

LEE KONG CHIAN
SCHOOL OF
MEDICINE



NANYANG
TECHNOLOGICAL
UNIVERSITY

Imperial College
London

Fabian C.L. Lim (PhD)
Associate Professor of Exercise Physiology
Lee Kong Chian School of Medicine
Nanyang Technological University
fabianlim@ntu.edu.sg

The Long and Short of Exercise as a Complement-modality for Promoting Cardio-metabolic Health

REDEFINING MEDICINE, TRANSFORMING HEALTHCARE

Health and Physical Activity

CHIN LEONG LIM

Singapore Sports Institute and Yong Loo Lin School of Medicine, National University of Singapore

LIFESTYLE-RELATED HEALTH CONDITIONS

Health has been defined by the World Health Organization, since 1948, as “a state of complete physical, mental and social well-being and not merely the absence of disease or

HEALTH BENEFITS OF PHYSICAL ACTIVITY AND EXERCISE

Epidemiological evidence strongly supports the benefits of PA in decreasing the risks and prevalence of CVD-, DM-, and MS-related premature deaths. The health-promoting effects of PA against these conditions appear

capabilities in their daily living activities compared to age- and sex-matched sedentary senior citizens (Tanaka and Seals 2003).

PHYSICAL ACTIVITY, PHYSICAL EXERCISE, AND PHYSICAL FITNESS

adults in Canada, the United States, Ireland, and Australia (Desroches and Lamarche 2007). There is also an increasing trend of MS in children and youth, in tandem with the growing trend of overweight and obese children and youth in the world (Huang, Ball, and Franks 2007). For example, 28.7 and blood concentrations of non-high-density lipoproteins and triglyceride, but positively associated with the concentration of circulating high-density lipoprotein (Grundy et al. 2012). The relative risks of CVD and CHD mortality in the first quintile (lowest 20 percent) for aerobic fitness were more than twice the risks of those in the fifth quintile (highest 20 percent). The prevalence of DM among

The Wiley Blackwell Encyclopedia of Health, Illness, Behavior, and Society, First Edition.

Edited by William C. Cockerham, Robert Dingwall, and Stella R. Quah.

© 2014 John Wiley & Sons, Ltd. Published 2014 by John Wiley & Sons, Ltd.

Exercise and Physical Activity in the Prevention and Treatment of Atherosclerotic Cardiovascular Disease

A Statement From the Council on Clinical Cardiology (Subcommittee on Exercise, Rehabilitation, and Prevention) and the Council on Nutrition, Physical Activity, and Metabolism (Subcommittee on Physical Activity)

Paul D. Thompson, MD; David Buchner, MD; Ileana L. Piña, MD; Gary J. Balady, MD; Mark A. Williams, PhD; Bess H. Marcus, PhD; Kathy Berra, MSN, ANP; Steven N. Blair, PED; Fernando Costa, MD; Barry Franklin, PhD; Gerald F. Fletcher, MD; Neil F. Gordon, MD, PhD; Russell R. Pate, PhD; Beatriz L. Rodriguez, MD, PhD; Antronette K. Yancey, MD; Nanette K. Wenger, MD

This statement was reviewed by and has received the endorsement of the American College of Sports Medicine.

Summary of Key Points

- (1) Physical activity and exercise training have important roles in:
 - A. Preventing atherosclerotic CAD;
 - B. Managing selected CAD risk factors, including elevated triglyceride levels, low HDL-C, hypertension, glucose intolerance, hypertension, obesity, and possibly cigarette use;
 - C. Treating patients with CAD, HF, and claudication.
- (2) Healthcare professionals should:
 - A. Engage in an active lifestyle;
 - B. Encourage schools to teach skills required for physically active lifestyles and communities to develop programs and facilities conducive to physical activity;
 - C. Be educated about exercise as a therapeutic modality and the importance of lifelong physical activity in their patients;
 - D. Routinely prescribe exercise and increased physical activity to their patients in accordance with recommendations provided by the CDC/ACSM⁷ and the AHA⁸;
 - E. Perform exercise testing before vigorous exercise in selected patients with cardiovascular disease and other patients with symptoms or those at high risk.
- (3) Additional research should:
 - A. Address behavioral strategies to increase and maintain physical activity over the lifespan;
 - B. Increase the scientific rationale supporting the importance of physical activity by examining the amount of exercise required to alter CAD risk, the effect of exercise on morbidity and mortality, and its cost-effectiveness.

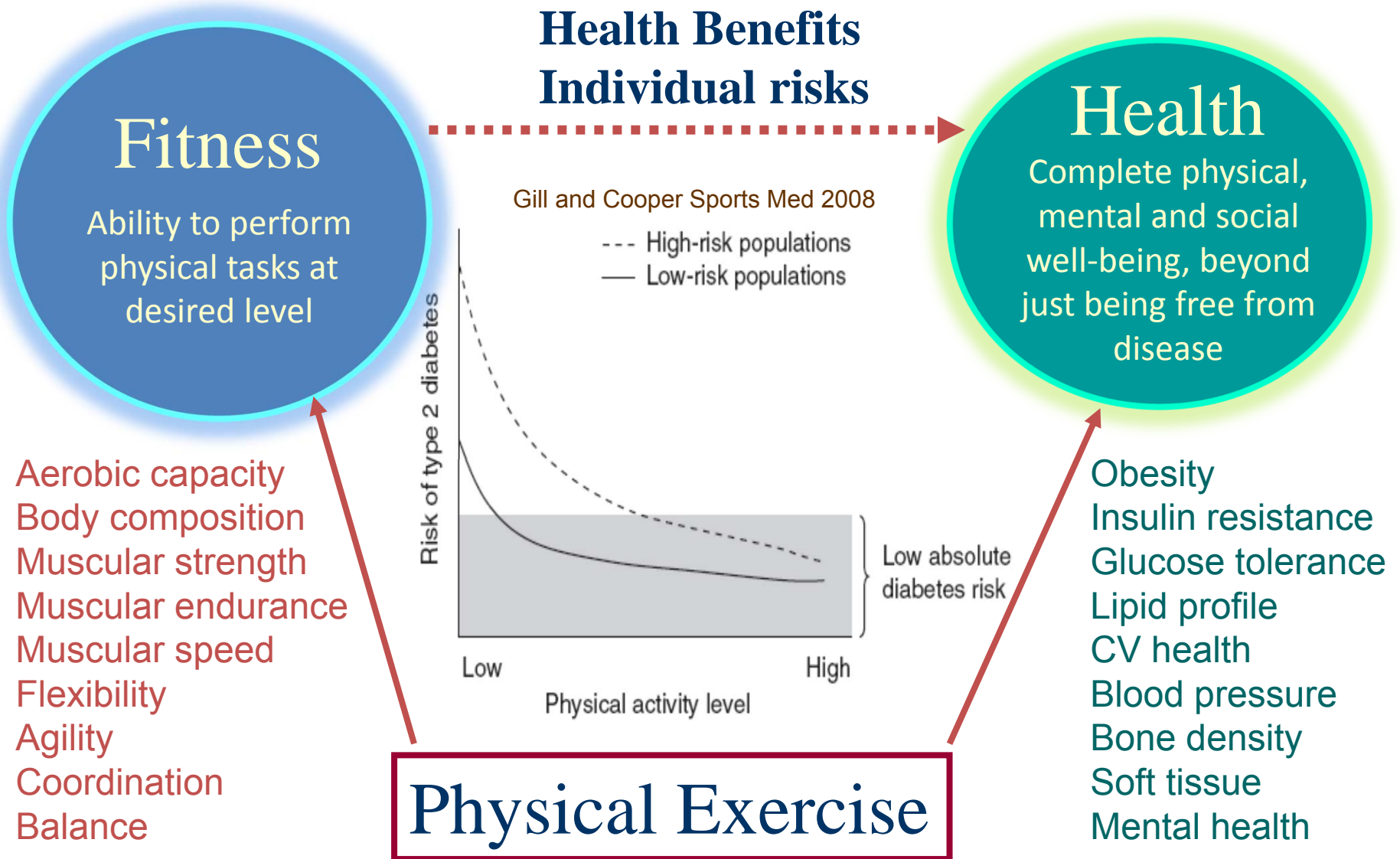
Studies of occupational and leisure-time physical activity have consistently documented a reduced incidence of CAD events in the more physically active⁹ and fit¹⁰ subjects. More recent studies have provided similar data by using measures of exercise capacity such as treadmill performance as an indicator of habitual physical activity. The data satisfy the criteria required to infer a causal relationship from epidemiological evidence.^{11,12} The results are strong, with the most physically active subjects generally demonstrating CAD rates half those of the most sedentary group. The data demonstrate a graded relationship of decreasing CAD rates with increasing levels of activity. Multiple studies were prospective and thereby demonstrate appropriate sequencing because the lower physical activity levels preceded the development of CAD rather than resulted from the disease itself. The results are consistent with all published studies documenting lower CAD rates in the more active subjects, although the relationship did not reach statistical significance in some individual reports. In many studies, the lower frequency of CAD was independent of other known atherosclerotic risk factors. The results are also plausible and coherent with evidence demonstrating beneficial effects of exercise on atherosclerotic risk factors, myocardial function, coronary artery size and vasodilatory capacity, vascular tone, and vulnerability to ventricular fibrillation. Available data do not provide clear evidence

