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EVALUATION OF THE OTAGO EXERCISE PROGRAMME WITH OR WITHOUT MOTIVATIONAL INTERVIEWING

**FEASIBILITY, EXPERIENCES, EFFECTS AND ADHERENCE
AMONG OLDER COMMUNITY-DWELLING PEOPLE**

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School of Health, Care and Social Welfare

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Marina Arkkukangas

Akademisk avhandling

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Akademin för hälsa, vård och välfärd

Abstract

Falls and injuries related to falls are one of the most common health problems among older people and are becoming increasingly more frequent. Regular exercise has been identified as one of the most effective fall-prevention activities for older people; however, awareness of the impact of exercise programmes and adherence to recommended exercise among the elderly population is generally low. Research examining how an exercise programme is administered to and experienced by elderly community-dwelling people is needed.

The overall aim of this thesis was to investigate the feasibility, experiences and effects of and adherence to the fall-preventive Otago Exercise Programme (OEP) with or without motivational interviewing (MI) among community-dwelling people aged 75 years or older.

Four studies were performed from October 2012 to May 2016 in a sample of 175 people. Both quantitative and qualitative research methods were used. The methods included the feasibility for conducting a randomized controlled trial (RCT) (I), individual face-to-face interviews (II), an RCT (III) and a prospective cohort study (IV). The intervention was given to two groups. The participants who received OEP with or without MI were compared with a control group that received standard care.

The feasibility of performing an exercise intervention with or without MI was acceptable from the perspective of the participating physiotherapists. From the perspective of the older participants performing the exercise with behavioural change support, the inclusion of monitored exercises in everyday life and daily routines was important. The participants also expressed experiencing more strength, improved physical functioning and greater hope for an extended active life during old age.

From the short-term perspective, there were significant improvements within the OEP combined with MI group in terms of physical performance, fall self-efficacy, activity level, and handgrip strength. Improved physical performance and fall self-efficacy were also found within the control group; however, corresponding differences did not occur in the OEP group without MI. There were no significant differences between the study groups after 12 weeks of regular exercise. Adherence to the exercises in the pooled exercise group was 81% at the 12-week follow-up.

At the 52-week follow-up, the behavioural factors being physically active and obtaining behavioural support in terms of MI had a significant association with adherence to the exercise programme.

These studies provide some support for the combination of OEP with MI as the addition of MI was valuable for achieving adherence to the exercise programme over time in older community-dwelling people.

There is possibility in every difficulty

Albert Einstein

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From the short-term perspective, there were significant improvements within the OEP combined with MI (OEP+MI) group in terms of physical performance ($p=.04$), fall self-efficacy ($p=.02$), activity level ($p=.02$), and handgrip strength ($p=.03$). Improved physical performance ($p=.03$) and fall self-efficacy ($p=.03$) were also found within the control group; however, corresponding differences did not occur in the OEP group without MI. There were no significant differences between the study groups after 12 weeks of regular exercise. Adherence to the exercises in the pooled exercise group was 81% at the 12-week follow-up.

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These studies provide some support for the combination of OEP with MI as the addition of MI was valuable for achieving adherence to the exercise programme over time in older community-dwelling people.

Keywords: behaviour, community-dwelling, exercise, falls, feasibility, motivational interviewing, older adults, Otago Exercise Programme, physical activity, randomized controlled trial, self-efficacy

Svensk sammanfattning

Fall och fallskador är det största hotet mot hälsan i den äldre befolkningen. Regelbunden fysisk aktivitet och träning ger betydande hälsovinster och kan minska risken för sjukdom, nedsättning av funktionsförmåga, för tidig död och framför allt förebygga fall och fallskador. Generellt är äldres följsamhet till fysisk aktivitet och träning låg. Ökad kunskap behövs som belyser hur rekommenderade träningsprogram upplevs av de äldre, vilka effekterna är när träning utförs i hemmiljö och vilka beteendefaktorer som har betydelse för följsamhet till träning.

Syfte med avhandlingen var att utvärdera ett fallpreventivt träningsprogram, Otago Exercise Programme (OEP) med eller utan stöd av motive-rande samtal (MI) för personer över 75 år i ordinärt boende avseende; genomförande, erfarenheter, effekter samt följsamhet till träning.

Avhandling består av fyra delstudier med deltagare från tre kommuner i Mellansverige. Studierna genomfördes under oktober 2012 till maj 2016. Både kvantitativa och kvalitativa forskningsmetoder användes. Studierna inkluderade genomförbarheten av en randomiserad kontrollerad studie (I), intervjustudie (II), en randomiserad kontrollerad studie (III) och en prospektiv kohortstudie (IV).

Delstudierna belyser genomförbarhet, erfarenheter, kortsiktiga effekter och beteendefaktorer viktiga för följsamhet av det fallpreventiva träningsprogrammet. Interventionen genomfördes i två olika grupper, OEP med eller utan stöd av MI och jämfördes med en kontrollgrupp som inte utförde någon ordinerad träning.

Genomförbarhet, erfarenheter, effekter och följsamhet studerades under och efter de 12 första veckornas medverkan i studien och vidare studerades beteendefaktorer av betydelse för följsamhet till träningen ett år efter påbörjad träning.

Resultatet visade att genomförbarheten av interventionen var acceptabel utifrån deltagande fysioterapeuters perspektiv. De äldre personerna som genomförde träning i kombination med MI upplevde att träningsdagbok och stöd av fysioterapeut var viktigt för genomförandet av träningen.

Möjlighet att kunna anpassa träningen utifrån individuella förutsättningar samt att kunna integrera träningen i dagliga rutiner var viktiga aspekter som framkom av de äldre deltagarna. Att känna sig starkare och mera funktionsduglig och aktiv upp i hög ålder var positiva erfarenheter av träningen som uttrycktes av de äldre personerna.

Efter 12 veckors träning med stöd av MI hade fysisk funktion ($p=.04$), tilltro till sin förmåga att utföra olika aktiviteter utan att falla ($p=.02$), aktivitetsnivå ($p=.02$), samt handgreppsstyrka ($p=.03$) ökat signifikant inom gruppen. Signifikanta skillnader avseende fysisk funktion ($p=.03$) och tilltro till sin förmåga att utföra olika aktiviteter utan att falla ($p=.03$) fanns även inom kontrollgruppen, däremot sågs inga skillnader i OEP gruppen. Inga signifikanta skillnader fanns dock mellan de tre olika grupperna. Följsamheten till träningen var hög i träningsgrupperna (81%) vid 12 veckors uppföljning.

Att träna med stöd av motiverande samtal och att ha en hög aktivitetsnivå när träning påbörjas var beteendefaktorer som positivt påverkade följsamhet vid 52 veckors uppföljning efter det att träningen påbörjats.

Dessa studier beskriver hur OEP med eller utan stöd av MI kan genomföras för äldre personers ordinära boende. Motiverande samtal som tillägg till OEP påverkar följsamhet till träning på lång sikt.

List of Papers

This thesis is based on the following papers, which are referred to in the text by their Roman numerals.

- I Arkkukangas M, Johnson ST, Hellström K, Söderlund A, Eriksson S, Johansson AC. A feasibility study of a randomized controlled trial comparing fall prevention using exercise with or without the support of motivational interviewing. *Prev Med Rep.* 2015 Feb 3;2:134-40. doi: 10.1016/j.pmedr.2015.01.007
- II Arkkukangas M, Sundler A, Söderlund A, Staffan Eriksson, Johansson AC. Older persons' experiences of a home-based exercise programme with behavioural change support [Accepted for publication]
- III Arkkukangas M, Söderlund A, Eriksson S, Johansson AC. Fall preventive exercise with or without behavior change support for community-dwelling older adults: A randomized controlled trial with short-term follow up. *J Geriatr Phys Ther.* 2017 Feb 27. doi: 10.1519/JPT.000000000000129 [Epub ahead of print]
- IV Arkkukangas M, Söderlund A, Eriksson S, Johansson AC. One-year adherence to the Otago Exercise Programme with or without motivational interviewing in older people [Re-submitted to journal]

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Contents

1. Introduction.....	12
1.1 Health and welfare	13
1.2 Ageing and the risk of falling.....	13
1.2.1 Fall prevention.....	14
1.3 Physical activity	15
1.3.1 Physical exercise.....	15
1.4 Home-based fall prevention exercises.....	16
1.5 Adherence.....	17
1.6 Behavioural medicine approach	18
1.6.1 Social cognitive theory and self-efficacy.....	18
1.6.2 Transtheoretical model of behavioural change.....	19
1.6.2.1 Stages of change theory	19
1.7 Motivational interviewing.....	21
2. Rationale.....	23
3. Aims of the thesis.....	24
4. Methods	25
4.1 Study designs.....	25
4.2 Study sample	26
4.3 Intervention with exercise and behavioural support.....	26
4.4 Data collection.....	27
4.4.1. Measurements.....	28
4.4.1.1 Self-monitoring measurements	29
4.5 Randomization	30
4.6 Data analysis	30
4.6.1 Statistics.....	30
4.6.2 Treatment fidelity	31
4.7 Ethical considerations	32
5. Results.....	33
5.1 Feasibility and experiences regarding intervention with behavioural change support.....	35
5.2 Effect of and adherence to exercise with or without motivational interviewing.....	38
5.2.1 Adherence.....	40

5.2.1.1 Self-monitoring	43
6. Discussion	44
6.1 Main findings	44
6.2 Risk of falling	45
6.3 Physical activity and exercise.....	46
6.4 Fall prevention exercise performed at home	47
6.5 Reinforcing adherence.....	48
6.6 Motivational interviewing to support exercise behaviour change	49
6.7 Methodological limitations and considerations.....	49
7. Conclusion	51
7.1 Clinical implications	51
7.2 Future research and implementation of fall prevention exercises at the municipal level	52
8. Tack	53
9. References.....	55

Abbreviations

EQ-VAS	EuroQol-Visual analogue scale
FES(S)	Falls Efficacy Scale- Swedish version
MI	Motivational interviewing
MINT	Motivational Interviewing Network of Trainers
MMSE	Mini Mental State Examination
NRS	Numeric rating scale
OEP	Otago Exercise Programme
PT	Physiotherapist
RCT	Randomized controlled trial
RTC	Readiness to Change
SCT	Social cognitive theory
SOC	Stages of change
SPPB	Short Physical Performance Battery
TTM	Transtheoretical model
WHO	World Health Organization

1. Introduction

Preface

As a physiotherapist (PT), my major task is to inspire and support people, especially in their transition towards increased physical activity. The knowledge of a persons' behaviour in relation to physical activity places me in the position of integrating behavioural medicine into the field of physiotherapy. In my clinical work, I have lengthy experience with the older people's values concerning their ability to function in daily activities and their independence.

In my meetings with older people who have experienced fall accidents, changes in functional impairment have been the most frequent consequences and have led to decreased activity in daily life. When exercise is introduced to older people, the older person is often left with an exercise programme that must be performed either in a public facility or in the home setting. Despite instructions and initial supervision, adherence to exercise programmes is low in this population, and highlighting this complex problem of exercise adherence constitutes the core of this thesis.

My interest is derived from clinical experience and the demand for knowledge concerning how health care providers can successfully support older adults in remaining active. How can we increase the uptake of exercise programmes and promote adherence to exercise over time? This is a core question in fall prevention efforts that aim to decrease injuries in the rapidly growing elderly population. Understanding the motives and behaviour of older people in relation to physical activities and exercise is of immediate interest.

1.1 Health and welfare

For individual equal rights to health and welfare, availability/accessibility, acceptability, quality and participation are central concepts.¹ The concepts of availability and accessibility refer to the environmental features of an intervention, for example, their contribution to increasing physical activity levels.

Acceptability refers to how individuals embrace different intervention measures. Quality refers to whether older people perceive their participation in the measures as valuable. Ageing is known to be associated with psychological, physiological and functional declines that may lead to increased disability and frailty. In conjunction with the rapid growth of the older population, the number of falls and the associated suffering and costs are expected to increase globally and to become a great health burden for society.^{2,3} This increase also establishes the need to develop physiotherapy methods that meet the increased demands associated with ageing and age-related problems. Participation is a core component and a prerequisite for the approach of physiotherapy with behavioural medicine.⁴

In this thesis, the right of older people to health is a central focus, and my ambition is to contribute new knowledge to the area of health and welfare research in general, particularly physiotherapy directed towards the older population.

1.2 Ageing and the risk of falling

Injury due to a fall is a major health problem and a leading cause of death among older people worldwide.⁵ Older age is a risk factor for falls, and approximately 30% of older people over the age of 65 years fall each year;^{6,5} among those over 75 years old, the fall risk is even higher. In Sweden, 50 000 people over 65 years of age are admitted to the hospital each year because of a fall, and hip fracture is one of the most severe injuries associated with falls.^{7,8} The worst scenario for a fall accident is a fatal outcome: four people over 65 years of age die each day from fall accidents in Sweden.⁸ The distribution of falls between men and woman shows that women are significantly more likely to experience falls.^{9,10} However, mortality is higher among men, especially after a hip fracture.¹¹

Falls and fall-related injuries are among the most common health problems in the older population.¹² In addition, the increasing number of falls is certain to become an economic burden on the health care system.^{3,13} Thus, it is of great importance to study preventive actions for falls among older community-dwelling people.

Community-dwelling people over 75 years of age with insecurity in relation to their independence and walking ability have been identified to be at risk of

falls.^{14,15} Other risk factors can be stratified depending on the individual's capabilities, the environment and individual behaviour.¹⁶ The risk of fall is highly dependent on the number of risk factors an individual has. Both the least active and the most active older people are at high risks for falls.¹⁷ To reduce the risk of falls, a common strategy among older people is to reduce physical activity,¹⁸ and one of the psychological consequences of a fall is low fall-related self-efficacy.¹⁴ Fall-related self-efficacy measures an individual's confidence in his or her ability to perform various daily activities without falling.¹⁹

Low fall-related self-efficacy has been associated with the reduction and avoidance of activities.²⁰ In turn, inactivity limits daily activities, decreasing physical functioning and fall-related self-efficacy (onwards termed fall self-efficacy). This vicious cycle can lead to an increased risk of a fall.^{14,21} However, the natural ageing process and adaptation are important to consider when activity levels decrease.²² Some of the physiological functions of the body that might be weakened due to ageing and inactivity are muscle functions, balance and walking ability. A combination of these alterations increases the risk of falling.^{23 24}

1.2.1 Fall prevention

Different fall prevention interventions have been directed towards different fall risks, such as modifying the home environment, treating visual impairments, supplementation with vitamin D, exercising and engaging in multifactorial programmes.²⁵⁻²⁷ Tai chi, which includes posture and balance movements, has also shown some promising results for protecting older people against the risk of falls.^{26,28,29} Multifactorial fall prevention programmes have been recommended as the most suitable and effective way for older adults to reduce the number of falls.^{30,31} Individualized multifactorial fall prevention programmes should include strength, balance and endurance exercises.^{26,32}

Overall, interventions that significantly reduce the rate of falls and the risk of falling are individual or group-based exercises, home-based exercises and modifications of the home environment,^{26,33} indicating the importance of physical activity and exercise for older people in a safe home environment.

However, there is no "one-size-fits all" solution considering the heterogeneity among the group of older people. When older people participate in fall-prevention programmes, personal beliefs regarding the effectiveness of the intervention are important. Different beliefs and motives for engagement also vary in an age-dependent manner; thus, older people have different expectations than younger people.^{34,35} According to Hill et al.,³⁶ older people are uncertain whether multifactorial fall prevention programmes performed in a clinical settings can reduce falls. Another obstacle for exercise arranged in a clinical or in a community setting is transfer hindrances. Thus, home-based training could be a convenient alternative for older adults with transfer limitations.

1.3 Physical activity

The definition of physical activity is adopted from Caspersen as “any bodily movement produced by skeletal muscles that results in energy expenditure”.³⁷ Physical activity provides possible protection against some of the decrease in bodily functions that occurs during ageing. Daily movements involving muscles, including activities such as gardening, climbing stairs and walking, can be defined as physical activity with low to moderate intensity.

Many people live a healthy and active life in old age, but with increasing age, there is an inevitable decline in several biological systems that may develop into increased health risks.²⁴ Physical activities and exercises may reduce many health risks and produce many benefits if performed regularly.³⁸ The current global recommendation is 150 minutes of moderate-intensity physical activity per week³⁹ to experience general health benefits.

Despite the well-known benefits of and general recommendations for physical activity, one-third of the population over 65 years of age does not meet the current recommendations.⁴⁰ When older people describe their experiences with physical activities, the factors that contribute to a positive experience are whether an activity is an enjoyable, social and personally pleasurable experience.⁴¹ In contrast, the key barriers for physical activity are a lack of social support, previous sedentary behaviour, competing priorities, environmental accessibility and apathy.³⁵ Since older people’s engagement in physical activities is influenced by behavioural factors, the inclusion of a behavioural medicine approach in physiotherapy is logical and is currently often used to support treatments aimed at increasing physical activity behaviours.

1.3.1 Physical exercise

Physical exercise constitutes a structured and targeted form of physical activity that aims to improve or maintain physical fitness and achieve certain goals.³⁷ Physical exercise has several advantages, such as the retention of physical functions including mobility, muscle functions, balance, and aerobic capacity and a reduced fear of falling.⁴²⁻⁴⁴ The general loss of muscle mass during ageing, especially in the lower extremities, presents a higher risk of dependence in daily living.

General exercise recommendations suggest exercising two hours per week as a single intervention can prevent falls in community-dwelling older people.⁴⁵ However, three hours of highly challenging balance exercises have a greater fall-preventive effect on the population over 65 years of age.⁴⁵⁻⁴⁷ To achieve positive health outcomes from an exercise programme aimed at fall prevention, strength, balance and aerobic features are recommended exercise regimens for older people.⁴⁸ Additionally, high-intensity muscle exercises should be implemented to increase the muscle strength. For older people exercising alone in an ordinary home setting, high-intensity muscle exercise could carry an undesirable risk of injury;⁴⁹ however, according to Raymond et

al., a reduced exercise intensity might be sufficient to achieve the desired improvements in functional performance during ageing.⁴⁹

Exercise that is suitable and preferred by the older population is a prerequisite for adherence.⁴¹ Additionally, the degree of frailty must be considered because the time to positive effects and benefits of exercise may be extended by frailty.⁴⁴ Exercise programmes that are performed submaximally must be further evaluated since the older population is a heterogeneous group affected differently by ageing as a result of, for example, chronic diseases and disability. Therefore, the demand for flexibility and individuality in exercise programmes must be considered,⁵⁰ and the extent, intensity and progression require further evaluation.

1.4 Home-based fall prevention exercises

The proportion of people over 65 years of age in Western countries is increasing, and most of these people still live in ordinary housing. Older people, especially those who already have some functional declines, face a high risk of fall accidents.²⁶ A fall injury can result in functional declines, pain and decreased mental health, and consequently, an increased risk of future fall accidents.^{51,52} To meet the needs of this population, physical exercise must be adjusted and provided in the actual environment in which the older people live and act.

Home-based exercises to improve strength, balance and walking have been a topic of fall prevention research with regard to reducing the incidence of falls and increasing cost effectiveness for older people.⁵³ However, exercise performed in an ordinary home is still associated with several difficulties. On the one hand, to increase balance, the exercise must be sufficiently challenging; on the other hand, more challenging exercise might increase the risk for a fall. An equivalent risk is also present for strength exercises, which must be individually demanding to result in increased strength.⁴⁵

Of all preventive actions, physical activity and exercise are among the most important.⁴⁸ When exercise is performed in a group with additional prescribed home exercises, it can improve balance and reduce fall rates among older people.³³ Over time, individually tailored fall prevention exercise programmes have become more common than general programmes. One example of an individually tailored exercise programme is the Otago Exercise Programme (OEP).⁵⁴ The OEP was developed in New Zealand by A John Campbell and M Clare Robertson and their research team at the University of Otago. Their target group was women over 80 years of age. This exercise programme has been shown to increase balance and strength, decrease fall rates and be associated with several other health benefits for older people, especially those over 80 years of age.^{55,56} In its original form, the exercise programme comprises individually tailored strength, balance and endurance exercises. The exer-

cises are functional and can be done with or without support, examples of exercises are; up on toes, back on heel, knee bends, heel to toe stands/walking, standing up from sitting, sitting down slowly and walk in a figure of eight.⁴⁷ Home-based support is offered by health care providers, and additional follow-up by telephone is conducted over a total exercise period of one year.⁴⁷ The OEP exercises progress through four different levels of difficulty. Balance exercises progress by using the “hold on” support as the easiest level and no support as the most difficult level.⁴⁷ The OEP exercise booklet used in these studies was translated into Swedish with permission from the original OEP developers.

It is recommended that the exercise be performed three times per week, with additional walks two times per week. However, the programme has also been shown to have positive effects on health outcomes when performed two times per week.³ The addition of regular walking has been suggested as a complement to increase physical activity levels.^{57 45}

However, for active and healthy older people with a low fall risk, the OEP’s goal to reduce falls may not be sufficiently challenging.⁵⁸ This phenomenon highlights the importance of identifying older people who will benefit from fall prevention exercise programmes such as the OEP. Changes in behavioural support are not included in the OEP, and investigators have questioned whether the programme is effective for reducing falls without this treatment component.⁵⁸ Since adherence to an exercise programme often involves a behavioural change, the addition of support for this process might provide a valuable contribution to adherence.

To monitor and evaluate exercise adherence, daily exercise diaries are commonly used.^{59 60} However, when filling in a diary, patients may aim to please the clinician or researcher, a factor that must be considered when using exercise diary or logs to self-monitor exercise adherence. Thus, close monitoring and management of exercise diaries are needed to evaluate changes in self-monitored exercise behaviour and adherence.

1.5 Adherence

Adherence can be defined as the extent to which the patient’s behaviour corresponds with caregiver recommendations and follows the mutual agreement to achieve established goals.⁶¹ The concept of adherence is viewed as the development of compliance that reflects “following the orders” of a caregiver’s recommendation.^{62,63} The concept of adherence includes autonomy for the person receiving the recommendation and allows him or her to independently decide to follow the recommendation or the mutual agreement.

Adherence to exercise programmes is fundamental for achieving positive outcomes. Exercise adherence among older adults is generally low despite different attempts to address acceptance and formulate attractive programmes.⁶⁴ However, factors that are fundamental to achieving adherence are commonly

overlooked. Attention should focus on behavioural factors that affect treatment adherence, such as patient beliefs, the complexity of a treatment regimen, and the resources available to the patient.⁶⁵ Other factors, such as comorbidity, disability and insufficient social support during ageing, also contribute to reduced adherence to exercise programmes. These factors reduce the probability of exercising, especially in relation to long-term adherence.⁶⁴ In contrast, fit older people with an active lifestyle and high self-efficacy for exercise are more likely to adhere to prescribed exercises and even more likely to adhere to exercise than younger people, at least over the short term.⁶⁶ Still, the challenge is to attain adherence over time, and therefore, behavioural features need to be considered when aiming to achieve exercise adherence.

1.6 Behavioural medicine approach

The biopsychosocial model of health is the foundation for the interdisciplinary field of behavioural medicine. In turn, behavioural medicine is the integration of knowledge from the behavioural, psychosocial, and biomedical sciences. Consequently, physical and psychological health problems are managed by the integration of these fields.⁶⁷ The knowledge and methods of behavioural medicine are applicable for the prevention, diagnosis and treatment of different health problems.⁶⁷ In this thesis, “behaviour” is defined as something an individual can do, think or feel.⁶⁸

The ability to learn new behaviours is based on both knowledge and the experience of consequences from identified previous behaviours and situations in life.⁶⁹ Behavioural medicine interventions for promoting physical activity or fall prevention in older people have rarely been investigated. In a recent study, the feasibility and effects of a behavioural medicine intervention to support increased activity related to behaviour was investigated. The participants were all older community-living women with chronic pain.⁷⁰ The results showed that support from a PT and home self-service staff was important for increasing activities in daily life and self-efficacy in activities.⁷⁰

Different methods have been applied to increase individual physical activity levels, and two factors were found to be important in interventions that promote physical activity among older people: motivation and self-efficacy.^{71,72} To strengthen the health and participation of older people, a behavioural medicine approach to physiotherapeutic activities can be advantageous.⁷³ The theoretical foundation of behavioural medicine can be found in social cognitive theory and the transtheoretical model of behavioural change, among other approaches.

1.6.1 Social cognitive theory and self-efficacy

Self-efficacy is an individual’s belief in his or her ability to succeed in a particular situation. The concept of self-efficacy originated in social cognitive

theory (SCT), a social learning theory developed by Bandura in the 1970s.⁷⁴ The SCT contains three important domains- individual, environment and behaviour- in which self-efficacy is a prominent determinant of successful outcomes in health care. Higher self-efficacy results in a greater commitment to achieving established goals.⁷⁴

The concept of “outcome expectations” is also a basic principle in SCT.⁷⁵ People act according to their judgement of expected consequences; that is, they take action when they expect a positive outcome from their action or avoid actions when the expected outcome is negative.⁷⁵ Stronger self-efficacy in relation to physical activity is related to higher expectations regarding the outcome of physical activity and pinpoints the relationship between self-efficacy and outcome expectations.⁷⁶ The outcome expectations are particularly important for changes in physical activity behaviour among older people.⁷⁶

Self-efficacy has been shown to be important in relation to activity levels and the incidence of falls.¹⁴ The emotional state of fear of falling among older people is known as a psychological consequence of falls; it can result in activity avoidance and, accordingly, a change for the worse in fall self-efficacy.^{42 77} A fear of additional falls has been reported in 30% of community-dwelling elderly people who had fallen at least once during the previous year.²⁶

1.6.2 Transtheoretical model of behavioural change

The transtheoretical model (TTM) is a broadly used model of behavioural change with roots in psychotherapy. The TTM integrates processes and principles from various theories from the traditions of Skinner, Rogers, and Freud,⁷⁸ which are well known in psychotherapy. To include the aspect of time in behavioural change in the TTM, the stages of change theory (SOC) was incorporated and has been well implemented in the health behaviour change context.⁷⁹ The SOC is characterized by five stages: precontemplation, contemplation, preparation, action and maintenance (Figure 1).⁷⁹

1.6.2.1 Stages of change theory

According to the SOC, a person can move across different stages with a starting point that depends on the person’s position in the “behavioural change” process.⁷⁹ The precontemplation stage describes a person who is not ready for behavioural change. The contemplation stage describes a person who is ready to change in the near future, while in the preparation stage, a person is ready but ambivalent about the change. In the action stage, a person has taken steps towards the behavioural change, and in the maintenance stage, the person has taken action for a longer time. The ultimate goal is to reach stage six. This final stage is the termination stage, in which habits are maintained regularly for a period longer than five years, and a person has 100% self-efficacy performing the new behaviour (e.g., regular exercise) with no risk of relapses.

This stage has been described as too strict and therefore is not commonly applied.⁷⁸

Having high self-efficacy depends on the individual's current stage of behavioural change; a higher stage indicates higher self-efficacy.⁸⁰ In older adults, barriers to physical activity in the precontemplation and contemplation stages are significantly higher than in the preparation and maintenance stages.⁸¹

One way to investigate a person's position in the change process is to ask four questions: Do you currently engage in regular exercise? Do you intend to engage in regular exercise in the next six months? Do you intend to engage in regular exercise in the next 30 days? Have you been exercising regularly for the past six months? The responses indicate the individual's stage of behavioural change.⁸² However, the SOC does not consider individual circumstances that may position a person within several different stages at the same time. Describing the stages in relation to a certain time order can be another limitation for capturing the individual variation in the behaviour change process,^{83,84} a factor that should be considered when applying the SOC.



Figure 1. Stages of change cycle.

1.7 Motivational interviewing

The integration of behavioural change strategies into physiotherapy has become more common in Sweden during the last decade. One way to address behavioural change strategies is through the use of motivational interviewing (MI),⁸⁵ which is currently commonly included in both education programmes and health care. MI is a way to communicate that enhances behavioural change and was developed by William R Miller and Stephen Rollnick.⁸⁶

MI was originally described by Carl Rogers, an American psychologist and one of the founders of humanistic theory.⁸⁷ Rogers wanted psychology to understand individuals' phenomenal experiences in terms of how individuals conceive reality and experience themselves.⁸⁷ The client-centred empathic conversation method involving listening and trying to get the patient to reflect on his or her situation was inspired by Rogers' non-directive counselling.⁸⁸

MI is a way to help people discover and address ambivalence regarding behavioural change. It indicates that the motivation for a behavioural change should come from and must be built on the actions of the person him- or herself.⁸⁹ The advisor works to support increased self-efficacy of the person for the specific behavioural change. MI has been shown to be an effective method for abuse/addiction, but it is also applied in other areas in modern health care, such as physical activity, obesity, hypertension and diabetes.⁹⁰⁻⁹² The combination of physical exercise with a programme designed to create a behavioural change in older people has been evaluated to a very limited extent.³⁴ Based on earlier experiences in other interventions, MI may be a method for empowering and motivating the individual to identify strategies for behavioural changes in exercise and physical activity.⁶⁹ However, the inconsistency of how MI is described and reported have been raised as a limitation in determining the effectiveness of MI for health behaviour changes.^{91,93}

MI can be defined as follows: It is a collaborative conversation style for strengthening a person's own motivation and commitment to change. It is important to remember that MI is used for and with someone; it is not applied to someone. MI and the skills associated with MI are learned through disciplined practice, which includes feedback from and rehearsal with a supervising guide.⁸⁸ Self-efficacy is an important component of MI and a determinant of whether the expected goals and outcomes will be achieved. The influences of SCT, TTM and SOC are evident.

MI combined with a physical exercise programme for community-dwelling older people with chronic pain has been shown to be effective for decreasing pain levels and increasing physical mobility, psychological well-being and self-efficacy.⁹⁴ In a systematic review of MI for older adults seeking primary care, promising results were obtained for different health outcomes, including an increase in physical activity levels. However, according to the authors, the results must be interpreted with caution because of the different interpretations of MI accuracy described by the researchers.⁹⁰

It is largely unknown how behavioural change in older adults can be optimally supported. Since motivation is important for behavioural change, one way of thinking about motivation is to consider how a person is likely to respond. Understanding motivation facilitates behavioural change and thus adherence. The challenge of how to motivate individuals and achieve adherence to an exercise programme aimed at preventing falls in older adults persists.

2. Rationale

Research has demonstrated the health benefits of exercises aimed at reducing falls among older people. Many individuals aged 75 years or older are in a transition toward becoming fragile and simultaneously experience an increased risk of falls. Previous exercise interventions have mainly focused on the physical benefits of preventing falls and have commonly been performed in clinical settings. With an increasing number of older people living in the community, opportunities for home-based exercise must be further evaluated. Despite efforts to prevent falls, the number of falls continues to rise in pace with the growth of the elderly population.

There is a need for knowledge and understanding of exercise programmes and adherence to exercise recommendations among older people. Behavioural medicine is relatively new to physiotherapy for older people, especially as part of fall prevention programmes. Behavioural support could increase adherence to physical exercise, thus providing a valuable contribution to fall prevention programmes. The experiences both the PTs and the older people who participate in such programmes are important to highlight since this is a new approach in physiotherapy for older people. In different health-related areas, MI may be effective for achieving general behavioural changes. However, the combination of community-dwelling older people, exercise behaviour change and MI for reducing falls is, to our knowledge, still unexplored in research.

Home-based interventions are of the utmost importance for older people who are starting to develop disabilities but still live in community housing. A behavioural medicine approach to physiotherapy might promote the acceptance of an exercise programme by this population and encourage them to maintain physical activity levels. The ultimate goal is for them to be able to maintain their independence and quality of life well into old age.

3. Aims of the thesis

The overall aim of this thesis was to investigate the feasibility, experiences, and effects of and adherence to the OEP with or without MI among community-dwelling people aged 75 years or older.

The specific aims were to study:

- The feasibility of a randomized controlled trial (RCT) comparing fall prevention using exercise with or without the support of MI (study I)
- Older people's experiences of performing fall preventive home-based exercise combined with support for behavioural change (study II)
- The short-term effect of a home-based exercise programme with or without behavioural change support compared with standard care in terms of physical performance, fall self-efficacy, balance, activity level, handgrip strength, adherence to the exercise and fall frequency (study III)
- Whether behavioural aspects in an intervention, RTC, fall self-efficacy and physical activity habits could predict long-term adherence to an exercise program by older people (study IV)

4. Methods

4.1 Study designs

An overview of the four studies included in this thesis is presented in Table 1.

Table 1. Studies in the thesis

Study	Participants	Design	Data collection
I. A feasibility study of a randomized controlled trial comparing fall prevention using exercise with or without the support of motivational interviewing.	45 older participants and 12 physiotherapists	A descriptive feasibility investigation of an RCT	Questionnaires regarding feasibility, effect measures and fall calendars collected at the three-month follow-up
II. Older persons' experiences of a home-based exercise programme with behavioural change support	12 participants from the OEP+MI group	An inductive explorative design with a qualitative approach	Face-to-face interviews
III. Fall preventive exercises with or without behavioural change support for community-dwelling older adults: A randomized, controlled trial with short-term follow-up	175 older participants, including 45 older participants from study I	An RCT with three study arms	Effect measures, fall calendars and exercise diaries collected at the 12-week follow-up
IV. One-year adherence to the Otago Exercise Programme with or without motivational interviewing in older people	114 participants from the exercise intervention groups in study III	A prospective cohort study	Exercise frequency collected through exercise diaries at the one-year follow-up

The RCT was registered at clinicaltrials.gov under NCT01778972. The CONSORT checklist was used to report the RCT (study III).⁹⁵ The TIDieR (Template for Intervention Description and Replication) checklist was also used in study III.⁹⁶ In qualitative study II, the COREQ checklist was used to improve the quality of the study reporting.⁹⁷

4.2 Study sample

The study group comprised older community-living individuals seeking walking aid from health centres or seeking home care in the municipality. Care managers, occupational therapists or PTs in the three communities collaborated with the research team to recruit participants. The eligibility criteria for study participation were age 75 years or older, the ability to walk independently in the home, and the ability to understand written and oral information in the Swedish language. The exclusion criteria were as follows: a score less than 25 on the Mini Mental State Examination (MMSE),⁹⁸ ongoing regular physical therapy treatment for injury and/or illness or being in terminal care.

The first 45 people randomized to one of the three study groups in study III and 12 PTs responsible for measurements and treatment were included in a study of the feasibility of conducting an RCT (study I). The 45 older participants comprised 71% women, and the median age was 83 years. Their median overall health status at baseline, measured with the EuroQol-Visual analogue scale (EQ-VAS)^{99 100} was 65 on a scale from 0-100, where 0 represented the worst imaginable health state and 100 the best imaginable health. The EQ-VAS was only assessed at baseline in study I.

After a 12-week follow-up, 12 of the participants in the OEP combined with MI (OEP+MI) group were asked to participate in an interview to share their experiences regarding exercise with behavioural change support (study II). All the participants (n=175) were followed up 12 weeks after randomization to assess balance, physical performance, fall self-efficacy, activity level, hand-grip strength and adherence to the exercise and fall frequency (study III). A total of 114 participants in the OEP and the OEP+MI groups, respectively, reported their exercising in an exercise diary over 52 weeks. Behavioural factors that were potentially important for adherence to the exercise programme were analysed in study IV.

4.3 Intervention with exercise and behavioural support

The participants who were randomized to the exercise intervention received home visits on six occasions and three telephone follow-ups during the 52-week intervention, all according to the OEP standardization.⁵⁴ The three groups were as follows:

The OEP group participated in exercises according to the OEP, a home-based exercise programme designed to improve strength, balance and endurance. The exercises were recommended to be performed by the participants in their home three times per week. During the home visits, the exercise was progressed along four levels of difficulty according to the OEP protocol and was adjusted individually for each participant. Weight cuffs were used for the

strength exercises and were individually adjusted for the participant. Additionally, the participants were instructed to go for walks on the days they did not exercise. Each session was designed to take approximately 1 hour.

The OEP+MI group received the OEP exercise combined with MI. