Feasible Model for Prevention of Functional Decline in Older People: Municipality-Randomized, Controlled Trial

Mikkel Vass, MD,* Kirsten Avlund, DMed Sci,† Jørgen Lauridsen, PhD,‡ and Carsten Hendriksen, DMed Sci†

(See editorial comments by Dr. Thomas Gill on pp 724–726)

OBJECTIVES: To investigate the effect of an educational program for preventive healthcare professionals in routine primary care on functional ability, nursing home admissions, and mortality in older adults.

DESIGN: A prospective, controlled 3-year follow-up study (1999–2001) in primary care with randomization and intervention at the municipality level and outcomes measured at the individual level in two age cohorts.

SETTING: Primary care.

PARTICIPANTS: Of 81 eligible municipalities in four counties, 34 agreed to participate. A total study population of 5,788 home-dwelling subjects aged 75 and 80 were asked to participate. Written consent was obtained from 4,060 persons (70.1%), of whom 2,104 were living in 17 intervention municipalities and 1,956 were living in 17 matched control municipalities.

INTERVENTION: Intervention municipality visitors received ongoing education, and local general practitioners were introduced to a short geriatric assessment program early in the study period. Control municipalities visitors and general practitioners received no education.

MEASUREMENTS: At the 3-year follow-up, the outcome measures of mortality and nursing home admissions were obtained from all, and the outcome measure of functional ability was obtained from 3,383 (95.6%) of 3,540 surviving participants.

RESULTS: Education improved functional ability (odds ratio = 1.20, 95% confidence interval (CI) = 1.01–1.42, \( P = .04 \)) in intervention municipality participants, notably in the 80-year-olds. There were no differences in mortality (relative risk (RR) = 1.06, 95% CI = 0.87–1.28, \( P = .59 \)) or rates of nursing home admissions after 3 years (RR = 0.74, 95% CI = 0.50–1.09, \( P = .13 \)). Subjects aged 80 benefited from accepting and receiving in-home assessment with regular follow-ups.

CONCLUSION: A brief, feasible educational program for primary care professionals helps preserve older people’s functional ability.


Key words: older people; preventive home visits; assessment; functional ability; community intervention
ed Kingdom in 1990, which was anchored in general practice, triggered a fierce debate because of the lack of conclusive evidence. The results of a long-awaited evaluation study have just been published, and since April 2004, the preventive assessment program in the United Kingdom is no longer a part of the general practitioner (GP) contract.

Since 1998, all Danish municipalities have been required by law to offer two annual preventive home visits to all citizens aged 75 and older. Their main purpose is to support personal resources and networking and to offer social support aimed at preserving functional ability. How to organize and implement the program is at the discretion of each municipality, which receives no detailed guidelines. This is in agreement with the Danish policy of decentralization. District nurses or physiotherapists/occupational therapists primarily conduct visits, and the GPs are rarely directly involved. Lay workers are not a part of the program. National evaluations report that about 60% of those aged 75 and older accept and receive the preventive home visits.

After the law had been in force for a few years, many municipalities came to recognize a need for more knowledge about home visitor qualifications, the best way to conduct the visits, and how to organize the program in the best way, which included targeting clients most in need of the services offered. However, because the legislation had already been introduced, a controlled feasibility study could not be conducted.

It seems relevant to argue that good health and independence, measured as functional ability, is a robust outcome, because it embraces the individual and the medical/administrative discourse. Many geriatric and gerontological primary care problems are associated with professional skills. Furthermore, many clinical and social problems due to functional disability can be improved through flexible interdisciplinary linkage. It was therefore hypothesized that active life expectancy could be improved through education of home visitors and their local GPs by introducing a simple tool, promoting the use of a common professional language, and underlining the importance of avoiding ageism.

The main purpose of the present study was to investigate the effect of an educational program for preventive healthcare professionals in routine primary care on functional ability, nursing home admissions, and mortality in older adults. In addition, the goal was to investigate whether the effects differed by age and baseline functional ability and whether regularity or number of visits was of importance for the possible beneficial effects.

