

Multi-component health promotion and disease prevention for community-dwelling frail elderly persons: a systematic review

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Abstract The objective was to investigate definitions of frailty used in studies of multi-component health promotion and disease-preventive (HPDP) intervention programmes for community-dwelling frail elderly persons and to review the content, organisation and effects of HPDP interventions. A systematic review of 19 articles was made, and the International Classification of Functioning, Disability and Health (ICF) was used as a structural framework for the analysis. The result shows that a consensus was reached on including various aspects of impairments in body functions and structures as an integral part of the frailty concept, with the exception of one subgroup: mental/cognitive functions. Additionally, opinions varied quite consistently regarding aspects of activity limitations and participation restrictions, personal and environmental fac-

tors. Ten of the 14 HPDP programmes covered various intervention elements referring to all four ICF components. Eleven programmes involved registered personnel only, while a more divergent pattern was seen in the remaining organisational aspects of the interventions: length of interventions and location plus age segments, participatory approach and contextual information, as well as the theoretical foundation of the interventions. Measures of body functions and structures were significantly improved in 5 out of 17 (29%) targeted aspects. For activity and participation, 12 out of 32 (38%) targeted aspects were positively changed, while the score for environmental factors was 7 out of 22 (32%), and for personal factors 8 out of 22 (36%). Our review suggests that further research is needed to explore and disentangle the complex interrelationships between various interventions and outcomes.

Keywords Vulnerability · Functional decline · Intervention · ICF · Interdisciplinary team

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Background

There is a growing need of interventions targeting elderly people at risk for decline, particularly frail elderly persons who are suffering from co-morbidity, facing functional decline and at risk of, or already, losing their ability to manage everyday activities (Tinetti et al. 1994; Ferrucci et al. 2004; Gill 2005; Vass et al. 2005). It is a heterogeneous group of people at various stages in the process of declining functional ability, and their need of care and rehabilitation varies according to their overall health and functional status. The rationale for the present study was the identified need to conduct an in-depth review of the current literature on the issue in order to compile

knowledge with the intention of forming an evidence-based platform for future interventions.

The ability to manage activities of daily life (ADL) characteristically deteriorates with age, and early signs, such as experienced difficulties, uncertainty and fatigue, are often followed by the need of assistance from someone else in order to manage daily activities (Reuben 1998; Avlund et al. 2001; Avlund et al. 2002). Several reports suggest that there is no single approach that effectively addresses functional problems. Similar to other geriatric syndromes, a multi-component approach may more effectively address functional difficulties (Elkan et al. 2001; Stuck et al. 2002; Ferrucci et al. 2004). Consequently, a multi-component health-promoting and disease-preventive intervention programme (HPDP programme) could avert and delay dependence in ADL and the development of functional decline.

Health promotion is the process of enabling people to increase control over, and to improve, their health, while disease prevention covers measures not only to prevent the occurrence of disease, such as risk factor reduction, but also to arrest its progress and reduce its consequences once established (WHO 2009a). The National Board of Health and Welfare in Sweden (Socialstyrelsen 2005) emphasises that health care should systematically integrate and target specific health-promoting and disease-preventive interventions on a daily basis in order to provide equal health for the whole Swedish population. Such interventions should be considered a natural part of the content in the entire care process. Multi-component interventions, or complex interventions, are conventionally defined as ones with several interacting components (Craig et al. 2008). This is not a strict definition, which invites a wide scope of interpretation. In this context, and for the purpose of this study, a multi-component HPDP programme is therefore defined as a programme consisting of coordinated, multi-strategic initiatives targeting health promotion and disease prevention in all types of organisations providing outpatient health care.

Frailty has become an established concept in research in recent years (Fried et al. 2001; Hogan et al. 2003; Ferrucci et al. 2004; Rockwood 2005a, b; Socialstyrelsen 2007). Notwithstanding, there is no consensus definition (Fried et al. 2001; Hogan et al. 2003; Ferrucci et al. 2004; Rockwood 2005a, b), and different terms are used for defining the concept (Hogan et al. 2003). Frailty becomes more prevalent with age and is associated with an elevated risk for adverse health outcomes including falls, hospitalisation, institutionalisation and mortality (Fried et al. 2001; Rockwood 2005a, b). One definition of frailty is: a state of decreased reserve resistance to stressors as a result of cumulative decline across multiple physiological systems, causing vulnerability to different outcomes (Ferrucci et al. 2004). This

definition of frailty is related to disability and co-morbidity, factors occasionally included in the concept itself and at times explained in relation to frailty (Hogan et al. 2003). Disability is an umbrella term for problems in body functions and structures (e.g. impairments), and activity limitations and participation restrictions, terminology derived from the International Classification of Functioning, Disability and Health (ICF) (WHO 2009c). Co-morbidity is typically defined as the concurrent presence of two or more medically diagnosed diseases. Some researchers advocate expanding the definition of frailty to include additional aspects, for instance, social elements (Markle-Reid and Browne 2003; Rockwood 2005b). An American study (Fried et al. 2001) showed that 7% of the population with 65 years and older could be defined as frail, while a Danish study (Schroll 2006) of 90 year-olds showed that 27% could be defined as very frail. A recently published study states that geriatric frailty is found in 20–30% of the elderly population over 75 years (Topinkova 2008). The prevalence figures vary in relation to increased age but might also differ in regard to the definition of key concepts.

An important public health priority is to identify effective interventions to manage on-going and long-term functional consequences of chronic disease and to improve the quality of life of older members of the community. There are some reviews concerning HPDP interventions for elderly persons (van Haastregt et al. 2000; Elkan et al. 2001; Stuck et al. 2002; Bouman et al. 2008c; Huss et al. 2008), but none of them focuses on frail elderly persons. In addition, the concept of frailty has been studied and reviewed earlier (Hogan et al. 2003) but without focusing on the clinical perspective where frailty is operationalised in HPDP programmes. Finally, it has been suggested that ICF should be used, among other fields, to describe impact, intervention and applied research (WHO 2009b). The ICF is a classification of health and health-related domains and is used to describe and measure health and disability. The domains are classified into two parts, each with two components. The first part covers “Functioning and Disability”, with the components “Body Functions and Structures”, and “Activities and Participation”. Since an individual’s functioning and disability occurs in a context, ICF also includes a second part, “Contextual Factors”, including the components “Environmental Factors” and “Personal Factors”. ICF offers a structural framework for classifying HPDP interventions for frail elderly persons and presenting the results in a common and internationally known language. This is likely to promote communication between the multiplicity of health care researchers when sharing and comprehending research (Jette 2006). Subsequently, the overall aim of this study was to investigate definitions of frailty used in studies of multi-component HPDP programmes for community-dwelling frail elderly

persons and to review the content, organisation and effects of HPDP interventions using ICF as a structural framework. More specifically, we addressed the following research questions:

- How is frailty defined and operationalised in HPDP interventions for frail elders?
- What are the typical components, content and organisational structure of applied multi-component HPDP programmes?
- What are the documented effects of multi-component HPDP interventions for frail elderly persons?

Methods

Eligibility criteria

The intention was to identify original articles on randomised controlled trials (RCTs) concerning community-dwelling persons 65 years or older defined as frail, and with, at least one intervention group of participants receiving multi-component HPDP interventions. Included HPDP interventions were designed to improve or maintain health status and quality of life as well as delaying functional decline and dependence in ADL.