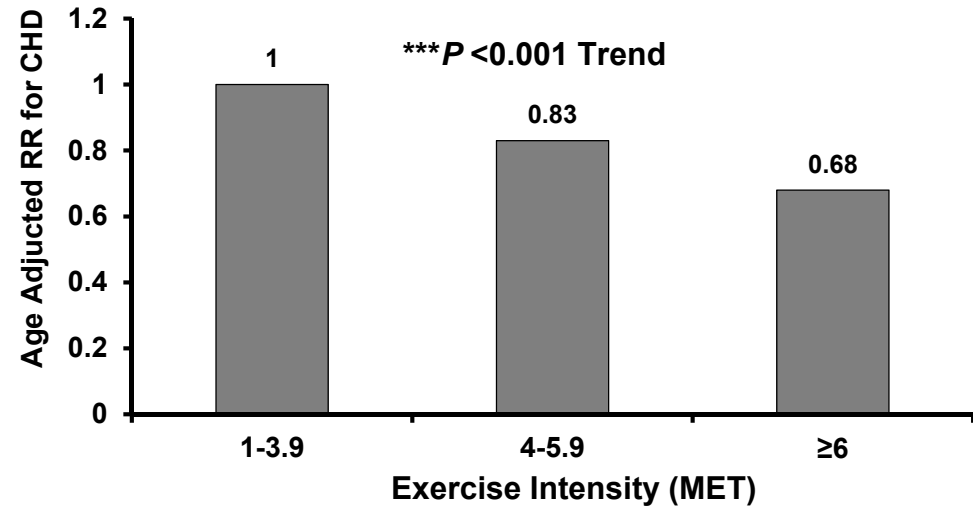
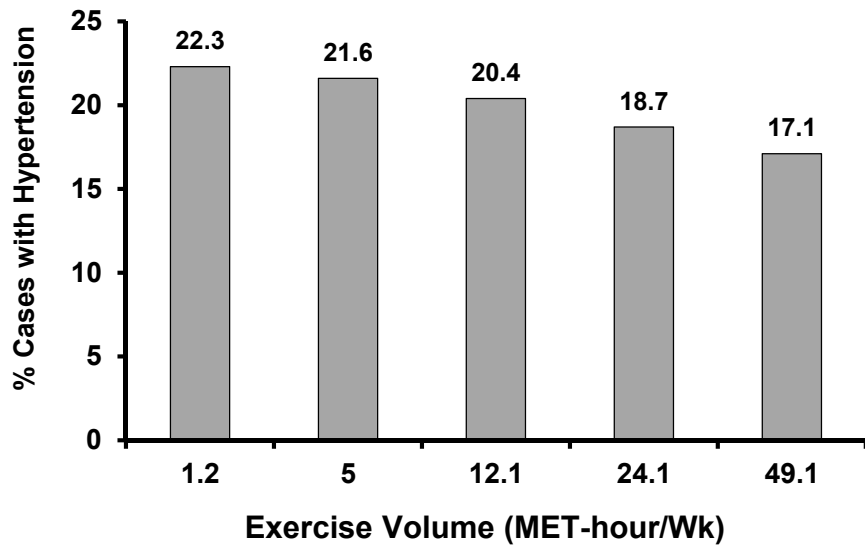
that risk factors is substantially less than that achieved by pharmacological therapies, although the exercise effect can be significantly magnified by other lifestyle changes such as changes in dietary composition and weight loss.

A meta-analysis of 52 exercise training trials of >12 weeks' duration including 4700 subjects demonstrated an average increase in HDL-C levels of 4.6% and reductions in triglyceride and LDL-C concentrations of 3.7% and 5.0%, respectively.^{13,16} The largest and most carefully controlled exercise trial, the HEalth, RiSk factors, exercise Training, And GENetics (HERITAGE) study, included 675 normolipidemic subjects who participated in 5 months of exercise training.¹⁷ HDL-C increased 1.1 mg/dL (3%) among the 299 men studied, whereas triglycerides and LDL-C decreased 5.9 and 0.9 mg/dL or 2.7% and 0.8%, respectively. HDL-C among the 376 women increased 1.4 mg/dL (3%), and triglycerides and LDL-C decreased 0.6 and 4.4 mg/dL or 0.6% and 4%, respectively. Greater increases in HDL-C may occur in individuals with baseline hypertriglyceridemia,¹⁸ but few studies have addressed the effect of exercise in subjects with lipid disorders.

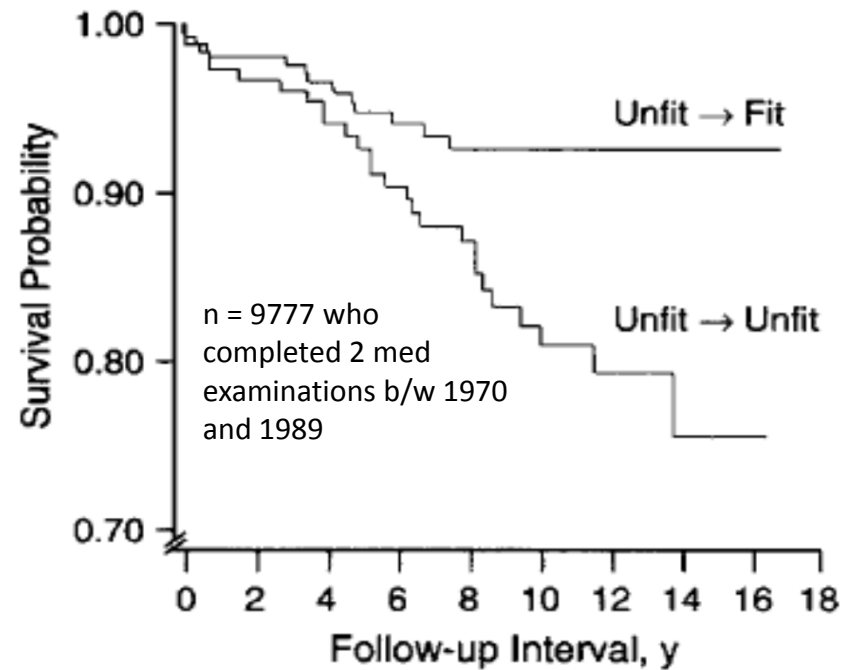
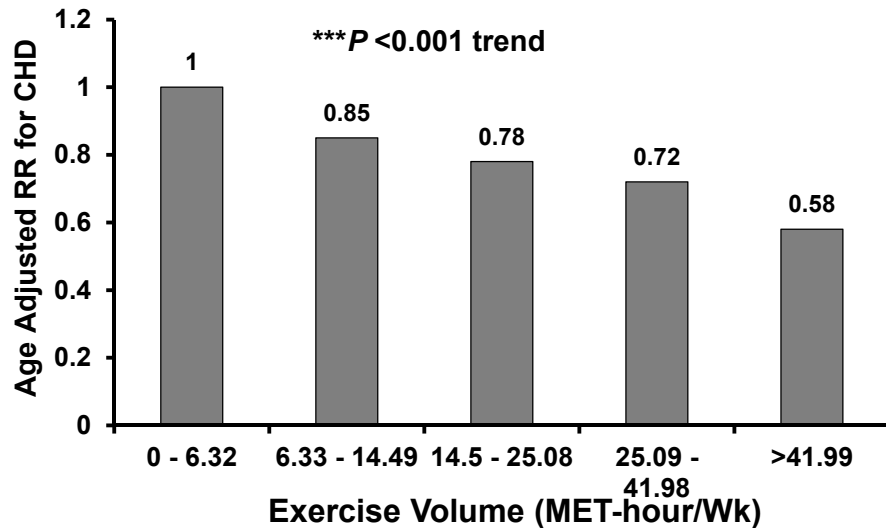
At least 44 randomized controlled trials including 2674 participants have studied the effect of exercise training on resting blood pressure.¹⁹ The average reduction in systolic and diastolic blood pressure was 3.4 and 2.4 mm Hg, respec-

