

# Positive health outcomes following health-promoting and disease-preventive interventions for independent very old persons: Long-term results of the three-armed RCT Elderly Persons in the Risk Zone



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## ARTICLE INFO

### Article history:

Received 4 October 2013

Received in revised form 25 December 2013

Accepted 27 December 2013

Available online 7 January 2014

### Keywords:

Health promotion  
Disease prevention  
Aged 80 and over  
Self-rated health  
Morbidity  
Symptoms

## ABSTRACT

The aim of this study was to analyze the long-term effect of the two health-promoting and disease-preventive interventions, preventive home visits and senior meetings, with respect to morbidity, symptoms, self-rated health and satisfaction with health. The study was a three-armed randomized, single-blind, and controlled trial, with follow-ups at one and two years after interventions. A total of 459 persons aged 80 years or older and still living at home were included in the study. Participants were independent in ADL and without overt cognitive impairment. An intention-to-treat analysis was performed. The result shows that both interventions delayed a progression in morbidity, i.e. an increase in CIRS-G score (OR = 0.44 for the PHV and OR = 0.61 for senior meetings at one year and OR = 0.60 for the PHV and OR = 0.52 for the senior meetings at two years) and maintained satisfaction with health (OR = 0.49 for PHV and OR = 0.57 for senior meetings at one year and OR = 0.43 for the PHV and OR = 0.28 for senior meetings after two years) for up to two years. The intervention senior meetings prevented a decline in self-rated health for up to one year (OR = 0.55). However, no significant differences were seen in postponing progression of symptoms in any of the interventions. This study shows that it is possible to postpone a decline in health outcomes measured as morbidity, self-rated health and satisfaction with health in very old persons at risk of frailty. Success factors might be the multi-dimensional and the multi-professional approach in both interventions. Trial registration: NCT0087705.

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## 1. Introduction

The number of very old persons (80+) is growing rapidly both in Sweden and elsewhere (SCB, 2009). This has made us aware of our responsibility not just to take care of the increasing number of older persons that will become ill and dependent but also to help those who are not yet in need of help, to mobilize resources to ensure that they stay independent and healthy (Hebert, 1997). To promote a good quality of life in old age, the effects of health-promoting and disease-preventive interventions should be studied. Both the individuals concerned and society at large would

benefit from the development of interventions to slow down the decline in health of older persons (Agree & Freedman, 2000).

Very old persons are often described as a group which is especially exposed to morbidity and symptoms that sometimes translate into functional disability and dependence (Fried et al., 2001). Morbidity is the incidence or prevalence of a disease (Kleinman, 1988), and symptoms represent an unpleasant or painful experience from any part of the body or psyche (Lenz, Pugh, Milligan, Gift, & Suppe, 1997). Despite the burden of morbidity and symptoms of old age, research shows that many older persons regard themselves as healthy (Sherman, Forsberg, Karp, & Törnkvist 2012). This fact suggests that health is more than the absence of disease. According to WHO' definition of health, health is "a state of complete physical, mental and social well-being" (WHO, 1948). The older persons that live in their own homes, managing most of their daily activities on their own, often have fewer symptoms and a higher quality of life than those who receive help (Hellstrom, Persson, & Hallberg, 2004). It has been shown that

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these persons who have not yet developed disability are the ones that benefit most from preventive interventions (Stuck et al., 2000). Older persons tend to have a strong inner drive to maintain health and should therefore be a suitable target for health-promoting and disease-preventive interventions (Fänge & Dahlin-Ivanoff, 2009). Even if their past lifestyle was not optimal, much can be done to reduce the risk of a decline in health in the future (Rivlin, 2007).

Health promotion can be described as a measure that enables persons to gain more control over their health, while disease-prevention, as its name implies, comprises actions to prevent diseases from developing (WHO, 1986). A number of programs have been developed for older persons. Most of them are disease-preventive, directed toward persons with specific diagnoses (Geddes & Chamberlain, 2001). However, no single approach has been found to prevent the complexity of the deterioration that comes with advancing age (Stuck, Egger, Hammer, Minder, & Beck, 2002). The intervention preventive home visit (PHV) has been frequently used and studied in recent decades. The general aims of such programs are to maintain health and independence, as well as preventing disability and hospital care, thereby reducing costs (Theander & Edberg, 2005; Kronborg, Vass, Lauridsen, & Avlund, 2006; Dahlin-Ivanoff et al., 2010). However, regardless of PHV being an appealing concept, the effects of PHV have been mixed and difficult to compare (van Haastregt, Diederiks, van Rossum, de Witte, & Crebolder, 2000; Elkan et al., 2001; Stuck et al., 2002). Group education has been shown to be a good model for making people change their risk behaviors (Taggart et al., 2012) and increasing participants' knowledge and self-efficacy (Lepore, Helgeson, Eton, & Schulz, 2003). However, research in the area of group education for older persons is limited.