Literature search

The following electronic databases were searched for articles published in English: Ageline, AMED, CINAHL, Cochrane Central Register of Controlled Trials, ERIC and PubMed (until November 2008). The search strategy was deliberately designed to capture a broad range of references, tailored to individual databases, and based both on MESH headings/subject heading and free text search. The following search terms were combined and used: frail elderly, frail, old, elder, health promotion, prevention or promotion and community. Since the term frailty is not used in all studies, we also included the following search terms: vulnerability, at risk, decline, disability and chronic condition.

The database searches resulted in 2,812 findings. All abstracts were pre-screened by one reviewer (the first author) for relevance, outcome and design. In all cases where it was impossible to determine if a study actually met the inclusion criteria on the basis of information in the abstract, the article was retrieved and reviewed in full. A final decision about what articles to include was made in cooperation with a second reviewer (the fourth author). Eighty-five potentially relevant references were selected for detailed evaluation. Publications that were duplicated, not RCTs, and studies in progress were excluded, as well as studies where included participants were younger than

65 years old, not community-dwelling, or not defined as frail (i.e. healthy elderly persons). We also excluded studies offering participants a single-component intervention, for example solitary physical exercise, rather than the desired multi-strategic initiatives exemplified by physical exercise and nutrition supplements or the identification and removal of home hazards. Finally, we excluded interventions that were not primarily offered a frail elderly person on an individual level (i.e. studies including care-givers or spouses) or interventions not offered in an outpatient setting. The two reviewers scanned the reference lists of excluded articles for any additional publication that might have been missed at previous search stages, but none was found.

Finally, a total of 19 articles (Hall et al. 1992; Leveille et al. 1998; Mann et al. 1999; Dalby et al. 2000; Rockwood et al. 2000; Stuck et al. 2000; van Haastregt et al. 2000; Chin et al. 2001; Hebert et al. 2001; Chin et al. 2002; Gill et al. 2002, 2004; Phelan et al. 2004; Holland et al. 2005; Gitlin et al. 2006a, b; Markle-Reid et al. 2006; Bouman et al. 2008a, b), all RCTs concerning community-dwelling persons 65 years or older identified as frail, vulnerable, at risk of functional decline, having disabilities or chronic conditions and receiving multi-component HPDP interventions were included for detailed review (Fig. 1).

Assessment of methodological quality

Methodological quality was determined by two reviewers (the first and fourth author) with the help of critical appraisal criteria in the Updated Method Guidelines for Systematic Reviews in the Cochrane Collaboration Back Review Group (van Tulder et al. 2003).

Data extraction and analysis

Since the 19 selected studies were not sufficiently similar to allow the pooling of data by statistical analyses, this review took a narrative form (Rychetnik et al. 2004). The range of available evidence was described and analysed in order to broaden the knowledge within the areas of the research questions investigated.

Accordingly, data were extracted in order to synthesise the results. Data were analysed using a deductive approach, and the ICF terminology (WHO 2009c) was used as a structural framework for the analysis. In practice, the investigated aspects of the three research questions were matched as far as possible to the corresponding ICF components' body functions and structures, activities and participation, environmental factors and personal factors. In analysing data according to the third research question, the effects of multi-component HPDP interventions, outcome assessments were judged in relation to the main target and

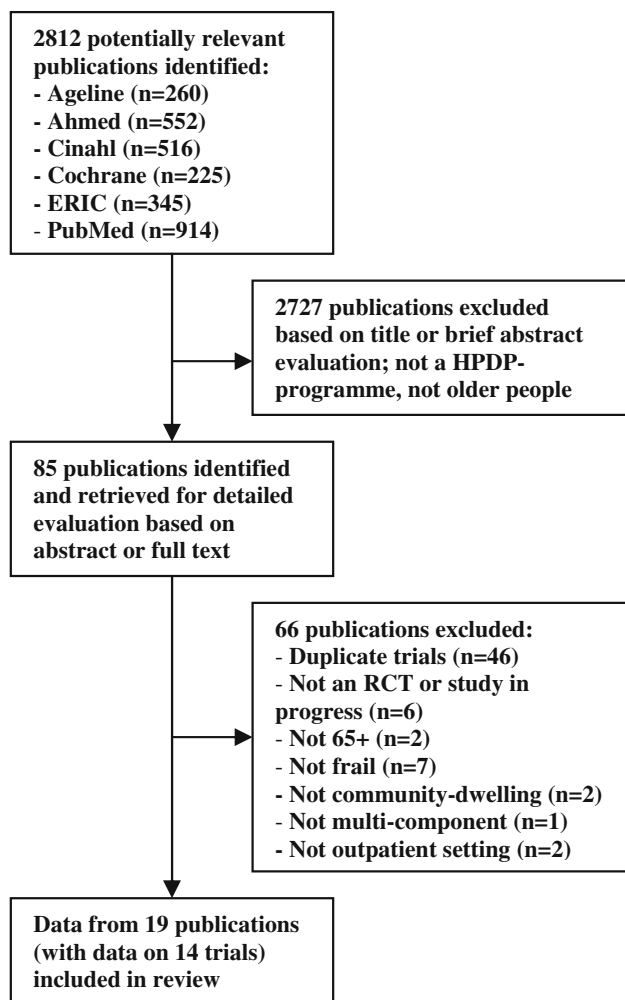


Fig. 1 Identification of 19 eligible RCTs concerning multi-component HPDP interventions for community-dwelling frail elderly persons

then classified as belonging to one ICF component. In cases where studies used lucid multidimensional outcome assessments, parts of the assessment were seen to belong to different ICF components. In addition, a form of vote-counting on the basis of p values (Sutton et al. 1998) was used. A significant difference ($p < 0.05$) between the intervention and the control group in respective trials was defined as a positive outcome for the intervention. Any disagreements between the reviewers (all four authors) on data extraction, or the analysis including classification of data into ICF components, were resolved in consensus discussions. The result of the review is presented for each research question.

Result

The 19 articles included in the review refer to 14 diverse trials; five trials have generated two separate reports each.

Ten of the trials were conducted in North America (five in the USA and five in Canada), and four trials have their origin in Europe (three in the Netherlands and one in Switzerland). In each of the 14 trials, a dissimilar multi-component HPDP programme was evaluated. The 14 trials included a total of 4,192 persons 65 years or older, 2,015 included in the intervention groups and 2,177 belonging to various control groups. The mean age of all participants was 79 years, and 69% of the participants were women (supplementary materials/appendix 1). The methodological quality of included trials varied; seven trials (Hall et al. 1992; Leveille et al. 1998; Mann et al. 1999; Dalby et al. 2000; Rockwood et al. 2000; Chin et al. 2001; 2002; Phelan et al. 2004; Holland et al. 2005) were of low quality according to the criteria (van Tulder et al. 2003), and seven trials were of high quality (Dalby et al. 2000; Stuck et al. 2000; van Haastregt et al. 2000; Hebert et al. 2001; Gill et al. 2002, 2004; Gitlin et al. 2006a; b; Markle-Reid et al. 2006) (Table 1).