METHODS
Design
A prospective, controlled 3-year follow-up study (1999–2001) with randomization and intervention at the municipality level and outcomes measured at the individual level was designed. Municipalities were included if they offered preventive home visits as prescribed by law and were able to facilitate fair or good rehabilitation and if GPs were able to participate by contract. Fifty of 81 municipalities in four counties met these criteria and were invited, and 34 municipalities agreed to participate. No demographic differences were seen between the participating 34 and the remaining 16 eligible municipalities. None of the municipalities discontinued participation, and none were lost to follow-up.

For sample size and power calculation, a variance component model for capturing the expected intracommunity correlation in the necessary cluster-sampling scheme was postulated. Calculations were conservative in that an unpaired design was envisaged, indicating a need for at least 15 municipalities in each group (intervention and control) and at least 100 older persons in each municipality. A matched randomization design was chosen to allow for the considerable variations in management and organization of preventive home visits among the municipalities. Randomization was performed independently of the investigators after paired matching of intracounty municipalities, urban/rural type, size, and geriatric services. After randomization, there were no differences in baseline characteristics between intervention and control municipalities (municipality size, population density, expenses per 75 inhabitants, total number/staffing of preventive home workers, and general collaboration between general practice and the home care systems).

The Intervention
Based on updated geriatric and gerontological documentation, all intervention municipality visitors received education, and local GPs working in the same intervention municipalities were introduced to a short geriatric assessment program. Twice a year, two key persons from each of the 17 intervention municipalities were entrusted with the task of introducing a standard assessment tool and of promoting training in its use and interpretation. Assessment of functional ability at every visit was recommended. If any suspicion of a health problem emerged, the visitors were asked to consider and discuss contact with the GP, who was urged to avoid ageism and take any encounter seriously. GPs were encouraged to incorporate a short geriatric assessment (the mnemonic 5 D’s: delirium, depression, dementia, drugs, drinks) in his/her usual clinical practice. In nine of the 17 intervention municipalities, at the beginning of the study period, local GPs also accepted and participated in a 2-hour small-group educational session.

Control municipalities received no education and conducted the national preventive program in their own way. Effects of the intervention were measured as a dichotomized variable (intervention versus control) and as a derived intervention-dose variable (high [education to visitors and GPs], medium [intervention only to visitors], control [no education]).

Study Population
The study population has been described in detail elsewhere. Briefly, two cohorts of people aged 75 to 80 living in the 34 municipalities were drawn from the Civil Registration Office. Four thousand three home-dwelling 75-year-olds and 1,785 home-dwelling 80-year-olds were asked to
participate by letter. Written consent was obtained from 2,876 (participation rate 71.8%) of the former and 1,184 (participation rate 66.3%) of the latter. At the 3-year follow-up, the main outcome measure was obtained from 2,529 of the 2,559 75-year-old survivors (98.8%) and from 957 of the 963 80-year-old survivors (99.3%). Twenty-two persons died and four were institutionalized before the intervention started, leaving 2,863 75-years-olds and 1,171 80-years-olds in the study population. There were no major differences in baseline characteristics between intervention and control participants. The derivation of the total study population is shown in Figure 1.19

Outcomes

Functional ability was measured at baseline using questionnaires and after 3 years using a validated mobility scale included as a dichotomized variable: able to manage all activities without help versus need of help for one or more activities.20,21 Mortality and nursing home admissions specified by the Civil Registration Office were measured after 3 and 5 years.

Covariates

The following covariates were used: number of home visits during the 3 years (0, 1–4, ≥5), regularity of preventive contacts (home visits and telephone calls) during the 3 years (regular yearly contacts, any contact, no contact), and sex. The 17 pairs of municipalities were based on the matched randomization, and live alone was measured as “yes” or “no” at baseline.

