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INDIVIDUALLY TAILORED PHYSICAL AND DAILY ACTIVITIES FOR RESIDENTS IN NURSING HOME SETTINGS - A SCANDINAVIAN MULTI-CENTRE STUDY

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Att resa betyder att nå ett mål. Att vandra betyder att vara på väg.
Theodor Heuss

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ABSTRACT

The overall **purpose** of this thesis was to describe the impact of an individually tailored intervention programme, in nursing home settings, on physical capacity, degree of dependence in activities of daily living (ADL), long-term participation in physical and/or daily activities, and self-rated well-being.
The different **aims** were
to present the rationale and design of the study
to describe the levels of physical and cognitive function, dependence in ADL, and degree of well-being of the participants at baseline,
to investigate the feasibility of measuring muscle strength, mobility, balance function, dependence in ADL, physical activity level, and cognitive function in elderly nursing home residents, and also to detect any correlations between these measurements,
to describe the effect of three months of individually tailored physical and daily activities for elderly nursing home residents on muscle strength, mobility, balance function, fall-related self-efficacy, dependence in ADL, and physical activity level,
to evaluate the long-term effects, within and between groups, on well-being, cognitive function, mobility, dependence in ADL, physical activity level, and different dimensions of physical function three months after the intervention was completed

Material and methods: Elderly residents (n=322) from nursing homes in three Scandinavian countries were randomised to either an Intervention group (IG) or Control Group (CG). The intervention consisted of individually tailored physical and daily activities for three months. Reliable and valid tests of muscle strength, mobility, balance function, fall-related self-efficacy, dependence in ADL, physical activity level, well-being and cognitive function were used. All participants were measured at baseline, after three months of intervention, and after three months of post-training.

Results: The median age of the participants was 85.5 years, and 74% of them were women. The median length of stay was 15 months, 64% were able to walk with or without walking aids, and 60 % were able to rise from a chair once. The measurements seem feasible, and no floor or ceiling effects were detected. Sixty-eight per cent completed between 10 and 13 weeks of intervention with a mean exercise dose of 105 minutes per week. Following intervention, a significant difference was found between groups regarding balance function, transfer ability and physical activity level, where the IG had improved while the CG deteriorated. Also, within the IG a significant improvement regarding functional leg muscle strength and walking/wheelchair speed was demonstrated, while the results for balance and dependence in ADL were maintained during the intervention period. Between the 3- and 6-month follow-ups, the test results for functional leg muscle strength, balance function, physical activity level and the cognitive and social dimensions of ADL deteriorated within the IG. Within the CG, a significant deterioration in balance function, dependence in ADL, and transfer ability, but a significant improvement in physical activity level, were seen between baseline and the 3-month follow-up.

Conclusions: This study demonstrates that balance, transfer ability, and physical activity level can be improved or maintained following 3 months of intervention in nursing home residents. Within the IG, leg muscle strength and walking/wheelchair speed also improved. However, the effects regarding leg muscle strength, balance function, and physical activity level were lost during the post-training period, and dependence in social and cognitive dimensions of ADL deteriorated. The duration and frequency of the intervention and levels of cognition had some impact on the outcome values. Low physical activity level, physical function and dependence in ADL were related to poor well-being, low cognitive function and low fall-related self-efficacy. The instruments used for testing seem to be feasible for elderly nursing home residents.

SVENSK SAMMANFATTNING

Avhandlingens **övergripande syfte** var att beskriva effekten av ett individuellt anpassat interventionsprogram för äldre personer boende på sjukhem avseende fysisk kapacitet, grad av beroende i aktiviteter i dagliga livet (ADL), deltagande i fysiska och /eller dagliga aktiviteter över tid och självskattat välbefinnande.

De **specifika syftena** var

att beskriva studiens bakgrund och design

att beskriva graden av fysisk och kognitiv funktion, beroende i ADL och välbefinnande hos deltagarna vid baseline,

att undersöka användbarheten av testinstrument för muskelstyrka, gång- och förflyttningsförmåga, balans, beroendegrad i ADL, fysisk aktivitetsnivå och kognitiv funktion för äldre boende på sjukhem och även korrelationen mellan dessa instrument,

att beskriva effekten av tre månaders individuellt anpassade fysiska och dagliga aktiviteter för äldre sjukhemsboende personer avseende muskelstyrka, gång- och förflyttningsförmåga, balans, fallrelaterad självtillit, beroendegrad i ADL och fysisk aktivitetsnivå,

att utvärdera långtidseffekter inom och mellan grupperna tre månader efter avslutad intervention avseende välbefinnande, kognitiv funktion, gång- och förflyttningsförmåga, beroendegrad i ADL, fysisk aktivitetsnivå och olika dimensioner av fysisk funktion.

Material och metod: Äldre sjukhemsboende personer (n=322) i tre Skandinaviska länder randomiserades till antingen Interventionsgrupp (IG) eller Kontrollgrupp (KG). Interventionen bestod av individuellt anpassade fysiska och dagliga aktiviteter i tre månader. Reliabla och valida instrument användes för att mäta muskelstyrka, gång- och förflyttningsförmåga, balans, fallrelaterad självtillit, beroendegrad ADL, fysisk aktivitetsnivå, välbefinnande och kognitiv funktion. Alla deltagare testades vid baseline, efter 3 månaders intervention och 3 månader efter avslutad intervention.

Resultat: Medianåldern var 85.5 år och 74 % var kvinnor. Medianvårdtiden var 15 månader, 64 % kunde gå med eller utan gånghjälpmedel och 60 % kunde resa sig från en stol. Testinstrumenten förefaller lämpliga att använda och inga tak- eller golveffekter kunde upptäckas. Sextioåtta procent genomförde mellan 10 och 13 veckors intervention och i medeltal 105 minuter per vecka. Direkt efter interventionen sågs en signifikant skillnad mellan grupperna gällande balans, förflyttningsförmåga och fysisk aktivitetsnivå där IG förbättrades och KG försämrades. Inom IG påvisades också en signifikant förbättring av funktionell benmuskelstyrka och gånghastighet medan resultaten för balans och beroendegrad i ADL var oförändrade under interventionsperioden. Mellan 3- och 6-månaders uppföljning hade resultaten för funktionell benmuskelstyrka, balans, den sociala och kognitiva delen av ADL-förmågan och fysisk aktivitetsnivå försämrats inom IG. Inom KG sågs en signifikant försämring i balans, förflyttningsförmåga och beroendegrad i ADL men en signifikant förbättring i fysisk aktivitetsnivå mellan baseline och 3-månaders uppföljning.

Konklusioner: Studien visade att balans, förflyttningsförmåga, och fysisk aktivitetsnivå kan förbättras eller behållas som en effekt av tre månaders intervention för äldre sjukhemsboende personer. Inom IG förbättrades även funktionell benmuskelstyrka och gånghastighet. Däremot förlorades effekten gällande benmuskelstyrka, balans och fysisk aktivitetsnivå efter avslutad intervention och den sociala och kognitiva dimensionen av ADL försämrades. Duration och frekvens av träning liksom kognitiv förmåga hade viss effekt på resultaten. Låg fysisk aktivitetsnivå, fysisk funktion och beroendegrad i ADL hade samband med lågt välbefinnande, låg kognitiv funktion och låg fallrelaterad självtillit. Instrumenten som användes för testning förefaller användbara för äldre personer boende på sjukhem.

LIST OF PUBLICATIONS

The thesis is based on the following original papers. Each paper will be referred to by its Roman numeral (Studies I-V)

I. Frändin K, Borell L, **Grönstedt H**, Bergland A, Helbostad JL, Puggaard L, Andresen M, Granbo R, Hellström K. A Nordic multi-center study on physical and daily activities for residents in nursing home settings: design of a randomized, controlled trial. Aging Clin Exp Res 2009;21(4-5):314-22.

II. Bergland A, Narum I, **Grönstedt H**, Hellström K, Helbostad JL, Puggaard L, Andresen M, Granbo R, Frändin K. Evaluating the feasibility and intercorrelation of measurements on the functioning of residents living in Scandinavian nursing homes. Phys Occup Ther Ger 2010;28(2):154-169.

III. **Grönstedt H**, Hellström K, Bergland A, Helbostad JL, Puggaard L, Andresen M, Granbo R, Frändin K. Functional level, physical activity and well-being in nursing home residents in three Nordic countries. Aging Clin Exp Res 2011;23(5-6):413-420

IV. **Grönstedt H**, Frändin K, Bergland A, Helbostad JL, Granbo R, Puggaard L, Andresen M, Hellström K. Effects of individually tailored physical and daily activities in nursing home residents on activities of daily living, physical performance and physical activity level: a randomized controlled trial. Gerontology. Published online December 20, 2012. DOI:10.1159/000345416.

V. **Grönstedt H,** Hellström K, Harms Ringdahl K, Helbostad JL, Bergland A, Andresen M, Puggaard L, Granbo R, Frändin K. Long-term effects of individually tailored physical training and activity in Scandinavian nursing home residents on well-being, cognition and physical function. An RCT **.** In manuscript.

Study V. This may not be the final version before publication.