Complementary-modality for Cardio-metabolic Health



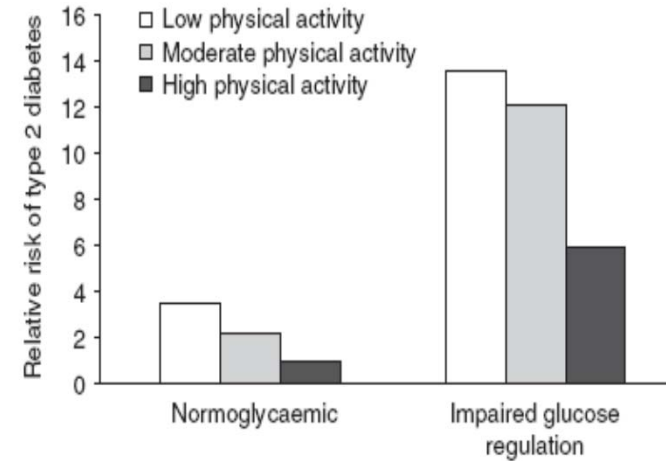
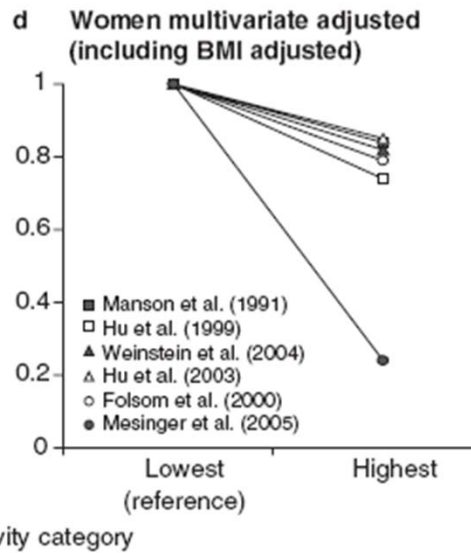
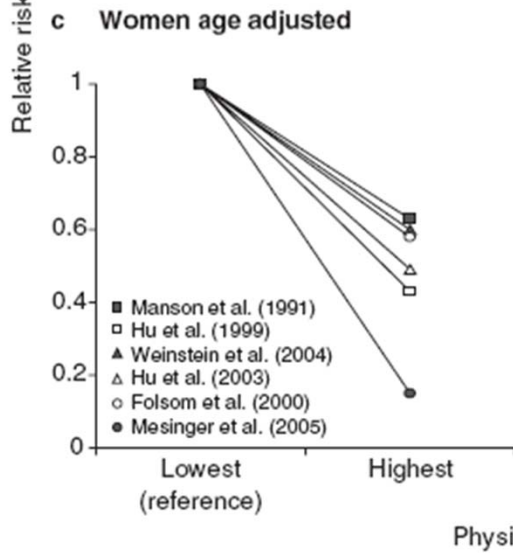
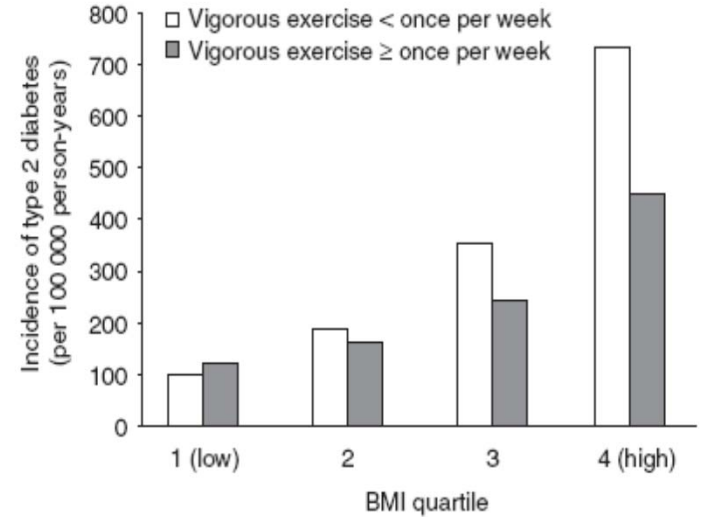
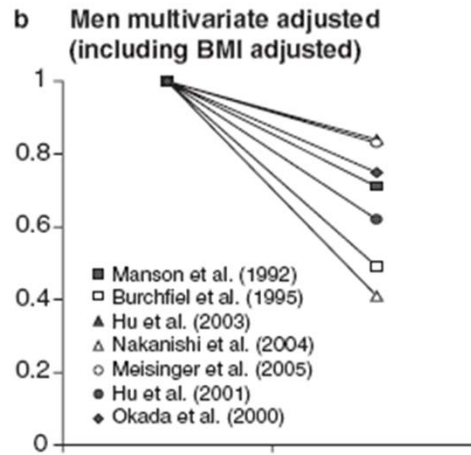
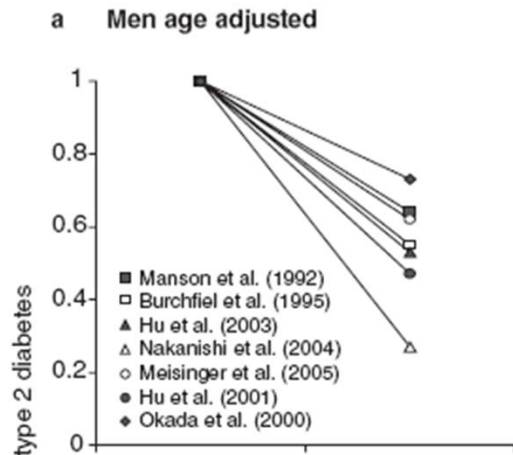


Tanasescu et al Exercise type and intensity in relation to coronary heart disease in men
 JAMA 288: 1994 – 2000, 2002
 44,452 men follow-up at 2-year intervals from 1986 through 31 Jan 1998

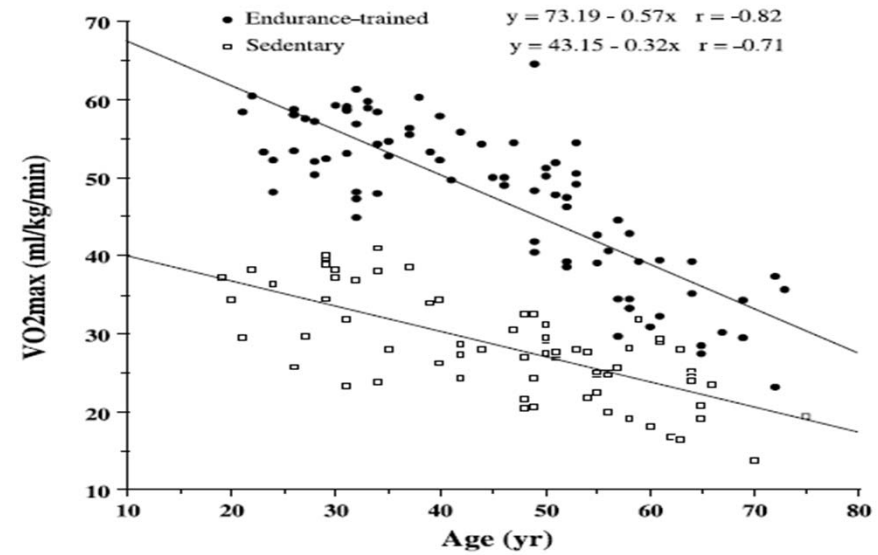
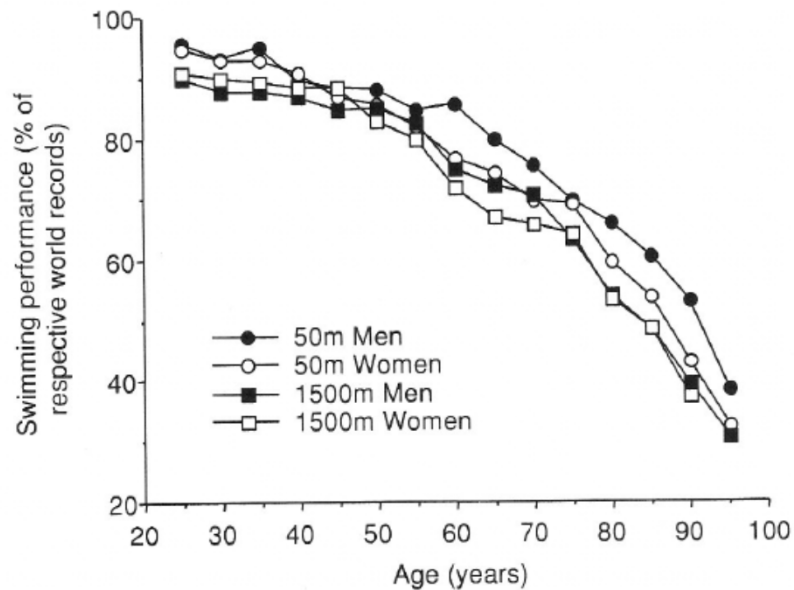
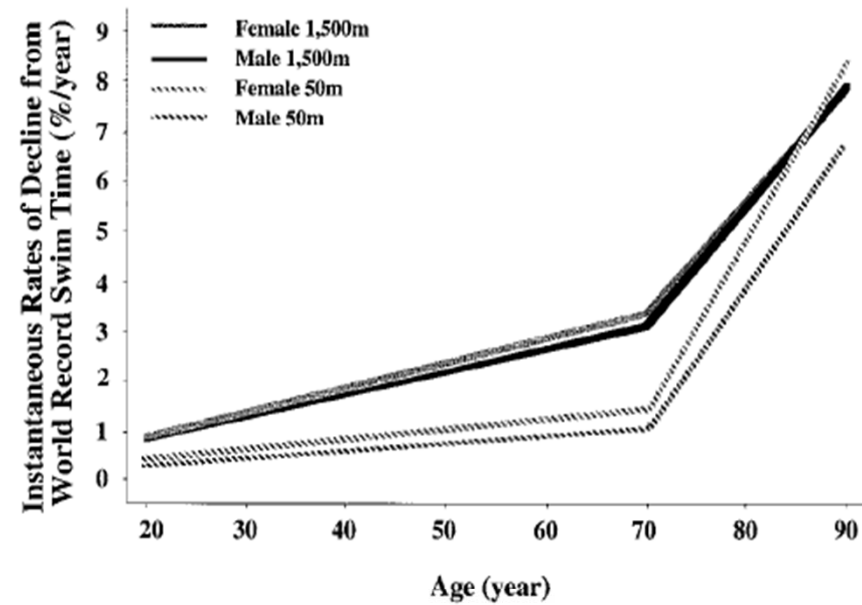
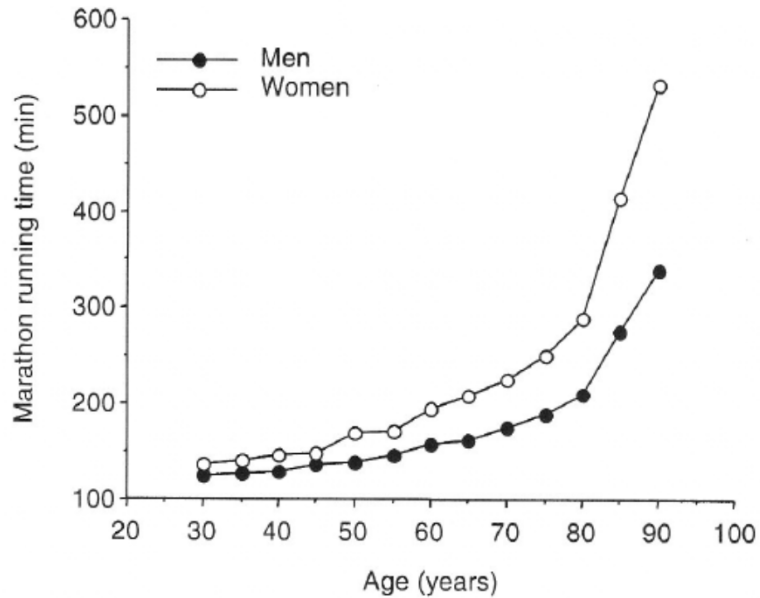