The interventions that have shown the most promising effects in older persons integrate both health-promotion and disease-prevention (Sommers, Marton, Barbaccia, & Randolph, 2000). These multidimensional programs targeting older persons need diverse professionals to be able to offer a broad spectrum of intervention components to carry out an effective program (Gustafsson, Edberg, Johansson, & Dahlin-Ivanoff, 2009). A health-promoting and disease-preventive intervention study, *Elderly Persons in the Risk Zone* (Dahlin-Ivanoff et al., 2010) was therefore set up to evaluate the outcome of a preventive home visit and multi-professional senior group meetings with one follow-up home visit. Earlier publications from this intervention study show that both interventions delayed deterioration in self-rated health, and that senior meetings postponed a decline in ADL in the short term (three months) (Gustafsson et al., 2012). Also, long term (2-years) evaluations show that both interventions postponed a decline in physical performance, falls efficacy, physical activities and ADL (Gustafsson et al., 2013; Ziden, Haggblom-Kronlof, Gustafsson, Lundin-Olsson, & Dahlin-Ivanoff, 2013). The aim of the present study was to analyze the long-term effect of the two health-promoting and disease-preventive interventions preventive home visits and multi-professional senior group meetings concerning morbidity, symptoms, self-rated health and satisfaction with health.

## 2. Methods

### 2.1. Trial design

Elderly Persons in the Risk Zone was a three-armed, single-blinded, randomized intervention study comprising two intervention groups and one control group. It addressed independently living very old persons aged 80 years or older. The regional Ethical Review Board in Gothenburg approved the study (ref.nr: 650-07).

Written informed consent was obtained from the participants. Trial registration: NCT0087705.

### 2.2. Participants and settings

Eligible persons for the study were drawn from official registers of all persons 80 years or older in two urban districts in Gothenburg, Sweden. The two urban districts were situated outside the city center, but within city limits, with a mix of self-owned houses and apartment blocks. The general educational level and income level of residents were slightly higher, and the sickness rate somewhat lower, compared to Gothenburg as a whole. Equal numbers of persons from the two urban districts were listed in random order and included consecutively using simple random sampling until the desired sample size was reached. For more details, see the study protocol (Dahlin-Ivanoff et al., 2010). Inclusion criteria were that the participants should live in their ordinary housing, not be dependent on the home help service or care arranged by the urban districts, be independent of help from another person in activities of daily living and to be without overt cognitive impairment i.e. having a score of 25 or higher as assessed with the Mini Mental State Examination (MMSE).

### 2.3. Interventions

The participants were randomized to receive either one of two interventions or to be in a control group.

#### 2.3.1. A preventive home visit

This intervention was in the form of a single home visit made by a nurse (RN), a physiotherapist (PT), a qualified social worker (SW) or an occupational therapist (OT). During this visit the participants received verbal and written information and advice about what the urban district can provide in the form of local meeting places, activities run by local associations, physical training for seniors, walking groups etc. Information was also provided about help and support of various kinds offered either by volunteers or by professionals employed by the urban districts, and about assistive devices and adaptation of housing. Furthermore, fall risks were identified and advice given on how to prevent falls. Information was also given about whom they could contact for different problems. The preventive home visit was guided by a protocol, which included an opportunity to further elaborate on certain elements (Table 1). The staff were prepared by joint training, and regular staff meetings were held to maintain the quality and standardization of the PHV. The visit lasted between one and a half to two hours.

#### 2.3.2. Multi-professional senior group meetings with one follow-up home visit (abbreviated as senior meetings)

The intervention senior meetings comprised four weekly meetings with no more than six participants in each group, and they each lasted for approximately 2 h including a coffee break. The main purpose was to focus on two different topics: (1) information about the aging process and its consequences and (2) provision of tools and strategies for solving problems that can arise in the home environment. A follow-up home visit took place two to three weeks after the group sessions were completed. The group meetings were multi-professional and multi-dimensional i.e. they were led either by an occupational therapist, a registered nurse, a physiotherapist or a qualified social worker, all of whom were responsible for their particular dimension of aging. The registered nurse was responsible for the topic of self-care and how to use medication. In this meeting how to take care of your health was discussed. Opening questions were: What does health mean to you? and What do you do to enhance or sustain your health? The

**Table 1**

The elements in the protocol used in the preventive home visit (PHV).