CONTENTS

LIST OF ABBREVIATIONS

ADL	Activities of Daily Living
BBS	Berg Balance Scale
COVS	Physiotherapy Clinical Outcome Variables
FES(S)	Falls Efficacy Scale - Swedish version
FIM	Functional Independence Measure
I-ADL	Instrumental Activities of Daily Living
MMSE	Mini Mental State Examination
NHLSD	Nursing Home Life Space Diameter
P-ADL	Personal Activities of Daily Living
PGCMS	Philadelphia Geriatric Centre Morale Scale
QOL	Quality of Life

1 INTRODUCTION

1.1 BACKGROUND

1.1.1 Disability and dependence among elderly nursing home residents

Disability is the major reason for institutionalisation in old age. In Sweden, there were 94,897 elderly persons living in nursing homes in 2007. Of these 70% were women, and the majority (56%) were 85 years or older (1). The most common reason for admission to Swedish nursing homes was dementia, and the degree of dependence in activities of daily living (ADL) was high (2). Selbaek et al (3) found that 81% of the residents in Norwegian nursing homes had dementia. In Denmark, in the year of 2010, 25% of the population between the ages of 85 and 89 years and 31% of the persons 90 years or older lived in nursing homes, sheltered accommodation, or dwellings for the elderly. Approximately 1.5% of the Danish population aged 65 years and older have been diagnosed with dementia (4).

Persons newly admitted to nursing homes often deteriorate in health and increase their dependence in ADL, which results in need of considerable help from others (5). Physical performance, especially walking speed, chair rise and balance, is strongly associated with the ability to perform ADL, including transfers (6), and it would be advisable to detect those needs and begin rehabilitation already from day one (7).

Frailty is considered to be highly prevalent in old age and is defined as a clinical syndrome with three or more of the following criteria present: unintentional weight-loss, self-reported exhaustion, weak grip strength, slow walking speed, and low physical activity level (8). One risk factor that contributes to decreased ADL performance is low levels of physical activity. A recent review showed that physical training could increase ADL performance, functional performance and QOL in institutionalised frail elderly (9). Gait instability is strongly associated with functional status and predisposes individuals to falls and likely contributes to a fear of falling, decreased confidence and self-imposed mobility restrictions (10). Fear of falling and avoidance due to fear of falling are common in older people, both in fallers and non-fallers (11). Loss of muscle strength is frequently found to be a risk factor for falls. Meuleman et al (12) demonstrated an increased muscle strength among nursing home residents after 8 weeks of resistance and endurance training, with the most impaired gaining the most function. Maximal aerobic power, muscular strength and explosive power decline even with healthy ageing and their values are lower in women. Women are therefore at risk of crossing functionally important thresholds much earlier than men (13).

In a study by Sackley et al (14), a 3-month occupational therapy and physiotherapy programme had no significant effect on mobility and independence among nursing home residents. An RCT by Serra-Rexach et al (15) demonstrated increased muscle strength and reduction in falls in ambulatory nursing home residents aged 90 and older, but they failed to show any effects on functional performance assessed as grip strength, walking ability, stair climbing and mobility. In contrast, in three systematic reviews (5, 9, 16) evidence was found showing that physical training had positive effects on mobility, physical functioning and cognition in institutionalised older patients.

1.1.2 Cognitive functions / Dementia

Cognitive functions are particularly vulnerable to ageing and are crucial for independent living. (17). Impaired executive functions may have devastating consequences for older adults as they involve a wide range of important capacities, such as the ability to organise and plan, inhibit inappropriate behaviour and adapt to new situations. Impaired processing speed is associated with reduced mobility and increased risk of falling (18).

Cognitive functions are affected by moving to a nursing home, and persons with dementia have been shown to have higher levels of functional dependence and were more likely to require assistance in all assessed task-specific ADL domains (19). McConnell et al (20) demonstrated that persons with mild cognitive impairment at admission initially decreased their dependence level in ADL but then increased the level during the first year of institutional living. Those with moderate dementia increased their dependence level while those with severe dementia showed an increase initially and then stability (20). Cognitive decline is associated with a decline in physical performance (21), and persons with dementia have a 3-fold risk of falling (22). Activity level, gait, and mobility measures in Alzheimer's disease are often also impaired, particularly turning and dual tasks (23). Recent research has demonstrated that physical exercise can prevent or delay dementia even in older adults with mild cognitive impairment (24-26).

Two recent reviews (27, 28) concluded that there is insufficient evidence of the effectiveness of physical activity on cognition and function in older people with dementia, and that further and better-designed research is required. There is some evidence that exercise improves walking and reduces decline in ADL performance among persons with dementia, and there is also some evidence that walking exercise performed individually reduces the decline in walking performance. The intervention should last at least a few months and, to be effective, the exercises should aim to challenge the individual's physical capacity (28). Poynter et al (29) concluded that all people have the potential to benefit from rehabilitation, regardless of cognitive function. However, individuals with severe cognitive impairment require a longer time in the rehabilitation setting.

Studies by Goldstein et al (30) and Diamond et al (31) have challenged the stereotype that people with dementia cannot improve their functional performance. Both studies found that improvement in functional scores was independent of both age and cognition. Geriatric patients with mild to moderate cognitive impairment benefit from rehabilitation and should not be routinely excluded from rehabilitation. Although cognitively impaired patients improve, they may not be able to maintain their improvement over time in comparison with the cognitively intact (32). The results from a study by Kolanowski et al (33) indicated that more cognitively and physically impaired residents have less stamina to engage in activities and that attendance at programmes does not guarantee engagement.

There is still a need of studies of high methodological value for identifying the optimal physical activity in terms of frequency, intensity and duration for persons with dementia of different types and severity (27, 28). In addition, outcomes that contribute to the quality of life of those with dementia should be examined (27).

1.1.3 Well-being

There is no universally accepted definition of mental well-being. It includes cognitive, emotional and behavioural responses at a personal level and should be interpreted in the socio-cultural context of the individual (34). Well-being is a subjective measure and refers to the way people feel about their lives (35), and a decline in mental well-being should not be viewed as a natural and inevitable part of ageing (36). WHO describes mental well-being as a state in which the individual realises his or her own abilities, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to his or her community (34). Well-being, according to Lawton (37, 38), is a general feeling of satisfaction and acceptance of oneself and the environment. Morale is a construct often used synonymously with psychological well-being, quality of life (QOL) and life satisfaction (39) and reflects an individual's perception of physical and mental health (40). It may be defined as a basic sense of satisfaction with oneself, a feeling that there is a place in the environment for oneself and a certain acceptance of what cannot be changed (40). First, morale is a subject-centred measure of well-being. Second, morale is an important component of QOL, which can certainly decline as people age (40). In this thesis, the definition of well-being and morale according to Lawton was used (37, 38).

As a consequence of a decline in health, mobility, autonomy and social contacts, frail older people are also at increased risk of decline regarding mental well-being (41, 42). A low level of well-being among older people has proven to be associated with loneliness, lack of social activities, impaired indoor and outdoor mobility, dependence in ADL, and living in institutions (43-46). Quality of life in dementia is described as "an integration of cognitive functioning, activities of daily living, social interactions, and psychological well-being" (47). Persons with moderate dementia can report on their quality of life even when they have poor insight into and awareness of their dementia (48, 49). In addition to treatment of specific symptoms among persons with dementia, it is important to evaluate the extent to which an intervention improves the well-being of the person being treated (49).

Few exercise studies with the aim of influencing depressive symptoms and well-being in nursing home residents with a high prevalence of physical and cognitive impairments have been carried out, and the results are inconsistent (35, 43). Most existing studies exclude people who are unable to walk or people with severe cognitive impairments (43). According to a systematic review in 2010, mental well-being in later life is modifiable through exercise and physical activity, but more evidence is needed regarding the long-term effects on well-being (50). Exercise can improve mental well-being (51), and a positive correlation has been reported between the degree of physical activity and QOL in old age (52). Aerobic exercise and resistance training were found to have the greatest effect on psychological well-being (50). Hypothetical mechanisms by which exercise may mediate psychological well-being include both psychological and psychosocial explanations (41). Rejeski and Mihalko (53) emphasise that how programmes are run and individually designed are as critical, if not more important, to quality-of-life outcomes than meeting specific criteria for frequency, intensity and duration.

1.1.4 Physical activity / inactivity

Physical activity is defined by WHO as any bodily movement produced by skeletal muscles that requires energy expenditure. Physical inactivity has been defined as the fourth leading risk factor for global mortality and is estimated to be the main cause of 20-30% of cancer, diabetes and ischemic heart diseases. The WHO also states that increased physical activity is not only an individual problem but also a societal one (54).

The health benefits deriving from physical activity are about the same for elderly persons as for other age groups (55). A high level of physical activity is associated with preservation of physical function in daily life (5, 9, 56-58), a low prevalence of depressive symptoms (59, 60), reduced anxiety and enhanced mood and self-esteem (36) and is also positively related to mental health and well-being (50, 53, 56, 61).