Definition of frailty

The articles presented a wide diversity of definitions of frailty and corresponding terms. Some studies contained an in-depth analysis of core concepts, theoretical frameworks and general paradigms enabling contextualisation. There was general agreement about including various aspects of impairments in body functions and structures as an integral part of the frailty concept. A notable exception was one subgroup: mental/cognitive functions. Opinions also differed quite consistently regarding aspects of activity limitations and participation restrictions, personal, and environmental factors. Methods for identifying, and in some cases differentiating and classifying severity were presented in most studies. Details of the analysis are presented below.

Frailty and impairments in body functions and structures

Three trials used the definition of frailty stated in the conceptual model developed by Buchner and Wagner (Leveille et al. 1998; Chin et al. 2001, 2002; Phelan et al. 2004; Holland et al. 2005). In the model, *frailty* is defined as: “A state of reduced physiological reserve associated with increased susceptibility to disability” (Chin et al. 2002). Frail elderly people are considered to be at high risk of functional decline, thus making a separation between, and a reason connection in-between, the concepts frail and at risk of functional decline. Deficits in neurological and musculoskeletal function and energy metabolism (i.e. impairments in body functions and structures) are enumerated as major determinants, and consequently also risk factors, for frailty. It proposes that frailty can be partly

Table 1 Results of quality criteria assessment based on the cochrane collaboration guidelines

Author and reference	A	B	C	D	E	F	G	H	I	J	K	Score	Quality
Bouman A (Bouman et al. 2008a, b)	+	?	+	?	-	+	?	+	+	+	+	7	High
Chin A Paw (Chin et al. 2001, 2002)	+	?	+	-	-	-	?	+	-	+	?	4	Low
Dalby (Dalby et al. 2000)	+	+	-	?	-	+	?	?	+	+	?	5	Low
Gill (Gill et al. 2002, 2004)	+	?	+	-	-	+	?	+	-	+	+	6	High
Gitlin (Gitlin et al. 2006a, b)	+	?	+	-	-	+	?	?	+	+	+	6	High
Hall (Hall et al. 1992)	+	?	-	?	-	+	?	?	-	+	?	3	Low
Hebert (Hebert et al. 2001)	+	?	+	-	-	+	?	?	+	+	+	6	High
Holland (Holland et al. 2005)	+	?	-	-	-	?	?	-	+	+	?	3	Low
Leveille and Pheland (Leveille et al. 1998; Phelan et al. 2004)	+	?	-	-	-	?	?	?	+	+	+	4	Low
Mann (Mann et al. 1999)	+	?	+	-	-	-	?	?	+	+	?	4	Low
Markle-Reid (Markle-Reid et al. 2006)	+	?	+	-	-	+	?	?	+	+	+	6	High
Rockwood (Rockwood et al. 2000)	?	?	+	-	-	+	?	?	+	+	?	4	Low
Stuck (Stuck et al. 2000)	+	+	-	-	-	+	?	+	+	+	+	7	High
Van Haastregt (van Haastregt et al. 2000)	+	?	+	-	-	?	?	+	+	+	+	6	High

A Was the method of randomization adequate? B Was the treatment allocation concealed? C Were the groups similar at baseline regarding to the most important prognostic indicators? D Was the patient blinded to the intervention? E Was the care provider blinded to the intervention? F Was the outcome assessor blinded to the intervention? G Were co interventions avoided or similar? H Was the compliance acceptable in all groups? I Was the drop-out rate described and acceptable? J Was the timing of the outcome assessment in all groups similar? K Did the analysis include an intention-to-treat analysis? + criterion fulfilled; - criterion not fulfilled; ? lack of information

prevented through the identification and monitoring of risk factors and prevention programmes designed to reverse physiological loss. As a consequence, a person can be frail but not necessarily disabled since activity limitations and participation restrictions are seen as a possible outcome of frailty not as a part of the concept itself. Subsequently, the concept of frailty was operationalised as the elderly person being inactive in combination with involuntary weight loss or low body mass index (BMI) (Chin et al. 2001, 2002), alternatively having at least one (Leveille et al. 1998; Chin et al. 2001, 2002; Phelan et al. 2004; Holland et al. 2005) or three chronic conditions (Stuck et al. 2000). Others considered an older person to be frail based on the existence of multiple medical problems (Rockwood et al. 2000) or unspecified functional impairments (Dalby et al. 2000; Rockwood et al. 2000). Two trials included impaired cognitive functions in the concept of frailty (Hall et al. 1992; Rockwood et al. 2000), and one of them specified dementia as a common condition among *frail older people* (Rockwood et al. 2000). In contrast, a number of articles stated that included participants should not be cognitively impaired (Mann et al. 1999; Holland et al. 2005; Gitlin et al. 2006a, b), or should be without dementia (Leveille et al. 1998; Gill et al. 2002, 2004; Phelan et al. 2004).

Frailty and activity limitations and participation restrictions

The concept of frailty can be expanded by accumulating functional decline or disability, including activity

limitations and participation restrictions (Hall et al. 1992; Mann et al. 1999; Dalby et al. 2000; Rockwood et al. 2000; Chin et al. 2001; Hebert et al. 2001; Chin et al. 2002; Gill et al. 2002, 2004; Markle-Reid et al. 2006). As a corollary, *physically frail* older people are considered to present high rates of impairments, activity limitations and participation restrictions (Gill et al. 2004), which in a deterministic way produce loss of autonomy (Hebert et al. 2001). Consequently, physical frailty was operationalised and assessed in clinical practice by tests of physical activities (Gill et al. 2002). Other methods of identifying the target group were to include elderly persons with difficulties in one or more areas of the motor section of the Functional Independence Measure (FIM) in the trial (Mann et al. 1999), those requiring minimal help with bathing and dressing (Hall et al. 1992), and those requiring home care (Chin et al. 2001, 2002; Markle-Reid et al. 2006).

Frailty and personal factors

In order to supplement the above frailty components, a personal factor with internal influences on functioning and disability was added in some trials. One trial added the experience of one or more falls within a year to *functional vulnerability* (Gitlin et al. 2006a, b), while another included the incidence of two or more falls within a 6-month period to define *elderly people at risk* (van Haastregt et al. 2000). Two trials considered a bereavement of any kind to

be a factor in frailty (Dalby et al. 2000; Rockwood et al. 2000), and another included persons that self-rated their health as poor in their denomination *older people with poor health status* (Bouman et al. 2008a, b).

Frailty and environmental factors

The issue of external, environmental, influences on functioning broadens the definition of frailty even further (Dalby et al. 2000; Rockwood et al. 2000; Stuck et al. 2000; Markle-Reid et al. 2006). For instance, persons reporting admission to hospital in the previous 6 months (Dalby et al. 2000), or who reported frequent physician contacts (Rockwood et al. 2000), were regarded as frail. In another study, an elderly person's use of six or more medications, one of several elements included in the term *at risk of functional decline*, was considered to be accumulating factors leading to a high risk of future nursing home admission (Stuck et al. 2000). Polypharmacy and adverse drug events were added as inclusion criteria in another trial (Rockwood et al. 2000). Finally, a separate conception of the complex structure of frailty was described in The Model of Vulnerability (Markle-Reid et al. 2006). Vulnerability is seen as a net result of an interaction between the person's personal resources (cognitive, emotional, intellectual and behavioural) and their environmental supports (social, material and cultural), both of

which, along with biological characteristics (age, gender and genetic endowment), are determinants of health. In other words, vulnerability can be seen as a continuum ranging between low and high levels, which can be influenced in any direction depending on personal recourses and environmental support (Markle-Reid et al. 2006).