Statistical Methodology

Mortality and nursing home admissions were analyzed using Cox regression and functional ability with logistic regression with and without the dead. All analyses were intention-to-treat analyses. When analyses were stratified by sex, results were in the same direction for men and women. Consequently, analyses were combined for men and women including sex as a covariate, thus retaining sufficient statistical power.

Ethics

The study complies with the Declaration of Helsinki and was approved by the relevant regional research ethical committees.

RESULTS

The results of the 3-year follow-up analyses in the total study population showed that educational intervention was associated with improved functional ability in persons living in the intervention municipalities (adjusted odds ratio (OR) = 1.20, 95% confidence interval (CI) = 1.01–1.42, $P = .04$). Intervention was not associated with mortality (adjusted relative risk (RR) = 1.06, 95% CI = 0.87–1.28, $P = .59$) and rates of nursing home admissions (adjusted RR = 0.74, 95% CI = 0.50–1.09, $P = .13$).

The age-stratified analyses showed that intervention was associated with beneficial effects on functional ability in the 80-year-olds but not in the 75-year-olds (Figure 2), with the largest effect in those with a high intervention dose ($P = .003$) (Table 1). No effects on mortality or rates of nursing home admissions were seen, although nursing home rates were insignificantly higher in participants living in the control municipalities in both age cohorts. This tendency became clearer after the study ended and the cumulated risk of nursing home admissions reached significance in the 80-year-old group (Figure 3). Days “saved” in nursing homes were 3,450 per 1,000 75-year-olds and 820 per 1,000 80-year-olds over 5 years (Table 2). When analyses were restricted to participants managing all activities without help at baseline, similar dose-response effects of intervention were seen (Table 1). No effects were seen in persons in need of help at baseline for one or more activities in either age group.

The number of home visits and regularity of contacts did not attenuate the associations between intervention and functional ability, but in the 80-year-old cohort, a dose-

![Figure 2. Mortality and nursing home admission risk ratios and functional ability odds ratios between intervention and control participants (95% confidence intervals) 1999–2001 in the two age cohorts. (All analyses adjusted for sex, functional status and living alone at baseline, and municipality pairs). Odds ratio less than 1 is associated with lower mortality, lower risk of admission to nursing home in the study period, and better functional ability on the Mobility-Help scale.](image)
response effect of the number of home visits \((P = .02)\) and regularity of contacts \((P = .02)\) on functional ability was observed, although it was not in the 75-year-old cohort.

**DISCUSSION**

The main claim is that a brief, manageable, and ongoing educational intervention for professionals working with preventive home visits was feasible and improved older people’s functional mobility. Effects were stronger in 80-year-old home-dwelling people than in 75-year-olds, and the difference in cumulated risk of nursing home admissions reached significance in the former cohort. Increased effects were seen when GPs in the community participated in the education. Accepting and receiving regular preventive home visits was associated with better functional mobility in 80-year-olds.

The premises for this proactive assessment model must be kept in mind. First, it must be seen in the context of the Danish healthcare system. The current Danish population is 5.3 million inhabitants, of whom 15% are aged 65 and older. The counties are responsible for hospital and specialized geriatric and psychogeriatric treatment and rehabilitation, the municipalities for home and institutional care and long-term rehabilitation. GPs are responsible for health problems in the primary care sector, where they are organized in independent, private practices contractually funded by the counties, but they have no community service authority. Hospital, general practice, and community services are all fully tax financed. Second, district nurses, who focused on establishing a trustful relationship and who were encouraged to raise issues of everyday life relevance and to offer general health-promoting advice and guidance, usually conducted the national in-home preventive assessment programs. If appropriate, identified relevant health or social problems revealed during the home visit could result in practical or personal support. Follow-up visits were able to identify changes over time. Third, all the participating study municipalities were motivated and had at least fair possibilities for promoting rehabilitation. They had all agreed to uphold the legislation and to join a scientific study and had claimed political support to act on discovered relevant needs and the will to solve identified problems identified during the visits. Finally, academics also working in primary care delivered the educational study intervention.

