Fall Prevention: past, present and future

www.NeuRA.edu.au
1960 - time zero
J. H. Sheldon – the grandfather of falls

The liability of old people to tumble and often to injure themselves is such a commonplace of experience that it has been tacitly accepted as an inevitable aspect of ageing, and thereby deprived of the exercise of curiosity. The literature, in fact, on what has always been a trial for the elderly and is now becoming a problem for the community is very meagre (Sheldon, 1948; Scott, 1954; Droller, 1955; Hobson and Pemberton, 1955; Howell, 1955; DeLargy, 1958; Boucher, 1959; Exton-Smith, 1959; Fine, 1959), and bears little relation to either the practical importance or the intrinsic interest of the subject. An essential preliminary to further investigation is a knowledge of what actually happens, and the present paper is an attempt to meet that need by an account of the natural history of these falls.

The inquiry was directed at old people living at home, since the hospital population of old age has a heavy pathological bias, and, in addition, faces postural risks different from those of the community at large. This paper presents the results of an inquiry into 500 falls which happened to 202 individuals—36 bad been brought to the casualty department of the Royal Hospital, old people (Fine, 1959), where the incidence of physics and, particularly, of mental defect is so much greater. The environment contributed a quota to the causation of 224 falls, whereas the cause lay within the old person in the remaining 276, though effective separation is difficult. Thus, while in some of the accidental fall a younger person would also have fallen, in many other balance would have been retained; for old people complain bitterly of inability to preserve their balance as they did when younger, saying, "Once you're gone, you've got to go"—a remark which reveals a considerable problem in defective physiology.

Accidental Falls
There were 171 falls (34% of total) in 125 individuals as follows:

<table>
<thead>
<tr>
<th>Cause</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>On steps</td>
<td>63</td>
</tr>
<tr>
<td>Missing last step or steps</td>
<td>15</td>
</tr>
<tr>
<td>Poor illumination</td>
<td>13</td>
</tr>
<tr>
<td>Varying</td>
<td>12</td>
</tr>
<tr>
<td>Various</td>
<td>33</td>
</tr>
<tr>
<td>Slipping</td>
<td>49</td>
</tr>
<tr>
<td>Falling over unexpected objects</td>
<td>36</td>
</tr>
<tr>
<td>Dark</td>
<td>12</td>
</tr>
<tr>
<td>Various causes</td>
<td>31</td>
</tr>
</tbody>
</table>

"The literature on what has always been a trail for the elderly and is now becoming a problem for the community is very meagre"
## On the Natural History of Falls in Old Age

<table>
<thead>
<tr>
<th>Condition</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accidental Falls</td>
<td>171</td>
</tr>
<tr>
<td>Drop Attacks</td>
<td>125</td>
</tr>
<tr>
<td>Trips</td>
<td>53</td>
</tr>
<tr>
<td>Vertigo</td>
<td>37</td>
</tr>
<tr>
<td>Recognisable CNS lesion</td>
<td>27</td>
</tr>
<tr>
<td>Bad Back</td>
<td>20</td>
</tr>
<tr>
<td>Posture Hypotension</td>
<td>18</td>
</tr>
<tr>
<td>Weakness in Leg</td>
<td>16</td>
</tr>
<tr>
<td>Falling out of Bed or Chair</td>
<td>10</td>
</tr>
<tr>
<td>Uncertain</td>
<td>23</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>500</strong> Falls</td>
</tr>
</tbody>
</table>

*(J.H. Sheldon BMJ 1960; Dec 10th)*
Phase 1: 1977-1988
Initial studies

- Documenting the size of the problem
- Falls risk assessment studies
- **Retrospective** studies of risk factors
  - Exton-Smith, 1977
  - Overstall, 1977
  - Grimley Evans, 1977, 1981
  - Campbell, 1981
  - Brocklehurst, 1982
  - Blake, 1988
Falls Frequency

<table>
<thead>
<tr>
<th>Age group</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>65-74</td>
<td>20%</td>
</tr>
<tr>
<td>75-84</td>
<td>30%</td>
</tr>
<tr>
<td>85+</td>
<td>50%</td>
</tr>
</tbody>
</table>

Legend:
- 3+ Falls
- 2 Falls
- 1 Fall
Future projections

- Falls
- Road trauma
- Violence
- Self harm

Cost in millions

Phase 2: 1988-1995+
Falls risk factor identification

- Large prospective studies
  - Tinetti, 1988
  - Campbell, 1989
  - Nevitt, 1989
  - O’Loughlin, 1993
  - Lord, 1994
  - Luukinen, 1995
RISK FACTORS FOR FALLS AMONG ELDERLY PERSONS LIVING IN THE COMMUNITY

MARY E. TINETTI, M.D., MARK SPEECHLEY, PH.D., AND SANDRA F. GINTER, R.N.

Abstract To study risk factors for falling, we conducted a one-year prospective investigation, using a sample of 336 persons at least 75 years of age who were living in the community. All subjects underwent detailed clinical evaluation, including standardized measures of mental status, strength, reflexes, balance, and gait; in addition, we inspected their homes for environmental hazards. Falls and their circumstances were identified during bimonthly telephone calls.

During one year of follow-up, 106 subjects (32 percent) fell at least once; 24 percent of those who fell had serious injuries and 6 percent had fractures. Predisposing factors for falls were identified in linear-logistic models. The adjusted odds ratio for sedative use was 29.3; for cognitive impairment, 5.0; for disability of the lower extremities, 3.8; for palmar reflex, 3.0; for abnormalities of balance and gait, 1.9; and for foot problems, 1.8; the lower bounds of the 95 percent confidence intervals were 1 or more for all variables. The risk of falling increased linearly with the number of risk factors, from 8 percent with none to 78 percent with four or more risk factors (P<0.0001). About 10 percent of the falls occurred during acute illness, 5 percent during hazardous activity, and 44 percent in the presence of environmental hazards.

We conclude that falls among older persons living in the community are common and that a simple clinical assessment can identify the elderly persons who are at the greatest risk of falling. (N Engl J Med 1988; 319:1701-7.)
Risk Factors for Falls in a Community-Based Prospective Study of People 70 Years and Older

A. John Campbell, Michael J. Borrie, and George F. Spears

1Department of Medicine and 2Department of Social and Preventive Medicine, University of Otago Medical School, Dunedin, New Zealand.

We investigated factors associated with falls in a community-based prospective study of 761 subjects 70 years and older. The group experienced 507 falls during the year of monitoring. On entry to the study a number of variables had been assessed in each subject. Variables associated with an increased risk of falling differed in men and women. In men, decreased levels of physical activity, stroke, arthritis of the knees, impairment of gait, and increased body sway were associated with an increased risk of falls. In women, the total number of drugs, psychotropic drugs and drugs liable to cause postural hypotension, standing systolic blood pressure of less than 110 mmHg, and evidence of muscle weakness were also associated with an increased risk of falling. Most falls in elderly people are associated with multiple risk factors, many of which are potentially remediable. The possible implications of this in diagnosis and prevention are discussed.
Psychosocial and demographic factors

- Advanced age ***
- Female gender **
- Living alone **
- History of falls ***
- Inactivity **
- ADL limitations ***
- Alcohol consumption -
Medical factors

- Impaired cognition ***
- Depression **
- Stroke ***
- Incontinence **
- Acute illness **
- Parkinson’s disease ***
- Vestibular disorders -
- Arthritis **
- Foot problems **
- Dizziness *
- Orthostatic hypotension *
Balance and mobility factors

- Impaired gait and mobility
- Impaired ability in standing up
- Impaired ability with transfers
- Impaired stability when standing
- Impaired stability when leaning and reaching
- Inadequate responses to external perturbations
- Slow voluntary stepping
Intensive balance and gait assessments
CLINICAL CORRELATES OF SWAY IN OLD AGE—SENSORY MODALITIES
Physiological Factors Associated with Falls in an Elderly Population

Stephen R Lord, PhD,* Russell D Clark, MBBS, FRACP, DTM&H,*† and Ian W. Webster, MD, FRACP*

Objective: To determine whether a battery of 13 sensorimotor, vestibular, and visual tests discriminates between elderly fallers and elderly non-fallers.

Design: One-year prospective study.

Setting: Conducted at a 124-bed Hostel for Aged Persons, in Sydney, Australia.

Participants: Ninety-five persons aged between 59 and 97 years (mean age 82.7 years) took part in the study. Of the 29 non-participants, four were ill, five were absent (on holidays, etc), and 20 declined. Residents were generally independent in activities of daily living although personal care assistance was available.

Results: Eighty-four participants were available for follow-up. In the follow-up year, 40 subjects experienced no falls, 11 subjects fell one time only, 33 residents fell on two or more occasions. There was a total of 145 falls. Discriminant function analysis identified proprioception in the lower limbs, visual contrast sensitivity, ankle dorsiflexion strength, reaction time, and sway with the eyes closed as the variables that significantly discriminated between subjects who experienced multiple falls and subjects who experienced no falls or one fall only. This procedure correctly classified 79% of subjects into multiple faller or non-multiple faller groups. Quadriceps strength was poorer in the multiple fallers compared with the non-fallers and once-only fallers, although the difference was not statistically significant. There was little difference in the mean scores for the tests of vestibular function in the non-fallers, once-only fallers, and multiple fallers.

Conclusion: It appears that this approach highlights some key physiological factors that predispose elderly individuals to falls. J Am Geriatr Soc 39:1194–1200, 1991

© 1991 by the American Geriatrics Society
Phase 3: 1994 – present
Interventions for preventing falls

Source - Medline
### Seven influential falls prevention studies

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multifactorial - community</td>
<td>Tinetti, 1994</td>
</tr>
<tr>
<td>Tai Chi - community</td>
<td>Wolf, 1996</td>
</tr>
<tr>
<td>Home exercise - community</td>
<td>Campbell, 1997, 1999</td>
</tr>
<tr>
<td>Multifactorial - care home</td>
<td>Ray, 1997</td>
</tr>
<tr>
<td>Multifactorial - ED</td>
<td>Close, 1999</td>
</tr>
<tr>
<td>Pacemakers - ED</td>
<td>Kenny, 2001</td>
</tr>
<tr>
<td>Cataract surgery - community</td>
<td>Harwood, 2005</td>
</tr>
</tbody>
</table>
Phase 4: the future
Some research questions

- Interventions for addressing fear of falling in addition to physical fall risk
- Step training for “inoculating” against falls
- Effective interventions for those with stroke, PD and dementia
- Evaluation of enjoyable activities such as yoga and dance as fall prevention strategies
Phase 4: the future Technology

- Activity monitoring
- Fall detection
- Automated adherence
- Directed routine assessments
- Automated screening
- Telehealth
Phase 4: The future
Research into Practice

- Fall prevention becomes everybody's business
- Older people are aware of their fall risk profile
- Older people have access to evidence-based home and group exercise programs
- Older people are vitamin D replete