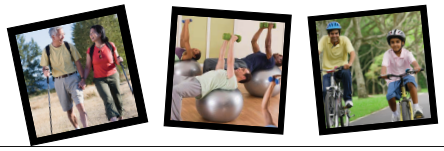
Physical Activity and the Primary Prevention of Fall Injuries

David M. Buchner, MD MPH

Shahid and Ann Carlson Khan Professor of Applied Health Sciences
Department of Kinesiology and Community Health
University of Illinois at Urbana-Champaign
dbuchner@illinois.edu

Aims

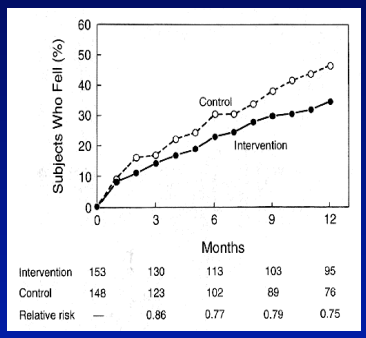
- Review some events leading to current recommendations for physical activity in fall prevention
- Discuss next steps in laying the basis for public health guidelines for primary prevention of falls



A brief history of two seminal projects

- FICSIT (Frailty and Injuries: Cooperative Studies of Intervention Techniques)
  - 7 of 8 studies tested exercise as an intervention component
  - Yale, Seattle, Emory, Farmington sites
- Otago Exercise Programme

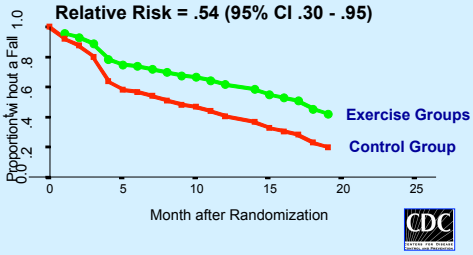
Yale FICSIT Study (1994): MRFIT on All Falls



Intervention	153	130	113	103	95
Control	148	123	102	89	76
Relative risk	—	0.86	0.77	0.79	0.75

Effect of Exercise on Time to First Fall After Randomization

Median follow-up=11 months (range 0-27)



Emory FICSIT Study

Adjusted Estimates from Anderson Gill extension of Cox Model

Variables	Risk Ratio	95% Confidence Interval	P
Time to one or more falls			
FICSIT fall definition			
Tai Chi indicator (0 or 1)	0.511	(0.361, 0.725)	.017
Balance Training indicator (0 or 1)	0.976	(0.710, 1.341)	.879
Fell last year	1.756	(1.336, 2.308)	.0006
Fear of falling	1.160	(1.009, 1.335)	.0004
Trouble falling asleep	0.606	(0.511, 0.717)	.00006

Farmington FICSIT Study

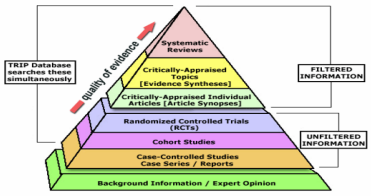
- 2 x 2 Factorial design -- Strength training vs balance training x 3 months, followed by Tai Chi maintenance program x 6 months
- Balance training improved 3 balance measures
- "No interaction between balance and strength training."
- Wolfson, et al. Balance and Strength Training in Older Adults: Intervention Gains and Tai Chi Maintenance. JAGS 1996;44:498-506

Meta-analysis of Otago Exercise Programme

- IRR (falls) = .65 (.57-.75)
- IRR (injurious falls) = .56 (.44-.71)
- IRR (hospitalized) = .52 (.27 – 1.01)
- Hospital costs of NZ$303 in controls versus NZ$188 in exercisers (p=ns) (38% reduction)
- Data consistent with ~40% reduction across all falls-related outcomes

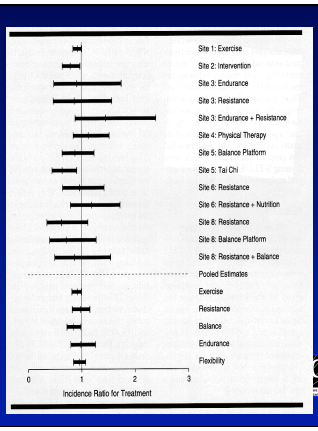
Robertson. JAGS 2002;50:905. moderate injury = either med care or bruise, sprain, cut abrasion, >3 d loss function

