KATHOLIEKE UNIVERSITEIT
LEUVEN

Prof Dr L. Vanhees

EXERCISE RECOMMENDATIONS IN ATHLETES

Exercise guidelines in asymptomatic older athletes

Prague, 07 May 2010

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Screening, evaluation and exercise guidelines in asymptomatic older athletes

Prague, 07 May 2010

CONTENT

- **Screening and evaluation**
  - **Why screening: Complications during exercise - sudden death**
  - Masters Athletes, apparently healthy
  - Sedentary/ Active adults ≥ 35 yrs, apparently healthy
- Recommendations for PA
  - AHA 1995 recommendations
  - Importance of intensity and volume of exercise
  - Update AHA 2007
  - How to select the optimal exercise intensity for an individual

For people who rarely exercise, the risk of sudden death during exercise is 56 times higher than the risk while at rest. PHOTO JEFFREY MAYES

Sudden death: the Detroit Half-marathon

Three runners died during the Detroit Half-marathon

Sudden cardiac death and physical activity

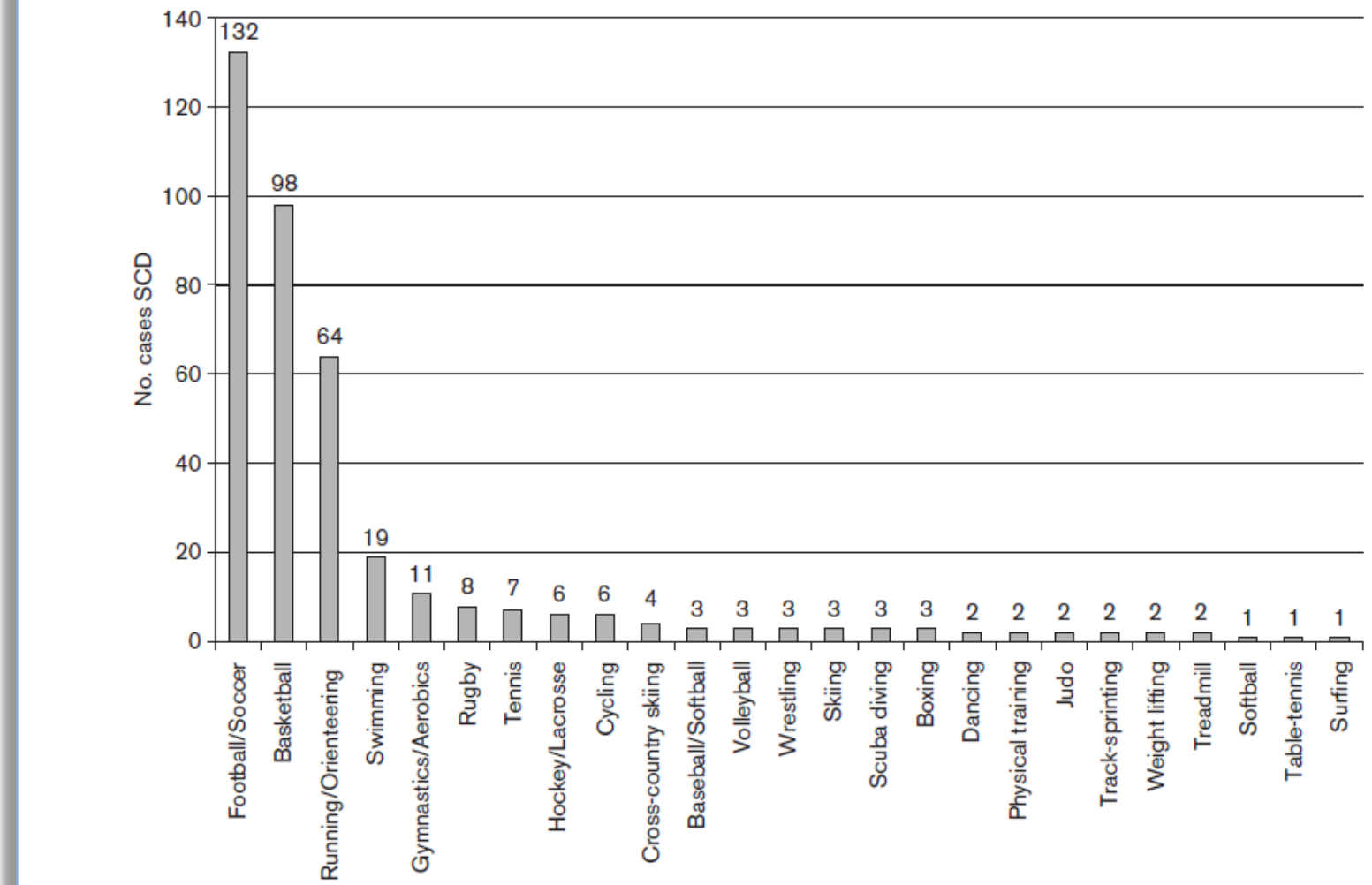
- The absolute indicence of sudden death during exercise is low in the general population:
  - 0.75 and 0.13/100 000 young male and female athletes
  - 6/100 000 middle-aged men
  - No estimates are available for middle-aged women and elderly

Sudden cardiac death during exercise

	ACTIVITY	AGE	RR
Pool et al. (1986) (All deaths)	All sports	12-73	1.8
Thompson et al. (1975-1980) (Cardiac deaths)	Jogging/running	30-64	7
Siscovick et al. (1984) (Cardiac deaths)	Vigorous exerc. Non-intense exerc.	20-75	5 55
RR= Relative Risk = Actual Risk/Expected Risk			

J. Pool, 1986 in Sports Cardiology, Exercise in health and disease, Eds R. Fagard & I Bekaert, 1986, pp223-227

Sudden cardiac death and PHYSICAL ACTIVITY
Review IOC - Lausanne



Number of cases of sudden cardiac death (SCD) by sport.

Bille K et al., EJCPR; 13: 859-875 2006

Sudden cardiac death and PA

- United Kingdom: 118 cases of sudden death*
  - 107 amateur sportsmen
  - Predominantly male (n=113)
  - Mean age 27.9 (range 7-59)
  - Sport discipline:
    - Soccer: 44 (37%)
    - Running: 24 (20%)
    - Cycling: 8 (7%)

- Belgium: 46 high leven endurance athletes (80% cyclists) with ventricular arrhytmias (45 male, median age 31 yrs) followed up for a median of 4.7 yrs. **
  - ➢ Sudden death: 9, ALL cyclists

*De Noronha SV et al. Heart 2009; 95: 1409-1414.
**Heidbüchel et al Eur Heart J 2003; 24: 1473-1480.

CAUSES of death during sports and recreational activities (n=36)

- Age: 13-62; median 35 yrs
  - <35 yrs:
    - Cardiomyopathy (28%)
    - Asymptomatic cardiovascular coronary heart disease (22%)
    - Myocarditis (22%)
    - Other (28%)
  - >35 yrs:
    - asymptomatic cardiovascular coronary heart disease (89%)
    - Cardiomyopathy (11%)

Yanai O et al. J Clin Forensic Med 2000; 7: 88-91

Prodromal Symptoms

Symptom	N
Chest pain / angina	15
Increasing fatigue	12
Indigestion / heartburn / gastrointestinal symptoms	10
Excessive breathlessness	6
Ear or neck pain	5
Vague malaise	5
Upper respiratory tract infection	4
Dizziness / palpitations	3
Severe headache	2
None	5
60 sudden deaths associated with squash playing (during or following 1 hour after the activity	

Northcote R. et al., 1986 in Sports Cardiology, Exercise in health and disease, Eds R. Fagard & I Bekaert, 1986, pp228-239

Prodromal Symptoms

Symptoms	N
Syncope/dizziness	10
Shortness of breath	7
Palpitations	6
Chest pain	4
118 subjects, 18% reported antecendent symptoms	

De Noronha SV et al Heart 2009; 95: 1409-1414

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Recommendations for Preparticipation Screening and the Assessment of Cardiovascular Disease in Masters Athletes.

An Advisory for Healthcare Professionals from the Working Groups of the World Heart Federation, the International Federation of Sports Medicine, and the American Heart Association Committee on Exercise, Cardiac Rehabilitation and Prevention

Maron B et al. Circulation 2001; 103: 327-334.

Scope and definition of Masters Sports Competition

- Masters Athletes: apparently healthy and normal individuals
  - > 35 yrs (wide range)
  - conditioned, experienced competitive athlete who continue to compete after their formal careers end
  - walk-up competitors with only sporadic training regimens (weekend warriors)
  - those who resume competition after long periods of physical inactivity

- Masters Sports:
  - organized forms of competition specifically designed for older athletes
  - ~50 sports (often intense competition)
  - endurance sports (marothons, triathlon, extreme sports)

Maron B et al. Circulation 2001; 103: 327-334.

Rationale

- Prevalence:
  ~1:15 000 joggers or 1/50 000 marathonrunners ↔ ~1/200 000 to 300 000 young high-school or college-aged athletes/year

- As **participation in masters sports accelerates** throughout the world, greater numbers of athletes will be enrolled in **intensive training programs** or competition abruptly after long periods away from strenuous training and the competitive sports arena, **often without preparticipation medical evaluations**. Therefore, the prevalence of **cardiac events among these athletes may increase further**, and it is this subset of athletes that is a major focus of this document

Maron B et al. Circulation 2001; 103: 327-334.

Objectives of preparticipation screening

- To ***identify*** (or raise the suspicion of) ***occult cardiovascular disease*** *that has the potential to cause sudden cardiac death,* nonfatal myocardial infarction, stroke, angina, acute coronary syndromes, or heart failure; this warrants further evaluation and recommendations regarding future participation
- In **athletes with known cardiovascular disease**, the purpose of this preparticiapation evaluation is *to determine whether continued sports participation is judicious and consistent with the severety and status of their disease.*
- Cardiovascular evaluation ***should be repeated if symptoms intervene or perceived risk increases*** **or for other clincial reasons**
- ***Asymptomatic status does not confer immunity*** from cardiac events and **subsequent periodic clinical examinations may be prudent** in this population.

Maron B et al. Circulation 2001; 103: 327-334.

Recommendations for the preparticipation cardiovascular evaluation

Emphasis on the detection of previously undiagnosed coronary artery disease.

AHA Consensus Panel Recommendations for Preparticipation Screening[50]

Family history
1. Premature sudden death
2. Heart disease in surviving relatives
Personal history
3. Heart murmur
4. Systemic hypertension
5. Fatigability
6. Syncope
7. Exertional dyspnea
8. Exertional chest pain
Physical examination
9. Heart murmur*
10. Femoral pulses
11. Stigmata of Marfan syndrome
12. Blood pressure measurement

*Precordial auscultation is recommended in both supine/sitting and standing positions to identify heart murmurs consistent with dynamic left ventricular outflow tract obstruction.

Maron B et al. Circulation 2001; 103: 327-334.

Recommendations for the preparticipation cardiovascular evaluation

Additionally:

- **<u>standard 12-lead ECG</u>** is recommended as part of a routine evaluation **for ALL masters athletes ≥ 40 yrs.**
  - identify unexpected evidence of a healed MI
  - detect certain diseases such as hypertrophic cardiomyopathy, long-QT,...
- **<u>maximal ECG exercise testing</u>** is recommended to:
  - **asymptomatic master athletes** with a **moderate-to-high CV risk profile** for CAD and desire to enter **vigorous competitive situations.**

    i*<u>ncreased risk profile:</u>*

    -men > 40 - 45y with ≥ 1 risk factor

    -women > 50 - 55y old (or postmenopausal) with ≥ 1 risk factor

    a) hypercholesterolemia or dyslipidemia
    b) systemic hypertension
    c) current or recent cigarette smoking;
    d) diabetes mellitus
    e) history of myocardial infarction or sudden cardiac death in a first-degree relatives < 60 yrs
  - **master athletes of any age with symptoms** suggestive of underlying CAD
  - **≥ 65 yrs old** even in the absence of risk factors and symptoms

    ➔ serves ONLY as a preliminary evaluation to estimate the likelihood that CAD is present

Maron B et al. Circulation 2001; 103: 327-334.

