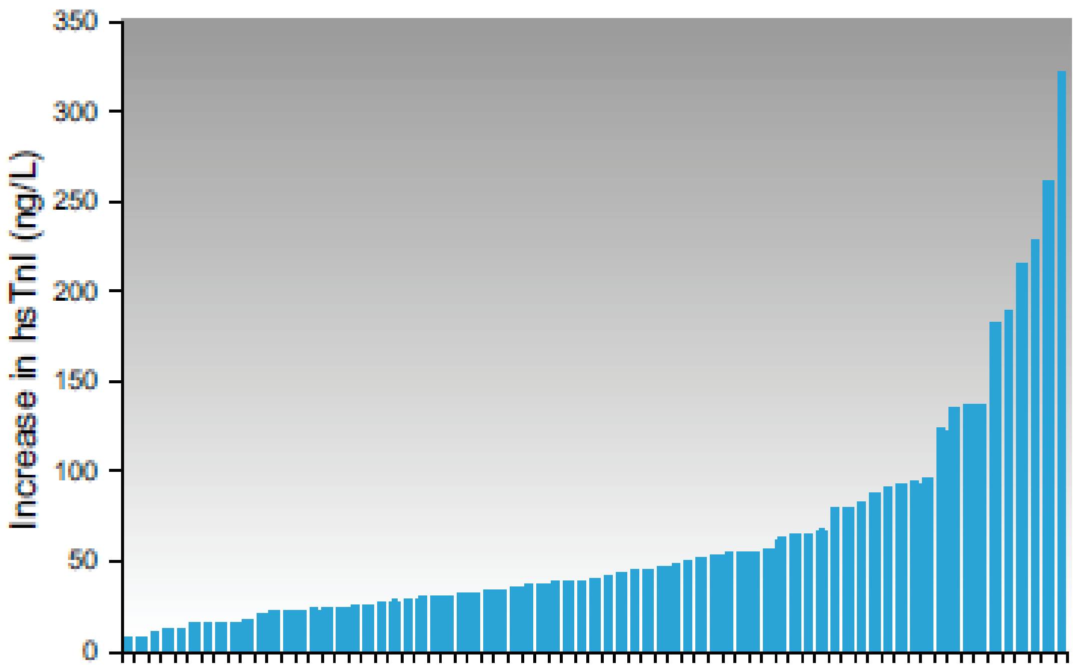
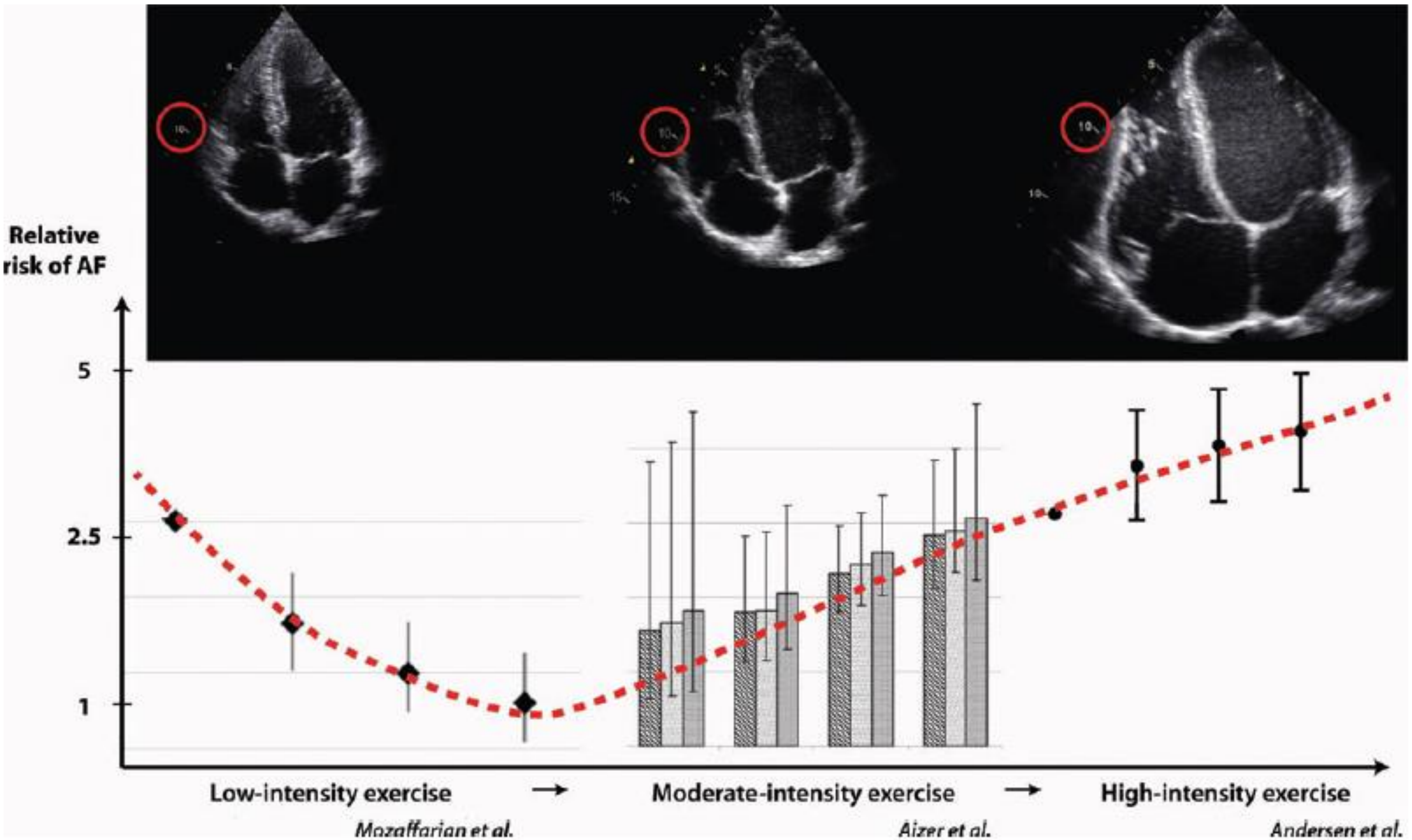