The Era of Meta-Analysis of Falls Interventions



http://www.ebmpyramid.org/help.php

FICSIT Fall Meta-analysis (1995)



A partial list of meta-analyses of fall interventions and # citations

- Province et al, *JAMA*, 1995 (FICSIT): 810
- Robertson et al, *JAGS*, 2002 (Otago): 189
- Chang et al, *BMJ*, 2004: 457
- Gates et al, *BMJ*, 2008: 118
- Sherrington et al, JAGS, 2008: 86
- Bischoff-Ferrari et al, JAMA, 2004 (Vita D): 672
- Cochrane meta-analysis, 2009 (community): 1285
- Campbell et al, Age Ageing, 2007 (exercise): 50
- Petridou et al, J Aging Health, 2009 (exercise): 3

By comparison
- RCT by Buchner et al, Aging, 1997 43
- Pate, JAMA, 1995 (CDC/ACSM rec) 4441

Google Scholar citation # in Nov 2010

Public Health shifts emphasis to moderate-intensity physical activity


Forty percent of people with access to trails report using them

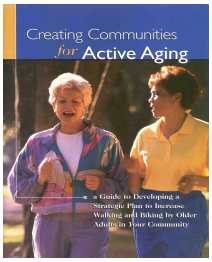
Walking trails improve community fitness

BUILDING community walking trails can lead to more exercise among residents and reach people who may otherwise be inactive, a study found. Researchers examining the effect of walking trails in rural Missouri counties found that half of users surveyed said they had increased their walking since the trails were improved or built. Walkers with a high school education or less were more than twice as likely to have increased their walking since they began using the trails, which were enhanced as part of a community-based health intervention. "Walking trails may be beneficial in promoting physical activity among segments of the population

The addition of walking trails can promote physical activity, especially among women, a study found.

can Journal of Preventive Medicine. Located on El southwestern Missouri

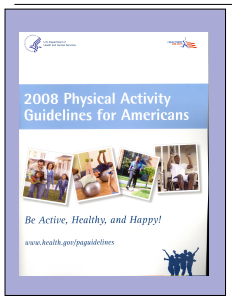
located primarily in resi- dential parks. Among peo- ple who had access to the



History of U.S. physical activity guidelines

- At least 33 physical activity guidelines issued between 1965 and 1995
  - Emphasis on fitness & vigorous aerobic activity
- 1995: CDC/ACSM recommendation
  - "Every US adult should accumulate 30 minutes or more of **moderate-intensity physical activity** on most, preferably all, days of the week."
  - (Originally released in a news conference in 1993!) [bold added]
- 1996: US Surgeon General's Report, Physical Activity & Health
  - First major consensus document on health benefits of physical activity

2008 Physical Activity Guidelines for Americans



- First national PA guidelines by U.S. Department of Health and Human Services
- Based upon extensive evidence review
- Comprehensive
  - Children age 6+, adolescents, adults, older adults, pregnant and postpartum women, people with disabilities and chronic conditions
  - Guidance on all types of physical activity

http://www.health.gov/paguidelines/

2008 Physical Activity Guidelines for Americans Key Guidelines for Older Adults

The following Guidelines are the same for adults and older adults:

- All older adults should avoid inactivity. Some physical activity is better than none, and older adults who participate in any amount of physical activity gain some health benefits.
- For substantial health benefits, older adults should do at least 150 minutes (2 hours and 30 minutes) a week of moderate-intensity, or 75 minutes (1 hour and 15 minutes) a week of vigorous-intensity aerobic physical activity, or an equivalent combination of moderate- and vigorous-intensity aerobic activity. Aerobic activity should be performed in episodes of at least 10 minutes, and preferably, it should be spread throughout the week.
- For additional and more extensive health benefits, older adults should increase their aerobic physical activity to 300 minutes (5 hours) a week of moderate-intensity, or 150 minutes a week of vigorous-intensity aerobic physical activity, or an equivalent combination of moderate- and vigorous-intensity activity. Additional health benefits are gained by engaging in physical activity beyond this amount.
- Older adults should also do muscle-strengthening activities that are moderate or high intensity and involve all major muscle groups on 2 or more days a week, as these activities provide additional health benefits.