Intervention content and organisation

As shown in Table 2, the 14 multi-component HPDP programmes reviewed exhibited both similarities and differences in numerous aspects of intervention content and organisation. Ten of the 14 HPDP programmes covered various intervention elements that refer to all four ICF components. Eleven programmes involved registered personnel only, while a more divergent pattern was seen in the remaining organisational aspects of the interventions; length of interventions and location plus age segments (not shown in the table), participatory approach and contextual information as well as in theoretical foundation of the interventions. A detailed description of the result follows.

Body functions and structures

Two main types of intervention elements were identified. One contained interventions using physical exercise in order to improve underlying impairment in functions

Table 2 Aspects of intervention content and organisation found in the 14 HPDP programmes

Author and reference	Body functions and structures	Activities and participation	Environmental factors	Personal factors	Theoretical foundation	Registered personnel	Participatory approach	Contextual information
Bouman A (Bouman et al. 2008a, b)	Yes (1)	Yes (1)	Yes (1)	No (0)	Yes (1)	Yes (1)	Yes (1)	No (0)
Chin A Paw (Chin et al. 2001, 2002)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	No (0)	No (0)	No (0)
Dalby (Dalby et al. 2000)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	No (0)
Gill (Gill et al. 2002, 2004)	Yes (1)	Yes (1)	Yes (1)	No (0)	No (0)	Yes (1)	No (0)	No (0)
Gitlin (Gitlin et al. 2006a, b)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	No (0)
Hall (Hall et al. 1992)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	No (0)	Yes (1)	Yes (1)	No (0)
Hebert (Hebert et al. 2001)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	No (0)	No (0)
Holland (Holland et al. 2005)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	No (0)	Yes (1)	Yes (1)
Leveille and Phelan (Leveille et al. 1998; Phelan Williams et al. 2004)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	No (0)	Yes (1)	No (0)
Mann (Mann et al. 1999)	No (0)	Yes (1)	Yes (1)	Yes (1)	No (0)	Yes (1)	No (0)	Yes (1)
Markle-Reid (Markle-Reid 2006)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	Yes (1)
Rockwood (Rockwood et al. 2000)	Yes (1)	Yes (1)	Yes (1)	No (0)	No (0)	Yes (1)	Yes (1)	No (0)
Stuck (Stuck et al. 2000)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	No (0)	Yes (1)	No (0)	No (0)
van Haastregt (van Haastregt et al. 2000)	Yes (1)	Yes (1)	Yes (1)	Yes (1)	No (0)	Yes (1)	No (0)	No (0)
Total ($n = 14$)	13	14	14	11	8	11	8	3

related to movement, for instance, strength, speed, endurance, flexibility and coordination training (Chin et al. 2001, 2002; Gill et al. 2002, 2004; Gitlin et al. 2006a, b). The other type comprised a screening for medical conditions and comprehensive geriatric assessments (CGA) followed by treatment recommendations (Leveille et al. 1998; Dalby et al. 2000; Rockwood et al. 2000; Stuck et al. 2000; van Haastregt et al. 2000; Hebert et al. 2001; Phelan et al. 2004; Holland et al. 2005; Markle-Reid et al. 2006; Bouman et al. 2008a, b). An additional intervention component was counselling for depression and low mood (Leveille et al. 1998; Phelan et al. 2004; Holland et al. 2005).

Activities and participation

A common element in this group of intervention components was different types of physical activity, for instance, walking, swimming and tai chi etc. (Hall et al. 1992; Leveille et al. 1998; Chin et al. 2001, 2002; Gill et al. 2002, 2004; Phelan et al. 2004; Holland et al. 2005). Furthermore, safe and effective performance in ADL and instructions in fall-recovering techniques were also reported (Gill 2002, 2004; Gitlin 2006a, b) as well as interventions with an overhaul of transportation and finances (Hall et al. 1992; Bouman et al. 2008a, b). Some programmes contained interventions directed towards communication (Rockwood et al. 2000; Stuck et al. 2000; Holland et al. 2005), for example, enhancing communication with one's general practitioner (GP) (Stuck et al. 2000; Holland et al. 2005). Interventions in the form of education in health (Stuck et al. 2000; Holland et al. 2005; Markle-Reid et al. 2006), or self-management of chronic illness (Leveille et al. 1998; Phelan et al. 2004; Holland et al. 2005; Markle-Reid et al. 2006), were also tested.

Environmental factors

All 14 HPDP programmes contained intervention elements aiming at altering one or more factors in the participant's environment. The identification and removal of home hazards for the prevention of falls were frequently described (Dalby et al. 2000; Stuck et al. 2000; van Haastregt et al. 2000; Hebert et al. 2001; Gill et al. 2002, 2004; Gitlin et al. 2006a, b; Markle-Reid et al. 2006). Two programmes included training in the proper use of prescribed assistive devices (Mann et al. 1999; Gill et al. 2002, 2004), of which the latter had a primary focus on environmental interventions (Mann et al. 1999). Additionally, several trials also offered a run-through of participants' medication use (Hall et al. 1992; Leveille et al. 1998; Dalby et al. 2000; Stuck et al. 2000; van Haastregt et al. 2000; Hebert et al. 2001; Phelan et al. 2004; Bouman et al. 2008a, b), and interventions with the goal of more supportive social

interactions (Hall et al. 1992; Dalby et al. 2000; Rockwood et al. 2000; van Haastregt et al. 2000; Holland et al. 2005; Markle-Reid et al. 2006). General advice about nutrition was incorporated in some interventions (Hall et al. 1992; Leveille et al. 1998; Rockwood et al. 2000; Stuck et al. 2000; Hebert et al. 2001; Phelan et al. 2004; Holland et al. 2005), and one intervention programme studied food enrichment with vitamins and minerals (Chin et al. 2001, 2002).

Personal factors

A person's lifestyle, habits and coping styles were the target for several intervention elements of the ICF component of personal factors. Instruction in strategies of problem-solving (Gitlin et al. 2006a, b), counselling for the reduction of smoking (Hall et al. 1992; Leveille et al. 1998; Phelan et al. 2004; Holland et al. 2005), to promote positive attitudes and self-efficacy (Markle-Reid et al. 2006) and group interventions designed to enhance feelings of fitness (Chin et al. 2001, 2002) were tested.

Theoretical foundation

Eight trials gave information on the theoretical foundation for parts of, or the whole of, their respective intervention. Theories adopted and implemented were: the one proposed by Bult and Rispen (Chin et al. 2001, 2002), functional consequences theory (Dalby et al. 2000), The Life Span Theory of Control (Gitlin et al. 2006a, b), The Model of Vulnerability (Markle-Reid et al. 2006), Yura's and Walsh's nursing model (Bouman et al. 2008a, b), and the conceptual model of Buchner and Wagner (Leveille et al. 1998; Phelan et al. 2004; Holland et al. 2005). The interventions recommended following CGA used in one trial were based on a literature research for current evidence (Hebert et al. 2001).