Blair et al, JAMA, 273: 1093 – 1098, 1995

Physical Activity and Risk of Diabetes Mellitus



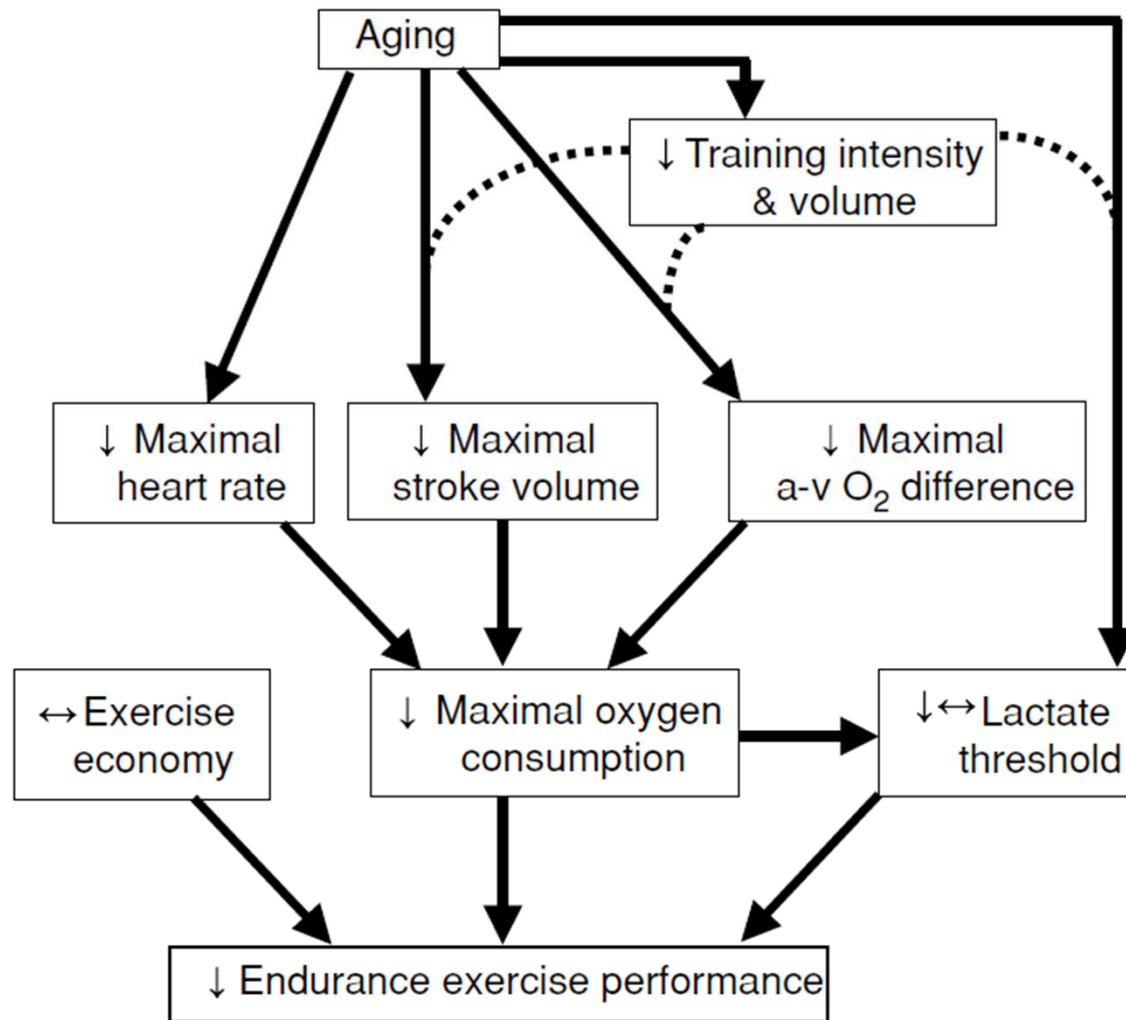
Endurance Performance over Lifespan



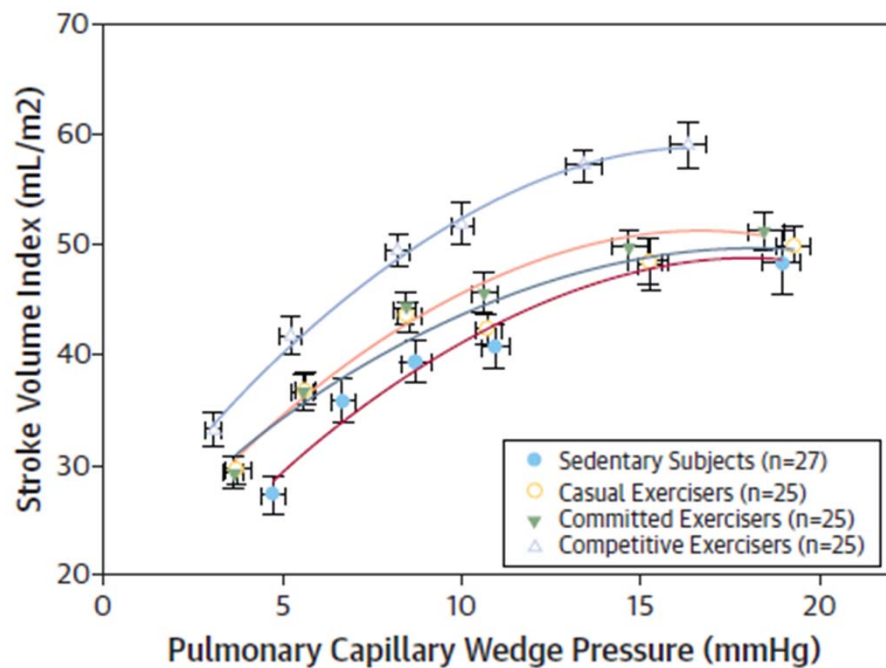
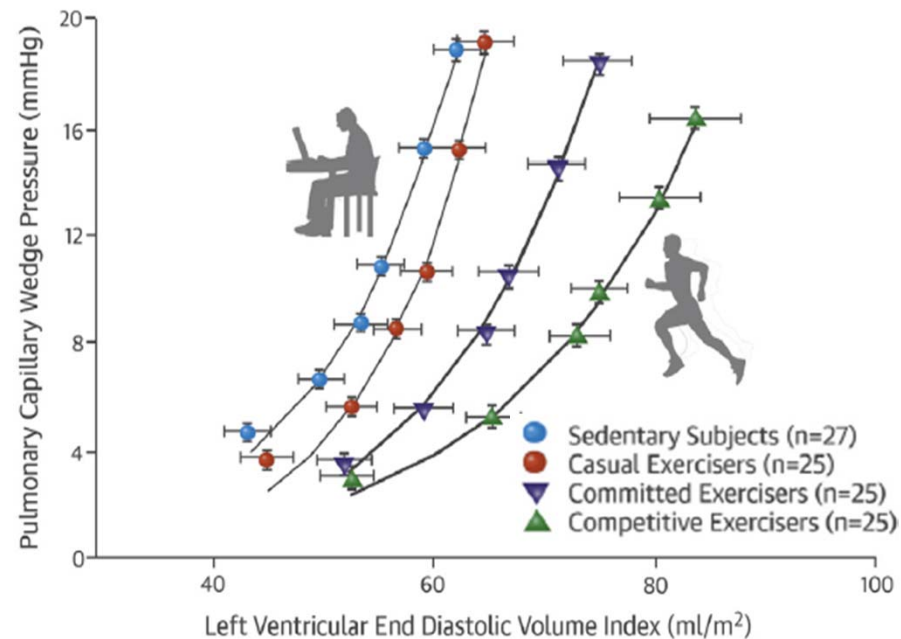
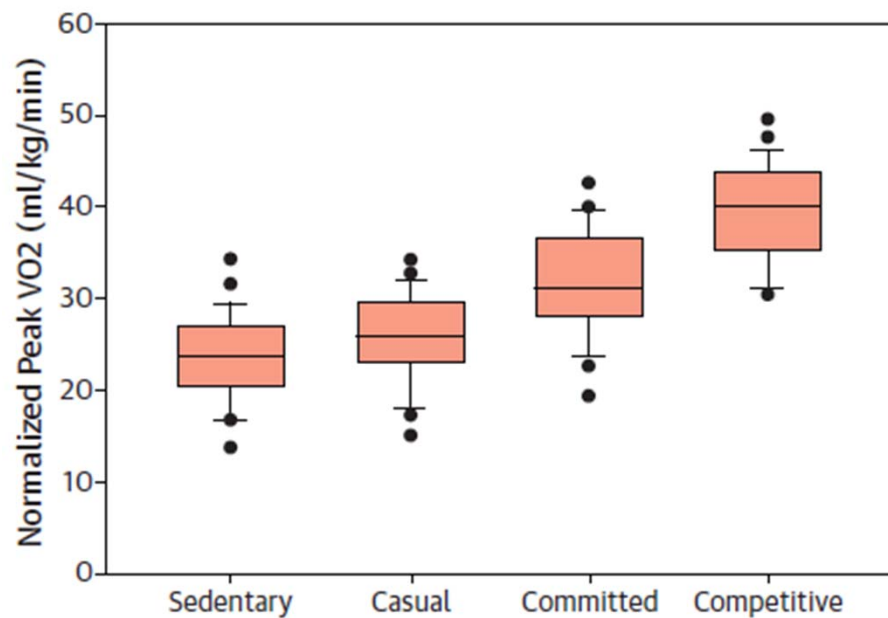
Tanaka and Seals. J Physiol, 586.1: 55-63, 2008

