

# SYSTEMATIC REVIEW OF THE EFFECT OF EXERCISE IN COMMUNITY-DWELLING HIGH-RISK FALLERS

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# Outline

- Background and Rationale
- Methods
- Results
- Discussion
- Conclusion
- Implications

# Background and Rationale

# Epidemiology of Falls

- Falls are one of the leading cause of death among seniors<sup>1</sup>
- 1 in 3 people (65yo+) fall once per year<sup>2,3,4</sup>
  - ▣ 50% will fall again
- Death rate due to falls is higher in women<sup>5</sup>
- High-risk fallers have an increased sedentary lifestyle
  - ▣ Decrease in strength & balance



# Fall Implications

- Increase morbidity
  - ▣ Medical, psychological and social sequelae<sup>7</sup>
  - ▣ Decreased self efficacy and independence<sup>6</sup>
- Increased mortality<sup>5</sup>
- Health care costs
  - ▣ Canadians 2.8 billion dollars per year<sup>8</sup>

# Fall Prevention Strategies

**Current literature suggests  
exercise prevents falls in the  
geriatric population<sup>9,10,11</sup>**

# Rationale for Systematic Review

- High-risk fallers are at increase risk of injurious falls leading to mortality and morbidity
- Statement of Purpose:
  - Although there is a large body of research on falls, current literature does not provide concrete protocols for high-risk fallers

# Research Question

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- In community-dwelling high-risk fallers, what is the effect of exercise on falls?



# Methods

# Operational Definitions

## □ Fall

- An event that results in a person coming to rest unintentionally on the ground or lower level, not as the result of a major intrinsic event, such as stroke, or overwhelming hazard<sup>12</sup>

## □ High-Risk Faller

- Recurrent faller with a history of 2 or more non-syncope falls within a year<sup>13</sup>, or
- Recruited from emergency room due to non-syncope fall

# Search Strategy

- Electronic Databases and Grey Literature:
  - ▣ EMBASE, MEDLINE, CINAHL, PEDro, PubMed,
  - ▣ clRcle, google scholar
- Reference tracking of selected articles
- Search terms:
  - ▣ Recurrent fallers, history of fall, community dwelling, frail elder, exercise, sport, physical therapy, fall, fall risk, accidental falls, emergency, injurious, fracture, medical, fall prevention



# Study Criteria

## Inclusion Criteria

- Population:
  - Men and women 65+ years old
  - Healthy participants
  - History of  $\geq 2$  non-syncope falls in last 12 months or recruited from emergency room due to non-syncope falls
  - Not residing in nursing homes
- Intervention:
  - Includes an exercise component
  - Includes pre and post data
- Outcome:
  - Falls

## Exclusion Criteria

- Cognitive deficits ( $\text{MMSE} \leq 24$ )
- Medical conditions increasing fall risk (cerebrovascular accident, Parkinsons disease, cardiac problems, transient ischemic attack)

# Evaluation of Methodological Quality

- PEDro Scale (0-10) <sup>14</sup>
  - ▣ 6+: High methodological quality
  - ▣ 4-5: Moderate methodological quality
  - ▣ 0-3: Low methodological quality

# Data Extraction and Analysis

## □ Data Extraction Form

- Participants
- Inclusion/exclusion criteria
- Training parameters
- Outcome measures
- Results
- Statistical analysis
- Drop outs
- Adverse effects
- Study quality tools
- Study conclusion
- Study limitations

## □ Data Analysis

- Qualitative synthesis of results

# Results

# Search Strategy Results

Eligible Studies: 3657



Title and Abstract Screening: 154



Full Text  
Screening: 7



# Methodological Quality of Studies

Study	PEDro Scale
Spice et al., 2008 <sup>18</sup>	6
Elley et al., 2008 <sup>17</sup>	7
Beyer et al., 2007 <sup>16</sup>	5
Mahoney et al., 2007 <sup>19</sup>	6
Skelton et al., 2005 <sup>20</sup>	6
Davison et al., 2005 <sup>6</sup>	7
Hauer et al., 2001 <sup>21</sup>	6