Nursing home residents are extremely inactive and MacRae et al (62) demonstrated that up to 94% of them spent their time sitting or lying down, in spite of the fact that they were capable of independent or supervised activity. It is not unusual to find residents in nursing homes who are capable of independent activity to be sitting or lying down for long periods of time – up to 17 hours a day in bed (33), and they are described by Deschamps et al (63) as having "an extremely sedentary lifestyle". A study by Cress et al (64) showed that residents in nursing homes take on average 3000 steps less per day than community dwellers.

A meta-analysis of 30 trials showed that exercise prevents and reduces the risk of developing secondary conditions that arise from functional decline and physical disuse (57). Especially mobility problems concerning functions like walking, getting into bed or a chair, stair-climbing and getting in and out of transportation vehicles have a negative influence on the ability to stay active (51). Nursing homes and most institutional settings generally lack proper environmental stimulation and opportunities for physical activity (57). Physical exercise has a positive effect on mobility and physical functioning in mobility-limited and/or physically disabled elderly patients (51).When nursing home residents are more actively engaged in daily activities, they report greater well-being and less depression and lower rates of mortality than unengaged residents. One problem in nursing homes is that well-meaning staff promote frailty by "doing for" residents to save time or by restricting activities to prevent fall injury. These approaches to care set up a vicious circle of frailty, which is hard to reverse (33).

Cognitive benefits from exercise are found primarily in executive control and frontal lobe functions, such as planning, divided attention and inhibition of responses (65-67). Aerobic fitness training for elderly persons can increase brain volume in regions associated with age-related decline in both brain structure and cognition(65). Regular physical activity develops or maintains the efficiency of the reactions involved in postural control, which generates a more appropriate motor response (68). Physically active adults have a lower risk of depression and cognitive decline than inactive adults. Participating in an activity, especially regular physical exercise, appears to decrease the risk of delirium in hospitalised older patients (69).

Frail sedentary older adults have good short-term responses to physical exercise, but there is a need of long-term follow-ups and longitudinal investigations in this population (57).

1.1.5 Rehabilitation

Geriatric rehabilitation has been defined as “evaluative, diagnostic, and therapeutic interventions whose purpose is to restore functional ability or enhance residual functional capability in elderly people with disabling impairments” (70). The goals of physical therapy and occupational therapy in long-term care settings are consistent with those of rehabilitation in general: to improve, maintain, or limit the decline in functional capacity, especially in the physical, daily living, mental and psychosocial domains; to teach adaptive strategies and techniques to foster compensatory functional abilities; to prevent costly complications; and to promote physical activity and quality of life. Increased physical and occupational therapy service to nursing home residents allowed more on-going treatment, follow-up, and restorative interventions (71).

Provision of physical rehabilitation interventions to long-term care residents is worthwhile and safe, reducing disability while causing few adverse events. There is a demand for ways of preventing any deterioration in health and to increase independence in activities of daily living, for example, walking and dressing (5). The most crucial type of training is active participation in the activities of daily life in order to prevent loss of independence (72).

A recent review of studies of physical rehabilitation in nursing homes showed that intervention duration was typically 12 weeks and treatment intensity 3x30-minute sessions per week. The mean attendance rate was 84% (73). Both short- and long-term interventions seem to have a positive effect. High-intensity exercise therapy seems to be somewhat more effective in improving physical functioning than low-intensity exercise therapy (51). Individual physical therapy can be effective, but a relatively quick detraining effect may be seen as soon as 10 weeks after therapy. The detraining phenomenon suggests that some form of maintenance exercise is needed (74). Very large effects should not be expected when studying already physically impaired older adults. Even a small positive effect can be considered of great value and of clinical relevance (51). Nursing home residents who participated in an exercise intervention for 6 months noted improved quality of life through better mobility, decreased fear of falling, and feelings of achievement and success. They valued the programme as an opportunity to do something for themselves, to add something to their weekly routine, to meet other people and to be more active generally. The professionalism of the exercise instructor appears to have been critical, balancing principles of safe and effective practice with the need to ensure that participants had fun in a supportive environment (75).

A review by Theou et al (76) examined the effectiveness of current exercise interventions for the management of frailty. The training not only improved walking speed, chair rise, balance, muscle function, flexibility and reduced ADL disability but also, to some extent, improved quality of life and cognition. Exercise seems to benefit the oldest old, frail women more than younger frail males, and seems to be more effective in the earlier stages rather than in the later stages o frailty. Interventions lasting longer than five months seemed to result in greater gains. The duration of each exercise session of exercise that seemed to be most beneficial was 30-45 minutes. However, there is insufficient evidence to allow any recommendations to be made about the content of the intervention, or any conclusions to be drawn about the long-term effect. In addition, it is not clear whether the training should be given in groups or individually for best effects (5).

1.1.6 Individually tailored intervention

Several authors emphasise the importance of individually tailored intervention programmes to prevent unnecessary functional decline (77, 78). The older and more physically and mentally frail the participant is, the greater the need for individually tailored exercise programmes developed and supervised by a trained specialist (56). The effect of individual interventions seems to be somewhat larger than the effect of group interventions, particularly with regard to physical function (51). Group exercises are not suitable for residents with severe cognitive impairment (79). Difficulties may exist for cognitively impaired persons to participate in group exercise programmes due to dependence on assistance during the exercise session (78, 80). Examination of overall adherence patterns indicates that most participants attended either >67% or <33% of the total exercise sessions. This pattern of commitment to exercise interventions suggests that exercise programmes may need to be specially tailored for the individual senior's changing needs, interests, physical and cognitive capabilities (81).

Older people form a heterogeneous group, and intervention programmes should focus on personal skills and self-confidence (82). Goals should be as realistic as possible, and aim at improving function and independence. Being actively involved in setting one's own goals and expressing expectations and wishes probably leads to better compliance. Experiencing autonomy is recognised as a means of promoting health and well-being in all age groups (83).

1.1.7 Participation and self-efficacy

The WHO recognises participation as a key indicator of human health and well-being. Participation is defined as involvement in life situations. Developmental theories suggest that participation patterns change across the life span. These changes are most notable among the elderly, particularly for those who are faced with decline in health, reduced income and death. Studies show that the number of chronic conditions present is one of the predictors of a lower level of participation (84).

The theory of self-efficacy states that the more one believes in the efficacy of a specific activity, the more likely (motivated) one is to perform that activity. Factors that are known to influence efficacy beliefs and motivate people to participate in rehabilitation are individualised care and goals (85). Self-efficacy can serve to impair or enhance performance and is strongly associated with such key performance-based measures as balance and gait, as well as self-reported activities of daily living (86). The relationship between self-regulatory factors and performance may be especially important for older adults (87). Efficacy beliefs, both self-efficacy and outcome expectations, are related to participation and functional performance (88). Fall-related self-efficacy was shown by Stretton et al (86) to be an important predictor of both physical performance and health-related quality of life.

1.1.8 Measuring function among elderly nursing home residents

Many instruments for evaluating functioning have been developed for research purposes and validated for older persons with better function and less frailty than nursing home residents. Measurements of muscle strength, balance, cognitive function, mobility, ADL, and physical activity are commonly used in the fields of geriatric medicine in general, but need to be evaluated in order to discern whether they are also suitable for use among nursing home residents.

To ensure that it is appropriate for its target group, an instrument should be examined in the target population, and the psychometric properties of the test should be reported (89, 90). Self-reports are closer to the concept of disability because they reflect subjective performance within a socio-cultural context, while assessment by an external observer is closer to objective functional limitations (91). Performance-based tests are better than self-reported measures in terms of validity, reliability and sensitivity to change (92). The Frailty Working Group recommends a mixture of objective performance-based measures and subjective reports when studying older persons who often have complex functional losses (42).

Clinical feasibility refers both to the ability to use an instrument and to its appropriateness to its intended task and target population. It concerns how well individuals can perform movements required in everyday life and can help target people at risk of functional dependence (93). When the correlation coefficient between two instruments is 0.9 or higher, it implies that they measure quite similar constructs, which could be a reason for omitting one of them (94).

1.1.9 Perspectives and framework

The basis for the intervention was the development of individualised training programmes based on evaluations made by occupational therapists and physiotherapists, on medical background and on needs and wishes expressed by the resident. Each resident participating in the intervention was initially invited to set his/her personal goals and to design a personal training programme together with therapists and staff members. The assumption underlying personally tailored interventions was that the needs, personality and disease-related prerequisites of each person must be respected and taken into account, and that this approach will lead to a better outcome of the intervention (95). Furthermore, Nowalk et al (81) experienced a problem with low adherence rates in nursing homes and suggested that residents of long-term care facilities may require individualised exercise interventions that can be adapted to their changing needs.

1.1.10 Rationale for this thesis

No empirical theory drawn from the best practice supporting autonomy and well-being for elderly residents in a nursing home setting has yet been presented. Increased focus on individual goals and personally adjusted intervention measures may be crucial.

This thesis is intended to extend our knowledge relating to the effects of individually tailored physical and daily activities for elderly persons in a nursing home setting.

1.2 AIMS

1.2.1 The overall aim of this thesis was to

Describe the impact of an individually tailored intervention programme in nursing home settings on physical capacity, degree of dependence in ADL, long-term participation in physical and / or daily activities, and on cognition and self-rated well-being. Part of the overall aim was also to describe the characteristics of elderly nursing home residents and to investigate the feasibility of using the selected measuring instruments in this population.

