DEPRESSION AND FALLS AMONG COMMUNITY DWELLING ELDERLY PEOPLE: A SEARCH FOR COMMON RISK FACTORS

A Biderman, J Cwikel, A V Fried, D Galinsky

DESIGN: This was a cohort study drawn from a primary care clinic, with a one year follow up. Dependent measures included: reporting two or more falls in the past year and a score of 7 or over on the S-GDS (Short Geriatric Depression Scale). A parsimonious set of risk factors was selected that predicted both outcomes based on a series of discriminant function analyses.

PARTICIPANTS AND SETTING: The setting was a primary care clinic serving a mixed socioeconomic population, in Beer Sheva, Israel. The sample included 283 General Sick Fund members, aged 60 and over, who completed both baseline assessments and one year follow up interviews.

MAIN RESULTS: Among the one year follow up, 12% of the sample reported frequent falls in the past year and 25.5% of the sample screened positive for depressive symptoms. A set of five risk factors that included: poor self rated health, poor cognitive status, impaired ADL, two or more clinic visits in the past month, and slow walking speed (>10 seconds over five metres) was successful at discriminating between fallers and non-fallers (86% discrimination) and between those with and without depressive symptoms (76%). For every risk factor added, there was a significant increase in the proportion of respondents who had depressive symptoms. A similar result was found for falls.

CONCLUSIONS: These results show that there is a common set of risk factors that increase the risk of two common outcomes in geriatric medicine, falls and depression. For a general practitioner or a geriatric physician, it might be easier to detect these risk factors than to diagnose depression or high risk for falls. When these risk factors are detected in patients the physician can then be more active in direct probing about depression and falls.

METHODS

SUBJECTS

The subjects were members of the General Sick Fund (Kupat Holim), the largest Health Maintenance Organisation in Israel, which was associated with the Labor Federation.
Respondents residing in the catchment area of an urban, community primary care clinic in Beer Sheva were asked to take part in a demonstration project. Of the 567 elderly persons who met the inclusion criteria (age over 60, independent function, ability to take part in an interview) 361 (64%) signed an informed consent form according to Helsinki Committee approval and agreed to take part in a project on fall prevention (NEFI- Negev Elderly Fall Intervention). Reasons for non-participation included lack of time or interest, inconvenience, or disinclination to become involved in an intervention programme. The respondents were interviewed either in their homes or in the clinic by trained interviewers. Interviews were conducted in Hebrew, Russian, Romanian, Spanish, English, and French depending on the preference of the respondent. At a one year follow up, 283 (78%) were re-interviewed. The main reasons for non-completion of second year interviews included inability to renew contact (n=15), refusal (n=15), death (n=7), significant health problems (n=7), moved out of town (n=9), other reasons (n=25). There were no significant differences between those who participated in the second interview and those who did not on falls, ADL, IADL, self rated health, cognitive impairment, and number of clinic visits (p=0.90, 0.85, 0.19, 0.50, 0.78, 0.43, respectively). Among the seven persons who died, there was a significant trend toward high scores of the depression scale (5 of 7 scored in the depressed range) and those who were lost to contact were also more likely to have had higher depression scores than those who were re-interviewed (34.3% versus 17.5%, p=0.03).

**Measures**

The baseline questionnaire included information on demographic variables, functional (ADL and IADL) status, self reported health assessment and change in health status, clinic visits, hospitalisations, chronic medical problems, and use of medications. Specific questions were asked about the frequency of meetings with friends and family. A series of 12 questions were asked about social and leisure time activities. Those who reported doing three or less were considered inactive. Both self rated health and self rated physical activity were based on single questions measured on a five point scale. The medical problems included heart disease, hypertension, diabetes, CVA, COPD, orthopaedic problems, muscular weakness, vision and hearing impairments, and mental illness. We defined vision and hearing problems as those that were not correctable by glasses or hearing aids. Respondents were asked whether they regularly used the following types of medications: diuretics, laxatives, digoxin, β blockers, corticosteroids, tranquilizers and hypnotic medications, insulin, oral hypoglicamics, anticoagulants, non-steroidal anti-inflammatory drugs, and any other drugs. (The interviewers were instructed to write down the commercial name of the medications and then consulted with a project physician in order to code it correctly).