# Study Characteristics

Spice et al., 2008<sup>18</sup>

Sample Size	Mean Age	% Female	Intervention (I)	Control (C)	Outcome Measure	Results
I #1=136 I #2=210  C=159	I #1= 83 I #2= 81  C = 83	I #1 =74.3% I #2 =71.3%  C =76.1%	<b>Intervention #1:</b> Multi-factorial (nurse lead Ax, referral to PT and other professionals)  <b>Intervention #2:</b> Multi-factorial (multi- disciplinary Ax by MD, RN, OT, PT)	Usual care	<u>Primary:</u> Proportion of fallers  <u>Secondary:</u> Mortality, functional mobility, fractures, move to institutional care	I #1: No effect on falls  I #2: <b>Positive            Effect:</b> Reduced the risk for future fall by 9%

## Elley et al., 2008<sup>17</sup>

Sample Size	Mean Age	% Female	Intervention (I)	Control (C)	Outcome Measure	Results
I = 155 C = 157	I=80.4 C=81	I = 68% C=70%	Multi-factorial (Nurse lead Ax, referral to interventions including Otago strength and balance exercise)	Usual care and two social visits	<u>Primary:</u> Rate of falls  <u>Secondary:</u> Strength, functional mobility, falls efficacy	No effect on falls

## Beyer et al., 2007<sup>16</sup>

Sample Size	Mean Age	% Female	Intervention (I)	Control (C)	Outcome Measure	Results
I = 32 C = 33	I = 78.6 C = 77.6	100 %	Exercise (6 months: warm up/cool down, flexibility, resistance training, balance)	No activities provided	<u>Primary:</u> L/E strength, measures of mobility & balance  <u>Secondary:</u> Number of falls	No effect on falls

## Mahoney et al., 2007<sup>19</sup>

Sample Size	Mean Age	% Female	Intervention (I)	Control (C)	Outcome Measure	Results
I = 174 C=175	I = 79.6 C = 80.3	I =78.7% C=78.3%	Multi-factorial (Nurse or PT lead falls Ax, referrals to other professionals and recommendations for a balance and walking exercise plan)	Home safety Ax and advise to see doctor	<u>Primary:</u> Rate of falls  <u>Secondary:</u> Hospitalization, nursing home admission	No effect on falls

## Skelton et al., 2005<sup>20</sup>

Sample Size	Mean Age	% Female	Intervention (I)	Control (C)	Outcome Measure	Results
I = 50 C = 31	I = 72.7 C = 73.2	100%	Exercise (FaME classes, Otago exercises and home exercise program)	Home exercises program	<u>Primary:</u> Rate of falls  <u>Secondary:</u> Mortality, move to residential care or hospital	<b>Positive Effect:</b> 31% fewer falls in the intervention group

## Davison et al., 2005<sup>6</sup>

Sample Size	Mean Age	% Female	Intervention (I)	Control (C)	Outcome Measure	Results
I = 159 C = 154	77	72%	Multi-factorial (Ax, gait re-training and functional training program)	Conventional care	<u>Primary:</u> Rate of falls and proportion of fallers <u>Secondary:</u> Hospital admissions, mortality, fear of falling	<b>Positive Effect:</b> 36% reduction in falls in the intervention group

## Hauer et al., 2001<sup>21</sup>

Sample Size	Mean Age	% Female	Intervention (I)	Control (C)	Outcome Measure	Results
I = 31 C = 26	82	100%	Exercise (3 months: Ambulatory training, functional performance and strength)	Motor placebo activities	<u>Primary:</u> Rate of fall  <u>Secondary:</u> Strength, ambulation speed, fear of falling, emotional status	<b>Non-significant Positive:</b> 25% reduction in falls in intervention group



# Summary of Results

## □ Study Design

### ■ All RCTs

### ■ Predominately female population

- 3 exclusively female population: Beyer, Hauer, Skelton

### ■ Recruitment

- Hospital: Beyer, Davison, Hauer
- Family physicians: Elley, Skelton
- Community advertisement: Mahoney, Spice