**Limitations**

Noninstitutionalized individuals were targeted, and the 30% overall refusal rate among eligible subjects may represent a weakness. However, analysis of the nonparticipants revealed no major differences in mortality between intervention and control municipalities at follow-up (data not shown).

At baseline, 81% of the 75-year-olds and 69% of the 80-year-olds were nondisabled. The mortality rates in both age cohorts over the 3 years were low, which is reported to favor the achievement of beneficial effects of in-home assessment. Because death is associated with functional decline, and there was an insignificantly higher mortality.

**Table 1. Odds Ratios (ORs) of Having Better Functional Mobility After 3 Years in Two Age Cohorts**

<table>
<thead>
<tr>
<th>Groups Compared</th>
<th>Age at Baseline</th>
<th>OR (95% Confidence Interval)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>75 ((n = 2,863))</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intervention vs control*</td>
<td>1.03</td>
<td>(0.83–1.28)</td>
<td>0.77</td>
</tr>
<tr>
<td>Intervention dose (vs control)*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Only municipality intervention</td>
<td>1.27</td>
<td>(0.93–1.73)</td>
<td>0.13</td>
</tr>
<tr>
<td>Municipality and GP intervention</td>
<td>0.85</td>
<td>(0.64–1.15)</td>
<td>0.31</td>
</tr>
<tr>
<td>Number of preventive home visits (vs no visits)†</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1–4</td>
<td>0.76</td>
<td>(0.60–0.96)</td>
<td>0.02</td>
</tr>
<tr>
<td>≥5</td>
<td>0.88</td>
<td>(0.57–1.37)</td>
<td>0.58</td>
</tr>
<tr>
<td>Contacts (vs no contacts) (visits and telephone calls)‡</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preventive contacts</td>
<td>0.80</td>
<td>(0.61–1.05)</td>
<td>0.11</td>
</tr>
<tr>
<td>Regular yearly contacts</td>
<td>0.91</td>
<td>(0.69–1.12)</td>
<td>0.49</td>
</tr>
<tr>
<td>No disability at baseline (manage all activities without help)§</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Only municipality intervention vs control</td>
<td>1.14</td>
<td>(0.80–1.62)</td>
<td>0.48</td>
</tr>
<tr>
<td>Municipality and GP intervention vs control</td>
<td>0.97</td>
<td>(0.70–1.34)</td>
<td>0.83</td>
</tr>
<tr>
<td>Preventive contacts vs no contacts</td>
<td>0.80</td>
<td>(0.61–1.05)</td>
<td>0.11</td>
</tr>
<tr>
<td>Regular yearly contacts vs no contacts</td>
<td>0.91</td>
<td>(0.69–1.12)</td>
<td>0.49</td>
</tr>
</tbody>
</table>

Note: Odds ratio $> 1$ is associated with better functional ability on the Mobility-Help scale.

* Analyses adjusted for sex, municipality pairs, functional status, and living alone at baseline.

† Statistically significant.

‡ Analyses adjusted for intervention dose, sex, municipality pairs, functional status, and living alone at baseline.

§ Analyses adjusted for sex, municipality pairs, and living alone at baseline; n = 2,863 age 75, n = 503 age 80.

GP = general practitioner.
rate in both intervention cohorts, the theoretical possibility of a survivor selection phenomenon could account for some of the effects, but when the dead were included in the analysis as disabled, all effects were similar (data not shown), and there was no difference in mortality after 5 years.

Blinding may represent a problem because the study was mentioned in the invitation letter and in local newspapers to obtain a high response rate for the questionnaire surveys. Consequently, all participants knew that their municipality took part in a project, but they did not know whether they belonged to an intervention or a control municipality. No overall differences in participant response rates were observed between intervention and control municipalities, and during the 3 study years, fewer persons accepted and received at least one preventive home visit in the intervention municipalities than in the control municipalities, which supports that most participants were blinded to the intervention.

