Falling: Causes, Consequences and how to avoid it

Risk factors

There are several risk factors associated with falling. Typical risk factors are:

- **Biological risk factors (sorted by order of significance in [7]):**
    - Muscle weakness
    - Balance deficit
    - Gait deficit
    - Visual deficit
    - Mobility limitation
    - Cognitive impairment
    - Impaired functional status
    - Postural hypertension
- **Behavioral risk factors(Not in sorted order):**
    - Inactivity
    - Side effects from medication
    - Alcohol use
    - Living alone
    - Staying at home
- **Home/environmental risk factors(not in sorted order)**
    - Dangers in the house or in public places.
    - Unfamiliarity with walking aids such as canes, crutches, walking chairs.

A fall is normally caused by the interaction of two or more of these risk factors. Home or environmental risk factors are involved in less than *half of all falls*. What this means is that more than half of all falls happen without the influence of environmental factors. The second and third most common single causes of falling are gait/balance disorders and dizziness/vertigo, followed by drop attacks, sudden falls without loss of consciousness or dizziness.

Many older adults are unaware of their risk factors, and therefore unable to take preventive actions. Even older adults with a history of falling have been given little education about the potential risk factors. Risk assessment, even self-administered, can be very beneficial, especially when the results are discussed with a healthcare provider.

It has been showed that many of the biological risk factors can be reduced by effectively. Specifically strength, gait and balance has been shown to be improvable in a number of studies.

60 % of falls happen in or around the house. While this sounds like a lot, older adults spend a lot of time at home, so one would expect this number to be higher.

Avoiding falls

One can easily reduce the risk of falling greatly by taking certain measures. A list of measures normally recommended by the authorities is given below:

- Begin a regular exercise program.
    - Exercises that improve balance and coordination are the most helpful.
    - Is the only measure that *by itself* reduces the risk of falling independently of individual circumstances.
- Have your health care provider review your medicines, even over-the-counter ones.
    - Avoid medicines that can make you dizzy or sleepy.
- Have your vision checked.
- Make your home safer.
    - Remove or fasten small rugs and carpets.
    - Remove wires and cords away from commonly taken paths. Tape wires to the walls, and if necessary install an additional power outlet.
    - Keep items where you can reach them without having to climb. If you have to use a step stool, get a stable one with handrails.
    - Remove loose items that can make you trip (books, papers, clothes, etc.) from the floor and stairs.
    - Add grab bars and non-slip mats to the bathroom.
    - Make your home brighter.
    - Repair broken or uneven steps and handrails in the staircase.
    - Avoid using the staircase more than necessary, for instance by installing a light switch at the top as well as the bottom of the stairs.
- Miscellaneous:
    - Wear shoes, even inside. Avoid walking barefoot or wearing slippers.
    - Get up slowly after you sit or lie down.
    - Keep yourself updated on your own medical conditions.
    - Learn how to properly use your walking aids.
    - Keep a healthy diet, drink enough water. Dehydration and malnutrition weaken your reflexes and attention.

Medical personnel are recommended by researchers to prevent falling by treating medical conditions that cause falls, as well as reducing the risk factors in the individual. When a fall happens, medical personnel is advised to spend time inquiring the details related to the accident in order to understand the causes of falling for the individual, and then try to counteract these risks.

Physiological aspects

The list below explains the physiological factors that contribute to stability. “A marked deficit in any one of these factors may be sufficient to increase the risk of falling; however, a combination of mild or moderate impairments in multiple physiological domains also may increase the risk of falling. By directly assessing an individual's physiological abilities, intervention strategies can be implemented to target areas of deficit.” [4]

- Reaction time
    - Hand
    - Foot
- Vision
    - Contrast sensitivity
    - Visual acuity
- Vestibular function
    - Visual field dependence
- Peripheral sensation
    - Tactile sensitivity
    - Vibration sense
    - Proprioception
- Muscle force
    - Knee flexion
    - Knee extension
    - Ankle dorsiflection

There exists an array of tests that can measure the performance on these aspects. Lord et al. [4] provides one possible set of tests. Some of these are likely possible to implement as a part of our application, but none of them are based on hip movement.

The test developed by Lord et al. [4] was used to classify older adults into fallers or non-fallers, and has an accuracy of 75 - 80 % in different experiments. If a test which disregards hip movement patterns performs well, it indicates that hip movement is only a minor factor in detecting fall risk.

Walking behaviour seems to be generally associated with falling. Lord et al. [6] shows that there is a negative correlation between falling and steps per minute, stride length and stride velocity. A positive correlation was shown between falling and stance duration and stance percentage. However, these physiological traits are all associated with old age, and old age is associated with falling, so the relation might be quite indirect.

“In old age, the ‘strategy’ for maintaining balance after a slip shifts from the rapid correcting ‘hip strategy’ (fall avoidance through weight shifts at the hip) to the ‘step strategy’ (fall avoidance via a

rapid step) to total loss of ability to correct in time to prevent a fall" [7].

Bibliography:

Information targeting older adults and their relatives

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http://www.cdc.gov/HomeandRecreationalSafety/Falls/WhatYouCanDoToPreventFalls.html

[2] "Preventing Falls: How to Develop Community-based Fall Prevention Programs for Older Adults", Centers for Disease Control and Prevention
http://www.cdc.gov/HomeandRecreationalSafety/images/CDC_Guide-a.pdf

[3] "Don't fall for it", the Australian Government Department of Health and Ageing
http://www.stopfalls.org/resources/downloadables/dont_fall_for_it.pdf

Scientific papers

[4] "A Physiological Profile Approach to Falls Risk Assessment and Prevention", Stephen R. Lord, Hylton B. Menz and Anne Tiedemann, Journal of the American Physical Therapy Association.
http://ptjournal.apta.org/content/83/3/237.full

[5] "Power Training Improves Balance in Healthy Older Adults" Rhonda Orr, Nathan J. de Vos, Nalin A. Singh, Dale A. Ross, Theodora M. Stavrinos and Maria A. Fiatarone-Singh. Journal of Gerontology: MEDICAL SCIENCES 2006, vol 61A, No. 1, 78-85.

[6] "Sensori-motor Function, Gait Patterns and Falls in Community-dwelling Women". Stephen R. Lord, David G. Lloyd, Sek Keung Li. Age and Ageing 1996:25:292-299.

[7] "Falls in older people: epidemiology, risk factors and strategies for prevention". Laurence Z. Rubenstein. Age and Ageing 2006; 35-S2: ii37–ii41.