Tanaka and Seals, J Appl Physiol, 95: 2152 – 2162, 2003

Age-associated Deterioration in Cardio-metabolic Functions

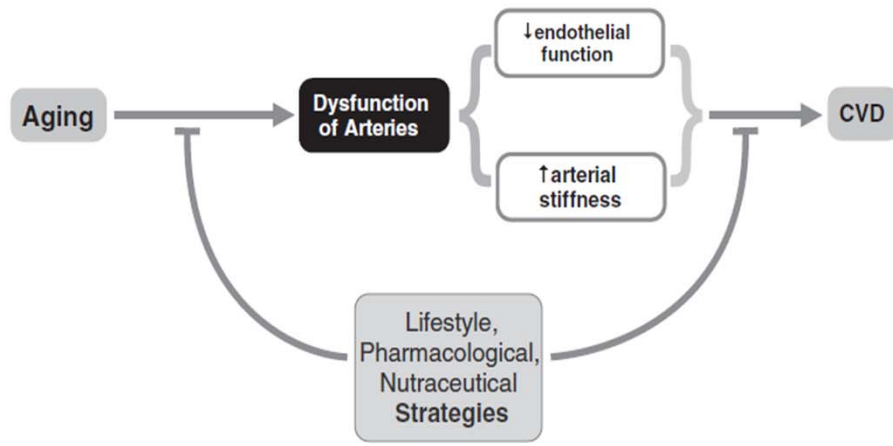


Decrease in endurance performance with age due mainly to cardio-metabolic deterioration

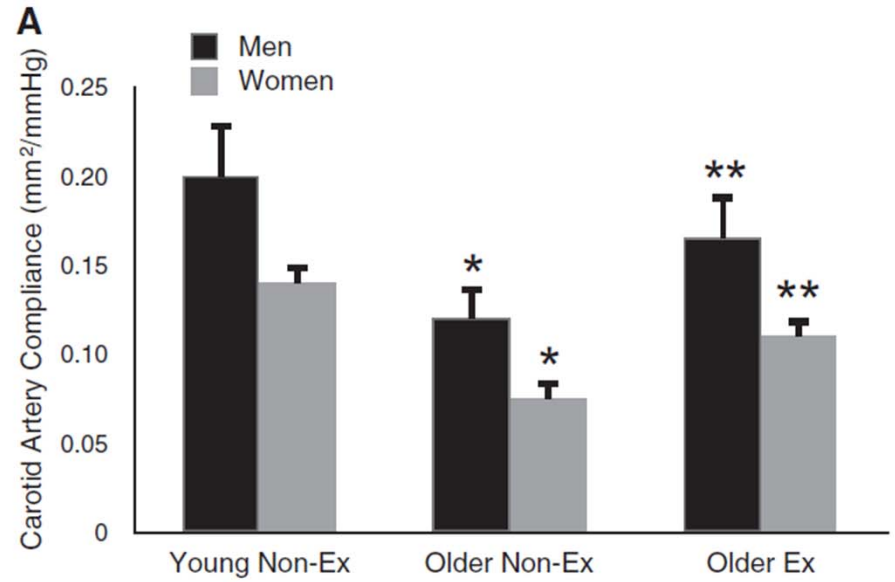


N = 102, > 64 years of age (CCLS)

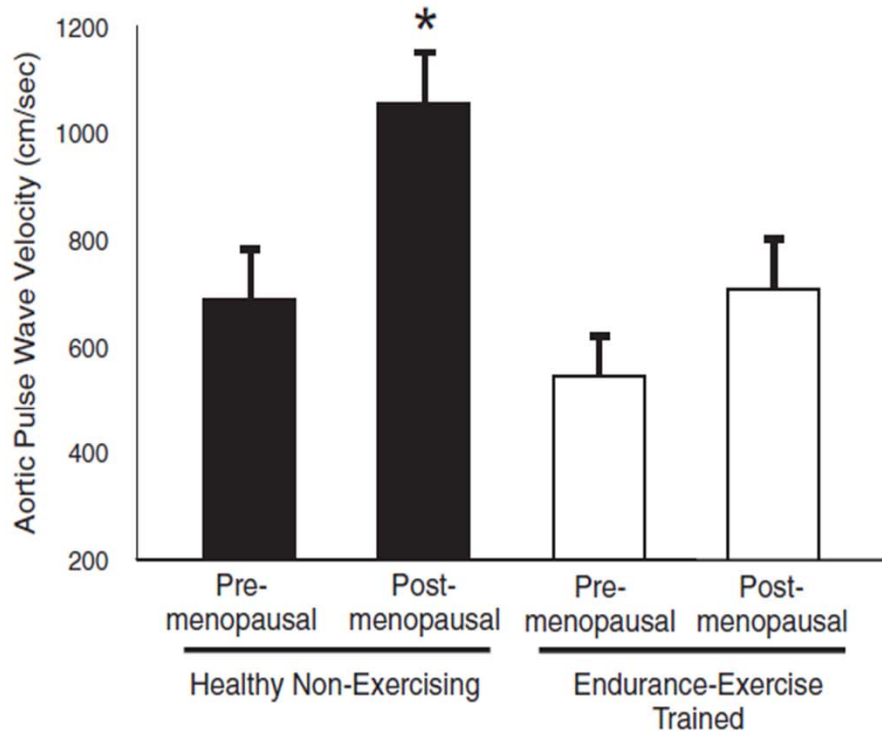
- 25 years of exercise history
- “Sedentary” = < 1/ wk; n = 27
- “Casual” = 2 – 3/wk; n = 25
- “Committed” = 4 – 5/week; n = 25
- “Competitive” = 6 – 7/ wk; n = 25



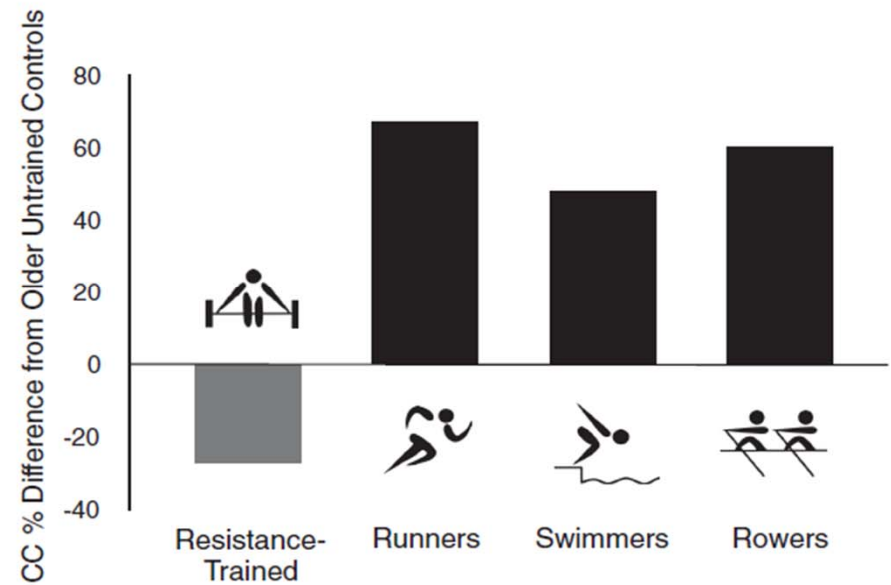
Seals, J Appl Physiol 117: 425 – 439, 2014