Protocol elements
1. Information and advice about, and when appropriate instructions, in a basic home exercise program including balance exercises
2. Assessment of the fall prevention checklist, information and advice on how to prevent identified fall risks and continue be active, and in adequate cases a “safety walk” in the home
3. Information and advice about technical aids and housing modifications, and, if necessary, where and whom to turn to for purchase or application
4. Information and advice about smoking alarms, and, if necessary, an offer to check the smoking alarm
5. Information about the range of help and support available in Gothenburg and in the urban district (volunteers, churches, mission fellow human, health centers, etc.), and where to turn to for help with health problems and illness, opening hours, phone times, and phone numbers
6. Information on the possibility of an appointment with a pharmacist at the local pharmacy for review of and counseling on medicines
7. Information and advice about incontinence
8. Display and hand over a brochure with information on the Swedish legislation and possibilities for advice on and assessment of driving capacity by professionals
9. Information and advice about what the urban district can provide in the form of local meeting places, activities run by local associations, physical training for seniors, walking groups for seniors, and possibility of receiving or providing volunteer interventions
10. Offer to register for “try-out” activities, a standalone group visit to local meeting places, a short introduction to computer sciences, petanque clubs for seniors, gyms for seniors, Nordic walking groups, etc.
11. Information about public transportation, including busses adapted for older adults, and of mobility service for the disabled
12. Information on the Social Services Act, and on where and whom to contact in the urban district in order to apply for home care services

participants discussed what to do in case of emergency, when to call for emergency help, and where to go if they needed health advice. The occupational therapist was responsible for activities in daily living and everyday technology, the physiotherapist's topic was to discuss the aging process, physical activity and nutrition, and the social worker was responsible for the topic of quality of life in old age and for discussions about help, support, activities and meeting places offered by the municipalities. The different professionals' role was to encourage and to guide the participants in the learning process, focused on health-promoting behavior. As the meeting was based a discussion, the participants' experiences formed the basis of the meetings. In contrast to traditional education, the professionals' role was to be enablers, while the participants were the experts. The group dynamics was used as a tool to provide an arena for knowledge exchange. A booklet was especially produced for the meetings. It includes texts that cover different areas of health such as self-care strategies and information on the topics that were discussed at each of the meetings (Table 2). <http://www.vardalinstitutet.net/livslots.pdf>.

### 2.3.3. Control group

The control group had access to the ordinary range of services if requested from the urban districts for older persons. The aim of the municipal provision of care for older persons is to ensure the ability to live as independently as possible. This includes remaining in their homes. When an older person in Sweden has difficulties managing independently, she or he can apply for assistance from the district. The extent of such support is subject to an assessment of needs and includes meals on wheels, help with cleaning and shopping, assistance with personal care, safety alarms and transportation service. The older person is also offered healthcare

**Table 2**

The themes from the booklet used in the senior meetings.

Themes from the booklet	Principal professional <sup>a</sup>
Aging	PT
Physical activity helps keep you physically fit	PT
Food is a prerequisite for health	PT
You can take care of problems with your health	RN
How to use medicines	RN
To cope with everyday life	OT
You do not need to feel insecure	OT
Technology in everyday life	OT
Will I lose my memory?	OT
Life events and quality of life during aging	SW
Anyone who needs help can get help	SW

<sup>a</sup> Physical therapist (PT); registered nurse (RN); occupational therapist (OT); and social worker (SW).

if needed, provided either by municipal home help or home medical care services.

### 2.3.4. Outcomes

Data were collected by research assistants (OT, PT, or RN) in the participant's own home at baseline, one year and two years after interventions. The research assistants were trained in how to administer the assessments, and the inter-rater reliability was tested. Frailty status was measured at baseline as a sum of eight core frailty indicators: weakness, fatigue, weight loss, low physical activity, poor balance, gait speed, visual impairment, and cognition. For cut of and more details see study protocol (Dahlin-Ivanoff et al., 2010). Those who had no frailty indicators were defined as non-frail, those who had 1–2 frailty indicators were defined as pre-frail and those who had >3 frailty indicators were defined as frail (Fried et al., 2001). Deterioration in morbidity, symptoms, self-rated health and satisfaction with health was followed from baseline to one year and from baseline to two years.

**2.3.4.1. Morbidity.** Morbidity were measured with the Cumulative Illness Rating Scale for Geriatrics (CIRS-G) (Linn, Linn, & Gurel, 1968), a quantitative rating instrument of the chronic medical illness burden modified for geriatric assessment. CIRS-G contains 14 organ system categories: heart, vascular, hematopoietic, respiratory, eyes–ears–nose–throat and larynx, upper gastrointestinal, lower gastrointestinal, liver, renal, genito-urinary, musculoskeletal, neurological, endocrine and psychiatric illness. The 14 categories are rated as follows: 0 no problem, 1 current mild problem, 2 moderate disability or morbidity/requires “first line” therapy, 3 severe/constant disability and 4 extremely severe with immediate treatment required. It was the interviewer who performed the rating after the participants had made their reports. We defined morbidity as having at least a number 2, i.e. moderate disability or morbidity, which requires first-line therapy. In this study the number of changes over time in moderate disabilities or morbidity requiring first-line therapy was summarized.