FIGURE 4. Exercise-induced increases in high-sensitive cardiac troponin I (hsTnI) levels in participants in the 2011 Boston marathon ($n = 71$). Each bar represents one subject, with all individuals demonstrating an increase in hsTnI postexercise. [Adapted from Eijsvogels et al. (59), with permission from Elsevier.]

Atrial fibrillation in athletes and the interplay between exercise and health

Ά Καρδιολογική Κλινική ΑΧΕΠΑ



Focal Fibrosis in the Endurance Athlete's Heart

Running Scarred or Running Scared?*

Ά Καρδιολογική Κλινική ΑΧΕΠΑ

FIGURE 1 LGE Images Depicting the Fibrosis Pattern in LGE+ Triathletes

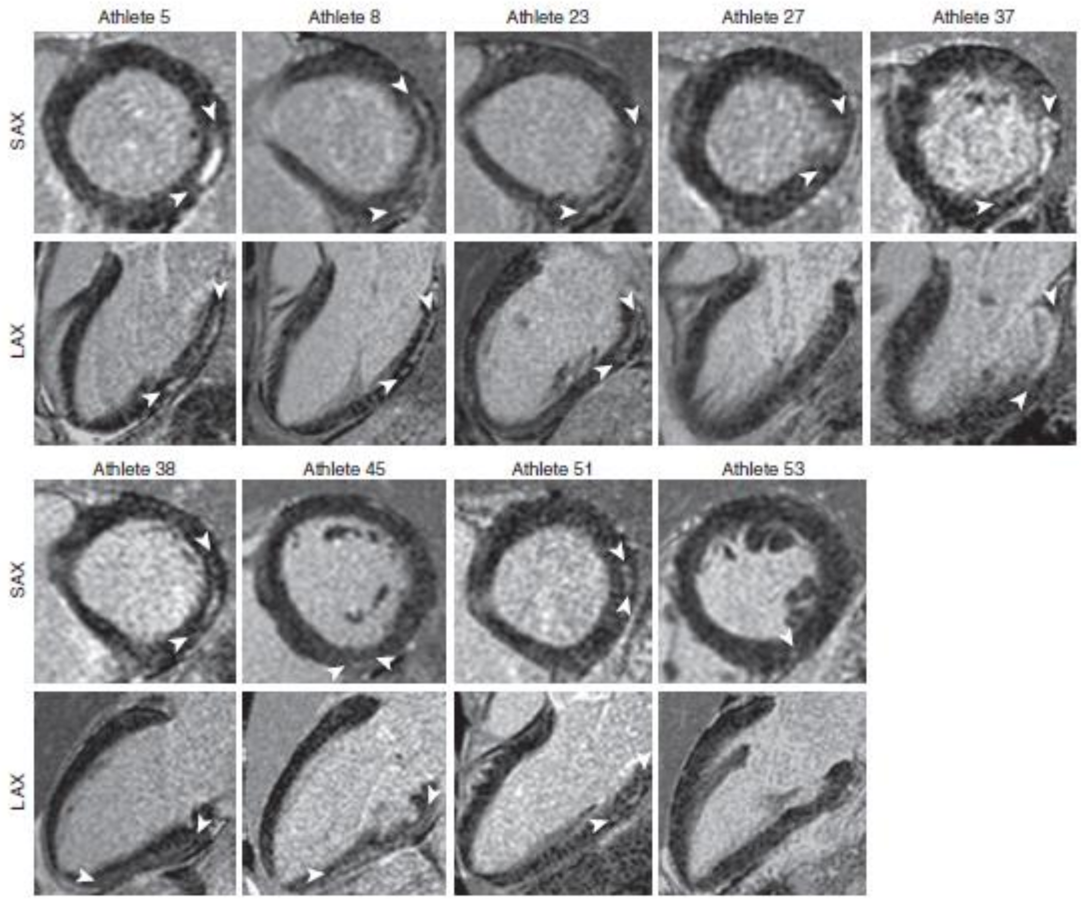
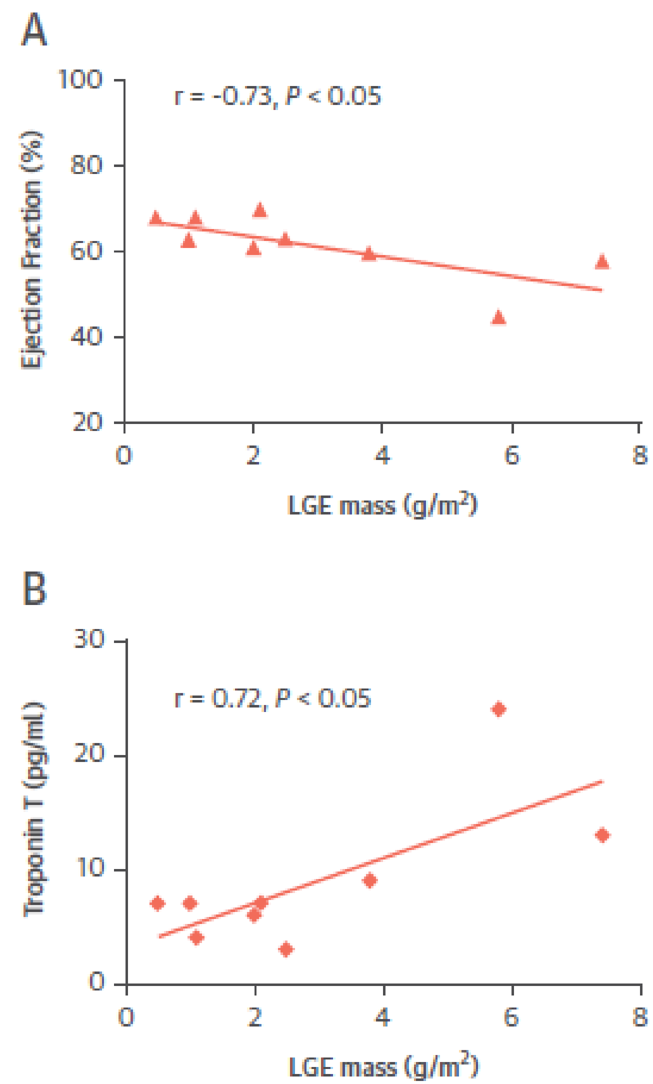