The following Guidelines are just for older adults:

- When older adults cannot do 150 minutes of moderate-intensity aerobic activity a week because of chronic conditions, they should be as physically active as their abilities and conditions allow.
- Older adults should do exercises that maintain or improve balance if they are at risk of falling.
- Older adults should determine their level of effort for physical activity relative to their level of fitness.
- Older adults with chronic conditions should understand whether and how their conditions affect their ability to do regular physical activity safely.

2010 WHO *Global Recommendations for Physical Activity and Health* for ≥ 65 years old

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

http://www.who.int/dietphysicalactivity/factsheet_recommendations/en/index.html

2010 AGS/BGS Clinical Practice Guideline: *Prevention of Falls in Older Persons*

OLDER PERSONS LIVING IN THE COMMUNITY

12. The multifactorial fall risk assessment should be followed by direct interventions tailored to the identified risk factors coupled with an appropriate exercise program.[A]
13. A strategy to reduce the risk of falls should include multifactorial assessment of known fall risk factors and management of the risk factors identified.[A]
14. The components most commonly included in efficacious interventions were:
    a) Adaptation or modification of home environment [A]
    b) Withdrawal or minimization of psychoactive medications [B]
    c) Withdrawal or minimization of other medications [C]
    d) Management of postural hypotension [C]
    e) Management of foot problems and footwear [C]
    f) Exercise, particularly balance, strength, and gait training [A]
15. All older adults who are at risk of falling should be offered an exercise program incorporating balance, gait, and strength training. Flexibility and endurance training should also be offered, but not as sole components of the program. [A]

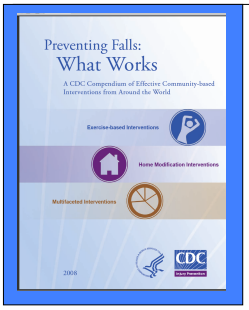
Overall, 8 of the 43 guidelines address exercise

http://www.americangeriatrics.org/

Comments

- Regular physical activity is routinely recommended for older adults, including those with chronic disease.
- Muscle strengthening activity routinely recommendation
- Role of PA in fall prevention is a "headline" (key guideline) in PA guidelines
  - Involvement of experts on falls in physical activity guidelines, e.g. Dr. Campbell, Dr. Skelton
- Good agreement among clinical and public health guidelines on fall prevention in older adults
  - Address prevention of falls in subgroup of older adults at increased risk

CDC recognition of evidence-based exercise programs to prevent falls



- Stay Safe, Stay Active (Barnett, et al.)
- The Otago Exercise Programme (Campbell, et al. and Robertson, et al.)
- Tai Chi: Moving for Better Balance (Li, et al.)
- Australian Group Exercise Program (Lord, et al.)
- Veterans Affairs Group Exercise Program (Rubenstein, et al.)
- Simplified Tai Chi (Wolf, et al.)

CDC usage of terminology of prevention (example = CVD)

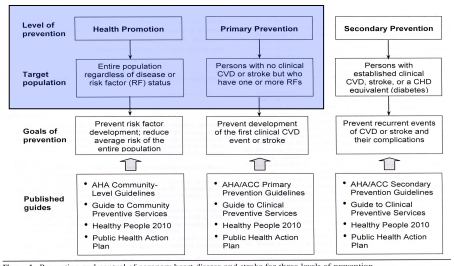


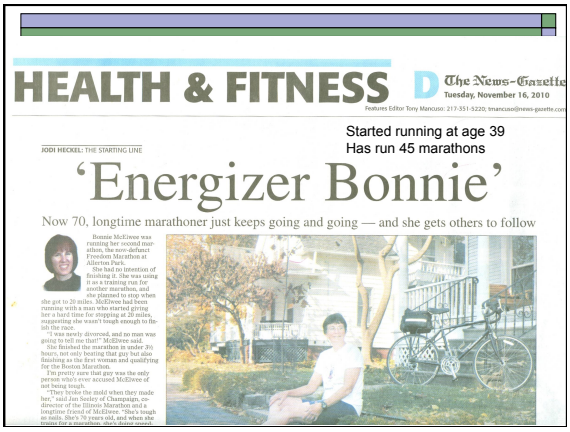
Figure 1. Prevention and control of coronary heart disease and stroke for three levels of prevention.