**2.3.4.2. Symptoms.** Self-reported symptoms were measured with the “The Göteborg Quality of Life Instrument (GQL)” (Tibblin, Tibblin, Peciva, Kullman, & Svardsudd, 1990), which is a self-estimate tool giving reliable and stable measurements of symptoms. The GQL instrument is divided into two parts, a symptom section and a well-being section. In this study we only used the symptom section. This part of the questionnaire contains 30 common symptoms with a yes or no response format. The respondents were asked if they were troubled with these

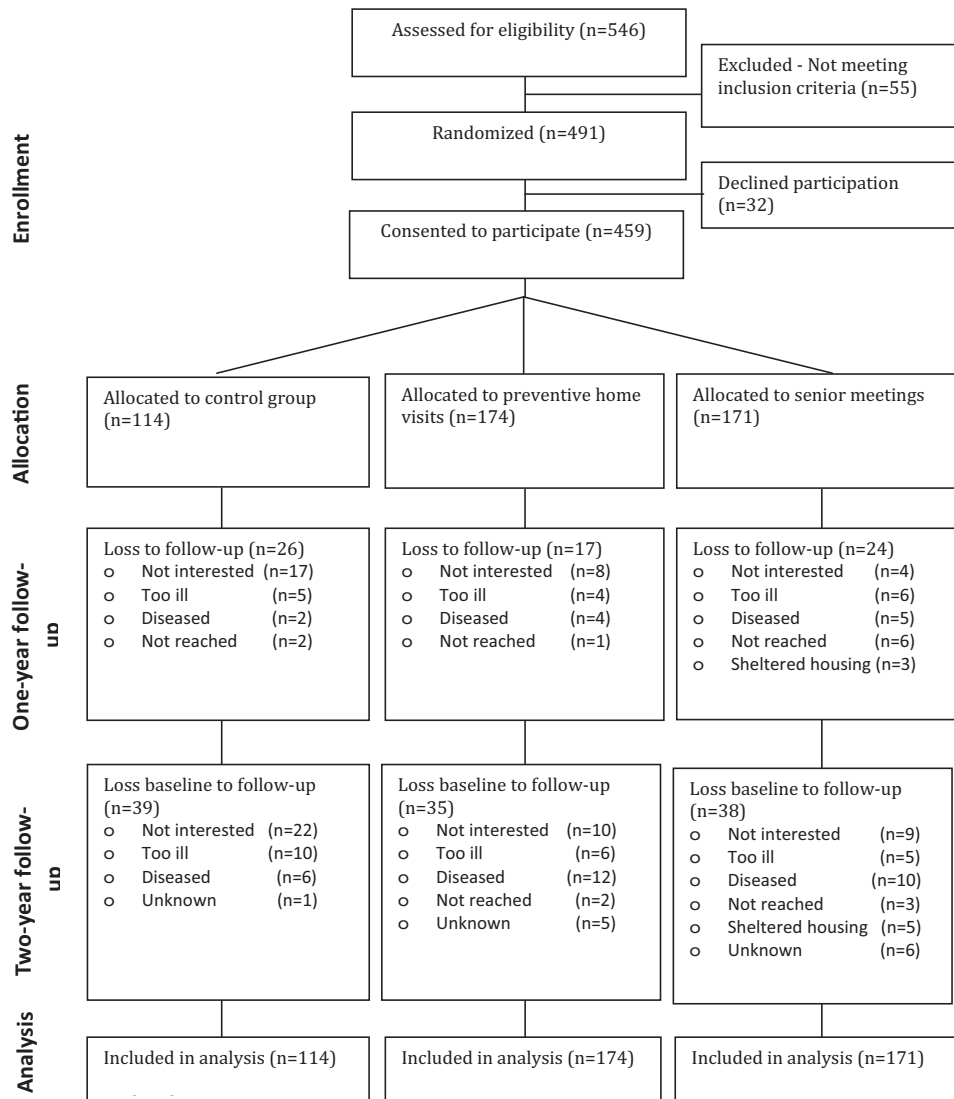
symptoms during the last three months. In this study the number of changes in symptoms over time was summarized.

**2.3.4.3. Self-rated health.** Self-rated health was measured by the first question in SF-36 (Sullivan, Karlsson, & Ware, 1995), where the participants were expected to choose one of the following responses: (1) excellent, (2) very good, (3) good, (4) fair, or (5) bad. In this study the response alternatives were operationalized into good (excellent, very good and good) and bad (fair and bad), and the number of changes in self-rated health over time was summarized.

**2.3.4.4. Satisfaction with health.** Satisfaction with physical and psychological health was measured with the Lisat-11 question about how satisfied you are with physical health and psychological health. Each item is scored on a 6-point scale from 1 (very dissatisfied) to 6 (very satisfied) (Bränholm, Fugl-Meyer, & Fugl-Meyer, 1991; Melin, Fugl-Meyer, & Fugl-Meyer, 2003). In this study the response alternatives was operationalized into satisfied (very satisfied, satisfied, rather satisfied) and not satisfied (very unsatisfied, unsatisfied and rather unsatisfied). The number of changes in satisfaction with health over time was then summarized.

#### 2.4. Sample size, randomization and blinding

A power calculation was conducted before the start of the study. The calculation was based on the expected relative change in functional abilities over time between study arms. This was due to the fact that the outcome measurements used in this study had not been tested for their ability to detect change over time (Altman, 1999). Based on 80% power to detect significance ( $p = 0.05$ , two-sided), 112 persons were required in each intervention group to be able to detect a difference of at least 15% between the intervention groups. Assuming a difference of at least 20%, a comparison between the control group and the intervention groups requires 75 persons in the control group. Accordingly, a total of about 300 persons were needed. To allow for dropouts, a total of about 459 persons were included. An independent researcher not involved in the enrolling of participants or in the interventions organized the allocation system used. The study participants were consecutively and randomly assigned to one of the three study arms by research assistants using opaque sealed envelopes. The research assistants who assessed the outcomes were blind to group assignment, i.e. they were not told which group participants belonged to, and they asked participants not to reveal it at follow-ups.



**Fig. 1.** The flow of participants through the study *Elderly Persons in the Risk Zone* and the reasons for declining participation at one and two-years follow-up.



## 2.5. Statistical analyses

The analyses were made according to the intention-to-treat principle. The basic assumption for imputing data was that very old persons are expected to deteriorate over time in the natural course of the aging process. Therefore, in this paper, the imputation method chosen was to replace missing values with a value based on the Median Change of Deterioration (MCD) between baseline and follow-up. Consequently, the MCD for an outcome measure was added to the individual value recorded at baseline, and imputed, substituting missing data at follow-up. Missing values due to death were imputed with worst-case values at the respective follow up. A complete case analysis was also made that showed aligned trends.

The number of participants that had changed in morbidity, symptoms, self-rated health and satisfaction with health compared to baseline was calculated during the course of the study using the measures described above. As the purpose of the interventions was not to improve the status of the participants but to delay deterioration, we dichotomized the participants into deteriorated/not deteriorated from baseline to follow-up in the final analysis. Analyses were made using an overall Chi<sup>2</sup> test, and were thereafter compared group-wise by calculating the odds ratio (OR). Two-sided significance tests were used throughout. A *p*-value of 0.05 or less was considered significant. Statistical analyses were performed using PASW Statistics, version 20.0 (IBM SPSS Inc., Chicago, IL, 2009).

## 3. Results

Of the 546 persons who were assessed for eligibility, 459 persons met the inclusion criteria, consented to participate, and were included in the study: 114 in the control group, 174 in the preventive home visit group, and 171 in the senior meetings group. The flow of participants through the study is shown in the CONSORT diagram, Fig. 1.

The proportion of dropouts at the one- and two-year follow-ups was 15% and 24%, respectively (*n* = 67/112). All groups were affected, but there was a significantly larger proportion of dropouts in the control group, 23% and 34% (*p* = 0.008/0.036), compared to the preventive home visit, 10% and 20%, and senior meetings, 14% and 22%. No significant differences were found at baseline between participants and dropouts concerning age, gender, marital status, academic education, or living conditions. “Not interested” was the main reason for declining participation in the preventive home visit group and the control group, while the main reason for declining participation in the senior meetings was more varied (Fig. 1). The dropouts at the one-year follow-up had significantly

worse health; 28% reported bad self-rated health compared to 18% among the participants (*p* = 0.03), and had used the municipal home help service to a greater extent than the participants (*p* = 0.002) at baseline. In addition, the dropouts at two years were significantly older (*p* = 0.001), had lower balance scores (*p* = 0.02), and were less physically active (*p* < 0.001) at baseline. Finally, at one year, a total of 11 persons (2%) had died, and at two years the number of deceased had risen to 28 (6%).

The baseline characteristics of the participants are presented in Table 3. There were no significant differences between the intervention groups and the control group in terms of demographic data, morbidity, symptoms, health or frailty. The median age of the participants in the control group was 86 years (range 80–97), 86 years in the preventive home visit (range 80–94) and 85 years in senior meetings (range 80–94).

### 3.1. Morbidity

The odds of seeing a progression in morbidity were significantly lower at the one- and two-year follow-ups in both interventions, compared to the control. The odds ratio was 0.44 (*p* = 0.001, 95% CI = 0.27–0.73) for the PHV and 0.61 (*p* = 0.048, 95% CI = 0.38–0.99) for senior meetings after one year and 0.60 (*p* = 0.035, 95% CI = 0.37–0.96) for the PHV and 0.52 (*p* = 0.008, 95% CI = 0.32–0.84) for the senior meetings after two years (see Table 4).