TABLE 2 Differences Between LGE⁺ and LGE⁻ Male Triathletes

	LGE+ Male Triathletes (n = 9)	LGE− Male Triathletes (n = 45)	p Value
Clinical parameters			
Age, yrs	47 ± 9	43 ± 10	0.260
Weight, kg	79 ± 8	77 ± 8	0.699
Height, m	1.79 ± 0.04	1.82 ± 0.07	0.326
BMI, kg/m^2	24.6 ± 3.2	23.4 ± 2.1	0.180
BSA, m^2	1.97 ± 0.8	1.98 ± 0.13	0.835
Exercise test			
Systolic BP at rest, mm Hg	129 ± 11	122 ± 12	0.140
Diastolic BP at rest, mm Hg	81 ± 8	82 ± 10	0.899
Peak systolic BP, mm Hg	213 ± 24	194 ± 26	**<0.05**
Peak diastolic BP, mm Hg	87 ± 12	89 ± 22	0.744
Heart rate at rest, beats/min	55 ± 9	54 ± 10	0.914
Peak heart rate, beats/min	166 ± 10	169 ± 12	0.578
ΔHeart rate rest/peak, beats/min	113 ± 14	114 ± 12	0.732
VO_{2max}, ml/kg per min	54 ± 10	55 ± 8	0.774
Ventilatory threshold, % of VO_{2max}	80 ± 8	79 ± 11	0.873
Maximal power, W	371 ± 95	416 ± 112	0.266
Exercise time, min	10 ± 3	12 ± 3	0.099
Ramp load, W/min	32 ± 7	31 ± 4	0.689
Blood parameters			
Hematocrit, %	0.43 ± 0.3	0.44 ± 0.3	0.303
HS TNT, pg/ml	9 ± 6	7 ± 10	0.635
NT-proBNP, pg/ml	89 ± 160	38 ± 31	**<0.05**
CMR parameters			
LVEF, %	62 ± 7	63 ± 5	0.623
LV mass index, g/m^2	93 ± 7	84 ± 11	**<0.05**
Extracellular volume, g/m^2	25 ± 3	21 ± 3	**<0.001**
Cellular volume, g/m^2	69 ± 6	64 ± 9	0.131
LVEDVi, ml/m^2	96 ± 13	98 ± 13	0.716
LVESVi, ml/m^2	37 ± 8	37 ± 9	0.971
LVSVi, ml/m^2	59 ± 13	61 ± 8	0.573
RVEF, %	59 ± 9	57 ± 7	0.406
RVEDVi, ml/m^2	98 ± 17	102 ± 15	0.497
RVESVi, ml/m^2	40 ± 9	44 ± 10	0.216
RVSVi, ml/m^2	59 ± 16	58 ± 9	0.859
Native T1, ms	1,005 ± 32	987 ± 27	0.082
Post-contrast T1, ms	522 ± 43	520 ± 38	0.894
ECV, %	26.3 ± 1.8	24.4 ± 2.2	**<0.05**
Competition history			
Number of competitions, n	77 ± 37	61 ± 63	0.991
Active years, n	15 ± 7	13 ± 8	0.400
Competitions per year, n	6 ± 2	6 ± 3	0.991
Swimming distance, km	64 ± 32	31 ± 25	**<0.01**
Cycling distance, km	4,418 ± 3,094	1,490 ± 1,114	**<0.0001**
Running distance, km	1,364 ± 1,282	885 ± 1,288	0.326
Total distance, km	5,852 ± 3,517	2,406 ± 2,025	**<0.0001**
Total time, h	279 ± 171	132 ± 146	**<0.05**
Number of sprint distances, n	13 ± 9	11 ± 11	0.734
Number of Olympic distances, n	15 ± 8	10 ± 9	0.128
Number of middle distances, n	6 ± 6	2 ± 4	**<0.05**
Number of Iron Man distances, n	6 ± 5	1 ± 3	**<0.001**

FIGURE 3 Correlation Between LGE Mass and Ejection Fraction and High-Sensitivity Troponin T

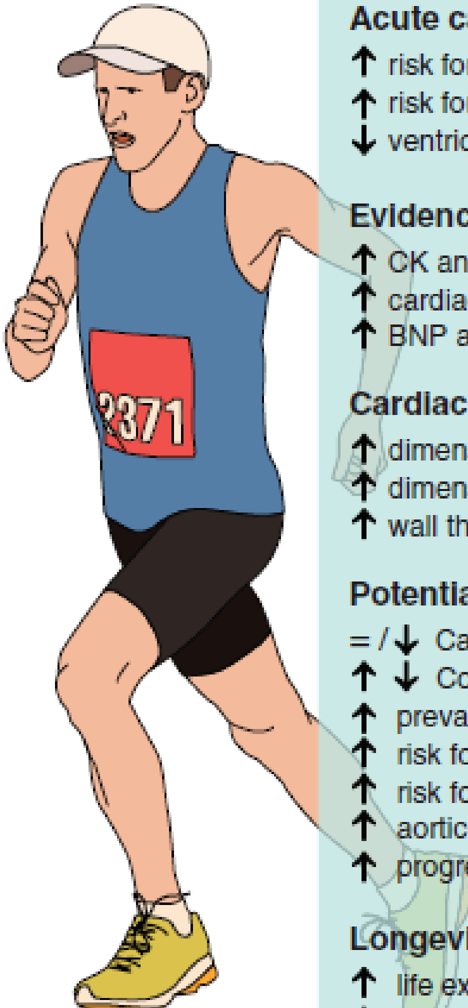


Ά Καρδιολογική Κλινική ΑΧΕΠΑ

JACC Im 2018

Can lifelong endurance exercise hurt the heart?