The results did not change when adjusted for municipality variation, which justifies the matched design. The municipalities could not be blinded to the intervention, but data collection from the municipalities varied in both directions. It may therefore be argued that there was no systematic overreporting from intervention municipalities, although it was impossible to avoid communication between home visitors working in intervention and control municipalities, even if no educational intervention took place in the latter. During the study period, county meetings took place (not a part of the study) during which preventive home workers from intervention and control municipalities exchanged experiences. This could have diluted some of the intervention, but all these “control interventions” would tend to underestimate positive effects.

**Strengths**

Study strengths were the absence of major baseline municipality differences, the high number of municipalities from several geographic regions, the high number of participants with an extremely low drop-out rate, and the incorporation of a detailed cost-effectiveness analysis, the promising results of which will be published elsewhere. The findings have widespread generalizability, also because of the highly feasible nature of the intervention design and the use of structured guidelines, which paved the way for easy implementation in regional education. A further strength is the ongoing possibility of follow-up. It is remarkable that effects on nursing home admissions continued after the intervention ended. The study questions whether 3 years in general is an optimal follow-up period, and it points to sustainable effects of the intervention.

**Implications**

It is noticeable that the educational efforts (indirect intervention) were measurable at the individual level, even if only 60% of the home-dwelling participant population accepted and received the core home-visit service. It underlines the educational potential in primary care and implies that preventive home visiting demands skill. It is tempting to state that general spin-off effects of the education to other professionals of the home care systems could be a contributory cause.

**Table 2. Mean Nursing Home Days in Intervention and Control Groups After 3 and 5 Years**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>75</td>
<td>Intervention (n = 1,460)</td>
<td>6.78 (n = 30)</td>
</tr>
<tr>
<td></td>
<td>Control (n = 1,403)</td>
<td>10.97 (n = 37) P = .13</td>
</tr>
<tr>
<td>80</td>
<td>Intervention (n = 632)</td>
<td>14.34 (n = 23)</td>
</tr>
<tr>
<td></td>
<td>Control (n = 539)</td>
<td>14.67 (n = 26) P = .95</td>
</tr>
</tbody>
</table>
The intervention effect was clearly stronger in the 80-year-old group when home visitors and GPs were presented to the assessment tools and instructed on how to interpret and use them. This underlines the often-claimed need for qualified interdisciplinary education and is fully in agreement with the intention of testing a simple tool for managing problems often occurring in older people. Being alert to tiredness in daily living seems, in addition to promoting notice of functional decline in the individual assessment situation, to catalyze and promote a common language for primary care professionals.

Targeting the older population lies at the heart of proactive health-promotion programs. An “optimal preventive period” in old age may be related to a susceptible phase in every individual’s functional pattern. Patterns of functional decline vary for men and women.10,12 Older men in general have better functional abilities than women in the same age group. Beneficial effects of home assessments have previously been found in favor of women.12 Hence, the influence of home visits on functional decline may have an age and sex bias.

Proactive prevention programs would only play a limited role once elderly people have passed “a point of no return” in a functional decline pattern. The possible reversibility in earlier stages of decline is fully in agreement with what some trials report.4,5 Moreover, these analyses established that all positive effects were seen when intervention effects were measured in those who were nondisabled at baseline.

These results suggest that, in a rich welfare state context, where a national, proactive, municipality-based in-home assessment program is being implemented, professional skill and interdisciplinary education should be given priority and greater attention should be paid to early triggers of functional decline. It is not possible from this study to conclude which authority in primary care can best manage a preventive program, but it seems justified to target the group of “not considerably disabled,” and not to start at too early an age because the beneficial effects are most obvious for 80-year-olds. Other preventive, sex-based strategies for the “younger old” may facilitate health promotion in old age.

ACKNOWLEDGMENTS
We thank all participating municipalities and Eva Jepsen, Lisbeth Willemoes Sorensen, and Annette Johannesen for following up the questionnaires. We are indebted to Christian Cato Holm for data management and development of municipality registration software.

REFERENCES