Mensah Am J Prev Med 2005:29(5S1):152

Primary prevention of fall injuries may be possible and feasible

- Involves issues beyond current approaches to chronic disease and disability prevention
  - Balance as a measure of health-related fitness
  - Role of activities typically regarded as aerobic or muscle-strengthening in maintaining balance
  - Health effects of light-intensity activity
  - Lifestyle activity approach
  - Extend interest in fall injury prevention into middle age

- What if we just remove "if they are at risk of falling" from the current U.S. guideline"?
  - **Older adults should do exercises that maintain or improve balance**.



HEALTH & FITNESS

The News-Gazette

Tuesday, November 16, 2010

Started running at age 39
Has run 45 marathons

'Energizer Bonnie'

Now 70, longtime marathoner just keeps going and going — and she gets others to follow

Effect of 3 months of 3 types of aerobic training

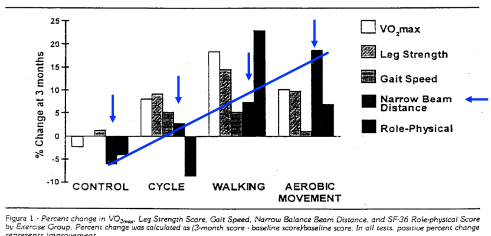


Figure 1 - Percent change in VO_{2max}, Leg Strength Score, Gait Speed, Narrow Balance Beam Distance, and SF-36 Role-physical Score by Exercise Group. Percent change was calculated as (3-month score - baseline score)/baseline score. In all tests, positive percent change represents improvement.

Buchner et al. Aging (Milano). 1997;9:112-9.

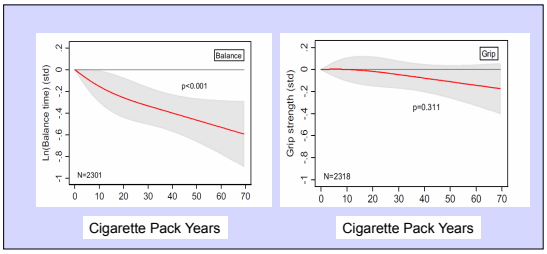
Cochrane Review: Exercise for improving balance in older people

- "This review investigated a variety of interventions. Those that appeared to have the greatest impact were walking; balance; co-ordination and functional exercises; muscle strengthening; and multiple exercise types."

http://www2.cochrane.org/reviews/en/ab004963.html

Effect of smoking on balance and grip strength

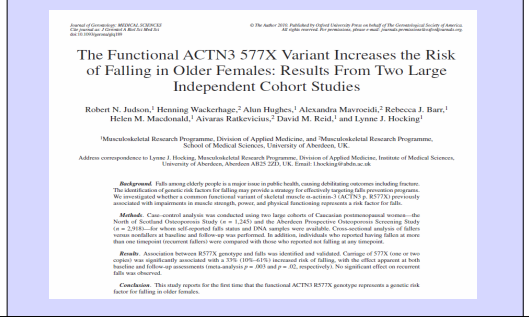
(At age 53, effect persists after adjustment for multiple confounders)



Strand et al. *J Gerontol A Biol Sci Med Sci* doi:10.1093/gerona/glq199
(1946 British Birth Cohort Study)

ACTN3 577X variant increases fall risk by 33%

(affects an actin binding protein in muscle fibers)



The Functional ACTN3 577X Variant Increases the Risk of Falling in Older Females: Results From Two Large Independent Cohort Studies

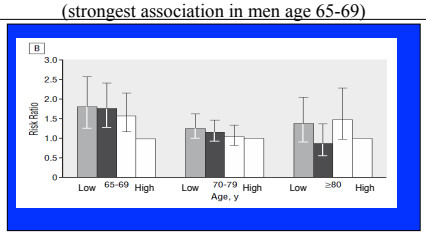
Robert N. Judson,[1] Henning Wackerhage,[2] Alun Hughes,[1] Alexandra Mavroeidi,[2] Rebecca J. Barr,[1] Helen M. Macdonald,[1] Aivaras Ratkevicius,[2] David M. Reid,[1] and Lynne J. Hocking[1]

[1]Musculoskeletal Research Programme, Division of Applied Medicine, and [2]Musculoskeletal Research Programme, School of Medical Sciences, University of Aberdeen, UK.