Intervention length and location plus age segments

The two shortest programmes were 3 months (Rockwood et al. 2000), respectively 17 weeks long (Chin et al. 2001, 2002). Several studies applied a 6-month intervention programme of varying intensity (Hebert et al. 2001; Gill et al. 2002, 2004; Gitlin et al. 2006a, b; Markle-Reid et al. 2006), other programmes had a duration of 12 (Leveille et al. 1998; Stuck et al. 2000; van Haastregt et al. 2000; Phelan et al. 2004; Holland et al. 2005) or 14 months (Dalby et al. 2000). In two programmes, the intervention length was 18 months (Mann et al. 1999; Bouman et al. 2008a, b), and in another 24 months (Stuck et al. 2000). The duration of the longest intervention program was 3 years (Hall et al. 1992). Most programmes were based on

individualised interventions and offered in the participant's own home through home visits by intervention personnel (Hall et al. 1992; Mann et al. 1999; Dalby et al. 2000; Rockwood et al. 2000; Stuck et al. 2000; van Haastregt et al. 2000; Hebert et al. 2001; Gill et al. 2002, 2004; Gitlin et al. 2006a, b; Markle-Reid et al. 2006; Bouman et al. 2008a, b). Three programmes used a combination of individual and group interventions and were located at neighbourhood senior centres (Leveille et al. 1998; Chin et al. 2001, 2002; Phelan et al. 2004; Holland et al. 2005). The targeted age group was 65 years or older (Hall et al. 1992; Holland et al. 2005), 70 years or older (Leveille et al. 1998; Dalby et al. 2000; van Haastregt et al. 2000; Chin et al. 2001, 2002; Phelan et al. 2004; Gitlin et al. 2006a, b; Bouman et al. 2008a, b) or 75 years or older (Stuck et al. 2000; Hebert et al. 2001; Gill et al. 2002, 2004; Markle-Reid et al. 2006).

Registered personnel

Eleven of the programmes employed registered personnel only, implying that all employees were fully qualified and legitimated in their respective health profession (Hall et al. 1992; Mann et al. 1999; Dalby et al. 2000; Rockwood et al. 2000; Stuck et al. 2000; van Haastregt et al. 2000; Hebert et al. 2001; Gill et al. 2002, 2004; Gitlin et al. 2006a, b; Markle-Reid et al. 2006; Bouman et al. 2008a, b), while three programmes engaged lay workers (Leveille et al. 1998; Chin et al. 2001, 2002; Phelan et al. 2004; Holland et al. 2005). The most common intervention profession engaged was the registered nurse (RN). In the programmes, the RNs worked alone (Markle-Reid et al. 2006), collaborated with the participant's GP (Dalby et al. 2000; Hebert et al. 2001), geriatrician (Stuck et al. 2000) or with social worker and lay worker (Leveille et al. 1998; Phelan et al. 2004; Holland et al. 2005). In some trials, the RN made a referral to relevant specialised resources needed, for example dietary counselling by a dietician (van Haastregt et al. 2000; Hebert et al. 2001; Bouman et al. 2008a, b) or peer counselling programmes (Hall et al. 1992). In another programme the RN had access to an interdisciplinary team (dietician, OT, PT and social worker) for discussing complex problems (Stuck et al. 2000). The result in the latter study indicated that the effect of the programmes was related to the RN's individual professional performance in conducting the interventions (Stuck et al. 2000). An interdisciplinary team, which included an occupational therapist (OT), an RN and a technician joined forces in one of the programmes (Mann et al. 1999), and in another, a team comprising an audiologist, dietician, geriatrician, OT, PT, RN, social worker and speech therapist worked together (Rockwood et al. 2000). A PT worked alone in one trial (Gill et al. 2002,

2004), while both OTs and PTs collaborated in another (Gitlin et al. 2006a, b).

Participatory approach

Eight programmes were characterized by interventions with an apparent participatory, or client-centred, approach. In some cases, these involved a health-coach, or RN, and the participants developed and followed-up an individual action plan with personal health goals (Hall et al. 1992; Leveille et al. 1998; Dalby 2000; Phelan et al. 2004; Holland et al. 2005; Markle-Reid et al. 2006; Bouman et al. 2008a, b), or used the Goal Attainment Scale (GAS) (Rockwood et al. 2000). Furthermore, a similar design but with individually identified problems in daily activities with goals according to the client's own priorities was used in another programme (Gitlin et al. 2006a, b).

Contextual information

A detailed description of the organisational setting and the resources of an intervention enable an evaluation of the generalisability and reproducibility of a specific programme. Three trials provided additional information about the context other than that of baseline characteristics of participants and basic information about the intervention itself. One gave concise information on the standard care available for all participants, the economic situation and regulations regarding assistive devices, and environmental interventions (Mann et al. 1999). Others briefly described the home-care resources and public services available for the participants (Markle-Reid et al. 2006), and brief information on the economic conditions of the trial (Holland et al. 2005).

Effects of multi-component HPDP interventions

The reviewed programmes presented a broad diversity of objectives for change and multiple outcome assessments, which enabled an analysis of the interventions according to the ICF components. Body functions and structures came to contain four subgroups of targets for change: functions related to movement, mental health/depression, pain and cognitive functions. The most frequent ICF component evaluated was activity and participation, which comprised five subgroups: ADL, IADL, physical performance/mobility, engagement in physical and social activities and communication. Environmental factors consisted of outcomes measuring five subgroups: admission to a nursing home or equivalent, health care utilisation, the number of medicines, social support and home hazards. Personal factors included four subgroups: general wellbeing/quality of life/self-rated health, survivorship, falls and fear of

Table 3 The effects of the 14 HPDP intervention programmes reviewed and presented as a form of vote-counting

Author and reference	Body functions and structures (4 subgroups, $n = 17$)	Activities and participation (5 subgroups, $n = 32$)	Environmental factors (5 subgroups, $n = 22$)	Personal factors (4 subgroups, $n = 22$)
Bouman A (Bouman et al. 2008a, b)	0 0	0 0	0 0	0 0
Chin A Paw (Chin et al. 2001, 2002)	+	+ 0		0
Dalby (Dalby et al. 2000)			+ 0 0	0
Gill (Gill et al. 2002; 2004)		+++	0	
Gitlin (Gitlin et al. 2006a; b)		+ + 0	+	+ + +
Hall (Hall et al. 1992)	0		+ 0	+ 0
Hebert (Hebert et al. 2001)	0	0 0 0 0	0 0 0	0 0
Holland (Holland et al. 2005)	+ 0 0	+ 0 0	0 0	0
Leveille and Phelan (Leveille et al. 1998; Phelan et al. 2004)	0	+ + 0	+ + 0	+ 0
Mann (Mann et al. 1999)	+ 0	+ 0 0 0		
Markle-Reid (Markle-Reid et al. 2006)	+		+	+ 0
Rockwood (Rockwood et al. 2000)	0	0 0 0	0	+ 0 0
Stuck (Stuck et al. 2000)	+ 0 0	+ 0	+ 0 0	0
van Haastregt (van Haastregt et al. 2000)	0	+ 0 0		+ 0
Total +/0	5/12	12/20	7/15	8/14

A significant difference ($p < 0.05$) between the intervention and the control group is marked by a “+”, a non-significant result by a “0”

falling and adaptive strategies/health behaviour. Multiple outcomes were sometimes used to target different subgroups of objectives for change. A significant difference ($p < 0.05$) between the intervention and the control group in the trial in question is marked by a “+”, a non-significant result by a “0” (Table 3). Measures of body functions and structures were significantly improved in a total of 5 out of 17 targeted aspects (29%). For activity and participation, 12 out of 32 (38%) of targeted aspects were positively changed, the score for environmental factors was 7 out of 22 (32%), and for personal factors the results were 8 out of 22 (36%) objectives for change. An in-depth analysis is depicted below.