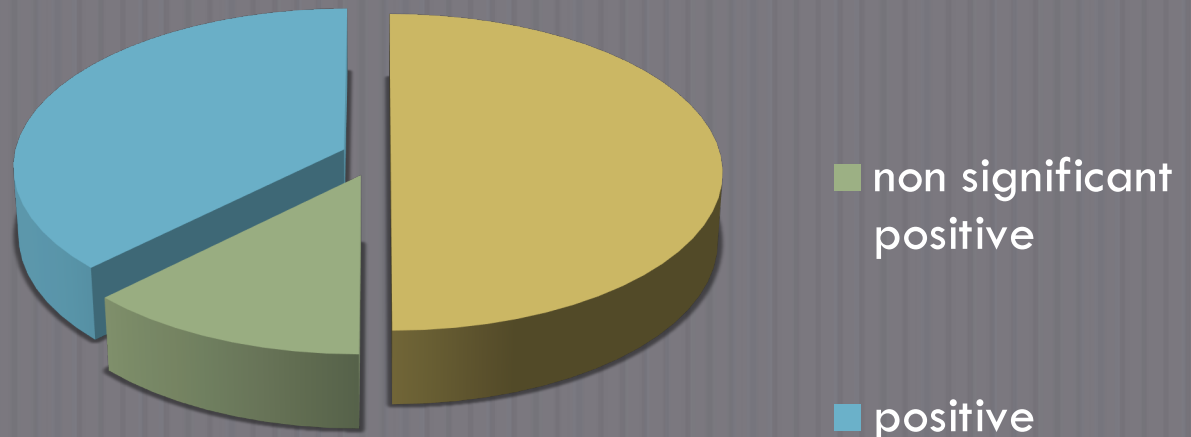
## □ Falls Outcomes

### ■ Reporting of falls

- Proportion of fallers: Beyer, Hauer, Spice
- Rate of falls: Mahoney, Elley Skelton
- Number of falls and proportion of fallers: Davison

## □ Effects on decreasing falls

- No effect: Beyer, Elley, Mahoney, Spice (Intervention #1)
- Non-significant positive effect: Hauer (25%)
- Significant positive effect: Davison (36%), Skelton (31%), Spice (Intervention #2 – 9%)



## □ Content of Exercise Intervention

- All but one study offered a strength and balance component

### ■ Frequency

- $\leq 3$ x/wk: Beyer, Elley, Hauer, Mahoney
- $\geq 4$ x/wk: Davison, Skelton
- Unreported: Spice

### ■ Intensity

- $>70\%$  max 1RM: Beyer, Hauer
- Moderate intensity: Elley
- Unreported: Davison, Mahoney, Skelton, Spice

### ■ Time

- $<3$  months: Hauer
- 6-9 months: Beyer, Elley, Skelton
- 12 months: Mahoney, Spice
- Unreported: Davison

## □ Type of Intervention

### ▣ Multi-factorial vs. Exercise-alone

- Multi-factorial: Elley, Davison, Mahoney, Spice
- Exercise alone: Beyer, Hauer, Skelton

### ▣ Group exercise vs. Individual exercise programs

- Group exercise: Beyer, Hauer
- Individual exercise: Elley, Davison, Spice
- Both: Skelton
- Recommendation for group exercise: Mahoney