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AHA/ACSM Scientific Statement

Recommendations for Cardiovascular Screening, Staffing and Emergency Policies at Health/Fitness Facilities.

Balady GJ, Chaitman B, Driscoll D, Foster C, Froelicher E, Gordon N, Pate R, Rippe J, Bazzarre T.

Circulation 1998; 97: 2283-2293.

Cardiovascular Evaluation of Adult/Senior Individuals engaged in leisure-time sport activities:

Position Stand from the sections of Exercise Physiology and Sports Cardiology of the European Association of Cardiovascular Prevention and Rehabilitation

M Börjesson, A Urhausen, E Kouidi, D Dugmore, S Sharma, M Halle, H Heidbüchel, H Björnstad, S Gielen, A Mezzani, D Corrado, A Pelliccia, L Vanhees.

EJCPR, 2010 in press

New ESC recommendations on preparticipation screening in adults/senior athletes

- Aim:

  to establish the **most practical method of cardiovascular evaluation** in **middle-age/senior individuals (> 35 yrs)** who are contemplating exercise or who are already engaged in non-professional competitive or recreational leisure sporting activity.

- Rationale:

  Consensus panel recommend that such **evaluation** should vary according to the 1) **individuals's cardiac risk profile** and the 2) **indented level of physical activity**

  - traditional risk factors for CAD
  - habitual physical activity level

SEDENTARY

What activity?

Low intensity activity

Assessment of risk (self- or by non physician)

- **NO** on every question → Eligible for low intensity physical activity
- **YES** on any question → **Screening by Physician**
  - •History
  - •Phys. Exam.
  - •resting ECG
  - •Risk Score
  - Low risk → Eligible for low intensity physical activity
  - High risk → **Maximal exercise testing**
    - Negative → Eligible for low intensity physical activity
    - Positive → Further evaluation by cardiologist, appropriate treatment and individually prescribed PA

Moderate - High intensity activity

Screening by physician

- •History
- •Phys. Exam.
- •Risk Score
- •Rest ECG

- Low risk → Eligible for exercise training
- High risk → **Maximal exercise testing**
  - Negative → Eligible for exercise training
  - Positive → Further evaluation by cardiologist, appropriate treatment and individually prescribed PA

ACTIVE
Adult/senior

What activity?

Low intensity activity

Moderate intensity activity

High intensity activity

Assessment of risk (self- or by non physician)

Negative

Positive

Screening by **physician**
- History
- Phys. Exam.
- Risk Score
- Rest ECG

Low risk

High risk

Max exercise testing

Negative

Positive

Eligible for low intensity physical activity

Eligible for moderate/high exercise training

Further evaluation, appropriate treatment and individually prescribed PA

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Physical Activity and Public Health -- A Recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine

Every US adult should accumulate 30 minutes or more of moderate-intensity physical activity on most, preferably all, days of the week. Those who perform lower-intensity activities should do them more often, for longer periods of time, or both.

Most adults do not need to see their physician before starting a moderate-intensity physical activity program.

HOWEVER:

men ≥ 40yrs
women ≥ 50yrs

who plan a vigorous program (intensity >60% individual maximum oxygen consumption) or who have either chronic disease or risk factors for chronic disease should consult **their physician** to design a safe, effective program.

Pate R.R. JAMA., 1995

Physical activity and mortality

Study population:

Selection of 12.866 men from a database (n= 361.622) age 35- 57, with 10-15% highest risk profile (smokers, cholesterol, DBD) and after exclusion of ischeamic heart disease, cholesterol ≥ 350 mg/dl, DBD ≥ 115 mm Hg and overweight ≥ 50%.

Methods:

- Follow-up: 6-8 years
- Endpoints: mortality (total, IHD, SD), myocardial infarction (fatal, non-fatal)
- Assessment physical activity (LTPA) by the Minnesota questionnaire

Leon et al., JAMA 1987;258:2388-2395.

Physical activity and mortality

	Low	Moderate	High
N	3486	4097	4055
LTPA (min/day)	15 (0-29)	**47** (30-68)	134 (>68)

	Low tertile (0-29 min/day)	Mid tertile (30-68min/day)	High tertile (>68 min/d)
<u>Mortality</u>			
- Total	1.00	0.73**	0.87
- IHL	1.00	0.64**	0.67*
- Sudden death	1.00	0.64**	0.67*
<u>Myocardinfarct</u>			
- Total	1.00	0.88	0.83

Adjusted for age, DBD, total cholesterol, smoking habits and treatment groups * p< 0.05, ** p< 0.01

Leon et al., JAMA 1987;258:2388-2395.

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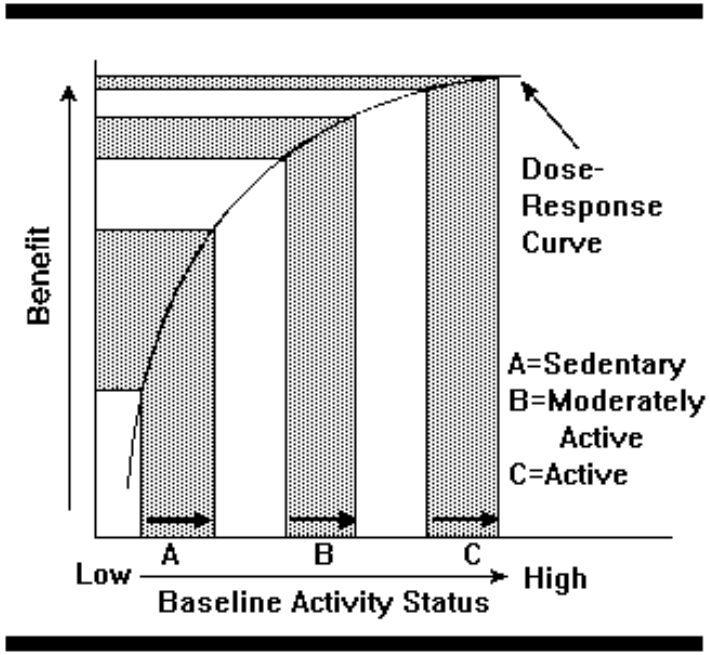


Figure 1.–The dose-response curve represents the best estimate of the relationship between physical activity (dose) and health benefits (response). The lower the baseline physical activity status, the greater will be the health benefit associated with a given increase in physical activity (arrows A, B, and C).

The health benefits of physical activity appear to accrue in approximate proportion to the total amount of activity performed, measured as either caloric expenditure or minutes of physical activity .

Observational studies have shown a significantly lower death rate from CHD in people who perform an average of **47 minutes vs 15 minutes** of activity per day, and in men who expend an estimated **2000 or more calories per week vs those who expend 500** or fewer calories per week. To expend these calories, about 30 minutes of moderate-intensity physical activity should be accumulated during the course of the day. One way to meet this standard is to walk 2 miles briskly.

Following slide provides examples of moderate-intensity physical activities.

Pate R.R. JAMA., 1995

Walking and Relative Risk CHD in men

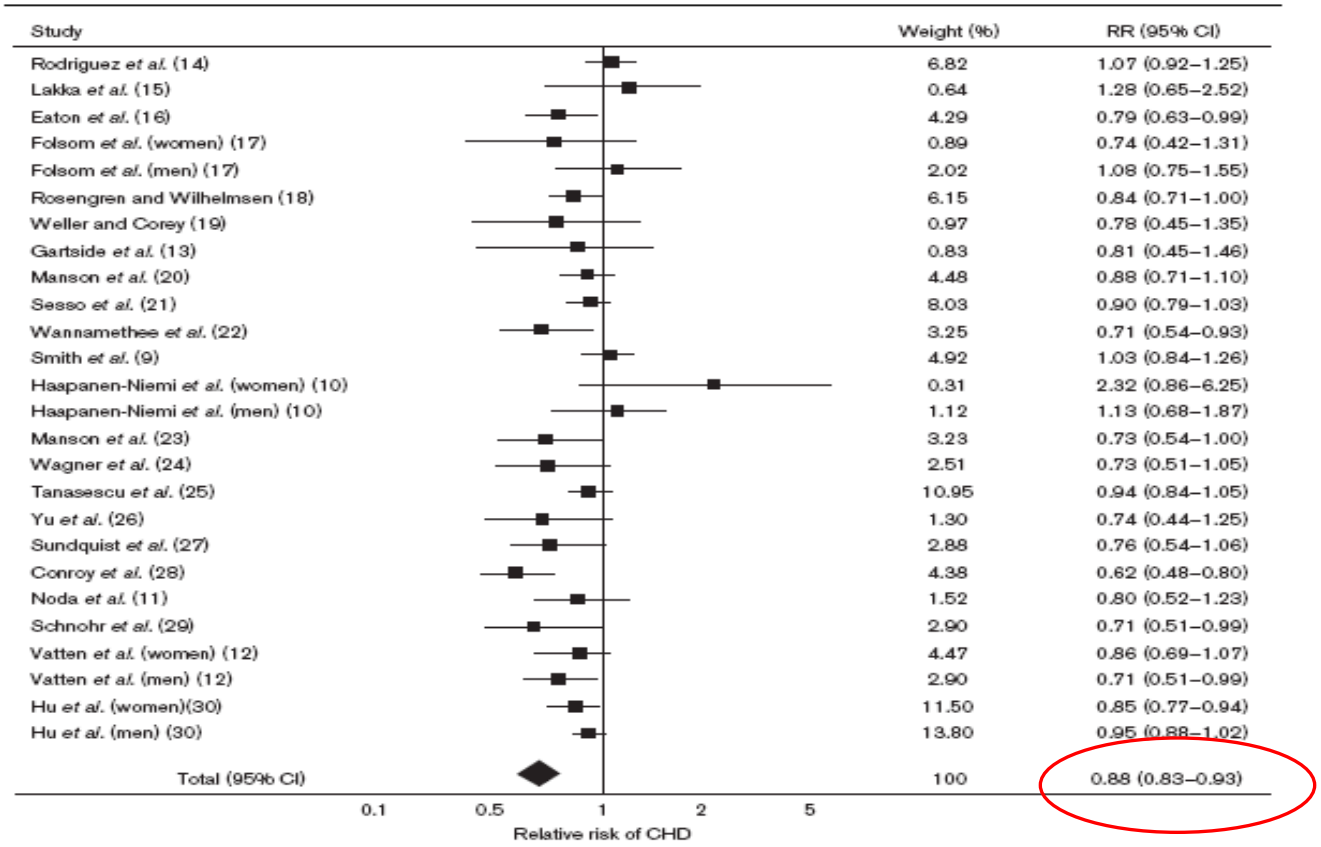
Table 5. Relative Risk for Coronary Heart Disease Associated With Walking and With Walking Pace Among Men Who Did Not Perform Vigorous Exercise Regularly (ie, <1 h/wk)*

	Walking, MET-h/wk					
	Quintile 1 0-1.19	Quintile 2 1.20-3.49	Quintile 3 3.50-6.99	Quintile 4 7.00-14.74	Quintile 5 ≥14.75	*P* Value
Cases, No. (person-years)	215 (49 592)	228 (51 111)	190 (46 185)	221 (44 519)	203 (47 775)	
Age-adjusted	Reference	0.97 (0.81-1.17)	0.86 (0.70-1.04)	0.95 (0.78-1.15)	0.74 (0.61-0.90)	.002
Multivariate model 1†	Reference	1.00 (0.83-1.21)	0.90 (0.74-1.10)	1.02 (0.84-1.23)	0.82 (0.67-1.00)	.04
Multivariate model 2‡	Reference	1.03 (0.85-1.25)	0.96 (0.78-1.17)	1.10 (0.90-1.34)	0.90 (0.73-1.10)	.27
	Usual Walking Pace, mph					
	<2	2 to 3	3 to 4	≥4		*P* Value
Cases, No. (person-years)	102 (11 950)	611 (124 571)	316 (92 620)	28 (10 040)		
Age-adjusted	Reference	0.66 (0.53-0.81)	0.52 (0.41-0.65)	0.45 (0.29-0.68)		<.001
Multivariate model 1†	Reference	0.74 (0.60-0.91)	0.60 (0.45-0.79)	0.50 (0.30-0.83)		<.001
Multivariate model 2‡	Reference	0.72 (0.54-0.94)	0.61 (0.45-0.81)	0.51 (0.31-0.84)		<.001

*All values are relative risk (95% confidence interval) unless otherwise specified. MET indicates metabolic equivalent.
†Adjusted for alcohol consumption, smoking, family history of myocardial infarction, and nutrient intake (polyunsaturated fat, *trans* fatty acids, folic acid, fiber and vitamin E supplements), as well as for baseline diabetes, high cholesterol levels, and hypertension.
‡Adjusted for covariates in model 1 and with walking volume in MET-hours per week and walking pace included in the same model.