### 3.2. Symptoms

There were no significant differences concerning the progression of symptoms in either of the intervention groups at the one- and two-year follow-ups compared to the control.

### 3.3. Health

The odds of deteriorating in self-rated health were significantly lower in the senior meetings group compared to the control group at the one-year follow-up, the odds ratio being 0.55 (*p* = 0.039, 95% CI = 0.31–0.97). At the two-year follow-up there were no significant differences between the groups (Table 4).

The odds of becoming less satisfied with physical health were significantly lower at the one- and two-year follow-ups in both interventions compared to the control. At the one-year follow-up the odds ratio was 0.49 (*p* = 0.015, 95% CI = 0.28–0.87) for PHV and 0.57 (*p* = 0.049, 95% CI = 0.32–1.00) for senior meetings, while at the two-year follow-up it was 0.43 (*p* = 0.013, 95% CI = 0.22–0.84) for the PHV and 0.28 (*p* = 0.001, 95% CI = 0.14–0.59) for senior meetings (Table 4).

**Table 3**

Baseline characteristics of study participants, their proportions and *p*-value for differences between groups.

Characteristics	Control group <i>n</i> = 114 <i>n</i> (%)	Preventive home visit <i>n</i> = 174 <i>n</i> (%)	Senior meeting <i>n</i> = 171 <i>n</i> (%)	<i>p</i> -Value
Mean age (range)	86 (80–97)	86 (80–94)	85 (80–94)	0.24
Female	70 (61)	111 (64)	113 (66)	0.63
Living alone	55 (48)	99 (57)	103 (60)	0.10
Academic education	25 (22)	40 (23)	32 (19)	0.69
Non-frail <sup>a</sup>	12 (11)	20 (11)	23 (14)	0.88
Pre-frail <sup>a</sup>	80 (70)	114 (66)	120 (70)	0.86
Frail <sup>a</sup>	22 (19)	40 (23)	28 (16)	0.73
Self-rated health, good	90 (79)	139 (80)	142 (83)	0.63
Moderate illness	102 (90)	163 (94)	160 (94)	0.34
Physical health (satisfied)	107 (94)	159 (91)	163 (95)	0.32
Psychological health (satisfied)	114 (100)	171 (98)	165 (96)	0.11
No perceived symptoms	6 (5)	4 (2)	8 (5)	0.69

<sup>a</sup> Frailty measured with the frailty indicators; weakness, fatigue, weight loss, physical activity, balance, gait speed, visual impairments and cognition and then categorized as non-frail (0 indicators), pre-frail (1–2 indicators) and frail (3 or more indicators).

**Table 4**

The proportion (%), odds ratio (OR), 95% confident interval (CI), and *p*-value for deterioration from baseline in morbidity, symptoms, self-rated health and satisfaction with physical and psychological health between study arms in “Elderly Persons in the Risk Zone”.

Outcome measure	Control group			A preventive home visit				Senior meetings			
		%	OR	%	OR	(CI)	<i>p</i> -Value	%	OR	(CI)	<i>p</i> -Value
Morbidity	(1-Year)	46	1	27	0.44	(0.27–0.73)	0.001	34	0.61	(0.38–0.99)	0.048
	(2-Year)	57	1	44	0.60	(0.37–0.96)	0.035	41	0.52	(0.32–0.84)	0.008
Symptoms	(1-Year)	56	1	49	0.76	(0.48–1.23)	0.265	58	1.10	(0.68–1.78)	0.696
	(2-Year)	61	1	54	0.66	(0.41–1.07)	0.093	61	0.87	(0.53–1.42)	0.584
Self-rated health	(1-Year)	27	1	18	0.58	(0.33–1.02)	0.060	17	0.55	(0.31–0.97)	0.039
	(2-Year)	33	1	24	0.64	(0.38–1.07)	0.090	32	0.95	(0.57–1.57)	0.837
Satisfaction with physical health	(1-Year)	28	1	16	0.49	(0.28–0.87)	0.015	18	0.57	(0.32–1.00)	0.049
	(2-Year)	21	1	10	0.43	(0.22–0.84)	0.013	7	0.28	(0.14–0.59)	0.001
Satisfaction with psychological health	(1-Year)	19	1	10	0.45	(0.23–0.90)	0.023	8	0.34	(0.17–0.72)	0.004
	(2-Year)	29	1	11	0.30	(0.16–0.56)	0.000	14	0.40	(0.22–0.72)	0.002

The odds of becoming less satisfied with psychological health were significantly lower at the one- and two-year follow-ups in both interventions compared to the control. At the one-year follow-up the odds ratio was 0.45 ( $p = 0.023$ , 95% CI = 0.23–0.90) for the PHV and 0.34 ( $p = 0.004$ , 95% CI = 0.17–0.72) for the senior meetings, while at the two-year follow-up it was 0.30 ( $p = 0.000$ , 95% CI = 0.16–0.56) for the PHV and 0.40 ( $p = 0.002$ , 95% CI = 0.22–0.72) for the senior meetings (Table 4).