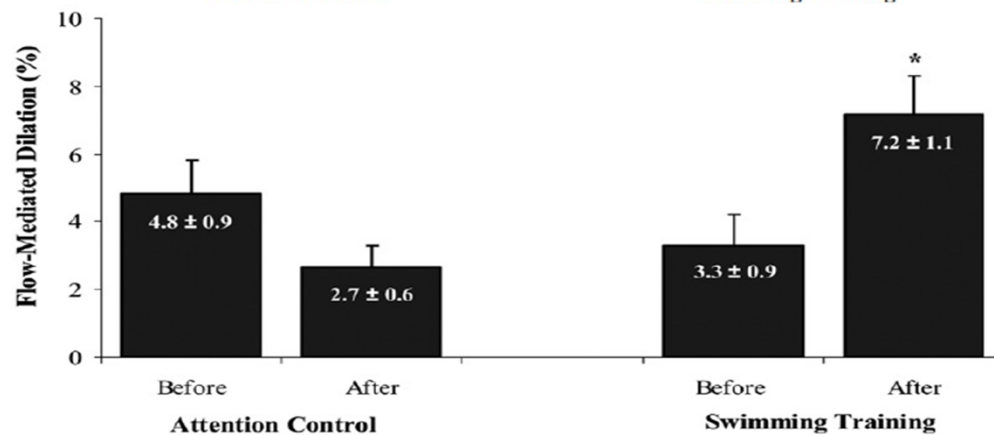
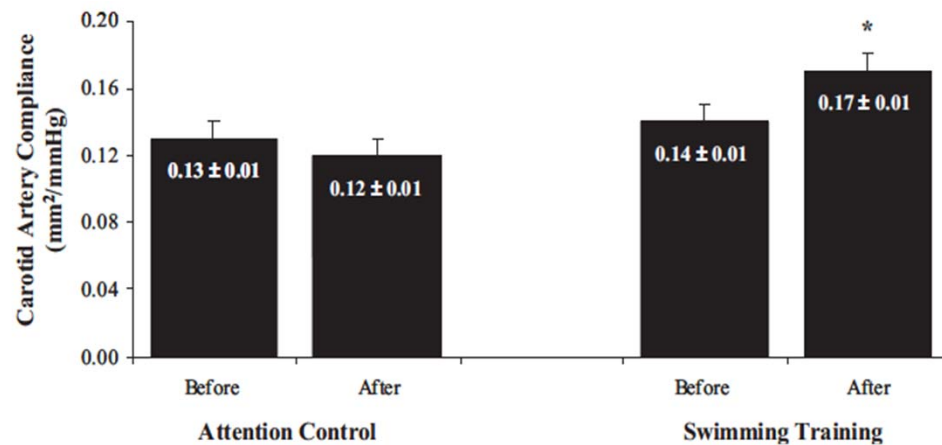
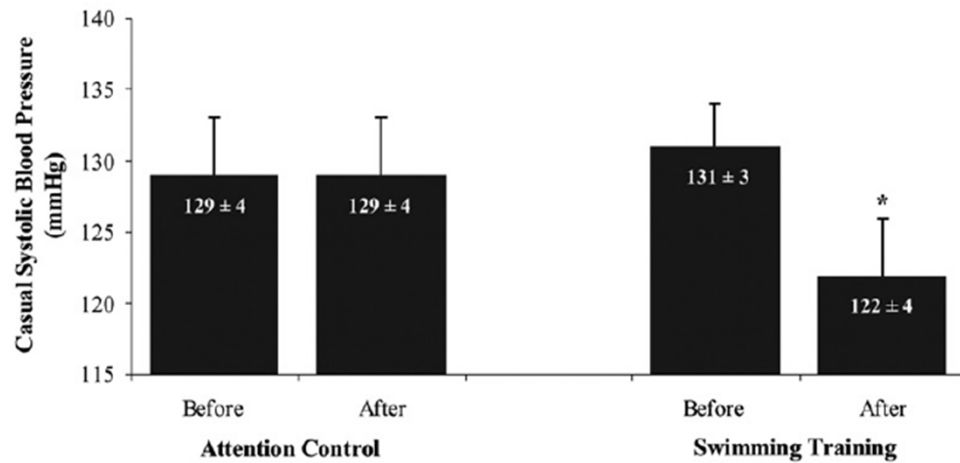
Moreau et al, Cardiovasc Res 57: 861 – 868, 2003



Tanaka et al, Arterioscler Thromb Vasc Res 18: 127 – 132, 1998



DeVan and Seals, Exp Physiol 97: 305 – 310, 2012



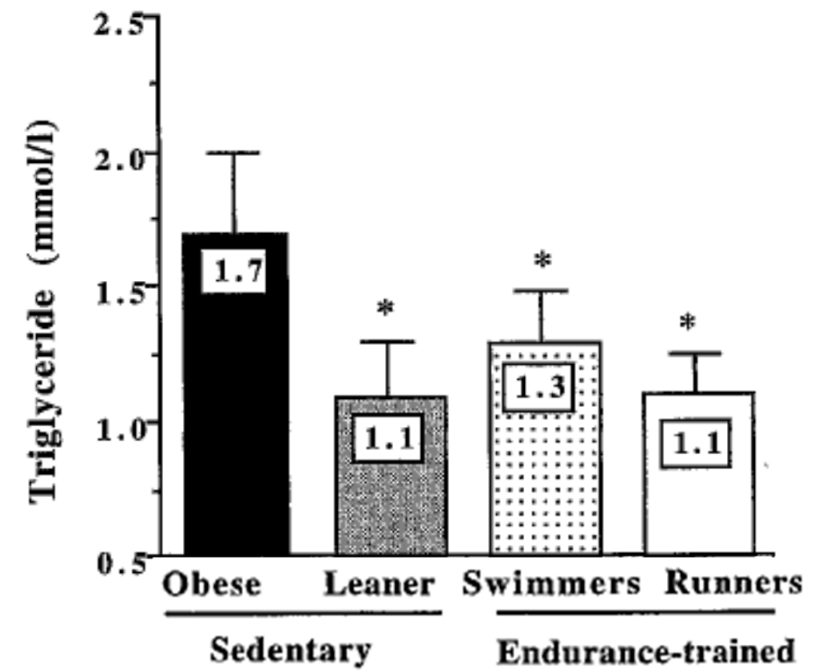
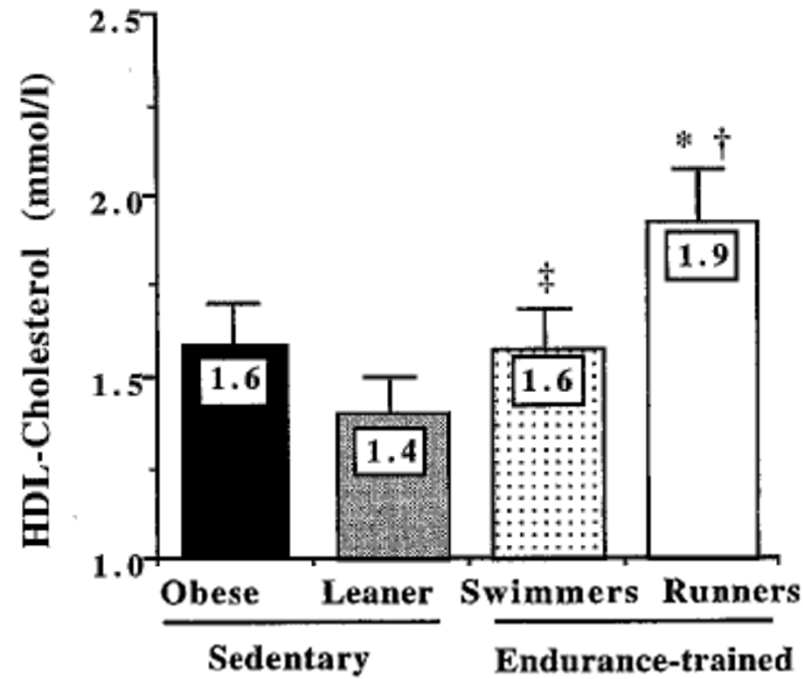
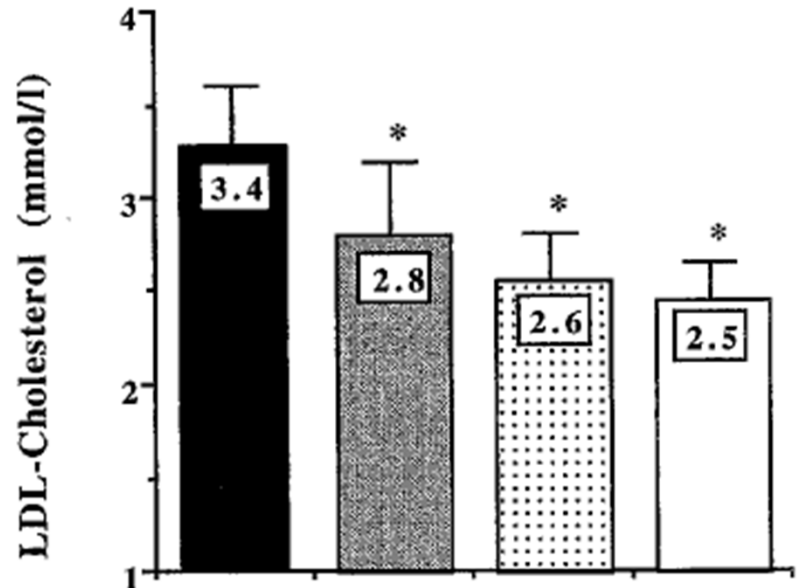
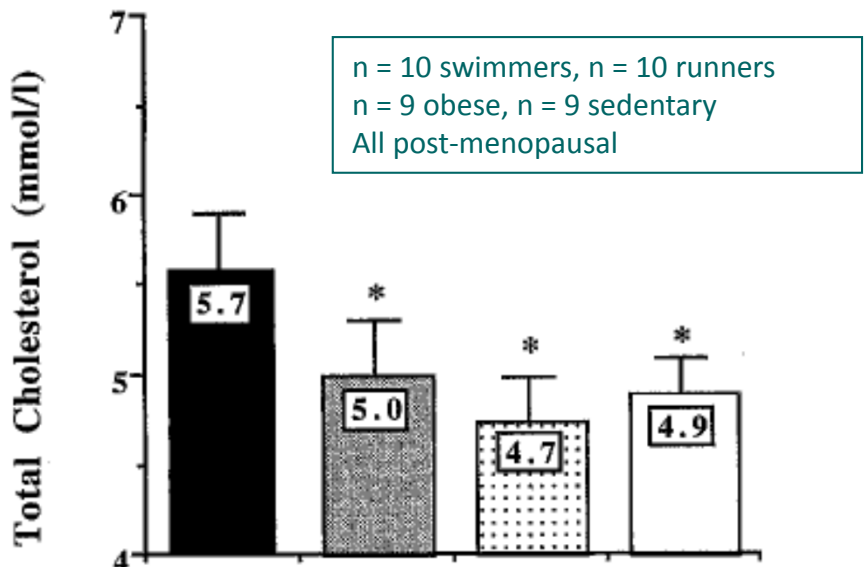
Nualnim et al, Am J Cardiol, 109:
1005 – 1010, 2012