Body functions and structures

Balance, an element of functions related to movement, was positively influenced by the intervention in two trials (Stuck et al. 2000; Chin et al. 2001). One of these trials also found a small effect on manual dexterity, reaction time and quadriceps strengths in the intervention group (Chin et al. 2001). The same trial failed to influence body mass index (BMI) (Chin et al. 2001), a result confirmed by others (Holland et al. 2005), who also evaluated and found fatigue and shortness of breath to be unaffected (Holland

et al. 2005). Decreases in participants’ depressive symptoms or mental health problems were found in two studies (Holland et al. 2005; Markle-Reid et al. 2006), whereas others found depressive symptoms unchanged (Hall et al. 1992; Leveille et al. 1998; Stuck et al. 2000; van Haastregt et al. 2000; Hebert et al. 2001; Bouman et al. 2008a, b, c). Pain increased in participants in one programme, but increased notably more in the control group (Mann et al. 1999), as opposed to a non-significant effect in another trial (Holland et al. 2005). It was impossible to detect any beneficial effect of intervention on cognitive functions in other trials (Mann et al. 1999; Rockwood et al. 2000; Stuck et al. 2000; Bouman et al. 2008a, b, c).

Activity and participation

A favourable effect on ADL was proven in six trials (Leveille et al. 1998; Mann et al. 1999; van Haastregt et al. 2000; Gill et al. 2002; Phelan et al. 2004; Gitlin et al. 2006), in contrast to another six trials which did not see any improvement (Rockwood et al. 2000; Stuck et al. 2000; Chin et al. 2001; Hebert et al. 2001; Holland et al. 2005; Bouman et al. 2008a, b, c). The disability scores differed significantly from baseline to follow up both at the 7- and 12-month follow-up in one study (Gill et al. 2002),

although the benefit of the 6-month intervention could not be seen at 3 months. This effect was observed only among participants with moderate frailty, not in those with severe frailty. Another trial found improvements in ADL function among those who reported any ADL disability at baseline but not among those not disabled at baseline (Phelan et al. 2004). The impact on ADL was demonstrated directly after a 12-month intervention period, but the effects were diminished after a second 18-month follow-up (van Haastregt et al. 2000). IADL was unchanged in four trials (Mann et al. 1999; Rockwood et al. 2000; Hebert et al. 2001; Bouman et al. 2008a, b, c), while three programmes found a significant reduction in IADL disability (Stuck et al. 2000; Gill et al. 2004; Gitlin et al. 2006). The reduction of IADL disability was non-significant in one trial at a second 12-month follow-up (Gill et al. 2004). Using a subgroup analysis, one study found significant effects only in participants who initially had mild to moderate IADL disability (Stuck et al. 2000). A positive effect on physical performance/mobility was presented by two trials (Chin et al. 2001; Gill et al. 2004), while others failed to demonstrate any impact on the same target (Leveille et al. 1998; Mann et al. 1999; Rockwood et al. 2000; van Haastregt et al. 2000; Hebert et al. 2001; Gitlin et al. 2006). A significant effect on participants' engagement in physical and social activities was reported (Leveille et al. 1998; Holland et al. 2005), but others showed no effect of intervention (Mann et al. 1999; van Haastregt et al. 2000). Communications were unaffected, both communications in general (Hebert et al. 2001) and between participants and physician (Holland et al. 2005).

Environmental factors

The multi-component HPDP programmes could not demonstrate any success in reducing the number of hospitalised participants or participants admitted to a nursing home (Leveille et al. 1998; Dalby et al. 2000; Rockwood et al. 2000; Stuck et al. 2000; Hebert et al. 2001; Gill et al. 2002; Phelan et al. 2004; Holland et al. 2005; Bouman et al. 2008a, b, c), nor in the use of health services (Hall et al. 1992; Dalby et al. 2000; Stuck et al. 2000; Hebert et al. 2001; Holland et al. 2005; Bouman et al. 2008a, b, c). One trial found, however, that the intervention group comprised significantly more persons remaining at home, both at the 1- and 2-year follow up (Hall et al. 1992), and another that the control group had required significantly more expenditure for institutional care than the intervention group (Mann et al. 1999). Yet another trial resulted in significantly fewer inpatient hospital days compared with controls (Leveille et al. 1998; Phelan et al. 2004). The latter trial also found that participants had a reduction in psychoactive medication use (Leveille et al. 1998), as

opposed to other non-significant results for medication use (Holland et al. 2005; Bouman et al. 2008a, b, c). An ambiguous result was found in a third study where intervention participants in fact increased their medication use (Stuck et al. 2000). This finding is in line with some trials in which the number of participants who were vaccinated significantly improved (Dalby et al. 2000; Stuck et al. 2000). Home hazards were evaluated and found to be positively influenced at the 6-month but not at the 12-month follow-up (Gitlin et al. 2006). The results for social support diverged, since one trial demonstrated a favourable result (Markle-Reid et al. 2006), whereas two did not (Hebert et al. 2001; Bouman et al. 2008a, b, c).

Personal factors

Among the reviewed trials, 13 out of 14 failed to demonstrate any impact on general well being, quality of life or self-rated health (Hall et al. 1992; Leveille et al. 1998; Rockwood et al. 2000; Stuck et al. 2000; van Haastregt et al. 2000; Hebert et al. 2001; Chin et al. 2002; Phelan et al. 2004; Holland et al. 2005; Bouman et al. 2008a, b, c), while one programme achieved a statistically significantly benefit in 3 out of 10 components of the SF-36 scale (Markle-Reid et al. 2006). The mortality rate was investigated in six trials (Hall et al. 1992; Dalby et al. 2000; Rockwood et al. 2000; Hebert et al. 2001; Gitlin et al. 2006; Bouman et al. 2008a, b, c). Four of them reported non-conclusive results (Dalby et al. 2000; Rockwood et al. 2000; Hebert et al. 2001; Bouman et al. 2008a, b, c), whereas two programmes exhibited a significantly lower mortality rate (Hall et al. 1992; Gitlin et al. 2006). A significant positive intervention effect on fear of falling was found in two studies (van Haastregt et al. 2000; Gitlin et al. 2006), but in one trial the effects were found to have diminished after a second 18-month follow-up (van Haastregt et al. 2000). The latter study also examined the number of falls among participants and found it unaffected by the intervention (van Haastregt et al. 2000). One study showed a significant effect on attained personal goals (Rockwood et al. 2000). Neither alcohol use nor smoking status was affected in one intervention (Leveille et al. 1998). The use of control-oriented strategies or health behaviours showed contradictory outcomes (Leveille et al. 1998; Gitlin et al. 2006; Markle-Reid et al. 2006).