#### 4. Discussion

The long-term evaluation of *Elderly Persons in the Risk Zone* as concerns morbidity, symptoms, self-rated health and satisfaction with health shows that a preventive home visit and senior meetings are able to postpone a progression of morbidity and delay loss of satisfaction with health for up to two years. Also, senior meetings succeeded in postponing deterioration in self-rated health for up to one year. However, we could not demonstrate that either of the interventions postponed the progression of symptoms.

The fact that health-promoting and disease-preventive interventions are successful in postponing progression in morbidity and maintaining the level of self-rated health and satisfaction with health has, as far as we know, never been demonstrated before. Earlier studies of preventive home visits have shown positive effects on falls, physical function, decreased hospital admissions and postponed mortality (van Haastregt et al., 2000). As for senior meetings, studies have shown earlier that group education interventions can be useful in supporting sustained changes in health literacy and for change in behavioral risk factors (Taggart et al., 2012). Our results are encouraging but might seem contradictory. For example, both interventions postponed further morbidity for up to two years although only senior meetings postponed deterioration in perceived health, and for only one year. The results might possibly be explained with the help of the study by Sherman et al. (2012), who found that 75-year-old persons perceived their health to be good or very good while simultaneously reporting many health problems. This implies that a postponed progression of morbidity has no effect on self-rated health.

Clearly there is also a difference between how the participants perceive their health and how satisfied they are with it. One explanation can be connected to the stereotypic view of aging and to the belief that “be old is to be ill” (Stewart, Chipperfield, Perry, & Weiner, 2012). If older persons expect age to be accompanied by ill health, they might express satisfaction with their state of health despite deterioration in health.

The fact that both interventions postponed morbidity but symptoms progressed in both cases may also appear to be a contradictory result. One plausible explanation for this might be the difference between the measurements. Symptoms are rated subjectively by the participants, while morbidity is first a report from the participants of their diagnosed diseases, which are then rated by the interviewer. It is well known that the reporting of subjective outcomes is colored by personality, culture and other factors (Suh, 2002). Therefore, it is possible that both interventions made the participants more aware of their symptoms, or that merely by asking the participants about their symptoms, the researchers altered the phenomenon itself (Tibblin, Tibblin et al., 1990). CIRS-G rating is done by a professional interviewer, who estimates the burden of disease in the affected organ system with the help of a manual. These two facts might imply that the CIRS-G is a more objective measure than measuring symptoms. CIRS-G has proven to be a good way of measuring morbidity. Wilhelmson, Rubenowitz-Lundin, Andersson, Sundh, & Waern (2006) found that interviewing older persons gives information about illness, functional impairment and health in a broader sense than a review of medical journals.

This study shows that it is possible to postpone a decline in health outcomes measured as morbidity, symptoms, self-rated health and satisfaction with health in independent very old persons at risk of frailty. Success factors in our study can be the multi-dimensional approach used in both interventions. Many components acting both independently and interdependently are at play in multi-dimensional or complex interventions. The sum of the parts in the intervention has been proven to be greater than the value of each part (Gitlin et al., 2006). A qualitative study of the older persons who participated in the senior meetings showed that they experienced the group meetings as a key to action (Behm, Ziden, Duner, Falk, & Dahlin-Ivanoff, 2013). Factors that contributed to this were that they learned a preventive approach (they gained a greater understanding of their health and learned to act strategically) and they belonged to a supportive environment (i.e. they could learn from each other, get good examples and share problems with others). This implies that several factors contributed to their positive experiences. The multi-professional approach is one of those factors since it contributed to the broad spectra of information delivered at the interventions. The participants received information about how to take care of their health (self-care) and how to prevent the deterioration that accompanies old age. Sherman et al. (2012) found that over 40% of the interviewed 75-year-old persons in their study reported problems with knowledge and understanding of their own health. As there is an association between illness and the person's capacity to comprehend health information (Piper, 2009), this finding implies

that older persons need much more information about health and self-care.

Both interventions were participatory, meaning that they focused on individual needs. A recent study of the experience of participating in PHV showed that the intervention empowered and strengthened the participants' self-esteem and gave them a more positive view of their aging (Behm, Ivanoff, & Ziden, 2013). Having a positive view of the aging process has been shown to be important because negative beliefs about aging have emerged as a notable risk factor for negative health outcomes among older persons (Stewart et al., 2012).