### ▣ Inclusion of home exercise program

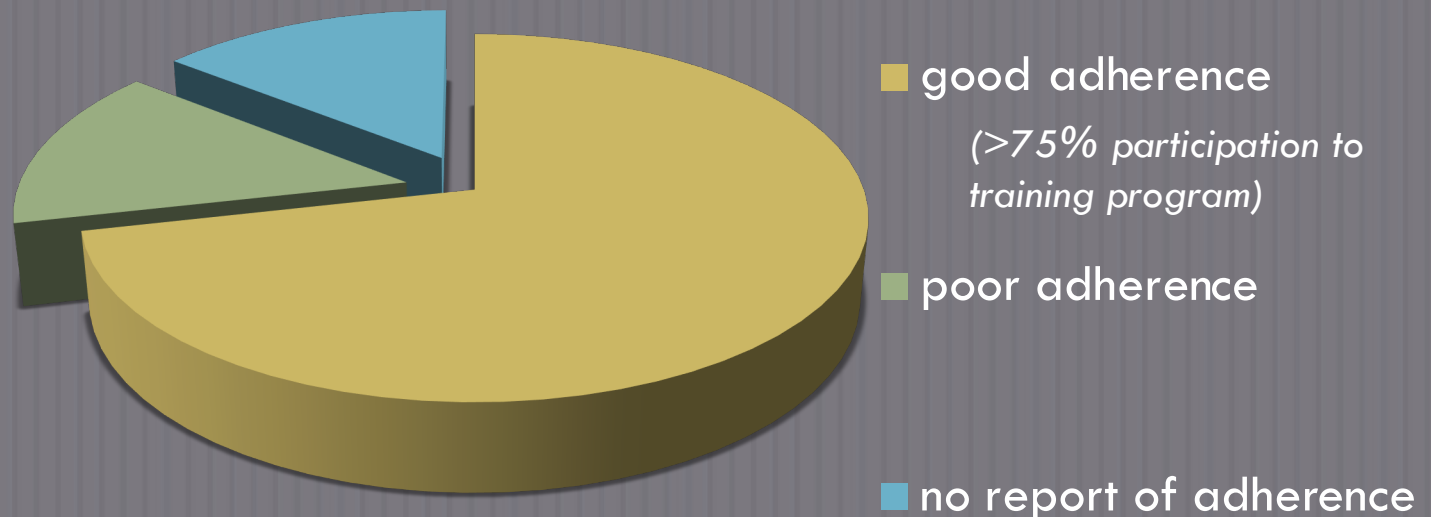
- Elley, Davison, Skelton

## □ Adherence to exercise

■ Good adherence: Beyer, Hauer, Skelton, Spice

■ Poor adherence: Elley

■ Not reported: Davison



# Discussion

# Discussion

- Lack of studies to conclude on the effects of exercise in high-risk fallers
  - Due to heterogeneity of study design and implementation of articles reviewed



## □ Types of Interventions

- Moderate support to recommend an individualized home-based exercise program

### ■ Multi-factorial vs. Exercise-alone

- Limited evidence on effectiveness of multi-factorial when compared to exercise-alone
- Challenges to multi-factorial delivery: barriers to accessibility to multiple health care practitioners, confusion to priority of interventions

## □ Content of Exercise Intervention

- Program delivery has a greater influence on fall outcome than program content
  - Supervised exercise intervention is more effective than specific exercise recommendations<sup>2,20</sup>
- High frequency programs showed a greater decrease in fall outcomes<sup>2,20</sup>
- Program duration had no effect on falls

## □ Adherence to exercise

- Previous literature suggests group exercise program increases adherence
  - However, this review cannot confirm these findings
- Continual supervision and progression of exercise are required to maintain good adherence
- Association between increase exercise adherence to decrease fall incidence

# Conclusion

# Main Findings

- The effect of exercise in high-risk fallers remains unclear
- This systematic review suggests that interventions should include:
  - ▣ A strength and balance component
  - ▣ Greater training frequency
  - ▣ An individualised home exercise program
  - ▣ Good adherence to supervised exercise program

# Implications

# Recommendations

## □ Recommendations for Clinicians

- Supervised, moderate to high frequency of delivery of exercise program in a group-based or individualized setting can prevent falls
- Multi-factorial or exercise-alone interventions result in equivalent outcomes
- Challenges in accessibility and motivational barriers may limit adherence to exercise

## □ Recommendations for Future Research

- Standardizing reports of falls and outcome measures
  - Variability of measures used in falls research limit ability to perform statistical analysis
- Articles should be powered to show the effect of exercise at reducing injurious falls<sup>3</sup>
- Evaluate effectiveness of short-term vs. long-term exercise intervention



## □ Recommendations for Future Research

- Evaluate the relationship between exercise adherence and barriers to exercise

  - High-risk fallers have even greater barriers

- Clinical trials need to evaluate the effects of exercise in high-risk community-dwelling fallers

# Limitations

- Heterogeneity of study design and falls outcome measures
  - A meta-analysis could not be conducted
- Only seven available RCTs
- Participants may or may not have received exercise as an intervention within the multi-factorial studies