Tanasescu et al. ,*JAMA.* 2002;288:1994-2000.

Physical activity during leisure time and primary prevention of coronary heart disease: an updated meta-analysis of cohort studies (Sofi et al. 2008)



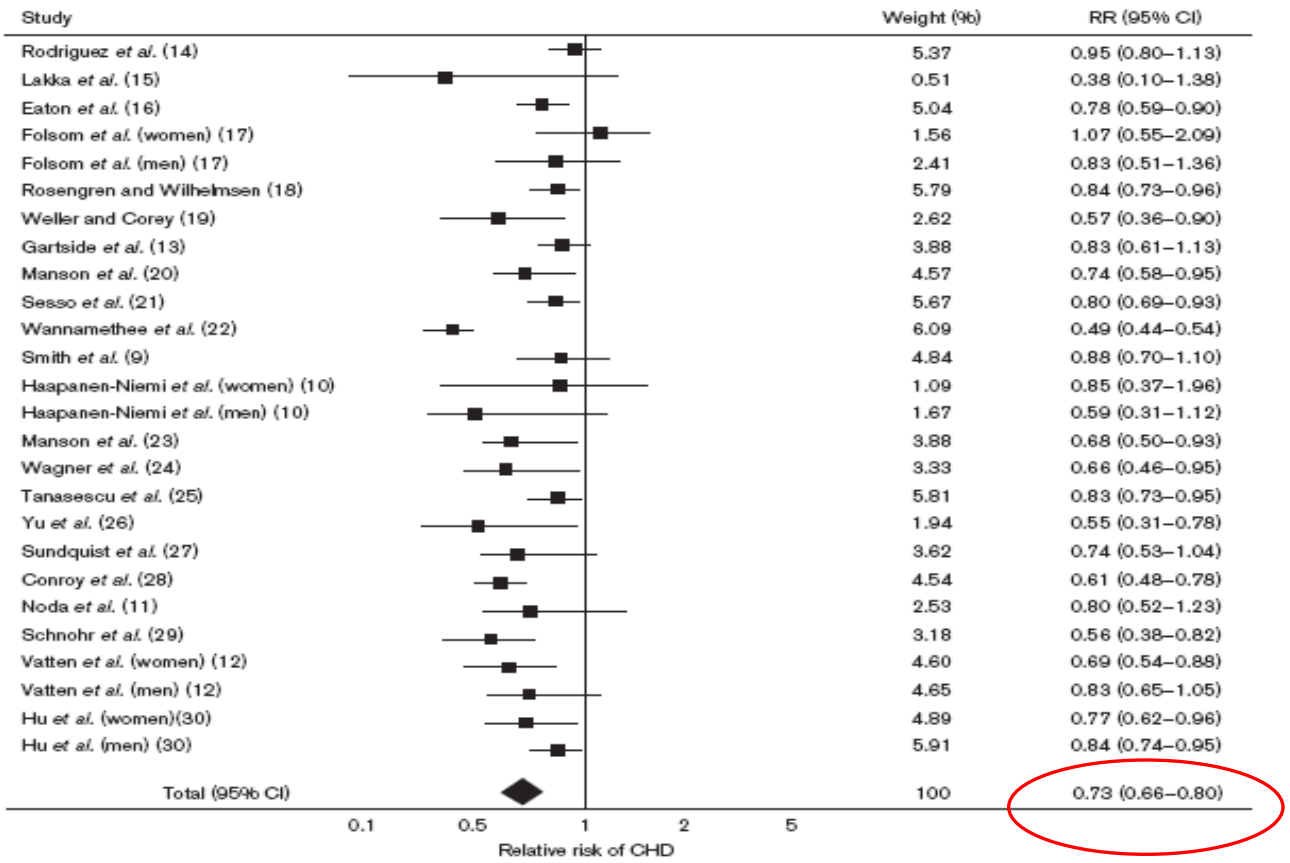
26 studies: n=513 472
Follow-up: 4-25 years

-12%

Risk of coronary heart disease for **moderate, compared with low or nil** physical activity during leisure time

Sofi et al.,EJCPR: Volume 15(3)June 2008 pp247-257.

Physical activity during leisure time and primary prevention of coronary heart disease: an updated meta-analysis of cohort studies (Sofi et al. 2008)



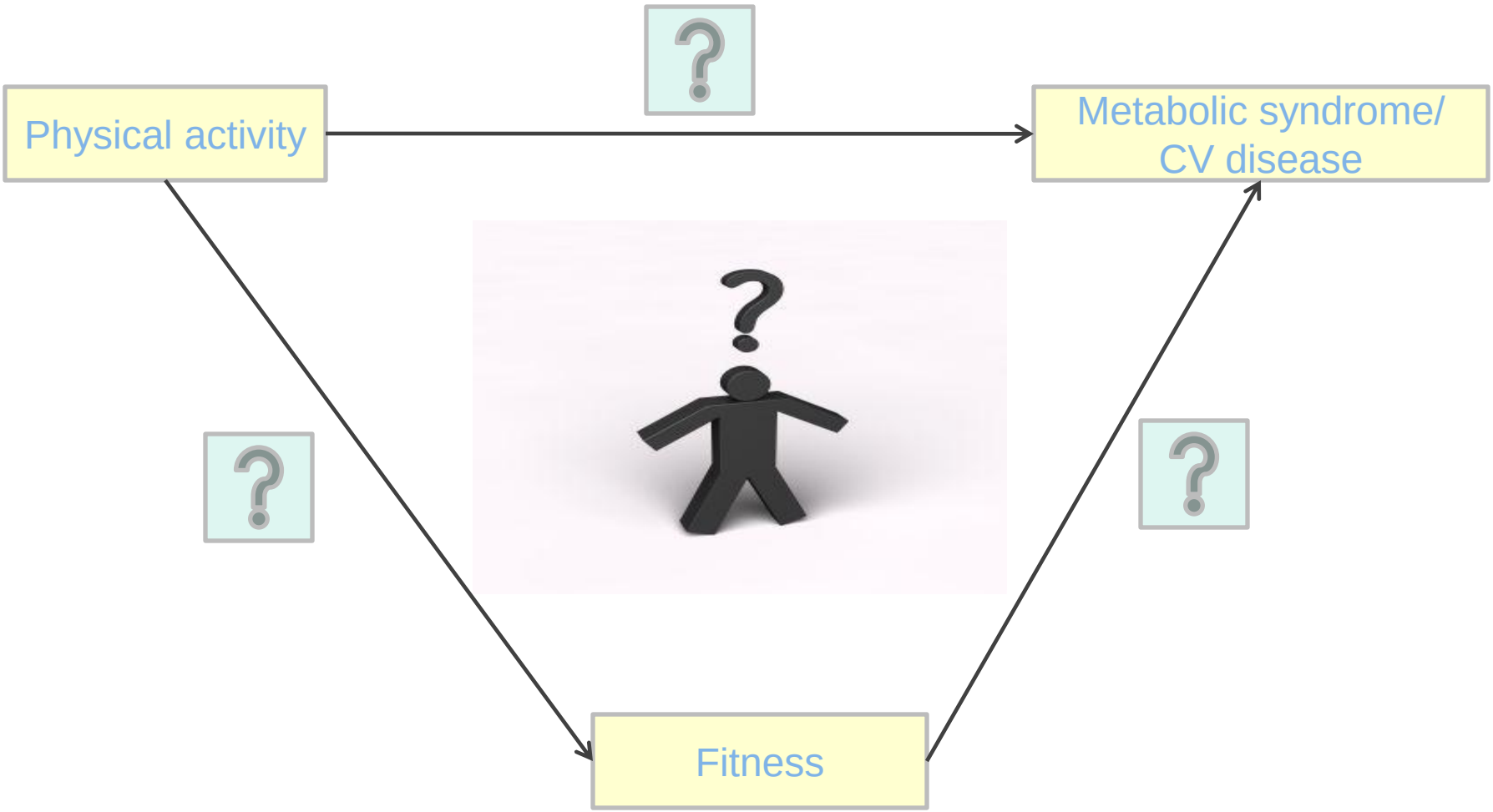
-27%

Risk of coronary heart disease for **high, compared with low or nil** physical activity during leisure time

Sofi et al.,EJCPR: Volume 15(3)June 2008 pp247-257.

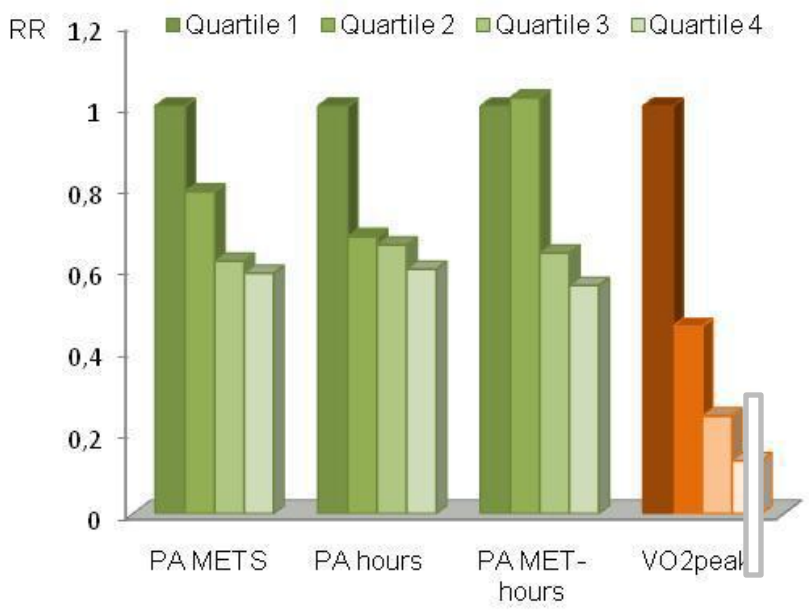
Physical fitness matters more than physical activity in controlling cardiovascular disease risk factors.