Address correspondence to Lynne J. Hocking, Musculoskeletal Research Programme, Division of Applied Medicine, Institute of Medical Sciences, University of Aberdeen, Aberdeen AB25 2ZD, UK. Email: l.hocking@abdn.ac.uk

Association between fall risk and bioavailable testosterone quartile in older men

(strongest association in men age 65-69)



Fall Risk

Bioavailable testosterone level risk ratios are adjusted for clinic site, age, participant race, history of falls, history of Parkinson disease, angina, arthritis, dizziness, cancer, and the use of central nervous system medications, use of walking aids, mobility limitations, and leg power

Orwoll et al. Arch Intern Med. 2006;166:2124-2131

Table 3. Characteristics associated with falling while walking, logistic regression models, 1990 ACLS mail-back survey, AOR (95% CI)

Characteristic	Fitness model	Physical activity model
MEN (*n*=6540)		
Fitness level (baseline)		
Low	**1.8 (1.1, 2.8)**	—
Moderate	1.4 (0.9, 2.3)	—
High	ref	—
Physical activity (MET-minutes/ week; baseline)		
0	—	**1.7 (1.1, 2.7)**
1–499	—	1.5 (0.9, 2.5)
>0, unknown	—	0.9 (0.5, 1.7)
≥500	—	ref
Age (years)		
≥65	1.1 (0.6, 2.0)	1.0 (0.6, 1.9)
45–64	0.8 (0.5, 1.3)	0.8 (0.5, 1.3)
20–44	ref	ref
Pain medications	**2.7 (1.6, 4.5)**	**2.7 (1.6, 4.6)**
Depression	**1.7 (1.0, 2.9)**	**1.8 (1.1, 3.0)**
Hearing loss	1.4 (0.9, 2.0)	1.4 (0.9, 2.1)
Regular walking (≥1 mile/week)	1.4 (1.0, 2.0)	1.4 (1.0, 2.0)

Falls during walking in men age 20+

- In ACLS cohort (N=10615), ~20% reported fall in past year at all ages.
- Younger adults mainly reported falls during sports or active exercise (as opposed to during walking)

Mertz et al. Am J Prev Med 2010;39:15–24

Automated Monitoring of Injuries Due to Falls Using the BioSense System

Achintya N. Dey, MA[1], Jerome I Tokars, MD MPH[1], Peter Hicks, MPH[2], Matthew Miller, BA[2] and Roseanne English,BA[1]

[1] Division of Emergency Preparedness and Response
National Center for Public Health Informatics
Centers for Disease Control and Prevention

[2] Constella Group, LLC – an SRA International company

The findings and conclusions in this presentation are those of the authors and do not necessary represent the views of the Centers for Disease Control and Prevention

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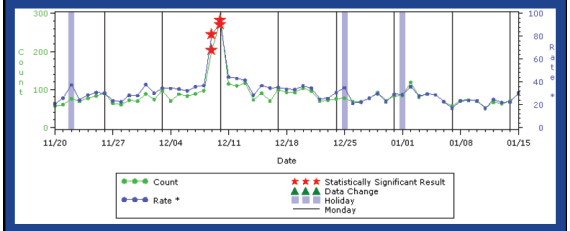
ED Chief Complaints of Fall, 17 Facilities, Cluster 8, Metro Area: E



Excess visits for falls: 137, 197

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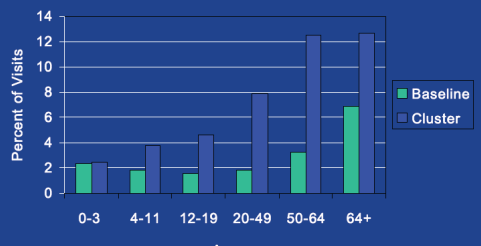
Percentage of Visits for Falls, by Age and Time Period



Baseline=28 days before clusters

Cluster=Day of falls clusters

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Ethnicity and falls

REVIEW

Episodes of falling among elderly people: a systematic review and meta-analysis of social and demographic pre-disposing characteristics

- Risk of falls in Caucasians = 1.68
- Risk of falls in Hispanics = .68

Review of Research on Benefits of Dancing

- Modest sized RCTs indicate that:
  - "older adults can significantly improve their aerobic power, lower body muscle endurance, strength and flexibility, balance, agility, and gait through dancing."
- ("Grade B–level evidence" assigned because no large (N>100) RCTs. Around 2-6 studies per physiologic effect.)