# References

- 1. Veterans Affairs Canada. 2002 May [cited 2009 Jun 10]: [2 screens]. Available from: ULR: <http://www.acc-vac.gc.ca/clients/sub.cfm?source=health?fallsp>
- 2. Moreland J, Richardson J, Chan DH, O'Neill J, Bellissimo A, Grum RM, et al. Evidence-based guidelines for the secondary prevention of falls in older adults. *Gerontology* 2003 Mar-Apr;49(2):93-116.
- 3. Tinetti ME. Multifactorial fall-prevention strategies: Time to retreat or advance. *J.Am.Geriatr.Soc.* 2008 August;56(8):1563-1565.
- 4. Loughlin JL, Robitaille Y, Boivin J, Suissa S. Incidence of and risk factors for falls and injurious falls among the community-dwelling elderly. *Am.J.Epidemiol.* 1993 02;137(3):342-354.
- 5. Scott V, Pearce M, Pengelly C. Public health agency of Canada: Technical report: Deaths due to falls among Canadians age 65 and over an analysis of data from the Canadian Vital Statistics as presented in: Report on Seniors' falls in Canada (section 2.4)
- 6. Davison J, Bond J, Dawson P, Steen IN, Kenny RA. Patients with recurrent falls attending Accident & Emergency benefit from multifactorial intervention--a randomised controlled trial. *Age Ageing* 2005 Mar;34(2):162-168.
- 7. Campbell AJ, Borrie MJ, Spears GF, Jackson SL, Brown JS, Fitzgerald JL. Circumstances and consequences of falls experienced by a community population 70 years and over during a prospective study. *Age Ageing* 1990;19(2):136-141.
- 8. Public Health Agency of Canada. You can prevent falls fact sheet No. 5. 2006 Feb [cited 2009 Jun 10]: [2 screens]. Available from: URL: [http://www.phac-aspc.gc.ca/seniors-aines/pubs/Falls\\_Prevention/fallsprevtn5\\_e.htm](http://www.phac-aspc.gc.ca/seniors-aines/pubs/Falls_Prevention/fallsprevtn5_e.htm)
- 9. Sherrington C, Whitney JC, Lord SR, Herbert RD, Cumming RG, Close JC. Effective exercise for the prevention of falls: a systematic review and meta-analysis. *J.Am.Geriatr.Soc.* 2008 Dec;56(12):2234-2243.
- 10. Petridou ET, Manti EG, Ntinapogias AG, Negri E, Szczerbinska K. What Works Better for Community-Dwelling Older People at Risk to Fall? A Meta-Analysis of Multifactorial Versus Physical Exercise-Alone Interventions. *J.Aging Health* 2009;0898264309338298v1.

- 11. Chang JT, Morton SC, Rubenstein LZ, Mojca WA, Maglione M, Suttorp MJ, et al. Interventions for the prevention of falls in older adults: Systematic review and meta-analysis of randomised clinical trials. *British Medical Journal* 2004 328:680–686.
- 12. Lord SR. Aging and falls: causes and prevention. *J.Musculoskelet.Interact.* 2007 Oct-Dec;7(4):347.
- 13. Morris R, Harwood RH, Baker R, Sahota O, Armstrong S, Masud T. A comparison of different balance tests in the prediction of falls in older women with vertebral fractures: A cohort study. *Age Ageing* 2007 Jan;36(1):78-83.
- 14. Physiotherapy Evidence Database (PEDro). Sydney: PEDro; 1999 [updated 1999 Mar; cited 2008 Nov 12]. PEDro scale [4 screens]. Available from: URL: [http://www.pedro.org.au/scale\\_item.html](http://www.pedro.org.au/scale_item.html)
- 15. Sackett DL. Rules of evidence and clinical recommendations for the use of antithrombic agents. *Chest.* 1986;89 2s-3s.
- 16. Beyer N, Simonsen L, Bulow J, Lorenzen T, Jensen DV, Larsen L, et al. Old women with a recent fall history show improved muscle strength and function sustained for six months after finishing training. *Aging Clin.Exp.Res.* 2007 Aug;19(4):300-309.
- 17. Elley et al. Effectiveness of a Falls-and-Fracture Nurse Coordinator to Reduce Falls: A Randomized, Controlled Trial of At-Risk Older Adults (See editorial comments by Dr. Mary Tinetti on pp 15631565). *Journal of the American Geriatrics Society* 2008;56(8):1383.
- 18. Spice CL, Morotti W, George S, Dent THS, Rose J, Harris S, et al. The Winchester falls project: a randomised controlled trial of secondary prevention of falls in older people. *Age Ageing* 2008 October 1.
- 19. Mahoney JE, Shea TA, Przybelski R, Jaros L, Gangnon R, Cech S, et al. Kenosha County falls prevention study: a randomized, controlled trial of an intermediate-intensity, community-based multifactorial falls intervention. *J.Am.Geriatr.Soc.* 2007 Apr;55(4):489-498.
- 20. Skelton D, Dinan S, Campbell M, Rutherford O. Tailored group exercise (Falls Management Exercise -- FaME) reduces falls in community-dwelling older frequent fallers (an RCT). *Age Ageing* 2005 Nov;34(6):636-639.
- 21. Hauer K, Rost B, Rutschle K, Opitz H, Specht N, Bartsch P, et al. Exercise training for rehabilitation and secondary prevention of falls in geriatric patients with a history of injurious falls. *J.Am.Geriatr.Soc.* 2001 Jan;49(1):10-20.

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# Questions?