Discussion

The examined studies presented a wide diversity of definitions of frailty and corresponding terms, which reflects the ongoing debate among researchers in the field. Our review, however, provides evidence for an agreement

within one area, the inclusion of different aspects of physical impairments in body functions and structures. Diversity was the rule rather than the exception in other areas, for example in the mental/cognitive and environmental aspects. This means that frailty can be apprehended as a one-dimensional concept due to the classification of content into a single ICF component, body functions and structures, or as a multidimensional concept comprising one or more remaining ICF components' activities and participation, environmental factors and personal factors. The lack of a consensus definition emphasises the necessity of a profound empirical definition of frailty, an assertion endorsed by Ferrucci et al. (2004). A strict definition of frailty is also needed to compare outcomes across studies (Fried et al. 2001; Hogan et al. 2003).

The review also demonstrates that frailty is not a steady state but rather a changeable result of complex interactions. The idea of frailty as a temporary condition influenced by several factors is supported by many researchers (Hogan et al. 2003; Ferrucci et al. 2004; Rockwood et al. 2005; Gill et al. 2006). The thought of frailty as transient and variable includes reversibility, although frailty is predetermined to end with mortality. A process can be influenced in any direction. It was possible to counteract the "frailty process", however, by means of certain HPDP interventions, as shown in several studies included in our review.

The analysis of the effects of multi-component HPDP interventions showed that different aspects of body functions and structures were significantly improved in a total of 5 out of 17 (29%) targeted aspects. For activity and participation, 12 out of 32 (38%) targeted aspects were positively changed, for environmental factors, 7 out of 22 (32%), and for personal factors, 8 out of 22 (36%). The sizes of the effects were modest, but several factors that might have influenced this need to be taken into account in the evaluation.

First, it is important to distinguish between different reasons why a trial fails to achieve a positive outcome. One reason for an unsuccessful intervention could be that the intervention itself is insufficient. In that case it is vital to determine whether the concept or theory used to guide an intervention is defective, or if the intervention components were inadequately administered. An in-depth analysis of the examined HPDP programmes was beyond the scope of this review but certainly awakes ideas for future research. Leveille et al. (1998) claim that the mixed findings revealed in disability trials highlight the difficulty of designing interventions and appropriate measures for evaluations in a population with complex needs and health problems.

Second, the programmes used a broad diversity of targets for change and multiple outcome assessments. In defining and choosing outcome measures, there is always a

risk that a certain trial is unable to detect positive intervention effects that in fact were produced. An unsuitable outcome assessment can give a false negative result, as might have been the case in the trial by Chin et al. (2001, 2002), where a non-sensitive assessment of ADL was utilised. Ferrucci et al. (2004) recommend that multiple assessments' measures of functional status should always be included in a trial in older populations because functional status is a core factor for quality of life. Unfortunately, functional status has proven difficult to define operationally. The frequently used self-report assessments, for instance, assessment of ADL, have often not been tested for reliability among frail older patients. In addition, in the above-mentioned trial (Chin et al. 2001, 2002), the intervention time was 17 weeks, and the follow-up might have been implemented too early, and too close to intervention endpoint, to detect any positive effects. In the case of intervention length, we found a wide time span, from 17 weeks (Chin et al. 2001, 2002) up to 3 years (Hall et al. 1992). Several authors (Ferrucci et al. 2004; Gill 2005) point out the risk of a high drop-out rate in intervention programmes for frail elderly persons due to co-morbidity, exhaustion and respondent burden, factors that are aggravated with time. The advice is to perform frequent follow-up visits, offer home assessment visits, and predetermine a brief "essential" assessment as an alternative to the full protocol. A design that allows the evaluation of short-term outcomes as well as long-term outcomes is recommended (Ferrucci et al. 2004). Additionally, Huss et al. (2008) also point out, in their review of multidimensional preventive home visit programmes, that effectiveness might have been influenced by factors such as adherence to advice, how participants actually follow recommendations, the setting and the underlying patterns of health care use.

Ten of the 14 HPDP programmes consisted of various intervention elements that refer to all four ICF components. Some programmes described their interventions in detail, others gave limited information on content. It is unknown whether some of the intervention components were more effective than others, although it is likely that it was the multi-component approach, the sum of all components, that led to the positive outcome verified in a number of programmes. The view that the sum of the parts in an intervention programme is greater than the value of each separate part is supported by Gitlin et al. (2006a; b). Others (Beswick et al. 2008), with future research in mind, suggest that a qualitative approach to study different HPDP interventions may help us to gain a better understanding of the complexity of the interventions, and how the participants experience them.

An explicit theoretical foundation for the intervention was found in eight of the programmes. One HPDP programme based on The Life Span Theory of Control (Gitlin

et al. 2006a, b) had significantly positive outcomes, whereas another intervention based on Yura and Walsh's nursing model, demonstrated no significant outcomes at all (Bouman et al. 2008a, b). As was the case for all the trials included, the uses of different theories in the above-mentioned programmes make them difficult to compare. On the basis of our study, we can not draw any conclusion about the importance of a theory-based intervention for outcome. Nevertheless, researchers argue that a theory increases the credibility of the result (Rychetnik et al. 2002). This leads us to the conclusion that the relation between interventions founded on theory and the outcome in HPDP programmes remains to be better explored. The matter of a participatory or client-centred approach is associated with a theoretical foundation and, as in the case of theory foundation, no obvious connection between a participatory approach and outcome could be seen in the reports included in this review. Even so, this is an interesting topic. Targeting functional tasks that older people themselves perceive as problematic can make a difference to outcome. The importance of goal setting in intervention programmes is pointed out by several authors, amongst them Bradley et al. (1999).

Eleven of the HPDP programmes employed registered personnel only, while three engaged lay workers. Does the profession, or the education of the intervention personnel, make a difference to outcome? This question is relevant since the result in one study (Stuck et al. 2000) indicated that the intervention effect was related to the different RNs' professional performance, implying that personal qualifications are more important than the profession itself. Vass et al. (2005) also found that the education of primary care professionals making home visits to frail elderly persons, regardless of profession, had an effect on functional ability amongst the participants. Others advocate special education to support health care professionals and improve their knowledge of the complexity of frailty (Gill 2005). Nevertheless, a multi-component intervention programme needs diverse professionals to be able to offer the broad spectrum of intervention components and to deliver the programme skilfully. It is naturally assumed that medically trained intervention personnel are essential since frailty incorporates aspects of body functions and structures, but other health professions are clearly required to contribute to the broad knowledge needed. Different professionals most likely have their own ways of "framing the problem", which implies that an interdisciplinary intervention team is desirable when dealing with the complexity of frailty. In one trial, the authors discussed the possibility that the non-significant result of their HPDP programme could be attributed to the fact that the intervention personnel (RN) were not part of a team (Bouman et al. 2008a, b). Taking this into consideration, an interdisciplinary team, working

towards a shared goal with the HPDP programme in question, is probably the most feasible organisation for such programmes. A team can also prevent the intervention from being vulnerable if dependent on a single person and his/her individual professional performance (Stuck et al. 2000).

Contextual information is an important aspect of HPDP programmes. Well-described and detailed information on the design and delivery of the programmes, the health care organisation, socioeconomics, demographic features of the population and local politics are important contextual characteristics for public health interventions (Rychetnik et al. 2002). Information on the intervention, the context and possible interactions between the two is essential when evaluating the applicability, generalisability and transferability of a HPDP programme. Rychetnik et al. (2002) have found that contextual issues have so far often been limited in publications of HPDP programmes. This has had a detrimental effect on evidence. In our review, only three trials out of 14 provided additional information about the context other than that of baseline characteristic of respective participants and basic information about the intervention itself. However, worth noticing is the fact that some trials have published separate study protocols or reports in which contextual information is included (Gill et al. 2003; Nicolaidis-Bouman et al. 2004, 2007). Even so, we draw the conclusion that contextual information in HPDP programmes is an area that has to be improved.

Finally, in discussing the results, there are questions about the timing of an intervention. At what age is it appropriate and effective to offer a HPDP programme to frail elderly persons, and, more importantly, at what stage of frailty? In this review, most studies included persons 70 years or older (Leveille et al. 1998; Dalby et al. 2000; van Haastregt et al. 2000; Chin et al. 2001, 2002; Phelan et al. 2004; Gitlin et al. 2006a, b; Bouman et al. 2008a, b) or 75 years or older (Stuck et al. 2000; Hebert et al. 2001; Gill et al. 2002, 2004; Markle-Reid et al. 2006). In contrast, Vass et al. (2005) recommend the inclusion of persons 80 years or older, due to the general rise in life expectancy in rich welfare states. The same authors have demonstrated significant effects on functional abilities in a HPDP programme for 80 year-old persons, while 75 year-old persons did not benefit. They also found that elderly persons, 75 or 80 years old, already dependent on others for help in daily activities did not benefit from the intervention, while people not yet dependent showed significant improvement. The latter results are confirmed by other researchers, who found that preventive home visits are effective when they target persons with a relatively good functional status (Stuck et al. 2002), and when they include a systematic evaluation of multiple domains (Stuck et al. 2002; Huss et al. 2008). Additionally, Hebert et al. (2001)

find that geriatric services often intervene only after the process of functional decline has started or even ended, instead of in the desired phase when older people have been identified as being at risk of losing their autonomy. Nourhashemi et al. (2001) state that the earlier in the downward process intervention is started, the more effective it will be. Other researchers agree (Chin et al. 2002; Vass et al. 2005; Bouman et al. 2008c) and argue that HPDP programmes should target older persons with moderate frailty instead of those with severe frailty. In relation to above statements and the inclinations found in our review, HPDP interventions are likely to be more successful in including elderly in an early stage of frailty rather than persons with more severe frailty.

With reference to the methodology used in this review, there are several important issues to discuss. In using the ICF heuristic framework in our analysis, we experienced challenges and difficulties. The main challenge was to interpret the substance in included articles and classify it into ICF components, most of which were probably not written with ICF in mind or with ICF terminology, with the risk of losing commonly used terms in the current field of knowledge. Nevertheless, we kept to our goal of finding new knowledge by looking at the research questions from an ICF point of view. A concrete example of difficulty in using ICF occurred in the process of analysing definitions of the core concept of frailty, hazarding a fraction of a possibly already existing underlying theory. Still, one must bear in mind that the methodology used for the analysis does not alter the inner meaning or content of an existing theory but sorts it and classifies it according to ICF terminology. Another linked problem was related to the various ways that one potentially could classify HPDP variables in terms of intervention content, organisation and outcome relative to the ICF components. For example, the intervention “instructions in problem solving” was defined in terms of the ICF component of personal factors because of the affinity to coping strategies. However, it might have been equally valid to refer the intervention to the ICF component of activity and participation because problem solving also reflects aspects of general tasks and demands. Nonetheless, inter-rater reliability in classifying data into ICF components was high, only a few disagreements between the reviewers were resolved in consensus discussions. Consequently, the principal disadvantage of using ICF as a structural frame for this study was identified as difficulties in clearly being able to differentiate among concepts and categories within the framework. Obviously, difficulties were partly due to how and to what extent key data were described in included studies, but one conclusion is that ICF itself needs to be refined for optimised clarity in concepts and language. Such refinement would enable health care researchers to fully utilise ICF’s potential as a

common language for communication of research. Despite experienced difficulties in using ICF, we recommend other health care researchers to apply ICF as a conceptual tool in various areas of research to enhance communication within, and between, different fields of knowledge, a recommendation also supported by others (Jette 2006). It is through application we learn, and together we can apprehend and develop this language with the ultimate goal of a common language for health care research worldwide.

Other methodological issues also need to be addressed. First, a meta-analysis would have been a natural first choice for the data analysis, but this was not feasible given the wide range of study designs with diverse intervention content, time and intensity. Also, even though a common area for outcome was targeted and evaluated, for instance ADL, different outcome instruments were used where dissimilar ADL-components were evaluated at variable times. Therefore, it seemed more appropriate to use a narrative form for this review and keep in mind the aim of this article—to broaden our knowledge of the research questions. Second, we included studies of both high and low methodological quality, and power calculations were not taken into consideration given our broad research questions and the narrative form employed for the review. Third, although an extensive search strategy was used to retrieve relevant studies, it is possible that we failed to detect all published articles fulfilling the inclusion criteria. Fourth, we deliberately avoided a search for unpublished outcome data. Owing to publication bias, the elimination of possible non-significant or negative outcome data selectively omitted from publication might exaggerate positive effects of HPDP programmes. Finally, and perhaps the main methodological issue, is the fact that only RCTs were included. Well-designed and properly executed RCTs are, by tradition, considered to be superior to other types of trials for evaluating the efficacy of health care interventions. However, this claim is questioned by other researchers (Rychetnik et al. 2002). They argue that one can question the reliance on the study design as the main criterion of the credibility of evidence because RCTs may have problems with accommodating the complexity and flexibility needed in public health care interventions, in the interpretation of results. For example, Kemm (2006) argues that RCTs do not provide any assurance that a particular treatment will produce the best outcome for a particular patient. Among others, Conato et al. (2000) consider RCTs and well designed observational studies, with either a cohort or a case-control design, to have equally suitable study designs when evaluating the same topic. In sum, our conclusions based on RCTs might have to be revised if studies using other designs were also reviewed.

Conclusion

The reviewed studies provide evidence for consensus by including various aspects of impairments in body functions and structures as an integral part of frailty with the exception for one subgroup: mental/cognitive functions. Multi-component HPDP programmes contain a broad spectrum of interventions covering body functions and structures, activity and participation, environmental and personal factors according to ICF. An interdisciplinary team including a diversity of health professionals seems to be the most feasible organisation for such programmes. The relation between theory-founded interventions and outcome in HPDP programmes remains to be better explored, and contextual information need to be better identified as a target area for improvement. Our review suggests that HPDP programmes are partially effective, but further research is needed to explore and disentangle the complex interrelationships between various interventions and outcomes. We recommend that future articles reporting on studies of multi-component health promotion and disease prevention for community-dwelling frail elderly persons should accurately describe their definition of frailty, the content of the intervention, a theoretical foundation for the intervention and the context in which the intervention is delivered. This will enable comparison, evaluation and a possible future replication of the intervention in question.

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