Ά Καρδιολογική Κλινική ΑΧΕΠΑ



Acute cardiovascular risks

↑ risk for sudden cardiac death
↑ risk for acute myocardial infarction
↓ ventricular function of the heart

Evidence of acute myocardial injury

↑ CK and CK-MB concentrations
↑ cardiac troponin concentrations
↑ BNP and NT-proBNP concentrations

Cardiac remodeling

↑ dimensions of right and left ventricle
↑ dimensions of right and left atria
↑ wall thickness

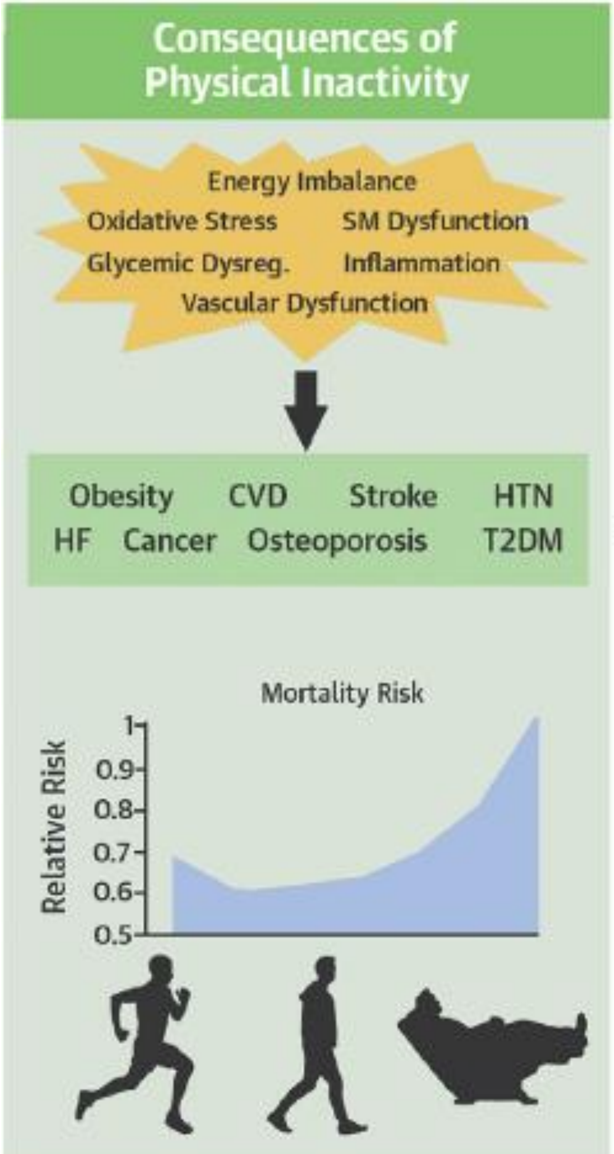
Potential cardiac maladaptations

= / ↓ Carotid intima media thickening
↑ ↓ Coronary artery calcification
↑ prevalence of myocardial fibrosis
↑ risk for atrial fibrillation
↑ risk for bradycardia
↑ aortic diameter
↑ progression of ARVC

Longevity

↑ life expectancy
↓ risk for cardiovascular mortality

FIGURE 9. An overview of potential deleterious cardiac effects of the performance of acute and chronic endurance exercise.



Fletcher, G.F. et al. J Am Coll Cardiol. 2018;

Ά Καρδιολογική Κλινική ΑΧΕΠΑ

TAKE HOME MESSAGE

- **Exercise and the heart: the good, the bad, and the ugly**

  Sanjay Sharma[1]*, Ahmed Merghani[1], and Lluis Mont[2] EHJ 2015

Sport, exercise, and daily activity: a double-edged sword revisited

Thomas F. Lüscher, MD, FESC EHJ 2016

ΕΥΧΑΡΙΣΤΩ