1.2.2 The specific aims were

Study I: To present the rationale and design of a Nordic multi-centre study aimed at describing the influence of an individually tailored intervention programme on physical capacity, degree of dependence in ADL, long-term participation in physical and/or daily activities and well-being in elderly nursing home residents.

Study II: To investigate the feasibility of measuring muscle strength, mobility, balance function, dependence in ADL, physical activity level, and cognitive function in elderly nursing home residents, and also to detect any correlations between these measurements.

Study III: To describe the levels of physical and cognitive function, dependence in ADL, and degree of well-being of the participants at baseline. A second aim was to compare groups of differing ages, levels of dependence in ADL, degree of fall-related self-efficacy, well-being and cognitive function.

Study IV: To describe the effect of three months of individually tailored physical and daily activities for elderly nursing home residents on dependence in ADL and balance function. A secondary aim was to describe the effect on muscle strength, mobility, fall-related self-efficacy, and physical activity level.

Study V: To evaluate the long-term effects, within and between groups, on well-being, cognitive function, dependence in ADL, transfer ability, physical activity level, and different dimensions of physical function three months after the intervention was completed.

2 METHODS

2.1 DESIGN

The main project was a multicentre, randomised, controlled trial with a parallel group design.

Table 1. Overview of Studies I-V

Study	Design	Participants, n	Main objectives
I	Descriptive	Total =322 Female =237 Male = 85	Description of the study design
II	Descriptive and correlative	Total =322 Female =237 Male = 85	Feasibility and inter-correlation of the instruments used in all five studies
III	Descriptive and comparative	Total =322 Female =237 Male = 85	Description of the study population at baseline
IV	Experimental	Total =266 Female =199 Male = 67	Effects on physical function after 3 months of intervention
V	Experimental	Total =241 Female =179 Male = 62	Effects on well-being, cognition and physical function at 3- and 6- month follow-ups

2.2 PARTICIPANTS

Nursing home residents from 24 nursing homes in Sweden, Norway and Denmark were invited to participate if they met the following inclusion criteria: 1) age over 64 years, 2) need of daily assistance in a minimum of one P-ADL- activity, 3) expected stay in the nursing home during the intervention period. Residents in a terminal stage of disease were excluded. The participants were randomised to either an Intervention Group (IG) or a Control Group (CG). According to the decision of the Regional Ethics Committee in Denmark, test results on the Mini Mental State Examination below 16 points was added as extra exclusion criteria in the Danish population. Thirty per cent of those invited declined to participate, and baseline data were collected from 322 residents. Of these, 266 (82.6%) were eligible for the 3-month follow-up and 241 (74.8%) for the 6-month follow-up. The mortality rate was eight participants in the IG and ten in the CG during the 6-month study period (Figure 1).

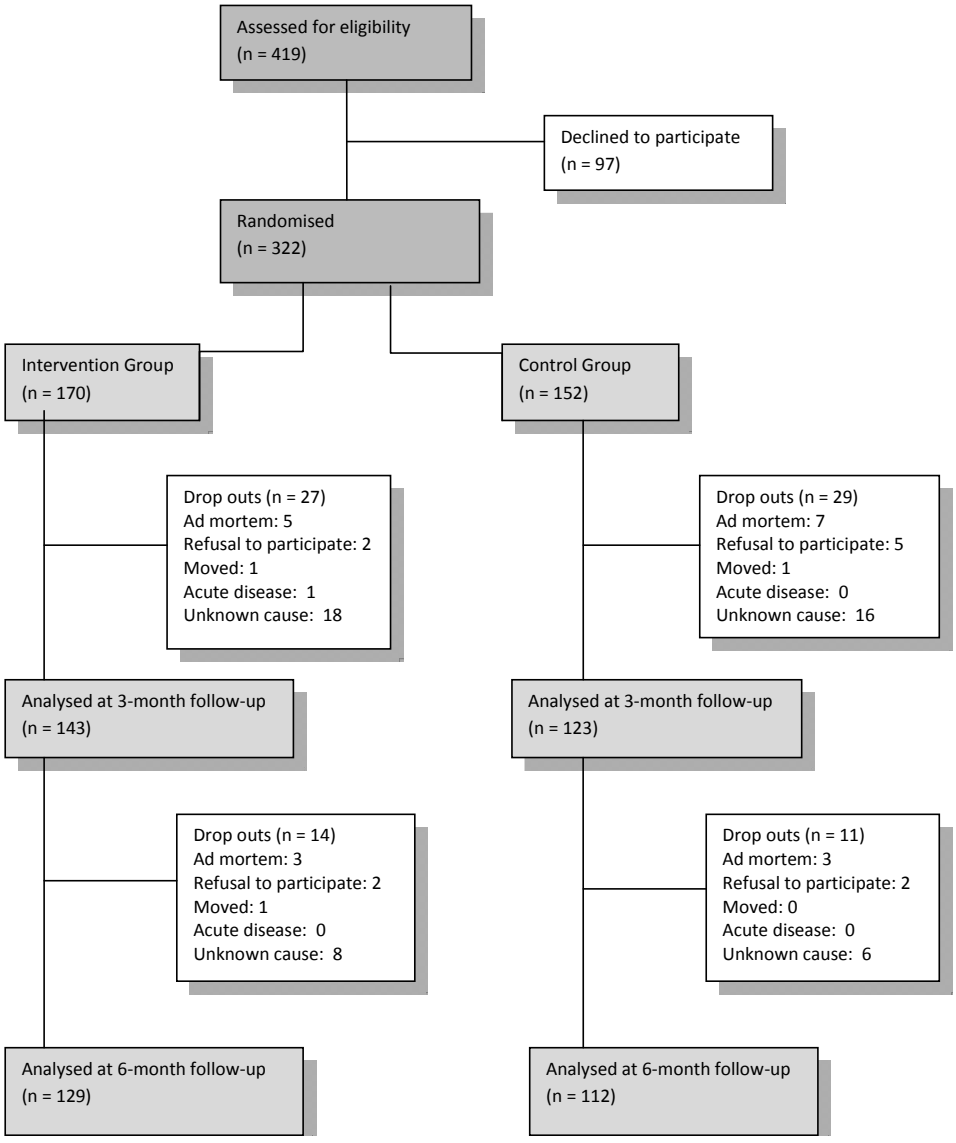

Figure 1. Participant flow throughout the trial

2.3 INTERVENTION

Trained physical- and occupational therapists were responsible for the intervention, and 30% extra rehabilitation time to carry out the intervention was financed by the project. Personal treatment goals were elicited in connection with an assessment of each subject in the IG. An individual activity programme was designed and revised once a week. The programmes consisted of exercises and activities in different combinations depending on the goals and physical and cognitive functions of each participant. The intervention contained the following activities: physical exercise, ADL- training, daily activities, and staff education. The minutes spent on each activity were recorded by the therapists responsible for the intervention. The CG received no extra intervention. For more details, please see Study I.

2.4 MEASUREMENTS

Table 2. Overview of variables assessed in Studies II-V

	II	III	IV	V
Socio-demographical				
- Age	X	X	X	X
- Gender	X	X	X	X
- Length of stay	X	X	X	X
- Mean number of diagnoses	X	X	X	X
- Mean number of drugs	X	X	X	X
Compliance	X	X	X	X
Muscle strength				
- Grip strength	X	X	X	
- The Timed Chair Stand Test	X	X	X	X
Mobility				
- 10 m at self-selected speed indoors	X	X	X	X
- 10 m at maximum speed indoors	X	X	X	X
Balance function				
-The Berg Balance Scale	X	X	X	X
Psychological factors				
- The Falls Efficacy Scale - Swedish version (FES(S))	X	X	X	X
- Question about fear of falling	X		X	
ADL				
- The Functional Independence Measure (FIM)	X items a-m + n-r	X items a-m	X items a-m	X items a-m + n-r
Transfers				
- The Physiotherapy Clinical Outcome Variables (COVS)	X	X	X	X
Physical activity				
- The Nursing Home Life Space Diameter (NHLSD)	X	X	X	X
Well-being				
The Philadelphia Centre Morale Scale (PGCMS)		X		X
Cognitive function				
-The Mini Mental State Exam (MMSE)	X	X		X

2.4.1 Background variables

Data regarding age, length of stay in the nursing home, number of diagnoses and medications were obtained from medical records.

2.4.2 Outcome variables

2.4.2.1 Muscle strength

Grip strength was tested with a Jamar dynamometer (Sammons Preston) in Sweden and Norway, a method that has been shown to have high intra- and inter-tester reliability (96) and validity (97). The test was repeated three times, and the mean value for each hand was used in the analysis. Higher values indicate stronger grip strength. In Denmark, the Collin handheld dynamometer was used (98, 99).

Leg muscle strength was evaluated by means of The Timed Chair Stand Test (100). Participants were asked to rise from a chair and then sit down five times consecutively. The total time was used as outcome, and lower values indicate better muscle strength. Ability to rise once without timing was used as a description of the study population at baseline. The test has been shown to have high test-retest reliability and is considered a sensitive test for evaluating the effects of exercise (101). It also has discriminative and concurrent validity properties (102).