Falls were defined as “an event when you find yourself unintentionally on the floor after you were in a standing or sitting position”. Retrospective falls in the past year were recorded, and those who had fallen were asked about the circumstances of the fall and its outcome. Only 0.3% of the sample in the baseline interview did not recall whether they had fallen or not and these were excluded from later analyses. Fallers were defined as having reported at least two falls in the past year. Depressive symptoms were evaluated using the short version of the Geriatric Depression Scale (GDS) that has been validated for use in Israel. The depression scale was used with its validated cut off score (7 and above is considered to be in the depressed range). Cognitive impairment was assessed using a shortened version of the short form of the Brookdale Cognitive Screening Test (BCST), which has also been validated in Israel. This test has six items, with each question being scored for full, partial or no correct answer. The cut off score was more than two items completely wrong or four items partially wrong.

In addition, respondents took part in a fall-risk assessment procedure—EFST (Elderly Falls Screening Test)—that has been described in detail elsewhere. The EFST consists of five items, three questions about falls (using the same definition as mentioned above), injurious falls and near falls, measurement of walking speed (>10 seconds over five metres is considered a slow gait) and an assessment of unsteady or uneven gait (for example, shuffling feet, wide walking base). Interviewers were specially trained to conduct the EFST. The one year follow up interview included the same items that measured the outcomes of interest in this study; falls and depression.

**Statistical methods**

The descriptive variables that describe the population were analysed by univariate distributions. Then bivariate analyses identified significant risk factors at baseline that predicted both depression and falls in the follow up period. All variables were dichotomised at either validated cut off points (depression, cognitive status) or at points where a physician would consider this a significant indicator of poor health (for example, greater than three chronic conditions, three or more routine medications, any ADL limitation). Unadjusted relative risk ratios (RR) were calculated. It was striking to note how many of the risk factors were common to both depression and falls. Those risk factors that were significantly associated with both depression and falls in the follow up period were entered into a series of discriminant function analyses to select a parsimonious group of factors that were common to both outcomes. When a set of five common factors were found, an index was created that counted the number of risk factors. Falls in the past year and a high score on the depression scale were added to this index to determine its success in predicting depression and falls, respectively over the one year follow up.
We looked separately at new incident cases of both depression and falls to generate hypotheses but found that the numbers were too small to conduct separate multivariate analyses. Ideally, the detection of separate risk factors should focus on such incident cases in order to find unique predictors for falls and depression, but this was not possible with these data. There were only 17 new fallers among elderly persons who did not report falls at baseline and 48 persons with high scores on physical activity, affective state, and fall history and the report of either falls or depression at the one year follow up.

RESULTS
The main demographic features of the study population are shown in table 1. This study concentrated on the young-old as the index group. Among the sociodemographic variables, only female gender is a consistent risk factor for both falls and depression. Most of the health related variables were consistent risk factors for both falls and depression, except a reported change for the worse in health status and problems with hearing or vision. In an effort to find specific medications that were related to falls or depression, we examined each medication in a separate series of bivariate analyses. Of the 10 medications, sedatives and hypnotics were significantly related to depression (p=0.004) and non-steroidal anti-inflammatory drugs (NSAIDs) were associated with falls (p=0.03). Limitations in activities of daily living (both basic and instrumental) were strongly associated with both outcomes, as were most of the parameters of gait, balance, and fall history. Depression at baseline was a significant risk factor for both outcomes, while cognitive impairment was significant only for depression.

We arrived at a parsimonious set of combined risk factors through a series of discriminant function analyses. The factors that were retained included: poor self rated health, poor cognitive status, impaired ADL, two or more clinic visits in the past month, and slow walking speed. As both ADL and IADL are markers for functional disability, we retained only ADL. The balance and gait factors from the fall risk assessment also are markers for functional disability, we retained only ADL.