Another possible success factor is that the interventions were introduced before these older persons were too frail. Several studies suggest that those who probably benefit most from a health-promoting and disease-preventive program are persons who have not yet suffered any restriction in activity levels or those in the early stages of activity restrictions (Fried, Ferrucci, Darer, Williamson, & Anderson, 2004; Guralnik, Ferrucci, Balfour, Volpato, & Di Iorio, 2001; Hardy, Dubin, Holford, & Gill, 2005). However, other studies show that interventions that targeted those persons have had limited or no effects (Harari et al., 2008).

Our results indicate that the intervention senior meetings had an advantage over preventive home visits in postponing deterioration in self-rated health. Senior meetings postponed deterioration for one year, but neither of the interventions was shown to have had any effect on self-rated health at the two-year follow-up. An earlier study of the same sample three months after the interventions reported that both a preventive home visit and senior meetings postponed deterioration in self-rated health (Gustafsson et al., 2012). Thus, the intervention effect of the PHV stayed at three months and the effect of the senior meetings lasted up to one year. The difference between the interventions may explain why senior meetings had an advantage over the PHV in postponing self-rated health. One difference is that the senior meetings were group-based. The group environment is able to support the members by giving them someone to share problems with. It also gives them the chance to learn from each other (Behm, Ziden, et al., 2013). Peer education is a known concept in the literature, where members of the same age group with similar experiences learn and share health information and health behavior. Fellow participants are often seen as credible sources of information (Shiner, 1999). Another difference is the duration of the intervention. The intervention preventive home visit is a single home visit which lasts for 1.5–2 h, and the intervention senior meeting consists of four meetings and a follow up home visit, each lasting for 2 h. Earlier studies of preventive home visits have concluded that more visits lead to greater effect (Stuck et al., 2002).

The interpretation of our results must take into account our attrition rate and how dropouts are dispersed between study arms, the internal validity. The average dropout rate was low (15%) considering the advanced age of the group, and it was significantly higher in the control group. Furthermore, dropouts had significantly worse health at baseline and reported more weight loss than participants. Subsequently, participants should be dealt with as a healthy population of survivors, particularly the control group, and thus the missing data should be classified as data not missing at random (Little & Rubin, 1987). Hence, using data only from complete cases (Bennett, 2001) would not render true estimates. No statistical strategy can fully deal with all types of missing data, but to ensure the best possible estimate a sensitivity analysis for using different imputation techniques was performed. The choice of imputation method was based on our assumption that older persons (80+) are expected to deteriorate over time, which was verified by our analysis of the dropouts. In line with our findings, Hardy et al. confirm that dropouts in interventions targeting older persons are more likely to show worse outcomes (Hardy, Allore, &

Studenski, 2009). Another way of approaching our missing data would be to use different imputation methods for different reasons for dropout. It is important to be aware that there is no universally applicable method of handling missing values, and that different approaches may lead to different results. However, we believe that it is important to base an approach on clear assumptions, and the conservative choice of imputation method used in this study rather underestimates the intervention effects.

The fact that we used age as a criterion to include those in an early stage of frailty can be discussed. Even if frailty develops as a consequence of age-related decline and that frailty increases with age (Clegg, Young, Iliffe, Rikkert, & Rockwood, 2013), frailty and age are distinct. Rather, frailty may be a measure of a person's biological age (Hogan, MacKnight, & Bergman, 2003). However, in this study the inclusion of those at risk of frailty was rather successful with in total 68% being in a pre-frail phase at baseline. Frailty is an important measure in geriatric and gerontological research and an evaluation of *Elderly Persons in the Risk Zone* as concerns two different measures of frailty are ongoing.

A vital matter when interpreting RCT results is external validity. The general educational and income levels of residents of the two urban districts were somewhat better, and their sickness rate somewhat lower, compared to Gothenburg as a whole. This could affect external validity in two ways. The fact that the participants in this study were well educated and in better health could have meant that the interventions had less impact than they might have had. On the other hand, being well educated makes it easier to understand new information, which could have led to a greater impact. The experience gained from this study forms the basis for the same interventions now being applied among immigrants.

The fact that this study focuses on very old persons whose needs may be less than many others also needs to be addressed. The reason for choosing this group was based on the assumption that those who benefit most from preventive interventions are those who do not yet suffer from dependency and are at risk of frailty (Stuck et al., 2000; Topinková, 2008). The results of this study strengthen that theory.

## 5. Conclusion

This study shows that it is possible to postpone a decline in health outcomes in very old persons at risk of frailty. Both a preventive home visit and senior group meetings can delay deterioration in morbidity and satisfaction with health for up to two years. The senior meetings seem to have a greater effect than the preventive home visit with respect to delaying deterioration in self-rated health, and this effect is evident after one year. Success factors here may be the multi-dimensional and multi-professional approach of the interventions, with several factors at play, acting both independently and interdependently.

## Conflict of interest statement

The authors declare that they have no competing interests.

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