Men and Women, 50 – 80 years old

- N= 19 Control; n= 24 Training
- Systolic BP : 140 – 159 mmHg, or
- Systolic BP: 120 – 139 mmHg with Diastolic BP < 99 mmHg

12 weeks swim training

- 15 – 20 min, 3 – 4 X / week
- ~ 60% MHR
- 40 – 45 min, 3 – 4 X/ week
- 70% - 75% MHR
- Continuous swimming

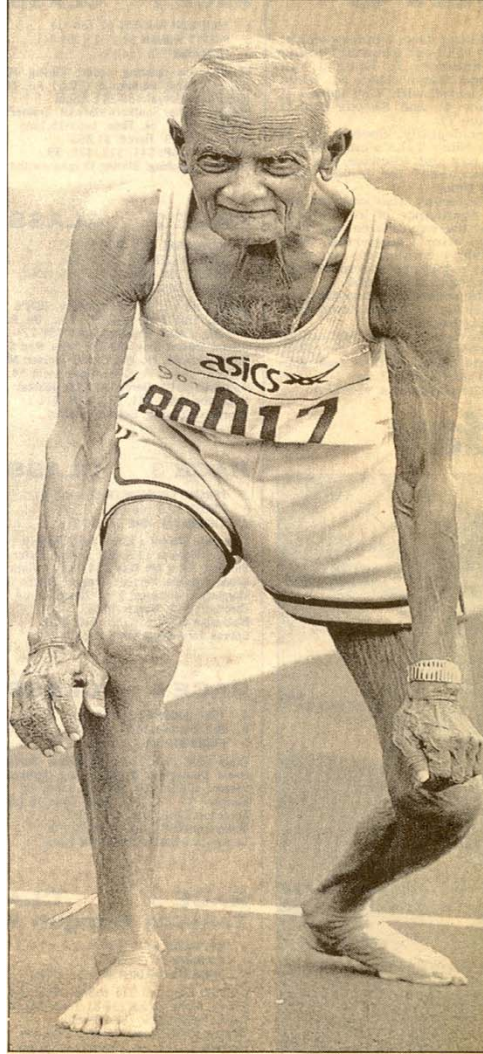


Defying Age with Exercise

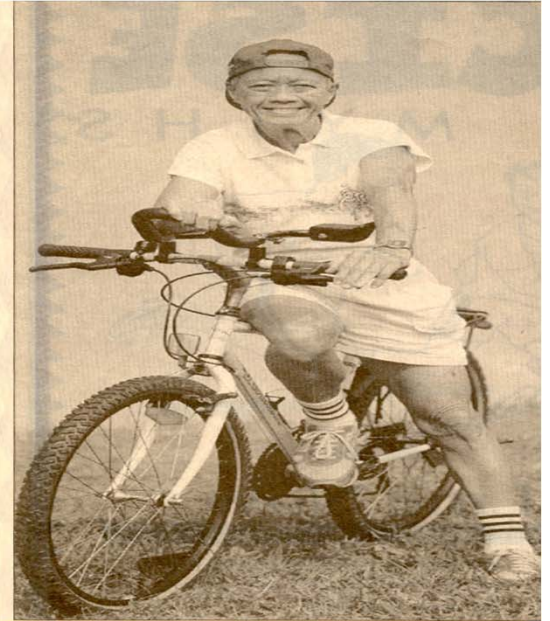
57 13 June 92 Saturday
Golden moment for Okada



57 14 June 92 Sunday
Narayana, 92 going great guns



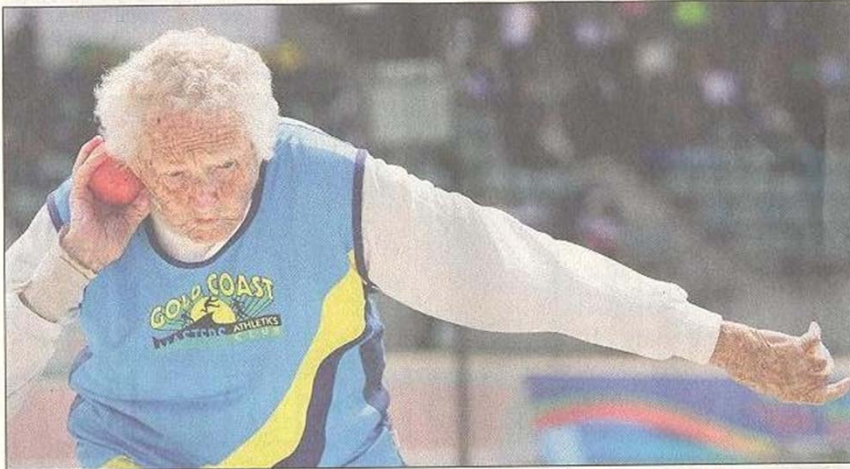
**Windsurfer,
swimmer,
cyclist –
at age 75**



**69-year-old cyclist
goes 44 km for charity**



Defying Age with Exercise



100-year-old granny takes shot at title
ST 12 Oct 2009



Margo Bates, who at 98 is the oldest swimming competitor, getting set for the start of the 100m backstroke at the World Masters Games at the Sydney Olympic Park Aquatic Centre. PHOTO: ASSOCIATED PRESS

ST 14 Oct 2009



Ms Nyad emerging from the Atlantic Ocean after her 160km swim across the Florida Straits from Cuba to the US without a shark cage. It was her fifth attempt to become the first person to complete the swim. PHOTO: AGENCE FRANCE-PRESSE



ST 7 April 2015

Ms Mieko Nagaoka celebrating her achievement in Matsuyama, Ehime prefecture in western Japan on Saturday. She was the sole competitor in her age group. PHOTO: AGENCE FRANCE-PRESSE

Defying Age with Exercise

24 Nov 2013 ST

100th marathon in sight

Chan, 83, will reach mark next year with 6 more races, then opt for shorter distances

Chua Siang Yee

He is often among the last to cross the finish line at marathons.

But 83-year-old Chan Meng Hui is showing no signs of stopping – not until he has 100 finisher medals and certificates under his belt.

Undoubtedly Singapore's oldest marathoner, he has completed 94 such races since he took up running at 50 years old.

Said the sprightly man who will turn 84 in January: "I will stop running the full 42.195km race only after my 100th marathon.

"I'll still take part in the shorter distances. Hopefully, then it'll be my turn to wait at the finish line instead of the other way round."

When he does hang up his running shoes, it will mark the end of what has been an extraordinary ambition, one which has seen him pound pavements in countries such as the United States, Switzerland and Thailand.

Chan already has his final six marathons firmly in his sights.

After next Sunday's Standard Chartered Marathon Singapore (SCMS), he will end the year by taking part in his running club MacRitchie Runners 25's annual ultramarathon.

Next year, he plans to take part in one marathon in Hong Kong, another in New Zealand and the Sundown Marathon, before hitting No. 100 – fittingly – at the next edition of the SCMS.

"I've never missed an edition. It feels like the right marathon to be No. 100," said Chan, whose son

Not skipping a habit
I've never missed an edition. It feels like the right marathon to be No. 100.

On taking part in the Standard Chartered Marathon Singapore

When I don't run, it's like something is missing. I feel lethargic. When I run, I feel free and it keeps me fit: I seldom fall sick.

On answering the call of the road time after time

called being mistaken for a burglar in Tromso, Norway. "My running partner and I stumbled onto a private property accidentally while looking for our hotel," he said.