The relation between the demographic, health status, physical activity, affective state, and fall history and the reporting of either falls or depression at the one year follow up is shown in table 2. Each factor is shown by the category representing a poorer state of health, and the risk ratio was calculated using the category that is indicative of better health as the index group. Among the sociodemographic variables, only female gender is a consistent risk factor for both falls and depression. Most of the health related variables were consistent risk factors for both falls and depression, except a reported change for the worse in health status and problems with hearing or vision. In an effort to find specific medications that were related to falls or depression, we examined each medication in a separate series of bivariate analyses. Of the 10 medications, sedatives and hypnotics were significantly related to depression (p=0.004) and non-steroidal anti-inflammatory drugs (NSAIDs) were associated with falls (p=0.03). Limitations in activities of daily living (both basic and instrumental) were strongly associated with both outcomes, as were most of the parameters of gait, balance, and fall history. Depression at baseline was a significant risk factor for both outcomes, while cognitive impairment was significant only for depression.

We arrived at a parsimonious set of combined risk factors through a series of discriminant function analyses. The factors that were retained included: poor self rated health, poor cognitive status, impaired ADL, two or more clinic visits in the past month, and slow walking speed. As both ADL and IADL are markers for functional disability, we retained only ADL. The balance and gait factors from the fall risk assessment also were closely related, and so walking speed was retained as it was the most significant single factor. Each factor that was retained remained significant in three quarters of the final discriminant functions. Depression at baseline was also retained in predicting falls, as were retrospective falls in the year before baseline in predicting depression. The discriminant functions were successful at distinguishing between fallers and non-fallers (82%) and those with depressed symptoms from those without (76%). The results were better at identifying the non-cases than the cases (84% for non-fallers, 64% for fallers; 82% for not depressed, 59% for those with

### Table 2: Sociodemographic, health, and functional risk factors for falls and for depression among community living elderly assessed at one year follow up (n=283)

<table>
<thead>
<tr>
<th>Factor</th>
<th>Prevalence %</th>
<th>RR (95% CI)††</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sociodemographic</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age &gt;75</td>
<td>15.5</td>
<td>0.56 (0.18 to 1.77)</td>
</tr>
<tr>
<td>Female</td>
<td>58.8</td>
<td>3.93 (1.57 to 9.87)</td>
</tr>
<tr>
<td>Education &gt;10 y</td>
<td>34.1</td>
<td>1.93 (0.99 to 3.77)</td>
</tr>
<tr>
<td>Friends - infrequent meetings</td>
<td>34.3</td>
<td>1.09 (0.56 to 2.13)</td>
</tr>
<tr>
<td>Family status - unmarried</td>
<td>31.8</td>
<td>2.28 (1.21 to 4.30)</td>
</tr>
<tr>
<td><strong>Health related</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor and very poor health (self rated)</td>
<td>23.7</td>
<td>4.82 (1.99 to 1.64)</td>
</tr>
<tr>
<td>Change for the worse in health status last 6 months (self rated)</td>
<td>27.7</td>
<td>1.32 (0.67 to 2.59)</td>
</tr>
<tr>
<td>≥2 clinic visits per month</td>
<td>30.1</td>
<td>1.76 (1.17 to 2.64)</td>
</tr>
<tr>
<td>≥3 Chronic diseases</td>
<td>62.0</td>
<td>2.27 (1.02 to 5.05)</td>
</tr>
<tr>
<td>≥3 Medications taken</td>
<td>41.2</td>
<td>1.93 (1.01 to 3.69)</td>
</tr>
<tr>
<td>Hospitalisation - any, during last year</td>
<td>23.3</td>
<td>1.56 (0.75 to 3.23)</td>
</tr>
<tr>
<td>Vision problems</td>
<td>15.9</td>
<td>0.95 (0.39 to 2.32)</td>
</tr>
<tr>
<td>Hearing problems</td>
<td>5.5</td>
<td>2.34 (0.95 to 5.80)</td>
</tr>
<tr>
<td><strong>Physical and leisure activities</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADL (any limitations)</td>
<td>10.6</td>
<td>6.23 (3.51 to 11.04)</td>
</tr>
<tr>
<td>IADL (2 or more limitations)</td>
<td>34.7</td>
<td>5.89 (2.76 to 12.54)</td>
</tr>
<tr>
<td>Total leisure activities &lt;3</td>
<td>11.3</td>
<td>0.73 (0.58 to 0.96)</td>
</tr>
<tr>
<td>Physical activity (self rated)</td>
<td>35.4</td>
<td>2.19 (1.16 to 4.14)</td>
</tr>
<tr>
<td><strong>Affective/cognitive</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depression at baseline</td>
<td>16.8</td>
<td>2.83 (1.50 to 5.34)</td>
</tr>
<tr>
<td>Cognitive impairment</td>
<td>7.8</td>
<td>2.27 (0.97 to 5.30)</td>
</tr>
<tr>
<td><strong>Falls and gait</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; one fall per year</td>
<td>11.2</td>
<td>6.64 (3.75 to 11.74)</td>
</tr>
<tr>
<td>Near falls often or occasionally</td>
<td>26.0</td>
<td>1.29 (1.10 to 1.51)</td>
</tr>
<tr>
<td>Slow walking speed</td>
<td>20.0</td>
<td>1.41 (1.16 to 1.73)</td>
</tr>
<tr>
<td>Unsteady/uneven gait</td>
<td>28.0</td>
<td>1.26 (1.10 to 1.43)</td>
</tr>
<tr>
<td>Injuries fall in the past year</td>
<td>8.5</td>
<td>1.35 (0.84 to 2.16)</td>
</tr>
</tbody>
</table>