2.4.2.2 Mobility

Walking or wheelchair propulsion indoors for a distance of 10 m was tested at self-selected and at maximum speed. There was no acceleration or deceleration phase. The time in m/s was used for analysis, and higher values indicate faster walking speed. The type of walking aid was recorded. The walking test has been shown to have good intra- and inter-rater reliability (103).

2.4.2.3 Balance function

The Berg Balance Scale (BBS) consists of 14 tasks of relevance for everyday life (104). Scoring is based on the ability to perform items independently and to meet certain time or distance requirements. Each item is scored along a scale from 0-4, giving a maximum total score of 56. Higher scores indicate better balance function. The scale has been shown to possess very good intra- and inter-rater reliability in both an elderly population and in stroke patients (104, 105). Acceptable validity estimates have also been reported (106).

2.4.2.4 Psychological factors

The Falls Efficacy Scale (FES) is a subjective rating scale regarding perceived fall-related self-efficacy. The scale has ten items, and each item is graded from 0-10, where 0 corresponds to "not confident at all" and 10 to "completely confident". Higher scores denote better confidence in performing the activities without falling. The scale was developed by Tinetti et al (107) and has been translated into Swedish and extended by Hellström et al (FES(S)) (108). FES(S) consists of 13 activities including both personal ADL (P-ADL) and instrumental ADL (I-ADL), giving a maximum score of 130. FES(S) has been demonstrated to have good test-retest reliability (108) and a good responsiveness ratio (109). Both concurrent (110) and predictive validity (111) are reported for FES(S).

A short question regarding fear of falling (response alternatives yes or no) was also included(112).

2.4.2.5 Activities of daily living (ADL)

The Functional Independence Measure (FIM) (113) describes residents' performance in daily activities according to a seven-level scale, where level 1 means total assistance and level 7 full independence. The instrument consists of 18 items, of which 13 address physical function (items a-m) and five social and cognitive functions (items n-r). The sum score ranges from 12 to 91 points, and higher scores indicate a higher level of independence. Both reliability and validity have been found to be good (114). Evaluation was done by the nursing staff, primarily by the person working most closely with the resident.

The Physiotherapy Clinical Outcome Variables (COVS) test covers 13 different activities related to transfers (115). Each item is scored on a scale ranging from 1-7, and with a sum score ranging from 12 to 91, where a high score indicates good function. The instrument has been demonstrated to have very good inter-rater and test-retest reliability (115) and construct validity (116) and to be sensitive to change (71).

2.4.2.6 Physical activity

The Nursing Home Life-Space Diameter (NHLSD) describes the extent and frequency of physical activity during the previous two weeks according to a six-level scale ranging from 0 (never) to 5 (>3 times a day), regarding how often the participant moves around in a predefined area. Whether the activity is performed independently (1) or independently (0) is also noted (117). The NHLSD is divided into two subscales where "semi total" (maximum 50 points) addresses the area and frequency of activity, and "total" also includes information about the need of assistance (maximum 100 points). Higher scores indicate a higher level of physical activity. The scale has been found to have high intra- and inter-rater reliability and good validity (117).

2.4.2.7 Well-being

The Philadelphia Geriatric Center Morale Scale (PGCMS) includes 17 items (38). There are two response alternatives and the maximum score is 17. A total score from 13-17 points represents "high morale", 10-12 points "middle range morale", and 0-9 points "low morale" (38). The scale has been translated into Swedish, and the Swedish version has been found to have satisfactory inter-rater reliability (118).

2.4.2.8 Cognitive function

The Mini-Mental State Examination (MMSE) is a brief screening test that quantitatively assesses the severity of cognitive impairment and documents changes over time (119). It ranges from 0-30 where high scores indicate good cognitive function. A total score of 24-30 points is classified as "no cognitive impairment", 18-23 points as "mild cognitive impairment" and 0-17 points as "severe cognitive impairment" (120). The test has shown satisfactory reliability (121).

2.5 SAMPLE SIZE

Based on a power analysis assuming a power of 80% of α of 0.05 and a drop-out rate of 10%, it was determined that 216 participants (108 in each study arm) would be sufficient to detect a difference between groups in FIM. In order to detect a mean difference of 3 points between groups for the Berg Balance Scale (122), 155 participants were needed in each study arm (n=310) using the same power as described above.

3 RANDOMISATION

3.1 PROCEDURE

Ward staff identified eligible participants according to the inclusion criteria and invited them to participate. After written informed consent, research Physiotherapists and Occupational therapists that were employed particularly for the study assessed all participants at baseline, immediately after 3 months of intervention and 3 months after the intervention was completed. After the baseline assessment participants were categorised into either independent or dependent on personal assistance in mobility (i.e. walking or wheelchair propulsion). Gender and dependence in mobility were then used as stratification variables. At each centre, participants in each nursing home ward were randomised to IG or CG, using a computer-generated random number list provided by a statistical adviser.

3.2 BLINDING

Assessors were blinded to the group assignment and not involved in the intervention.

3.3 STATISTICAL ANALYSIS

3.3.1 Studies I-V

Descriptive statistics were used to describe frequencies, central tendency and variability. The Kolmogorov-Smirnov test was used to check for normal distribution.

3.3.2 Additional analysis Studies I, III-V

The Mann Whitney U-test, the Kruskal-Wallis test and Chi-Square test were used for between-group differences. Within-group differences were calculated with Friedman's test and the Wilcoxon's signed-ranked test for analysis of changes. For normally distributed variables, differences between groups in change over time as well as changes within groups at the 3-month follow-up were assessed by independent and paired samples t-tests respectively. The level of significance was set at $p \leq 0.05$. Analysis was done both according to per protocol and intention-to-treat (ITT) principles. The ITT analysis was done by last value carried forward. Mean change is presented as the difference (positive or negative) between the participants' baseline values and the values at the 3-month follow-up and also between the 3- and 6-month follow-ups for each measurement. Missing data were handled as described in Study III.

3.3.3 Additional analysis Study II

Spearman's correlation coefficient was used to explore correlation among the variables. Floor and ceiling effects were considered to be present if more than 15% of the respondents achieved the highest or lowest possible score. Ceiling effect relates only to those instruments that have a defined maximum score.

4 ETHICS

Informed consent was obtained from all participants or, when the participant was diagnosed with dementia, from significant others. The project was approved by the Ethics Committees at all participating centres.

5 RESULTS

5.1 BASELINE DATA

There were no statistical differences regarding group characteristics at baseline (Table 2). The median age of the population (n=322) was 85.5 years with a range of 64-102. Seventy-four per cent were women. The median length of stay was 15 months with a range of 0-252 months. Two thirds (64%) were able to walk with or without walking aids, and 60 per cent were able to rise from a chair once. The median number of diagnoses for 242 participants (80 unknown) was 3 (range 1-8), and the median number of drugs for 210 participants was 6 (range 0-18). The median value of MMSE was 19 (range 0-30), which indicates mild cognitive impairment (119), and the median score on PGCMS was 11 points (range 0-17), which indicates "middle range morale" (38). The question regarding fear of falling was answered by 228 participants at baseline, of whom 120 (53%) stated "Yes". Analysis of internal drop-outs revealed that those who did not complete any of the follow-ups had a higher cognitive level (MMSE p=0.03, FIM n-r p=0.007) but walked more slowly (p=0.042 and 0.05) than those who completed the 6-month follow-up. In addition, participants in the IG who dropped out before the 6-month follow-up had completed fewer weeks of intervention than those who completed the whole study period.

Table 2. Baseline data and characteristics of the Whole Study Group (n=322), the Intervention Group (n=170), and the Control Group (n=152).

	The Whole Study Group		**Intervention Group**		**Control Group**		**P***
	n (%)	Median (range)	n (%)	Median (range)	n (%)	Median (range)	
Age	322 (100)	85.5 (64-102)	170 (100)	86 (64-101)	152 (100)	85 (64-102)	0.855
Length of stay	300 (93)	15 (0-252)	161 (95)	15 (0-252)	139 (91)	14 (0-186)	0.518
Ability to walk	205 (64)		107 (63)		98 (64)		0.530
Ability to rise	193 (60)		104 (61)		89 (58)		0.280
Number of diagnoses	242 (75)	3 (1-8)	130 (76)	3 (1-8)	112 (74)	2 (1-7)	0.222
Number of drugs	210 (65)	6 (0-18)	111 (65)	6 (0-18)	99 (65)	6 (0-14)	0.684
The Mini Mental State Examination	305 (95)	19 (0-30)	161 (95)	19 (0-30)	144 (95)	19 (0-30)	0.762
The Philadelphia Geriatric Center Morale Scale	305 (95)	11 (0-17)	164 (96.5)	11 (2-17)	141 (93)	11 (0-17)	0.227

* Mann Whitney U-test, significance level ≤ 0.05

5.2 BETWEEN-GROUP DIFFERENCES

Following intervention, a significant difference was found between groups regarding balance function ($p = 0.001$), physical activity ($p = 0.038$) and transfer ability ($p = 0.024$), where the IG had improved while the CG deteriorated. There was no significant group difference in mean change for ADL ($p = 0.293$). The ITT analysis did not change the results (Study IV). There were no significant differences between the IG and CG regarding the mean change in any outcome between the 3- and 6-month follow-ups. Values close to significance were seen in FIM n-r ($p=0.061$) and balance function ($p=0.052$), where the IG deteriorated more than the CG. The ITT analysis brought out a significant difference in social and cognitive functions (FIM n-r $p=0.035$), where the IG improved and the CG deteriorated, but did not affect the results in any other way (Study V).