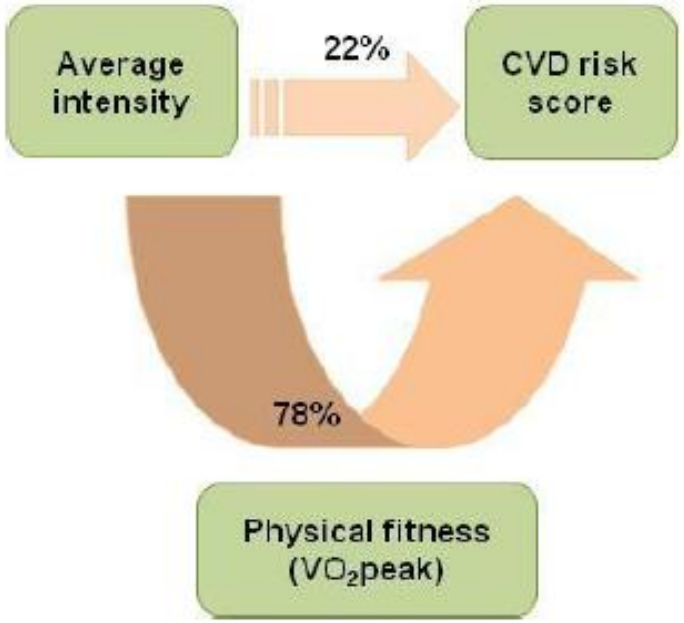
Improving outcomes with exercise: fitness or risk factors?



B. Sassen, V. Cornelissen, H. Kiers, H.Wittink, G. Kok, L. Vanhees , EJCPR, 2009

Physical fitness matters more than physical activity in controlling cardiovascular disease risk factors





Left figure: adjusted (age and gender) odds ratios for having the metabolic syndrome in different categories of physical activity and in the categories of physical fitness . Quartile 1 corresponds to the lowest category. P-value for trend < 0.05 for all. Right figure: pathway of the relation between physical activity and CVD risk score through physical fitness.

Sassen et al, 2009

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Physical Activity and Public Health: Updated Recommendation for Adults From the American College of Sports Medicine and the American Heart Association

TABLE 4. Physical activity recommendations for healthy adults aged 18–65 yr—2007.

1. To promote and maintain good health, adults aged 18–65 yr should maintain a physically active lifestyle. I (A)
2. They should perform moderate-intensity aerobic (endurance) physical activity for a minimum of 30 min on five days each week or vigorous-intensity aerobic activity for a minimum of 20 min on three days each week. I (A)
3. Combinations of moderate- and vigorous-intensity activity can be performed to meet this recommendation. For example, a person can meet the recommendation by walking briskly for 30 min twice during the week and then jogging for 20 min on two other days. IIa (B)
4. These moderate- or vigorous intensity activities are in addition to the light intensity activities frequently performed during daily life (e.g., self care, washing dishes, using light tools at a desk) or activities of very short duration (e.g., taking out trash, walking to parking lot at store or office).
5. Moderate-intensity aerobic activity, which is generally equivalent to a brisk walk and noticeably accelerates the heart rate, can be accumulated toward the 30-min minimum by performing bouts each lasting 10 or more minutes. I (B)
6. Vigorous-intensity activity is exemplified by jogging, and causes rapid breathing and a substantial increase in heart rate.
7. In addition, at least twice each week adults will benefit by performing activities using the major muscles of the body that maintain or increase muscular strength and endurance. IIa (A)
8. Because of the dose-response relation between physical activity and health, persons who wish to further improve their personal fitness, reduce their risk for chronic diseases and disabilities, or prevent unhealthy weight gain will likely benefit by exceeding the minimum recommended amount of physical activity. I (A)

Haskell W.L. et al., 2007

Physical Activity and Public Health in Older Adults: Recommendation from the American College of Sports Medicine And the AHA

Light-intensity activities : 1.1 - 2.9 METs.

Moderate-intensity activities : 3.0 - 5.9 METs.
Walking at 3.0 miles per hour requires METs of energy expenditure and is therefore considered as moderate-intensity.

Vigorous-intensity activities : ≥ 6.0 METs
Running at 10 min/mile (6.0 mph) is a 10 MET activity and is therefore classified as vigorous intensity.

Nelson M.E. et al., 2007

Physical Activity and Public Health: Updated Recommendation for Adults From the American College of Sports Medicine and the American Heart Association

TABLE 3. Physical activity recommendations included in the Dietary Guidelines for Americans, 2005 (US Department of Health and Human Services, 2005).

Engage in regular physical activity and reduce sedentary activities to promote health, psychological well-being, and a healthy body weight.
To reduce the risk of chronic disease in adulthood: Engage in at least 30 min of moderate-intensity physical activity, above usual activity at work or home, on most days of the week.
For most people, greater health benefits can be obtained by engaging in physical activity of more vigorous intensity or longer duration.
To help manage body weight and prevent gradual, unhealthy body weight gain in adulthood: Engage in approximately 60 min of moderate- to vigorous-intensity activity on most days of the week while not exceeding caloric intake requirements.
To sustain weight loss in adulthood: Participate in at least 60–90 min of daily moderate-intensity physical activity while not exceeding caloric intake requirements. Some people may need to consult with a healthcare provider before participating in this level of activity.
Achieve physical fitness by including cardiovascular conditioning, stretching exercises for flexibility, and resistance exercises or calisthenics for muscle strength and endurance.

Haskell W.L. et al., 2007

American College of Sports Medicine

AMERICAN COLLEGE of SPORTS MEDICINE

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The American College of Sports Medicine (ACSM) and the American Heart Association (AHA) released updated physical activity guidelines in 2007. These guidelines outline exercise recommendations for healthy adults and older adults and are an update from the 1995 guidelines. Choose your category below, and find recommendations, research and tips from ACSM and AHA. Together, we are proud to serve as a public resource to help people live healthier, more active lives.

Read the healthy adults manuscript

Read the older adults manuscript

Guidelines for healthy adults under age 65

Basic recommendations from ACSM and AHA:

Do moderately intense cardio 30 minutes a day, five days a week
Or
Do vigorously intense cardio 20 minutes a day, 3 days a week

AMERICAN COLLEGE of SPORTS MEDICINE

Physical Activity & Public Health Guidelines

American Heart Association. learn and live.

AMERICAN COLLEGE of SPORTS MEDICINE www.acsm.org

Guidelines for healthy adults under the age 65

Guidelines for healthy adults over age 65 or age 50-64 with chronic conditions

Basic recommendations from ACSM and AHA:

Do moderately intense cardio 30 minutes a day, five days a week

Or

Do vigorously intense cardio 20 minutes a day, 3 days a week

And

Do eight to 10 strength-training exercises, eight to 12 repetitions of each exercise twice a week.

Moderate-intensity physical activity means working hard enough to raise your heart rate and break a sweat, yet still being able to carry on a conversation. It should be noted that to lose weight or maintain weight loss, 60 to 90 minutes of physical activity may be necessary. The 30-minute recommendation is for the average healthy adult to maintain health and reduce the risk for chronic disease.

AMERICAN COLLEGE of SPORTS MEDICINE

Physical Activity & Public Health Guidelines

American Heart Association. learn and live.

AMERICAN COLLEGE of SPORTS MEDICINE www.acsm.org

Guidelines for healthy adults under the age 65

Guidelines for healthy adults over age 65 or age 50-64 with chronic conditions

Improvements from the 1995 recommendation

Although the 2007 recommendations are similar to the 1995 recommendations at the core, eight improvements have been made:

1. Moderate-intensity physical activity has been clarified.

1995 : most, preferably all days per week" as the recommended frequency
2007 : five days per week as the new recommended minimum.

2. Vigorous-intensity physical activity has been explicitly incorporated into the recommendation.

- The recommendation: encourage participation in either moderate- and/or vigorous-intensity physical activity.
- Vigorous-intensity is now an integral part of the physical activity recommendation.

AMERICAN COLLEGE of SPORTS MEDICINE

Physical Activity & Public Health Guidelines

American Heart Association. learn and live.

AMERICAN COLLEGE of SPORTS MEDICINE www.acsm.org

Guidelines for healthy adults under the age 65

Guidelines for healthy adults over age 65 or age 50-64 with chronic conditions

Improvements from the 1995 recommendation

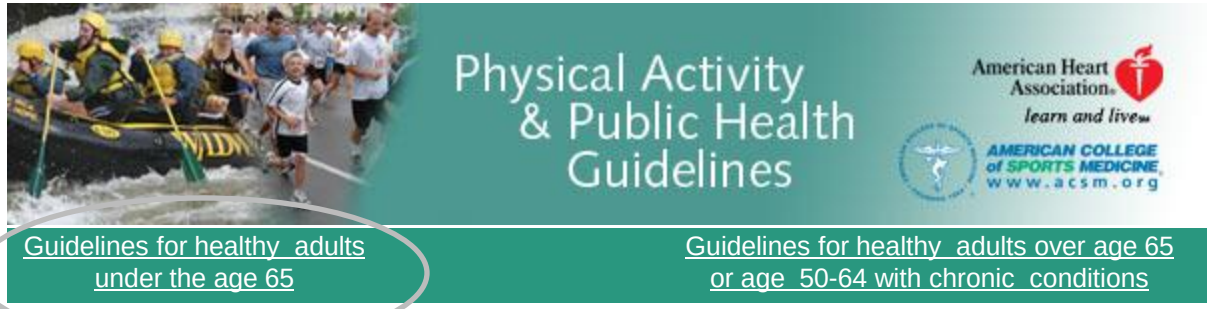
Although the 2007 recommendations are similar to the 1995 recommendations at the core, eight improvements have been made:

3. Specified: Moderate- and vigorous-intensity activities are complementary in the production of health benefits and that a variety of activities can be combined to meet the recommendation.

- Combination of activities : the amount (intensity x duration) of activity performed during the week
- The concept of METs : to assign an intensity value to a specific activity.

4. Specified: Aerobic activity needed is in addition to routine activities of daily life.

- The recommended amount of aerobic activity VERSUS routine activities of daily living which are of light intensity, (such as self care, casual walking or grocery shopping, or less than 10 minutes of duration such as walking to the parking lot or taking out the trash)



Improvements from the 1995 recommendation

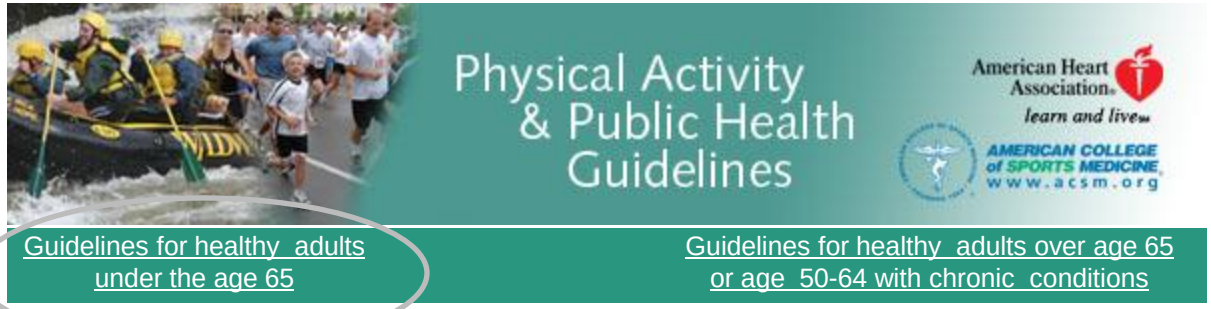
Although the 2007 recommendations are similar to the 1995 recommendations at the core, eight improvements have been made:

5. "More is better."

- Above the recommended minimum amount provides even greater health benefits
- The point of maximum benefit for most health benefits has not been established but likely varies with genetic endowment, age, sex, health status, body composition and other factors.
- Exceeding the minimum recommendation further reduces the risk of inactivity-related chronic disease.

6. Short bouts of exercise.

1995: confusion regarding how short these episodes must be
2007: the minimum length of these short bouts is clarified as being 10 minutes



Improvements from the 1995 recommendation

Although the 2007 recommendations are similar to the 1995 recommendations at the core, eight improvements have been made:

7. Muscle-strengthening recommendation now included.

8. Clarification in wording.

- Wording changes in the recommendation have been made to enhance clarity in communications.

  For example, the term “aerobic,” or endurance, has been added to clarify the type of physical activity being recommended and to differentiate it from muscle-strengthening exercises, which are now part of the core recommendation.

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Guidelines for healthy adults under the age 65

Guidelines for healthy adults over age 65 or age 50-64 with chronic conditions

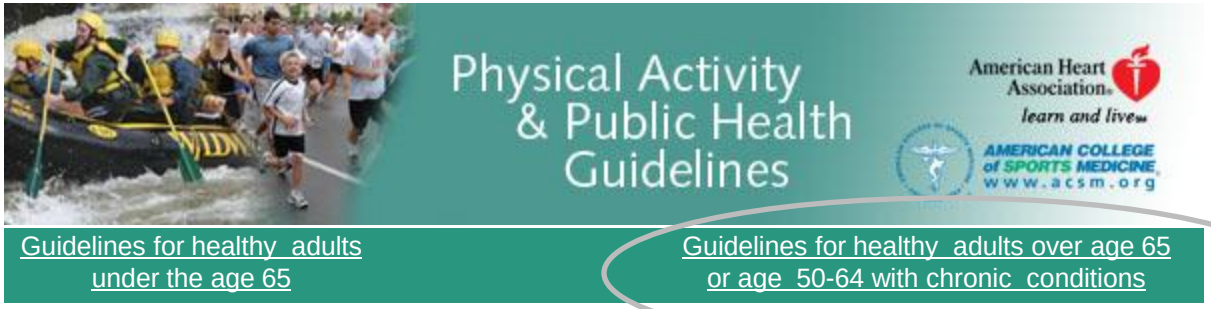
are similar to those for younger adults

Basic recommendations from ACSM and AHA:

Do moderately intense aerobic exercise 30 minutes a day, five days a week
Or
Do vigorously intense aerobic exercise 20 minutes a day, 3 days a week
And
Do eight to 10 strength-training exercises,
10-15 repetitions of each exercise twice to three times per week
And
If you are at risk of falling, perform balance exercises
And
Have a physical activity plan.

Both aerobic and muscle-strengthening activity is critical for healthy aging.
Moderate-intensity aerobic exercise means working hard at about a level-six intensity on a scale of 10. You should still be able to carry on a conversation during exercise.

Older adults or adults with chronic conditions should develop an **activity plan** with a health professional to manage risks and take therapeutic needs into account. This will maximize the benefits of physical activity and ensure your safety.



Guidelines for healthy adults under the age 65

Guidelines for healthy adults over age 65 or age 50-64 with chronic conditions

Key points to the guidelines for older adults

Although the guidelines for older adults and adults with chronic conditions are similar to those for younger adults, there are a few key differences and points to consider.

Start, and get help if you need it. Older adults: meet or exceed 30 minutes of moderate physical activity on most days of the week; however: below this threshold may be necessary for older adults with functional limitations.

Functional health is an important benefit of physical activity for older adults. Physical activity contributes to the ease of doing everyday activities, such as gardening, walking or cleaning the house.

Strength training is extremely important. Strength training is important for all adults, but especially so for older adults,

- prevents loss of muscle mass and bone
- is beneficial for functional health.

If you can exceed the minimum recommendations, do it!

→ If you can exceed the minimum, it's better!

Flexibility is also important. Each day you perform aerobic or strength-training activities, take an extra 10 minutes to stretch the major muscle and tendon groups, with 10-30 seconds for each stretch. Repeat each stretch three to four times. Flexibility training will promote the ease of performing everyday activities.

Resistance Exercise in Individuals With and Without CVD Disease 2007 Update: A Scientific Statement From the AHA Council on Clinical Cardiology and Council on Nutrition, Physical Activity, and Metabolism

TABLE 3. Guidelines and Statements Regarding Resistance and Flexibility Training

	Resistance Training		Flexibility Training	
Population	Sets; Reps	Stations/Devices*	Frequency	Goal
Healthy/sedentary adults				
2007 AHA Scientific Statement	1 set; 8–12 reps for persons <50–60 y of age; 10–15 reps at reduced levels of resistance for persons 50–60 y of age	8–10 exercises	2–3 d/wk	Stretching the major muscle or tendon groups, 2–3 d/wk
2006 ACSM Guidelines[110]	1 set; 8–12 reps (range, 3–20 reps) performed at a moderate rep duration (≈3 s concentric, ≈3 s eccentric)	8–10 exercises	2-3 nonconsecutive d/wk	Static stretching, major muscle tendon units a minimum of 2–3 d/wk; stretch to the ROM at a point of tightness, 15–30 s/stretch, 2–4 reps/stretch
Elderly persons				
2001 American Geriatrics Society[121]	Low: 40% 1-RM; 10–15 reps	Not specified	2–3 d/wk	3–5 stretches/key muscle group; hold for 20–30 s; 3–5 d/wk
	Moderate: 40%–60% 1-RM; 8–10 reps High: >60% 1-RM; 6–8 reps			
Cardiac patients				
2007 AHA Scientific Statement	1 set; 10–15 reps	8–10 exercises	2–3 d/wk	Stretching the major muscle or tendon groups, 2–3 d/wk
2004 AACVPR guidelines[111]	1 set; 12–15 reps	6–8 exercises	2–3 d/wk	
2006 ACSM guidelines[110]	1 set; 10–15 reps	8–10 exercises	2–3 d/wk	

Reps indicates repetitions; ROM, range of motion; ACSM, American College of Sports Medicine; and AACVPR, American Association of Cardiovascular and Pulmonary Rehabilitation.

*Minimum 1 exercise per major muscle group, for example, chest press, shoulder press, triceps extension, biceps curl, pull-down (upper back), lower-back extension, abdominal crunch/curl-up, quadriceps extension or leg press, leg curls (hamstrings), and calf raise.

NO DIFFERENCES IN AMOUNT OF REPETITIONS AND STATIONS
ONLY DIFFERENCES IN INITIAL RESISTANCE OR WEIGHT LOAD

Those persons with CVD, the level of resistance should be reduced and number of repetitions increased, resulting in a lower relative effort and reducing the likelihood of breathholding and straining.

Williams M.A. Et al., 2007

Resistance Exercise in Individuals With and Without CVD Disease 2007 Update: A Scientific Statement From the AHA Council on Clinical Cardiology and Council on Nutrition, Physical Activity, and Metabolism

TABLE 4. Recommendations for the Initial Prescription of RT

Resistance training should be performed
In a rhythmical manner at a moderate to slow controlled speed
Through a full range of motion, avoiding breathholding and straining (Valsalva maneuver) by exhaling during the contraction or exertion phase of the lift and inhaling during the relaxation phase
Alternating between upper- and lower-body work to allow for adequate rest between exercises
The initial resistance or weight load should
Allow for and be limited to 8–12 repetitions per set for healthy sedentary adults or 10–15 repetitions at a low level of resistance, for example, <40% of 1-RM, for older (>50–60 y of age), more frail persons, or cardiac patients
Be limited to a single set performed 2 d/wk
Involve the major muscle groups of the upper and lower extremities, eg, chest press, shoulder press, triceps extension, biceps curl, pull-down (upper back), lower-back extension, abdominal crunch/curl-up, quadriceps extension or leg press, leg curls (hamstrings), and calf raise

Williams M.A. Et al., 2007

Resistance Exercise in Individuals With and Without CVD Disease 2007 Update: A Scientific Statement From the AHA Council on Clinical Cardiology and Council on Nutrition, Physical Activity, and Metabolism

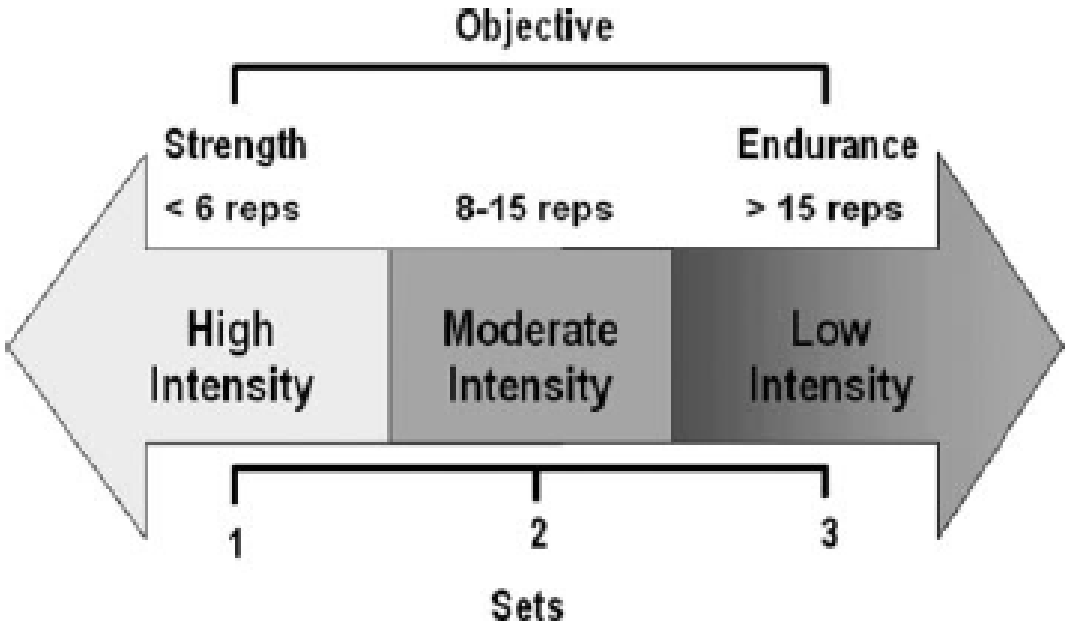


Figure. Classification of weight training intensity (resistance). A lower repetition range with a heavier weight may better optimize strength and power, whereas a higher repetition range with a lighter weight may better enhance muscular endurance. Using weight loads that permit 8 to 15 repetitions (reps) will generally facilitate improvements in muscular strength and endurance.

Williams M.A. Et al., 2007

Exercise in improving health *v. Performance*

Conference on 'Multidisciplinary approaches to nutritional problems'
Symposium on 'Performance, exercise and health'

Table 1. Components of physical fitness and examples of activities to achieve fitness within each component

Component	Definition	Activities to achieve fitness
Cardio-respiratory fitness	Ability of the heart, lungs and circulatory system to adequately supply O_2 and nutrients to working muscles	Aerobic-type activity such as jogging, hiking, brisk walking, bicycling, aerobic dance
Musculoskeletal fitness:	Fitness of skeletal muscle and bones	Resistance training, weight lifting
Muscular endurance	Ability of muscle to maintain submaximal force levels for an extended period of time	Weight lifting using lighter weights with a higher number of repetitions
Muscular strength	Ability of muscle to produce its maximal force	Weight lifting using heavier weights with a lower number of repetitions
Muscular power	Ability of muscle to produce a large amount of force quickly	Plyometrics, bounding
Flexibility	Ability of a joint to move fluidly through its complete range of motion	Yoga, stretching exercises

Thompson J.L. et al., 2008

Exercise in improving health *v. Performance*

Conference on 'Multidisciplinary approaches to nutritional problems'
Symposium on 'Performance, exercise and health'

Table 2. A comparison of various physical activity recommendations to improve and maintain health

Health category	Recommendation	Reference
General health	Accumulation of ≥ 30 min moderate-intensity physical activity on most, preferably all, days of the week	Pate *et al.*[4], National Institutes of Health Consensus Development Panel on Physical Activity and Cardiovascular Health[5]
	A total of ≥30 min at least moderate-intensity physical activity/d on ≥5 d/week	Department of Health[6]
	Healthy adults 18–65 years of age need moderate-intensity aerobic (endurance) physical activity for a minimum of 30 min on 5 d/week or vigorous-intensity aerobic physical activity for a minimum of 20 min on 3 d/week; combinations of moderate- and vigorous intensity activity can be performed to meet the recommendation; to maintain good health and physical independence, adults should perform exercises that maintain or increase muscular strength and endurance for ≥2 d/week	Haskell *et al.*[7]
Cancer prevention	Be moderately physically active, equivalent to brisk walking, for ≥30 min/d; and as fitness improves, aim for ≥60 min moderate, or for ≥ 30 min vigorous, physical activity every day (evidence indicates convincing decreased risk for colo-rectal cancer, probable decreased risk for post-menopausal breast cancer and endometrial cancer and limited–suggestive decreased risk for cancers of the lung, pancreas and breast (premenopausal))	World Cancer Research Fund/American Institute for Cancer Research[8]
Weight loss and prevention of weight regain	Marked health gains can be achieved with participation in a minimum of 150 min/week and overweight and obese individuals should gradually increase to this initial goal; there may be advantages to progressively increasing exercise to 200–300 min (approximately 45 min/d)/week to facilitate long-term maintenance of weight loss	Jakicic *et al.*[10]
	60 min moderate-intensity physical activity/d should be performed to prevent weight gain and confer additional health benefits	Institute of Medicine, Food and Nutrition Board[11]
	45–60 min moderate-intensity physical activity/d is needed to prevention overweight and obesity; prevention of weight regain may require 60–90 min moderate-intensity activity or lesser amounts of vigorous-intensity physical activity/d	Saris *et al.*[12]
Bone health	To preserve bone health adults should perform weight-bearing aerobic (endurance) activities, activities that involve jumping and resistance exercise; bone loading forces should be moderate to high in intensity; weight-bearing activities should be done three to five times per week and resistance training should be done two to three times per week; a combination of weight-bearing endurance activities, activities that involve jumping and resistance exercise that targets all major muscle groups for 30–60 min/d	Kohrt *et al.*[9]

Thompson J.L. et al., 2008

Exercise in improving health *v. Performance*

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	A total of ≥30 min at least moderate-intensity physical activity/d on ≥5 d/week
	Healthy adults 18–65 years of age need moderate-intensity aerobic (endurance) physical activity for a minimum of 30 min on 5 d/week or vigorous-intensity aerobic physical activity for a minimum of 20 min on 3 d/week; combinations of moderate- and vigorous intensity activity can be performed to meet the recommendation; to maintain good health and physical independence, adults should perform exercises that maintain or increase muscular strength and endurance for ≥2 d/week
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Thompson J.L. et al., 2008

Exercise in improving health *v. Performance*

Conference on 'Multidisciplinary approaches to nutritional problems'
Symposium on 'Performance, exercise and health'

Table 2. A comparison of various physical activity recommendations to improve and maintain health

Weight loss and prevention of weight regain	Marked health gains can be achieved with participation in a minimum of 150 min/week and overweight and obese individuals should gradually increase to this initial goal; there may be advantages to progressively increasing exercise to 200–300 min (approximately 45 min/d)/week to facilitate long-term maintenance of weight loss 60 min moderate-intensity physical activity/d should be performed to prevent weight gain and confer additional health benefits 45–60 min moderate-intensity physical activity/d is needed to prevention overweight and obesity; prevention of weight regain may require 60–90 min moderate-intensity activity or lesser amounts of vigorous-intensity physical activity/d
Bone health	To preserve bone health adults should perform weight-bearing aerobic (endurance) activities, activities that involve jumping and resistance exercise; bone loading forces should be moderate to high in intensity; weight-bearing activities should be done three to five times per week and resistance training should be done two to three times per week; a combination of weight-bearing endurance activities, activities that involve jumping and resistance exercise that targets all major muscle groups for 30–60 min/d

Thompson J.L. et al., 2008

Exercise and Physical Activity for Older Adults

TABLE 1. Summary of ACSM/AHA physical activity recommendations for older adults.

The current consensus recommendations of the ACSM and AHA with respect to the frequency, intensity, and duration of exercise and physical activity for older adults are summarized below. The ACSM/AHA Physical Activity Recommendations are generally consistent with the *2008 DHHS Physical Activity Guidelines for Americans*, which also recommend 150 min·wk^{-1} of physical activity for health benefits. However, the DHHS Guidelines note that additional benefits occur as the amount of physical activity increases through higher intensity, greater frequency, and/or longer duration. The DHHS Physical Activity Guidelines stress that if older adults cannot do 150 min of moderate-intensity aerobic activity·wk^{-1} because of chronic conditions, they should be as physically active as their abilities and conditions allow.

Endurance exercise for older adults:

Frequency: For moderate-intensity activities, accumulate at least 30 or up to 60 (for greater benefit) min·d^{-1} in bouts of at least 10 min each to total 150–300 min·wk^{-1}, at least 20–30 min·d^{-1} or more of vigorous-intensity activities to total 75–150 min·wk^{-1}, an equivalent combination of moderate and vigorous activity.

Intensity: On a scale of 0 to 10 for level of physical exertion, 5 to 6 for moderate-intensity and 7 to 8 for vigorous intensity.

Duration: For moderate-intensity activities, accumulate at least 30 min·d^{-1} in bouts of at least 10 min each or at least 20 min·d^{-1} of continuous activity for vigorous-intensity activities.

Type: Any modality that does not impose excessive orthopedic stress; walking is the most common type of activity. Aquatic exercise and stationary cycle exercise may be advantageous for those with limited tolerance for weight bearing activity.

Resistance exercise for older adults:

Frequency: At least 2 d·wk^{-1}.

Intensity: Between moderate- (5–6) and vigorous- (7–8) intensity on a scale of 0 to 10.

Type: Progressive weight training program or weight bearing calisthenics (8–10 exercises involving the major muscle groups of 8–12 repetitions each), stair climbing, and other strengthening activities that use the major muscle groups.

Flexibility exercise for older adults:

Frequency: At least 2 d·wk^{-1}.

Intensity: Moderate (5–6) intensity on a scale of 0 to 10.

Type: Any activities that maintain or increase flexibility using sustained stretches for each major muscle group and static rather than ballistic movements.

Balance exercise for frequent fallers or individuals with mobility problems:

ACSM/AHA Guidelines currently recommend balance exercise for individuals who are frequent fallers or for individuals with mobility problems. Because of a lack of adequate research evidence, there are currently no specific recommendations regarding specific frequency, intensity, or type of balance exercises for older adults. However, the ACSM Exercise Prescription Guidelines recommend using activities that include the following: 1) progressively difficult postures that gradually reduce the base of support (e.g., two-legged stand, semitandem stand, tandem stand, one-legged stand), 2) dynamic movements that perturb the center of gravity (e.g., tandem walk, circle turns), 3) stressing postural muscle groups (e.g., heel stands, toe stands), or 4) reducing sensory input (e.g., standing with eyes closed).

The ACSM/AHA Guidelines recommend the following special considerations when prescribing exercise and physical activity for older adults. The intensity and duration of physical activity should be low at the outset for older adults who are highly deconditioned, functionally limited, or have chronic conditions that affect their ability to perform physical tasks. The progression of activities should be individual and tailored to tolerance and preference; a conservative approach may be necessary for the most deconditioned and physically limited older adults. Muscle strengthening activities and/or balance training may need to precede aerobic training activities among very frail individuals. Older adults should exceed the recommended minimum amounts of physical activity if they desire to improve their fitness. If chronic conditions preclude activity at the recommended minimum amount, older adults should perform physical activities as tolerated so as to avoid being sedentary.

Physical Activity and Public Health in Older Adults: Recommendation from the American College of Sports Medicine And the AHA

Recommendation	Aerobic Activity			Muscle-Strenghtening Activity			
	Frequency	Intensity	Duration	Frequency	Number of exercise	Sets and repetitions	Flexibility/ Balance
Older adults, 1999, Health Canada	4-7 d/wk	Moderate intensity but may progress to vigorous	Accumulate 30 to 60 min of moderate intensity activity in bouts of at least 10 min each	2-4 d/wk	-	Weights that a person can lift 10 times "before they become too heavy"	Daily flexibility; and balance activities
Older adults, 2007, ACSM/AHA Recommendation (described in present Paper)	A minimum of 5 d/wk for moderate intensity, or a minimum of 2 d/wk for vigorous intensity	Moderate intensity at 5 to 6 on a 10-point scale; vigorous intensity at 7 to 8 on 10-point scale	Accumulate at least 30 min/d of moderate intensity activity, in bouts of at least 10 min each continuous vigorous activity for at least 20 min/d	At least 2 d/wk	8-10 exercises involving the major muscle groups	10-15 repetitions	At least 2d/wk flexibility; for those at risk for falls, include exercises to maintain or improve balance
Healthy adults, 2007, ACSM/AHA (companion recommendation to 2007 older adults recommendation)	A minimum of 5 d/wk for moderate intensity, or a minimum of 2 d/wk for vigorous intensity	Moderate intensity between 3 and 6 METS; vigorous intensity above 6 METS	Accumulate at least 30 min/d of moderate intensity activity, in bouts of at least 10 min each continuous vigorous activity for at least 20 min/d	At least 2 d/wk	8-10 exercises involving the major muscle groups	8-12 repetitions	-

TABLE 1. Summary of selected preventive or therapeutic recommendations for aerobic activity, muscle strengthening activity, flexibility activity and balance exercises

Nelson M.E. et al., 2007

CONTENT

- **Screening and evaluation**
  - Complications during exercise : sudden death
  - Masters Athletes, apparently healthy
  - Sedentary/ Active adults ≥ 35 yrs, apparently healthy
- **Recommendations for PA**
  - AHA 1995 recommendations
  - Importance of intensity and volume of exercise
  - Update AHA 2007
  - **How to select the optimal exercise intensity for an individual**

Prescribing exercise as preventive therapy

Box 2: Recommended levels of exercise required to improve physical activity and fitness levels for health benefits

Low-intensity (light effort) aerobic exercise

- 20%-39% of heart rate reserve, or about 2-4 METs (metabolic equivalents)
- About 60 min per day
- Most (preferably all) days of the week
- Examples: light gardening, light walking

Moderate-intensity aerobic exercise

- 40%-59% of heart rate reserve, or about 4-6 METs
- 20-60 min per day
- 3-5 days per week
- Examples: brisk walking (15-20 min per mile), dancing

High-intensity aerobic exercise

- 60%-84% of heart rate reserve, or about 6-8 METs
- 20-60 min per day
- 3-5 days per week
- Examples: jogging, swimming

Resistance and flexibility exercise

- 1-2 sets (each set 8-12 repetitions) of 8-10 different resistance exercises of moderate intensity that engage the large muscle groups, 2-4 days per week
- People over 60 yr and frail people may need to engage in more repetitions (10-15) to compensate for a lower resistance requirement
- Gentle reaching, bending and stretching exercises of the major muscle groups to improve flexibility (hold each stretch for 10-30 seconds) for a minimum of 2-3 days per week (preferably 4-7)

Note: Aerobic exercise can be accumulated in short (10-minute) sessions of activity throughout the day. The approximate MET values provided are estimates for middle-aged adults (40-64 yr). The required METs would be lower for elderly and very elderly people, and higher for younger adults.[15] In general, the higher the intensity of activity, the less time required for health benefits. Each aerobic exercise session should begin with a warm-up (exercise designed to raise heart rate and body temperature) and end with a cool-down (mild exercise designed to slowly decrease heart rate and body temperature).

Warburton D.E.R. , 2006

Prescribing exercise as preventive therapy

Table 1: Estimated time required to meet recommended daily energy expenditures for common activities*

Activity	METs	EE	Body mass, kg; time required to meet daily energy expenditure, min								
			50	60	70	80	90	100	110	120	130
Leisure											
Backpacking	7.0	0.12	26	21	18	16	14	13	12	11	10
Basketball, game	8.0	0.13	23	19	16	14	13	11	10	9	9
Basketball, shooting baskets	4.5	0.08	40	33	29	25	22	20	18	17	15
Bicycling, general stationary	7.0	0.12	26	21	18	16	14	13	12	11	10
Bicycling, light (10.0-11.9 mph [16-19.2 kph])	6.0	0.10	30	25	21	19	17	15	14	13	12
Bicycling, moderate (12.0-13.9 mph [19.3-22.4 kph])	8.0	0.13	23	19	16	14	13	11	10	9	9
Bicycling, vigorous (14.0-15.9 mph [22.5-25.6 kph])	10.0	0.17	18	15	13	11	10	9	8	8	7
Running, 5.0 mph (8 kph); 12 min/mile (7.5 min/km)	8.0	0.13	23	19	16	14	13	11	10	9	9
Running, 7.5 mph (12 kph); 8 min/mile (5 min/km)	12.5	0.21	14	12	10	9	8	7	7	6	6
Running, 10.9 mph (17.5 kph); 5.5 min/mile (3.4 min/km)	18.0	0.30	10	8	7	6	6	5	5	4	4
Skiing, cross-country, 4.0-4.9 mph (6.4-7.9 kph) (moderate)	8.0	0.13	23	19	16	14	13	11	10	9	9
Tennis, general	7.0	0.12	26	21	18	16	14	13	12	11	10
Walking, 2.0 mph (3.2 kph)	2.5	0.04	72	60	51	45	40	36	33	30	28
Walking, 3.5 mph (5.6 kph)	3.8	0.06	47	39	34	30	26	24	22	20	18
Walking, 5.0 mph (8.0 kph)	8.0	0.13	23	19	16	14	13	11	10	9	9

Warburton D.E.R. , 2006

Prescribing exercise as preventive therapy

Table 2 continued

Activity	METs	EE	Time, min; total energy expenditure, kcal										
			10	15	20	25	30	35	40	45	50	55	60
Daily living													
Carrying small children	3.0	0.05	35	53	70	88	105	123	140	158	175	193	210
Chopping wood	6.0	0.10	70	105	140	175	210	245	280	315	350	385	420
Cleaning house, general	3.0	0.05	35	53	70	88	105	123	140	158	175	193	210
Groceries, carrying without shopping cart	2.5	0.04	29	44	58	73	88	102	117	131	146	160	175
Groceries, carrying upstairs	7.5	0.13	88	131	175	219	263	306	350	394	438	481	525
Ironing	2.3	0.04	27	40	54	67	81	94	107	121	134	148	161
Mopping	3.5	0.06	41	61	82	102	123	143	163	184	204	225	245
Mowing lawn, general	5.5	0.09	64	96	128	160	193	225	257	289	321	353	385
Raking lawn	4.3	0.07	50	75	100	125	151	176	201	226	251	276	301
Shovelling snow, manually	6.0	0.10	70	105	140	175	210	245	280	315	350	385	420
Sweeping floors or carpet	3.3	0.06	39	58	77	96	116	135	154	173	193	212	231
Sweeping sidewalk	4.0	0.07	47	70	93	117	140	163	187	210	233	257	280
Vacuuming	3.5	0.06	41	61	82	102	123	143	163	184	204	225	245
Walking the dog	3.0	0.05	35	53	70	88	105	123	140	158	175	193	210

Warburton D.E.R. , 2006

Prescribing exercise as preventive therapy

Box 5: Examples of training ranges calculated on the basis of intensity level of exercise and maximum heart rate (HR_{max})

Light-intensity exercise (45%-54% HR_{max})

Example: 60-yr-old woman

- HR_{max} (226 – age) = 226 – 60 = 166 beats/min
- 45% of HR_{max} = 75 beats/min
- 54% of HR_{max} = 90 beats/min
- Training range = 75-90 beats/min

Moderate-intensity exercise (55%-69% HR_{max})

Example: 45-yr-old man

- HR_{max} (220 – age) = 220 – 45 = 175 beats/min
- 55% of HR_{max} = 96 beats/min
- 69% of HR_{max} = 121 beats/min
- Training range = 96-121 beats/min

High-intensity exercise (70%-89% HR_{max})

Example: 63-yr-old man

- HR_{max} (220 – age) = 220 – 63 = 157 beats/min
- 70% of HR_{max} = 110 beats/min
- 89% of HR_{max} = 140 beats/min
- Training range = 110-140 beats/min

Box 4: Equations for predicting a person's maximum heart rate

Men: 220 – age

Women: 226 – age

Obese people: 220 – (0.5 × age)

Warburton D.E.R. , 2006

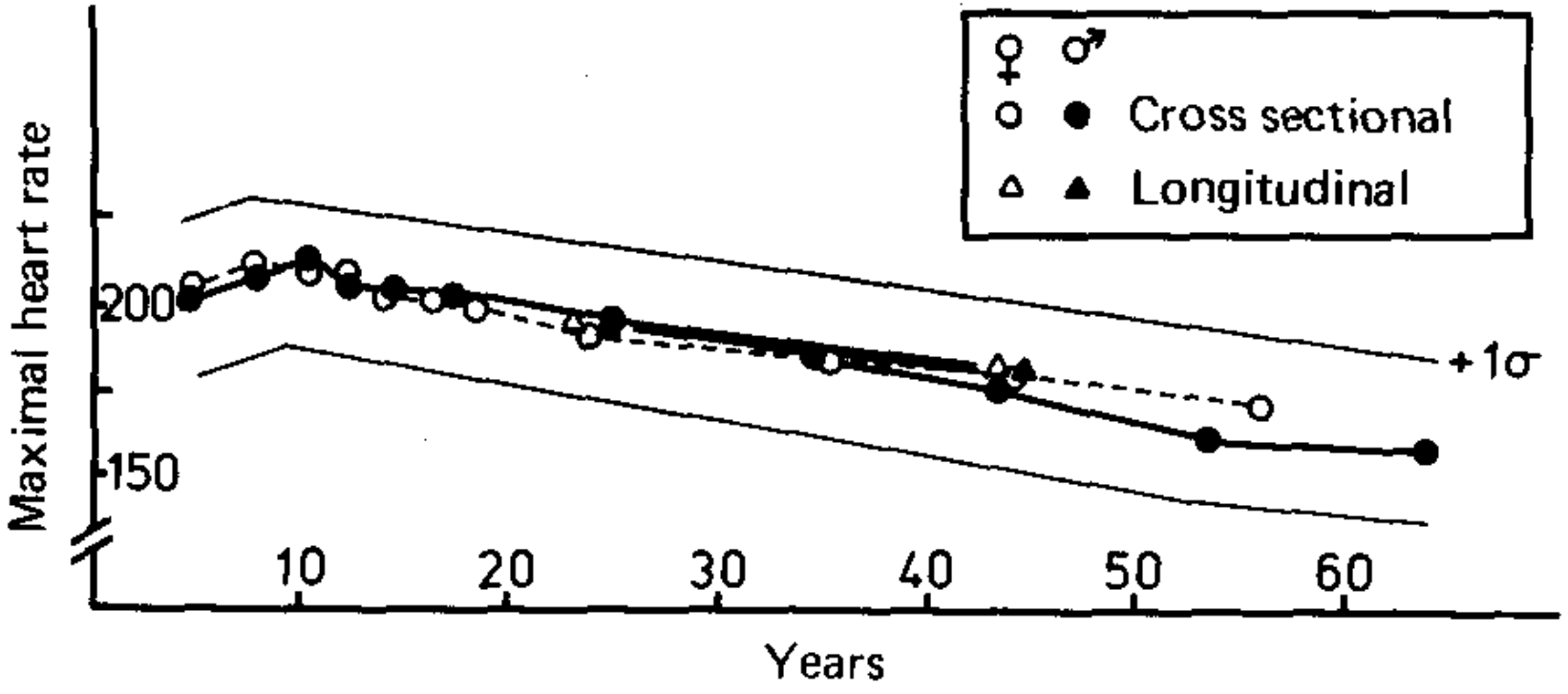
Exercise Intensity
Criteria for evaluation of intensity

- Estimations
  - Maximal heart rate: 220 – age
  - Target heart rate
- Borg score
- Talking test
- Exercise tests
  - Functional
  - Submaximal (VAT)
  - Maximal (Hrmax)

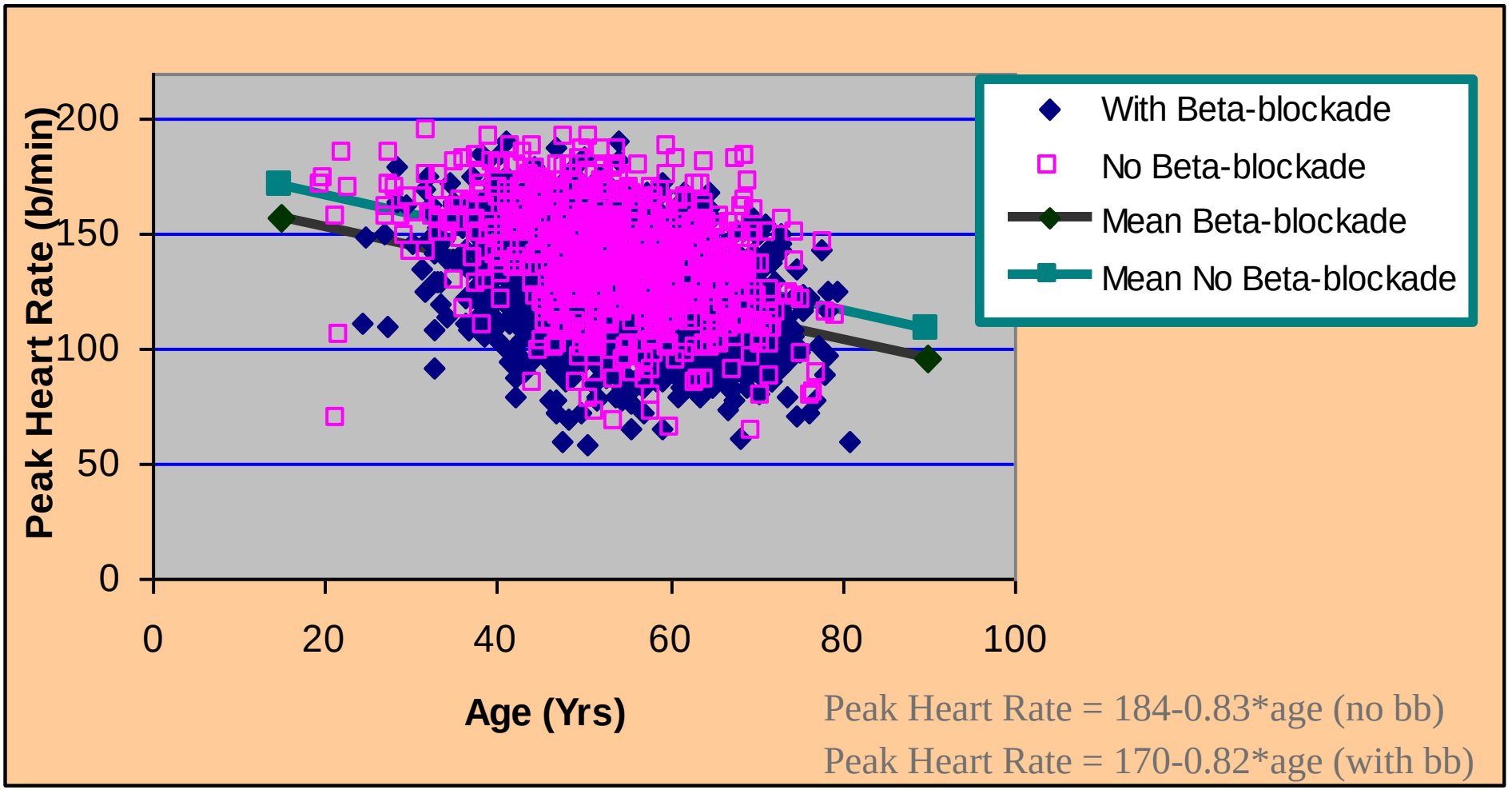
Maximal Heart rate and age

- Heart rate during maximal exercise in 350 healthy subjects (4-65 years)

  (From Ästrand and Rodahl, Textbook of Work Physiology, 2nd Ed, 1977)



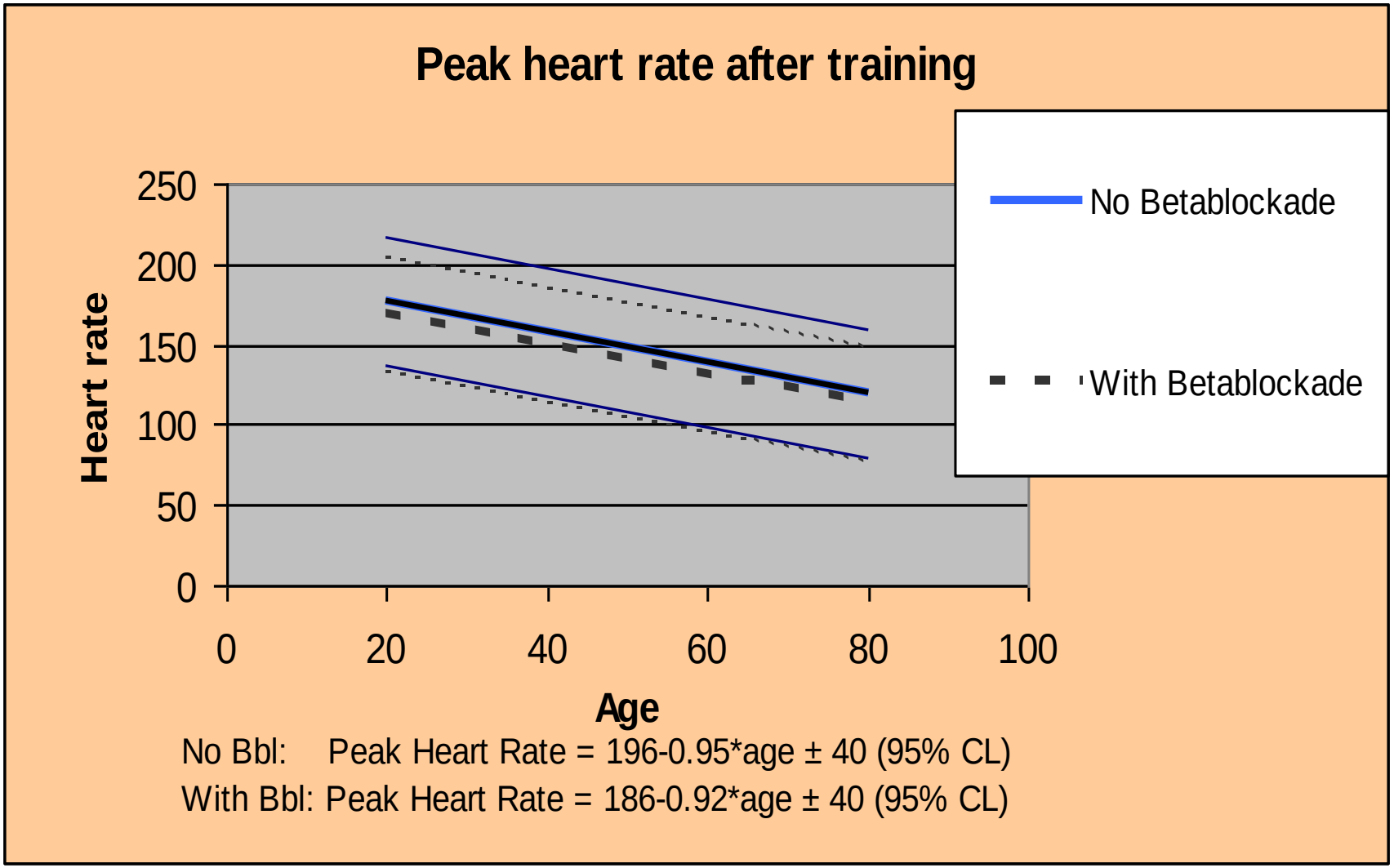
Peak Heart rate – Age
(Data in patients with CAD (n=2647) before training)



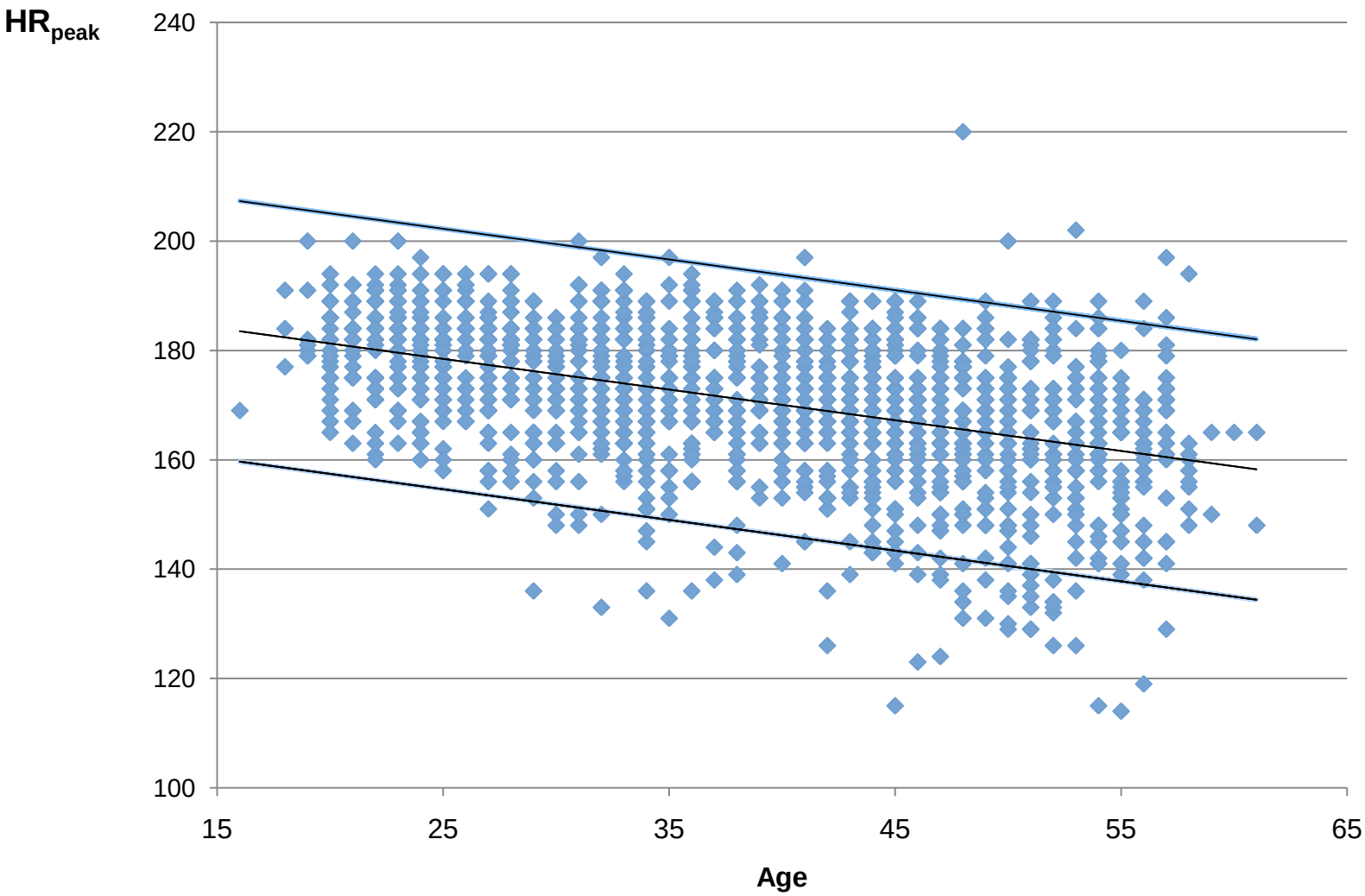
Vanhees et al, JCPR, 2006

Relation peak heart rate-age in CAD patients treated with (n=1449) and without (n=533) ß-blockers

(L. Vanhees, JCPR 2006)



Data Up-Lift: 1880 Police employees (Vanhees et al, 2010)

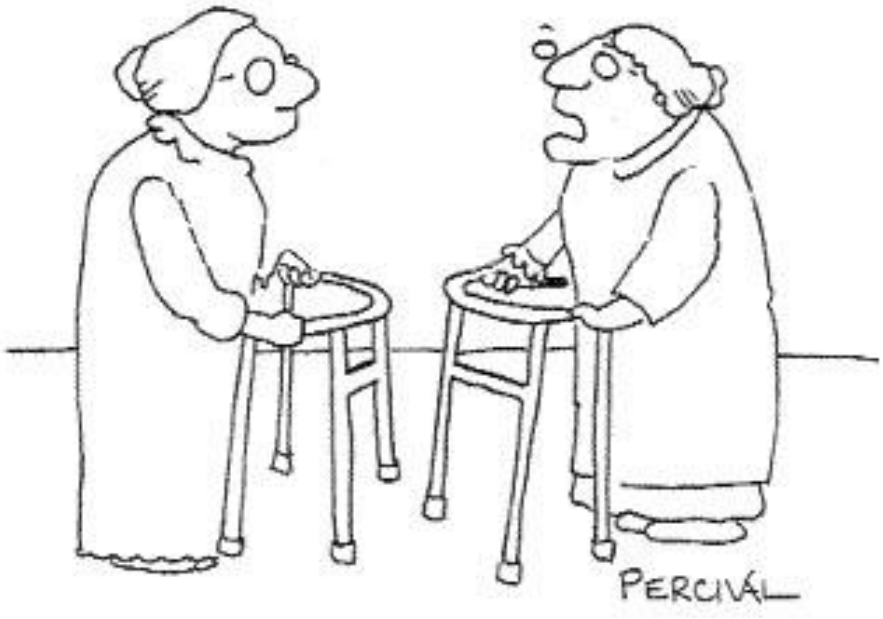


$HR_{max} = 192 - 0{,}56 * age \pm 24$ bpm

Exercise Intensity
Criteria for evaluation of intensity

- Estimations
  - Maximal heart rate: 220 – age
  - Target heart rate
- Borg score
- Talking test
- Exercise tests
  - Functional
  - Submaximal (VAT)
  - Maximal (Hrmax)

Rating of perceived exertion	Classification of intensity
< 9	Very light
10–11	Light
12–13	Moderate
14–16	Heavy
> 16	Very heavy



The problem of all young people,
they can't stand on there own feet
anymore