Keough et al. J Aging Physical Activity, 2009, 17, 479-500

Australian Occupational Therapy Journal

Australian Occupational Therapy Journal (2010) **57**, 42–50 doi: 10.1111/j.1440-1630.2009.00848.x

Research Article

LiFE Pilot Study: A randomised trial of balance and strength training embedded in daily life activity to reduce falls in older adults

Lindy Clemson,[1] Maria Fiatarone Singh,[1] Anita Bundy,[1] Robert G. Cumming,[2] Elvina Weissel,[3] Jo Munro,[1] Kate Manollaras[1] and Deborah Black[1]

[1]*Faculty of Health Sciences, The University of Sydney, Lidcombe, New South Wales, Australia,* [2]*Centre for Education and Research on Ageing, The University of Sydney, New South Wales, Australia, and* [3]*Department of Veteran Affairs, New South Wales, Australia*

Background: *Exercise as a falls prevention strategy is more complex with people at risk than with the general population. The Lifestyle approach to reducing Falls through Exercise (LiFE) involves embedding balance and lower limb strength training in habitual daily routines.*

Methods: *A total of 34 community-residing people aged ≥ 70 years were randomised either into the LiFE programme or into a no-intervention control group and followed up for six months. Inclusion criteria were two or more falls or an injurious fall in the past year.*

collection. A larger randomised trial is needed to investigate long-term efficacy, mechanisms of benefit and clinical significance of this new intervention.

KEY WORDS *accidental fall, balance, exercise, falls prevention, self-efficacy.*

Introduction

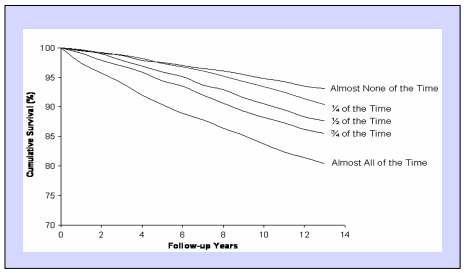
Our current lifestyle encourages doing things more efficiently and with minimum effort. We use remote con-

Interest in light-intensity activity (aka reducing sitting time, "NEAT")

- Increasing evidence for health benefits of more light intensity activity and less sitting time
  - Better metabolic health (e.g. diabetes risk) and reduced risk of obesity
  - Women's Health Initiative: increase sitting time => higher CVD risk, independent of MVPA

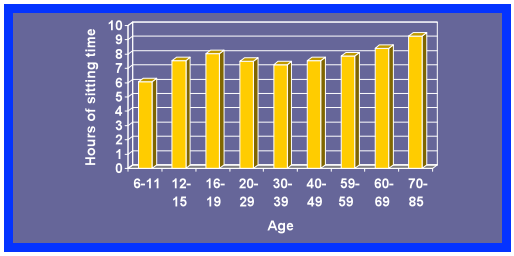
Self Reported Sitting Time and Mortality Risk

17 ,013 men and women age 18–90 yr in Canada Fitness Survey



Katzmarzyk et al. MSSE 2009;41:998

Sitting Time assessed by accelerometer in NHANES



– Mathews. AJE 2008;167:875-881

Did the Yale FICSIT Study reduce sitting time?

- Most intervention group participants were prescribed "Progressive, competency-based balance and strengthening exercise programs."
- Prescribed exercise for 15-20 minutes, twice per day (!)

Tinetti et al. New Engl J Med 1994;331:821

Additional needs

- 1) Standard index of balance (analogous to VO2max as standard measure of aerobic fitness)
  - "there was a lack of a core set of standardised measures to determine balance ability across the 34 studies, which limits the interpretation of results". [Cochrane Review on Exercise and Balance]
- 2) Dose-response studies
- 3) More information on the independent effects of balance on health

Other opportunities to extend scope of physical activity guidelines re: fall prevention

- Stretching and falls
  - Reviews consistently report no significant health benefits of stretching
- RCTs of different approaches to initiating physical activity and there effect on injury and fall risk
  - Any exist?

Summary

- 1) A sound strategy—
  - Identifying risk factors for falls
  - RCTs of interventions to reduce fall risk
  - Meta-analyses of RCTs

  has resulted in major public health guidelines for physical activity in fall prevention
- 2) It is possible that further research could lead to more comprehensive public health guidelines dealing with physical activity and primary prevention of fall injuries