"The door opened and there were four men playing card games inside. We saw a gun on the table and thought: 'Oh no.'"

"Thankfully, we showed them our papers and said we were here for the marathon. The nice men even let us stay for the night."

He also made headlines in Hong Kong.

Said Chan: "I was running on the highway when I had a stomachache. There were no mobile toilets nearby so I said to the medics in my limited Mandarin that I needed the toilet.

"They couldn't understand me and the ambulance sent me to a nearby hospital thinking I was in trouble.

"When I reached the hospital, there were a stretcher, paramedics and nurses waiting for me."

In the end, he used the hospital's toilet before the ambulance dropped him off on the highway to





THE TURBANED TORNADO

Fauja Singh

He is the oldest marathon runner in the world. In April, just three weeks after his 101st birthday, he ran the London Marathon in seven hours and 49 minutes. Singh has completed eight other marathons in the past 12 years, including the Toronto Waterfront Marathon, which he ran when he was 100 years old. He says: "Age may bring wisdom, but if you want stamina, endurance and a lifetime of good health, turn to nutritious vegetarian foods. I attribute my longevity to simple Punjabi vegetarian foods, such as chapati, dal, sabji and saag. When I reach my destination, I will be able to say that no animals had to suffer because of my food choices along the way."

EVOLVE! CAMPAIGNS



Jeopardy of Exercise Participation

H10 | HOME

THE STRAITS TIMES FRIDAY DECEMBER 23, 2005

Drowning of triathlete ruled misadventure

He had advanced heart disease and suffered heart attack in swimming leg

By ELENA CHONG

A PRODUCTION manager at computer giant Hewlett-Packard suffered a heart attack while swimming in the sea off East Coast Park during a triathlon two months ago.

Mr Ho Wai Piew, 40, who took part in the triathlon for the first time on Oct 22, also had advanced coronary arterial disease, a coroner's court heard yesterday.

He was 25 minutes into the 750m swimming leg of the New Balance Corporate Triathlon when his body was found floating in the sea. He was among 1,500 participants and 375 companies taking part in the triathlon, which is held every year.

At yesterday's inquiry into his death, the investigating officer, Staff Sergeant Keith Aw Kok Leong from the Bedok Police Division, said in his investigation report that Mr Ho and his colleagues, Ms Chua Hwee Koon, 37, and Mr Song Jae Won, 36, arrived at East Coast Park for the race at about 9.30am.

Forty minutes later, Mr Ho went to the starting line to compete in the swimming leg.

Ms Chua was to compete later in the 5km run while Mr Song was to cycle for 20km.

When the race began at 10.20am, Mr Ho was last seen by Ms Chua as he dived into the wa-



FIRST-TIME TRIATHLETE: Mr Ho, 40, was 25 minutes into the swimming leg of the event on Oct 22 when tragedy struck.



PHOTO: COURTESY OF THE CHEONG FAMILY
RAFFLES JUNIOR COLLEGE STAR: Thaddeus was so keen to represent Singapore at the SEA Games that he spent the June school holidays training twice a day.

OUR BEST

Triathlon body may look into health screenings to prevent future incidents

By LIN XINYI

THE latest mishap in an endurance event might prompt the Triathlon Association of Singapore to do more to prevent future accidents.

Participants who registered for yesterday's Osim Singapore International Triathlon (Osit) had to answer two medical-related questions - one on their medical history and one on their allergies.

But the association may soon look into health screenings before an endurance event, said president Mark Tay.

He insisted, however, that the TAS did all that it could to ensure that the safety measures were in place yesterday, when participant Calvin Leg Wee Sing died.

Lee, 42, took part in the 1.5km swimming leg of the Olympic distance Mix/Open relay, and was seen to be struggling close to 350m away from the finish line.

In under a minute, he was brought to shore, where two paramedics were already on standby.

There, they immediately performed cardiopulmonary resuscitation (CPR) on him, before two doctors took over.

The doctors also tried to revive Lee with an automated external defibrillator (AED).

Lee was taken in an ambulance to Changi General Hospital at 1.25pm - 19 minutes after he was spotted by a marshal at sea.

Said Tay: "We came up with a compre-



Doctors tried to revive Calvin Lee (above) with an AED. PHOTO: WWW.EASINGAPORE.ORG

"We came up with a comprehensive and near-perfect safety and medical evacuation plan."

Triathlon Association of Singapore president Mark Tay.

medical attention in both theory and practice.

Much emphasis was also placed on the swimming route, added Tay, because the swim leg is the most dangerous.

A total of two lifeguards, two paramedics and 12 marshals - some of whom were armed with a canoe, jet ski or powerboat, were surveying the waters off East Coast Park.

Meanwhile, six ambulances were on site.

Dr Patrick Goh, consultant sports physician at SportMed Central at Gleneagles Hospital, said that the response and evacuation time was good.

"The timeframe of 19 minutes seems reasonable. It doesn't seem like there were any unnecessary delays," he said.

When asked about the probable causes of death, Dr Goh listed a few possibilities.

He said: "Of the exercise-related deaths, heart attacks are the most common cause."

Triathlon tragedy: Family, friends stunned

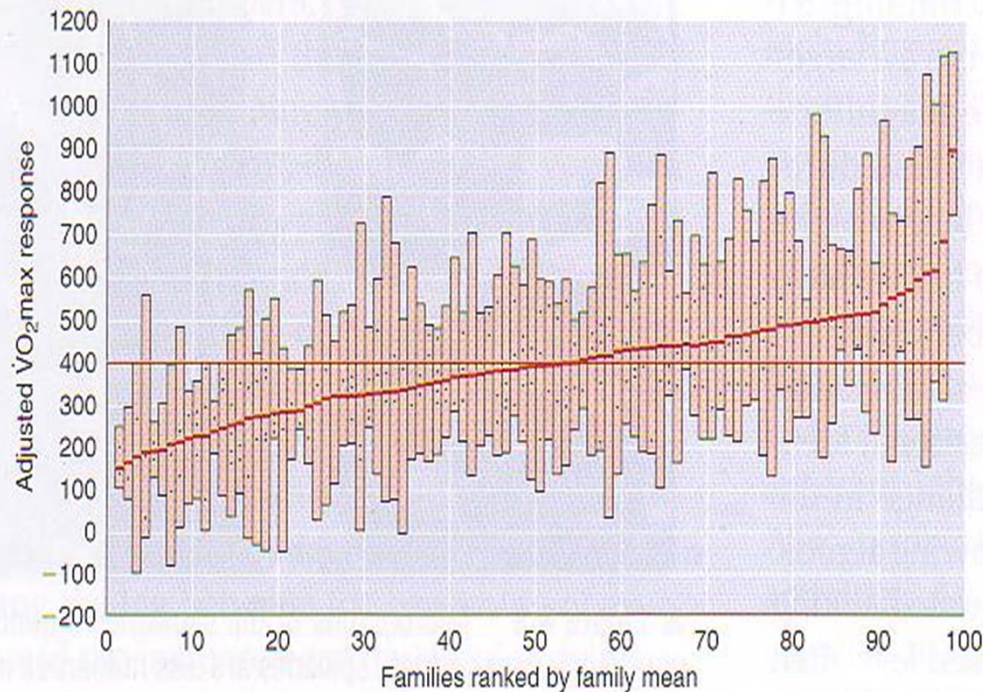
42-year-old CEO was said to be most active

chanical and production engineering from the National University of Singapore (NUS), had been with Deutsche Telekom for about 12 years.

an automated external defibrillator (AED) also failed. He died later at CGH.

Organisers say that the sea was relatively calm when the incident occurred,

Response-variation to Exercise Training



Adapted from C. Bouchard et al., 1999, “Familiar aggregation of VO_2max response to exercise training. Results from HERITAGE Family Study,” *Journal of Applied Physiology* 87: 1003–1008.

Variations in improvement in VO_2max following 20 weeks of endurance training by family.

Average \uparrow was 18% but the range was 0–53%.

The range was influenced by mainly genetics and not by age, sex and race.

E.g., CKMM, β -Sarcoglycan, GTP Cyclohydrolase

Measured outcomes

Varied responses to exercise stimulus

- Low – High Responders
- Slow – Fast responders
- ST– LT responders

Non-responders

Responders

ACSM/AHA Recommendations

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

William L. Haskell, PhD, FAHA; I-Min Lee, MD, ScD; Russell R. Pate, PhD, FAHA;
Kenneth E. Powell, MD, MPH; Steven N. Blair, PED, FACSM, FAHA;
Barry A. Franklin, PhD, FAHA; Caroline A. Macera, PhD, FACSM;
Gregory W. Heath, DSc, MPH, FAHA; Paul D. Thompson, MD; Adrian Bauman, PhD, MD

- 30 min of moderate-intensity aerobic PA 5 d/wk or,
- 20 min high-intensity aerobic PA 3 d/wk
- 8 – 10 strength training exercise, 8 – 12 reps, 2 x/wk
- 60 – 90 min exercise duration may be necessary for weight loss;
- Accumulate 300 min moderate intensity exercise/wk for wt loss
- Accumulating short bouts of PA (10 min) can also be beneficial

LEE KONG CHIAN
SCHOOL OF
MEDICINE



NANYANG
TECHNOLOGICAL
UNIVERSITY

Imperial College
London

THANK YOU