*p<0.05; **p<0.01; ***p<0.001; ****p<0.0001. †Unadjusted relative risks (RRs) and 95% confidence intervals (CIs). ††Falls: two or more falls in the past year. §Depression: total of seven or more on the short geriatric depression scale (GDS).
depressive symptoms). The discriminant analysis results did not change when depressive symptoms were added to the predictors for falls. However, the addition of falls to the set of predictors improved the case detection of depression from 59% to 63%.

Figure 1 shows the percentage of the sample that reported falls by the number of risk factors. The second column shows the model with the addition of depressive symptoms. There was no set order in which risk factors were added and therefore any additional factor increased the risk of falls. There was a significant increase in discriminating fallers from non-fallers with the addition of each factor up until three factors, at which point there is a non-significant decrease (χ² for trend = 28.2, p<0.00001). With the addition of depression, there is an increase in falls reported at each level (χ² for trend = 29.6, p<0.00001). However, the addition of depression as a risk factor did not improve the explanatory power (p=0.79).

As there were no significant changes between the level at three risk factors and the level at four or more, these were combined as is shown in figure 2. Here, it is clear that the set of risk factors succeeds very well in predicting both depressive symptoms and falls. The proportion of respondents reporting both falls and depressive symptoms increases dramatically for each risk factor added. In the case of depressive symptoms, the proportion of respondents increases from 14% with no risk factors to 78% with three or more risk factors, yielding a relative risk of 6.6 (χ² for linear trend = 29.7, p<0.0001). The addition of falls to the set of risk factors did not improve the predictive power for depression (similar to predicting falls in fig 1). With falls, the increase in the proportion of respondents who reported falls increased from 3.5% with no risk factors to 46% with three or more risk factors, yielding a relative risk of 13.4 (χ² for linear trend = 29.0, p<0.0001).

DISCUSSION
The results of this study support the third hypothesis about the relation between falls and depression as common outcomes from a set of other risk factors. We were able to identify five risk factors that individually and in combination increased the risk of falls and depression among community dwelling elderly persons seen in primary care. The five risk factors identified were poor self rated health, poor cognitive function, impaired ADL, two or more clinic visits in the past month, and slow walking speed. They represent different, yet overlapping domains in geriatric assessment: medical conditions, psychosocial status, cognitive function, and functional status. Self rated health and two or more recent clinic visits can indicate both acute and chronic morbidity with the addition of negative effect on morale.16 Frequent clinic visits may also be a sign of help seeking, a need for attention, or an indication of a lack of an adequate social support.17 Poor cognitive function reflects neuropsychological status and may be associated with depression.18 Impaired ADL is an expression of functional dependence and one of the most commonly used measures in assessing health in old age. Slow walking speed...
represent psychomotor performance that combines physical agility, strength and proprioception and may also be an expression of psychological status, especially depression. The findings are consistent with the principle of “multifinality,” which means that the presence of a specific risk factor can lead to multiple outcomes, reinforcing the need to adopt a multifactorial model for the change in health status among the elderly.

The identification of depression among the elderly population has been shown to be problematic in primary care. Typically, primary care physicians only recognize a small portion (around 20%) of elderly patients with depression. The main reason is that many elderly persons somatise their depression (around 20%) of elderly patients with depression. The main reason is that many elderly persons somatise their depression (around 20%) of elderly patients with depression.