5.3 WITHIN-GROUP DIFFERENCES

5.3.1 Intervention Group

Directly after the intervention period, the IG showed a significant improvement regarding walking/wheelchair speed (self-selected $p = 0.038$, maximum $p = 0.003$) and functional leg muscle strength ($p = 0.019$), while the results for ADL and balance function were maintained during the intervention period. The ITT analysis did not change the results (Study IV). Between the 3- and 6-month follow-ups, the results from the cognitive and social dimensions of ADL (FIM n-r $p=0.006$), physical activity level (NHLSD semi total $p=0.027$), functional leg muscle strength (the Timed Chair Stand Test $p=0.017$) and balance function (BBS $p=0.001$) deteriorated. According to the ITT analysis, FIM items a-m also deteriorated between the 3- and 6-month follow-ups ($p=0.033$) (Study V).

5.3.2 Control Group

A significant deterioration in ADL ($p = 0.012$), balance function ($p = 0.004$) and transfer ability ($p = 0.023$), but a significant improvement in physical activity level (semi total $p=0.043$), were seen between baseline and the 3-month follow-up. The ITT analysis confirmed the results of FIM a-m and balance function, while transfer ability (COVS) also demonstrated a significant deterioration between baseline and the 3-month follow up ($p=0.021$) (Study IV + V). There were no significant differences between the 3- and 6-month follow-ups in any of the outcome variables (Study V).

5.4 ADDITIONAL ANALYSIS

5.4.1 The older old

Participants over the age of 85 (n=181) showed significantly lower cognition ($p=0.016$), a lower level of physical activity ($p\leq0.002$), lower grip strength for both hands in Sweden and Norway combined ($p<0.05$), and for the dominant hand in Denmark ($p=0.033$) at baseline than the younger group (Study III).

5.4.2 High dependence in ADL

Participants (n= 147) with high dependence in ADL (COVS <58 points) had a significantly longer length of stay ($p<0.005$), lower fall-related self-efficacy ($p<0.005$) and a lower level of cognitive function ($p=0.05$) at baseline than those with a low degree of dependence. A lower level of physical activity ($p<0.005$), slower walking/wheelchair speed ($p<0.005$), weaker grip strength ($p<0.05$), and worse balance function ($p<0.005$) were also demonstrated (Study III).

5.4.3 Low fall-related self-efficacy

The group (n=133) with low FES P-ADL scores (< 40 points) had lower levels of physical activity ($p\leq0.05$), and well-being ($p<0.001$). They also had a slower walking/wheelchair speed ($p<0.005$), weaker leg muscle strength ($p<0.005$), worse balance function ($p<0.005$) and transfer ability ($p<0.005$) at baseline than the group with high fall-related self-efficacy. In addition, a higher degree of dependence in ADL ($p<0.001$) was demonstrated (Study III).

5.4.4 Levels of well-being according to PGCMS

Participants (n=136) with low PGCMS scores (<11 points) showed lower fall-related self-efficacy ($p=0.003$) and a slower self-selected walking/wheelchair speed ($p=0.038$) at baseline than the group with higher scores. The distribution of the three levels of well-being (low - middle range - high morale) at baseline was almost equal in both IG and CG. Within the IG, the level of well-being at baseline did not influence the mean changes between the 3- and 6-month follow-ups in any of the outcomes. This was also true of the CG with one exception, the "middle range morale" group deteriorated in falls-related self-efficacy between the 3- and 6-month follow-ups, while the other two groups improved ($p=0.016$) (Study V).

5.4.5 Levels of cognition according to MMSE

Participants (n=143) with low MMSE scores (<19 points) were older ($p=0.034$), showed higher fall-related self-efficacy in I-ADL ($p=0.014$) and were less physically active ($p<0.001$) at baseline than participants with higher scores. They also performed worse in tests of grip strength ($p<0.005$, Denmark excluded), leg muscle strength ($p=0.018$) and balance ($p<0.001$) and showed a higher degree of dependence in ADL ($p<0.001$) (Study III).

Every other participant had "severe cognitive impairment" according to baseline MMSE. The distribution of the other two levels of cognition was about one fourth for each level in the IG, but there were significantly fewer ($p=0.029$) with "mild cognitive impairment" in the CG compared

to the IG. The group with "severe cognitive impairment" within the IG deteriorated in transfers (p=0.01) during the intervention period, while the others improved, especially the group with "mild cognitive impairment". No significant differences between the 3- and 6-month follow-ups according to levels of cognition could be detected in any of the outcome variables within the IG. Within the CG, the "no cognitive impairment" group improved their physical activity level (NHLSD total: p=0.042) between the 3- and 6-month follow-ups, while the other two groups, especially the group with "severe cognitive impairment", became less active (Study V).

5.4.6 Length of stay

A length of stay shorter than 14 months was significantly correlated with lower dependence level in ADL ($p<0.001$), better balance function ($p<0.001$), higher level of physical activity ($p=0.003$), faster maximal walking/wheelchair speed ($p=0.002$) and better transfer ability ($p<0.001$) at baseline. The same correlations with length of stay were seen at the 3-month follow-up regarding ADL function ($p=0.007$), balance function ($p<0.001$), physical activity level ($p=0.032$), maximal walking/wheelchair speed ($p=0.05$) and ability to transfer ($p<0.001$).

5.5 FEASIBILITY OF MEASUREMENTS (STUDY II)

5.5.1 Completion of tests

Participation in tests of muscle strength, mobility, balance function, fall-related self-efficacy, ADL, physical activity level and cognitive function was >70% (71-97%), except for the 10 m walking/wheeling propulsion at maximum speed (69.9%) and the Timed Chair Stand Test. Regarding leg muscle strength, 44.2% were not able to rise from a chair once, and the Timed Chair Stand Test was completed five times in a row by 44.7%. The three highest performance rates were observed for grip strength: dominant hand (97.7%), FIM a–m (97.2%), and FIM n–r (96.0%).

5.5.2 Floor and ceiling effects

Measurements used in all the Scandinavian countries with less than 10% missing ($n > 290$) were MMSE, BBS, and FIM. No ceiling effect was observed in the instruments that have a defined maximum score, i.e., BBS, FES(S), MMSE, FIM, COVS, and NHLSD. The observed minimum score zero, or a defined minimum score greater than zero, was recorded less frequently than in 15% of the completed tests. The most frequently observed minimum score zero was recorded on BBS (9.9%), FES(S) (7.1%), and grip strength: non dominant hand (4.6%).

5.5.3 Intercorrelations

Significant correlations were found between measurements of strength, mobility, balance, ADL, physical activity level and cognitive function, ranging between 0.14 and 0.90. Nineteen comparisons have a correlation coefficient of 0.50 or more. High correlation coefficients were

seen between BBS and COVS (r=0.90), FIM a-m and COVS (r=0.85), BBS and FIM a-m (r=0.82).

5.6 INTERVENTION

5.6.1 Compliance

Data regarding the length and frequency of the intervention were collected from a total of 122 participants (72%). Sixty-eight per cent (n = 83) completed 10–13 weeks with a mean exercise dose of 105 min/week (SD± 59.7). The most common reasons for not completing the whole intervention period were illness, acute hospital admission or unwillingness to continue to participate in the study (Study III + IV).

5.6.2 Content

Fifty-three per cent of the interventions focused on decreasing activity limitations (transfers, standing, walking, personal care, individual activity). Functional impairments (range of motion, balance/coordination, strength, dexterity) comprised 32.2% of the interventions, instructions for self-administered training 0.7%, technical aids 2.7% (i.e. walking aids), guidance of staff 2.1% and other activities 9.8% (Study IV) (Table 3).

Table 3. The proportion of total treatment time spent on each component of the intervention (n=172)

Intervention Components	Proportion of total treatment time (%)
Activity limitations (transfers, standing, walking, personal care, individual activity)	54
Functional impairments (range of motion, balance / coordination, strength, dexterity)	32.2
Instructions for self-administered training	0.7
Technical aids	2.7
Guidance of staff	2.1
Other	9.8

5.6.3 Frequency and duration

At the 3-month follow-up, participants (n=79) who had taken part in 150 min or more of intervention/week had significantly better balance (p = 0.003), better transfer ability (p = 0.046) and were more physically active (p =0.005) than the others. When checking up on baseline characteristics, those who had taken part in more than 150 min of intervention/week had a shorter length of stay (p = 0.035), fewer diagnoses (0.001), fewer prescribed drugs (p = 0.001) and to a lesser extent were afraid of falling (p = 0.053) compared to others. However, there were no significant differences in baseline characteristics between those who had reached the 10 weeks of intervention and those who had not. Those who had participated in more than 10 weeks of intervention significantly improved in physical activity level (p = 0.05) and maximal walking/wheelchair speed (p =0.05) while the others deteriorated. No major

adverse events associated with the prescribed exercises and activities were observed (Study IV). When checking up on the three levels of cognitive function no significant difference was observed regarding the frequency and duration of intervention (Table 4).