In this study, we used low ADL as a risk factor for falls and depression. Clinical observations and the literature led us to believe that decline in ADL was more likely to precede the development of depression or falls. In other studies, ADL or physical disability have been used as outcome variables (for example, Tinetti et al and Bruce et al). As others have noted, any one condition can initiate a process of decline in health status in elderly persons, which may then involve other psychological systems leading to functional impairment and disability.

Leisure time physical activity and exercise have been shown to be positively associated with general wellbeing, and lower levels of depression and anxiety, while protecting from the risk of fracture and falls. Our results on the centrality of walking speed and ADL are consistent with these findings. Exercise programmes especially designed for older persons are a promising area for fall prevention.

The results in this study did not implicate hearing and visual problems as risk factors for falls despite the fact that these have been often reported. This may either be because of the relatively small number of respondents with either visual or hearing problems in the study, but probably because of the young-old age group and independent status of the study sample.

The high rate of participation in the study (64%) indicates that the issues of mobility and falls are of interest to a broad selection of independently dwelling elderly persons. We have no further information on those who chose not to participate in the project at Time 1, but their reasons for declining indicate that they may be a more active group.

The study relied on self report of falls, which is known to have some systematic reporting bias because of retrospective recall. However, this practice is consistent with other research protocols that have found that reported falls are an adequate proxy measure for fall incidence. Furthermore, the other results in the study give strong convergent validity to the fall reports.

The multifactorial causation of falls and depression suggests that the most appropriate treatment approach is multidisciplinary, involving medical, functional, and psychosocial aspects of geriatric care. Identification of those patients at high risk of either depression or falls by attending to the accumulation of risk factors, can be a step in primary prevention. The physician’s recommendation can not only improve compliance to medication, but can positively influence attendance at physical exercise and social activities and other lifestyle changes. In interviewing the elderly patient, it is worth asking specifically about the occurrence of falls and to use sample depression screening tests, for example.

In conclusion, falls and depression are common and interrelated symptoms in the elderly. More studies are needed to further elucidate their relation and to strengthen efforts to prevent their occurrence or at least to detect and treat them effectively. This may afford a better quality of life for the rapidly growing elderly segment of the population.

**Key points**

- Depression and falls among elderly persons are two common conditions that are relatively underdiagnosed and undertreated in primary care.
- The objective was to investigate whether there was a common set of risk factors that could predict an increased risk of both falls and depression.
- The setting was a primary care clinic serving a mixed socioeconomic population, in Beer Sheva, Israel. The sample included 283 General Sick Fund members, aged 60 and over, who completed both baseline assessments and one year follow up interviews.
- At the one year follow up, 12% of the sample reported frequent falls in the past year and 25.5% of the sample screened positive for depressive symptoms.
- A set of five risk factors was successful at discriminating between fallers and non-fallers (66% discrimination) and between those with and without depressive symptoms (76%). The risk factors found were poor self rated health, poor cognitive status, impaired ADL, two or more clinic visits in the past month, and slow walking speed (>10 seconds over five metres).
- For every risk factor added, there was a significant increase in the proportion of respondents who had depressive symptoms. A similar result was found for falls.
- For a general practitioner or a geriatric physician, it might be easier to detect these risk factors than to diagnose depression or high risk for falls. When these risk factors are detected in patients the physician can then be more active in direct probing about depression and falls.

**Authors’ affiliations**

A Biderman, Department of Family Medicine, Faculty of Medical Sciences, Ben Gurion University of the Negev, and Klalit Health Services, Beer Sheva, Israel

J Cwikel, Department of Social Work and Centre for Women’s Health Studies and Promotion, Ben Gurion University of the Negev

A V Fried, D Galinsky, Department of Geriatric Medicine, Soroka Medical Centre, Faculty of Medical Sciences, Ben Gurion University of the Negev

**Funding:** this work was partially supported by a grant from Israel’s National Insurance Institute, Division on Special Projects and ESHEL-JONIT. The work was based on the NETI (Neger Elderly Falls Intervention) project.

**Conflicts of interest:** none.

**REFERENCES**


www.jech.com