Table 4. Frequency and duration of the intervention according to levels of cognitive function

	No cognitive impairment (n=19)	Mild cognitive impairment (n=29)	Severe cognitive impairment (n=65)	p
<150 min>				
Mean (SD)	114.23 (±75.2)	101 (±50.9)	82.45 (±57.7)	0.063
<10 weeks>				
Mean (SD)	10 (±3.0)	10 (±2.9)	9.8 (±2.8)	0.513

6 DISCUSSION

6.1 MAIN FINDINGS

Nursing home residents in Scandinavia form a heterogeneous group regarding both characteristics and functional level. Effects of the intervention were seen in balance function, walking/wheelchair speed, transfer ability and functional leg muscle strength. Between the 3- and 6-month follow-ups, the cognitive and social dimensions of ADL, functional leg muscle strength and balance function deteriorated within the IG. The physical activity level increased in both groups during the intervention period but then decreased within the IG between the 3- and 6- month follow-ups. Dependence in ADL, balance function and transfer ability decreased within the CG between baseline and the 3-month follow-up, but remained unchanged between the 3- and 6-month follow-ups. We could not demonstrate any effects on cognition or well-being in either of the two groups.
Participation in tests generally reached more than 70%, and no floor- or ceiling effects were seen. Due to high inter-correlations, the FIM a-m and COVS seem to measure the same construct and might therefore be interchangeable. Sixty-eight per cent of the participants completed most of the intervention period, but a mean of recommended 150 min/week was not reached on group level.

6.2 CONSIDERERATION OF FINDINGS

6.2.1 Physical activity and rehabilitation

An updated review by Cochrane (123) regarding physical rehabilitation for older people in long-term care was recently published. The authors conclude that physical rehabilitation for long-term care residents may be effective, but the effects appear quite small and may not be applicable to all residents. Our results should, in the first place, apply to people with the described characteristics and levels of function and not necessarily living in nursing homes or other sheltered accommodation. Despite the fact that the updated review (including meta-analyses of ADL and mortality) included an additional 18 studies compared to the first review in 2009, there is still insufficient evidence to be able to draw conclusions about the sustainability of any improvement or about what interventions are most appropriate. In accordance with our results, there is some evidence that independence in ADL is enhanced, or declines less, as a result of physical rehabilitation interventions when compared with normal care. We were also able to demonstrate positive intervention effects on muscle strength and balance which was confirmed by the Cochrane review (123). The levels of well-being and cognition were unchanged on a group level in our study. In addition, there was no significant difference between or within groups regarding fall-related self-efficacy. According to the Cochrane review (123), there is some evidence of effect on mood but little evidence of effect on cognition and fear of falling.

To promote and maintain health and physical independence, older adults need moderate-intensity aerobic physical activity for a minimum of 30 min five days a week or vigorous-intensity aerobic activity for a minimum of 20 min three days a week. Older adults should engage in regular physical activity according to their abilities and conditions so as to avoid sedentary behaviour (124). The amount and frequency of our intervention were demonstrated to have an impact on outcomes. Participation for more than 150 minutes per week was associated with better balance, better transfer ability and a higher physical activity level after the intervention period. Those who had participated for 10 weeks or more improved in physical

activity and maximal walking/wheelchair speed. It seems that some of the intervention results may be explained by the amount and frequency of intervention, but this may not be the crucial point. The results of a study by Simons and Andel (125) suggest that benefits of exercise in advanced old age may be universal rather than specific to the type of exercise. Maybe researchers in this area should put less effort into trying to reveal the appropriate amount and content of rehabilitation interventions, and more into how well it is performed and how motivated the nursing home residents are to perform and complete physical interventions.

6.2.2 Self-efficacy

In social cognitive theory, human behaviour is extensively motivated and regulated by the on-going activity of self-influence. The stronger the perceived self-efficacy for that particular behaviour or activity, the higher the goals people set for themselves and the firmer their commitment to them. People form beliefs about what they can do, they anticipate the likely consequences of prospective actions, they set goals for themselves, and they otherwise plan courses of action that are likely to produce desired outcomes. People cannot influence their own motivation and actions well if they do not pay adequate attention to their own behaviour, the conditions under which they occur, and the immediate and distal effects the behaviour produce (126, 127).

Older individuals typically have reduced self-efficacy and a lack of strategy acumen, as compared with younger adults. When combined with low control beliefs, these characteristics might discourage certain older individuals when there are signs of difficulty, resulting in withdrawal of effort (87). Frail elderly persons in nursing homes are likely to need support from rehabilitation and nursing staff to be aware of the training effects and, maybe most important, be aware of when the training is actually taking place. To rise from a chair five times or walk a few metres is not exercise, in many elderly persons' opinion, but it could often be just the right level of training. Walking with the support of a walker for instance, corresponds to a moderate level of activity intensity for the very old (17).

6.2.3 Goal-setting

Short-term attainable goals help people to succeed by enlisting effort and guiding action in the here and now. The regulation of behaviour is not solely a personal matter, especially for nursing home residents. The surrounding systems, such as health care systems, environment, social services etc. are also important. There is tension between nursing homes as places that take care of seriously ill and disabled people and as places where people live. The environment provides models for behaviour, and if the care policy promotes inactivity rather than activity, the residents themselves are not capable of maintaining or increasing their activity level (127).

Within goal setting theory an individual's involvement in the process is considered to be fundamental to its effectiveness in ensuring lasting change. A key component of goal-planning is that goals need to be specific and set at the right level (128). Interviews of elderly community dwellers from 11 European countries demonstrated that older people want to be involved in their care. However, not all people want to take control over decisions regarding their medical care. The desire for participation in decision-making varies considerably within the group of older people and changes with time. An individual and flexible approach to each person in the ageing

population is needed (129). Our intervention was planned in cooperation with the participants, and they had to express their own goals for the intervention. To analyse the goals and goal attainment would be an interesting subject for future research.

6.2.4 Cognition and well-being

We could not demonstrate any significant effects of our intervention on cognition or well-being. WHO's definition of well-being is based on the assumption that individuals have the intellectual capacity to make complex subjective judgments about their lives. Many questions have been raised about the ability of persons with dementia to make such judgments and about the point at which they become unable to do so. Judgments about what is important to QOL may change as dementia progresses or as the individuals living situation changes (49). The majority of our participants had mild to severe dementia and were maybe less capable of judging their well-being. However, the major conclusion from a review published in 2001 (53) was that physical activity positively influences various outcomes associated with quality of life regardless of the age, activity status and health (including cognition) of the participants.

The fact that participants with low cognitive function were rating their fall-related self-efficacy higher than those with higher levels of cognition could be due to memory problems and subsequently worse insight in their own ability. It is important to bear in mind what each instrument is intended to measure. In this case it could be easy to "slip into" the conclusion that a persons' balance ability is good but what it means is that a person does perceive high fall-related self-efficacy.

In a study by Chin et al (41), psychological well-being in frail elderly people was not responsive to 17 weeks of intervention with exercise and/or micronutrient foods. The authors conclude that changes in well-being may occur after long-term interventions. In another RCT, Chin et al (35) concluded that neither strength training nor all-round, functional training of moderate intensity is effective in improving QOL, vitality or depression of older people living in long-term care facilities. However, that training was performed only twice a week and not for 30 minutes a day as recommended for older adults (124). A high-intensity functional exercise programme over three months (the FOPANU study) had no impact on well-being in older nursing home residents. The authors concluded, however, that an exercise programme as a single intervention may have short-term effects on well-being among people with dementia (43). On the other hand, important mental benefits were experienced by many participants as a result of a 12-month exercise programme in a study by Fox et al (61). The results demonstrated improved mood, improved physical self-perceptions of strength, fitness and ability to function better in ADL but no measureable changes in function. Physiotherapy, rehabilitation and health care more generally appear to be rooted in some basic assumptions that a reduction in impairment necessarily equates with improved quality of life (130). To whom is the treatment effect clinically significant? Kazdin (131) emphasises that the goals of a patient could be achieved even though the goals of the therapist may not have been.

Ideally, activities should demand concentration, be interesting, and be challenging yet not exceed one's skill level. In negotiating goals, it is important to note that a change in life satisfaction is often unrelated to changes in objective markers of fitness. Our intervention programme was not designed to deliberately influence well-being or cognition, but effects

mediated by the activity itself would not have been surprising. Geriatric patients with mild to moderate cognitive impairment benefit from rehabilitation and should not be routinely excluded from rehabilitation. Although cognitively impaired persons improve, they may not be able to maintain their improvement over time in comparison with the cognitively intact (32). Exercise experiences of nursing home residents aged 86-99 years who participated in 6-month exercise intervention were investigated by Stathi et al (75). By the end of the intervention, participants noted improved quality of life through better mobility, decreased fear of falling, and feelings of achievement and success. They valued the programme as an opportunity to do something for themselves, to add something to their weekly routine, to meet other people and to be generally more active.

6.2.5 Life-long training

We were able to demonstrate positive effects regarding physical activity level, functional leg muscle strength and balance function directly after the intervention period, but a reduction during the post-training period. This is in line with a study by Hauer et al (132), where 57 community dwelling geriatric patients were training 3 times/week for 3 months. The authors concluded that training programmes should continue so as to keep patients active and to prevent the decline in strength and functional performance. Physical training has to be an ongoing activity in order to give and maintain positive results.

Nursing home residents form a frail group who, due to impaired cognitive and physical functions, often have difficulty carrying out the training on their own. The group with "mild cognitive impairment" within our IG increased their ability to transfer during the intervention but then decreased it between the 3- and 6- month follow-ups. Access to rehabilitation staff seems crucial to achieve and maintain improvements in function among nursing home residents. It appears that the persons with mild cognitive impairment would benefit most from supervised training.

As it is true of all human beings and age groups that effects of exercise need constant reinforcement through continuous exercise, it is not surprising that the improvements gained by our participants disappeared when the intervention measures came to an end (124). The fact that the CG deteriorated in ADL and balance during the first three months could support that.

Baum et al (74) concluded that individual physical therapy can be effective, but a relatively fast detraining effect may be seen as soon as 10 weeks after therapy. The detraining phenomenon suggests that some form of maintenance exercise is needed. It is likely that very few residents will improve in their physical function in all targeted areas. However, the objective should be to maintain the highest level of physical functioning possible to preserve overall health status and quality of life in this group of institutionalised persons (133).

6.3 METHODOLOGICAL CONSIDERATIONS

6.3.1 Measures of cognition and well-being

There is general consensus that quality of life measurement should focus on the subjective experience of the individual. This implies that the individual in question is the most valid source

of information. Nursing home residents may not be able to respond to self-report measures or may lose this ability during their stay, due to dementia. In a study by Gerritsen et al (134), PGCMS was successfully completed by 94-100% in MMSE score >22, 81% in scores 13-21, 72% in scores 5-12, 3 % in scores <5. Low correlations were found between self-report and proxy assessment in groups with a low cognition level. This may suggest that the validity of self-report scales decreases with the level of cognition, but also that the validity of observational scales is lower in the low cognition group (134). Persons with mild to moderate dementia can be considered good informants of their own subjective states, paving the way to considering patient responses rather than proxy measures as the gold standard for assessing QOL for persons with dementia (135).

The British Geriatrics society and the Royal College of Physicians of London recommended PGCMS as the most appropriate instrument for assessment of subjective well-being among the elderly. To make the questions comprehensible to elderly persons, they are phrased as simply as possible without multiple clauses, difficult vocabulary or several response alternatives. The length of the scale is also limited so that it would not result in fatigue or inattention (40). The PGCMS is considered to be a positive scale but still has more items that contain negative affects or conditions (12 out of 17) than the Geriatric Depression Scale (134).

The effect of the "gate keeper" of the interviewer seems to be rather substantial in our study when using the PGCMS. Some staff might feel that it is inconvenient to ask questions about how an elderly person experiences ageing and the risk of becoming disabled. There is a risk that the interview will point out negative components that would not have been considered otherwise.

We could not show any impact of the intervention on well-being but this could depend on the fact that the questions in PGCMS mainly concern how the individual copes with becoming old and its consequences. It may be that the participants are imagining a longer period, maybe 10 or 20 years, when answering the questions and making the comparisons between "now" and "then". It could also be the case that well-being in this group does not change in such a short time as three or six months.

6.3.2 Physical activity

Originally the NHLSD was a measure of mobility, and need of assistance in this activity, developed for nursing home residents. We used it as a measure of physical activity. It does raise the question if this really is a measure of physical activity. How physically active can you say that a person is when he or she needs a wheelchair and assistance to wheel it? What if the resident needs assistance in mobility and does not get it? Does that really mean that the individual has a low physical activity level? We find that it does, and that NHLSD measures the present level of activity but not what the individual is capable of doing when given optimal conditions. In the context of nursing homes, it would be valuable to measure even the most dependent individual's activity level and to evaluate changes in care management for this purpose. The NHLSD is easily handled and measures even small changes that could give valuable information about a frail person's activity level and the effects of actions taken, both environmentally and personally orientated, to improve this level.

6.3.3 Feasibility

Residents in nursing homes seem to be too frail to accomplish all tests, which corresponds well with our results that those who performed the Timed Chair Stand Test had significantly better results on grip strength, BBS, MMSE, COVS, FIM a-m as well FIM n-r compared to those who had missing results on the Timed Chair Stand Test. The Timed Chair Stand Test was completed five times in a row by 45.7% of our participants. Of the others, 8.7% were only able to rise once, 2.2% twice, 1.6% three times, and 1.2% four times, whereas 38.5% were unable to rise. It seems to be a measure that is useful only for a limited proportion of elderly nursing home residents. Why the 10 m walking/wheelchair test at maximum speed was completed by only 69.9% (self-selected 77%) is not clear. It could be due to exhaustion caused by the other tests. The order in which the tests were to be performed was stipulated, and the walking test was performed first at a self-selected speed and then at a maximum speed. If a participant's maximal walking range was about 10 m, another test of 10 m was not carried out. As FIM a-m and COVS are measurements of the same construct, i.e. ADL including transfer ability, the correlation should be high as also demonstrated. The high correlation also with BBS reflects that balance control is the foundation of our ability to move and perform ADL.

6.3.4 Clinically meaningful change

Johnston et al (136) found that a gain of one point in FIM score was associated with 2-3 minutes less care for basic activities of daily living at home. The CG in our study dropped five points in FIM a-m scores during the first 3 months, which may correspond to 10-15 minutes more of care time per individual (25-38 more hours for the whole group).

In the range of 56 to 54, each 1-point drop in the Berg Balance Scale scores is associated with 3-4% increase in fall risk. In the range of 54 to 46, a 1-point change in the Berg Balance Scale scores leads to a 6-8% increase in fall risk. Below the score of 36, fall risk is close to 100% (137). The CG dropped four points in BBS scores during the first 3 months but from such a low level (21 p) that the fall risk was already close to 100%.

Clinically meaningful differences in gait speed equal 0.1 m/s according to Bean et al (138), but unfortunately our IG did not reach that threshold after the intervention period (self-selected speed +0.04 m/s, maximum speed +0.08 m/s).

6.3.5 Design and analysis

Our study was conducted in different nursing homes, and several testers performed the data collection. Although a thorough training of all testers was carried out, the reliability of the results might have suffered somewhat. Analyses were performed both per protocol and by intention-to-treat measures which is recommended at RCT's. Furthermore, it is possible that the CG might have been "contaminated" and the regular treatment been influenced by the intervention, as the randomisation was carried out within each nursing home ward.

6.3.6 Future research

To further explore effects of training for frail elderly people it would be of interest to investigate the relationships between individual goals, goal achievement, compliance with training and outcomes. In addition, effects of training for longer time periods than three months would be of great interest. There is also a lack of knowledge concerning what type of exercise and physical activity would benefit persons with dementia most.

7 CONCLUSIONS

Study I: Although it is a great challenge to carry out an intervention study directed toward such a frail population, it is of great interest to find out whether individually tailored and enhanced activities can lead to reduce dependence in ADL and increase well-being.

Study II: The instruments used for testing of muscle strength, mobility, balance function, dependence in ADL, physical activity level and cognitive function, seem to be feasible for nursing home residents in the three Scandinavian countries. Participation in the tests was 70% or more except for the 10 m walking test and the Timed Chair Stand Test, and among those tested no floor or ceiling effect was perceived. More research is needed to enable the establishment of an accreditation standard for use in nursing homes.

Study III: Elderly residents in nursing homes in Sweden, Norway and Denmark form a frail but heterogeneous group regarding functioning, and mostly at a low level. Low physical activity level, physical function and dependence in ADL were related to poor well-being, cognitive function and fall-related self-efficacy.

Study IV: Balance function, transfer ability, and physical activity level can be improved or maintained following 3 months of individually tailored physical and daily activities in nursing home residents. An intervention based on characteristics of a person's individual treatment goals seems to be a feasible way of training, and both the duration (weeks) and frequency (min/week) of the intervention were shown to have an impact on the outcome.

Study V: Within the IG, functional leg muscle strength, balance function, and physical activity level deteriorated during the post-training period. In addition, the level of dependence in the social and cognitive dimensions of ADL increased. There were no differences within the CG or between groups in any outcome for the same time period. Levels of cognition had some influence on the outcome results in both groups. No effects on well-being or cognition could be shown in either group during the whole study period.

Main conclusions: This study demonstrates that balance function, transfer ability, and physical activity level can be improved or maintained following 3 months of intervention in nursing home residents. Within the IG, leg muscle strength and walking/wheelchair speed also improved. However, the effects regarding leg muscle strength, balance function, and physical activity level were lost during the post-training period, and dependence in social and cognitive dimensions of ADL deteriorated. The duration and frequency of the intervention and levels of cognition had some impact on the outcome values. Low physical activity level, physical function and dependence in ADL were related to poor well-being, low cognitive function and low fall-related self-efficacy. The instruments used for testing seem to be feasible for elderly nursing home residents.

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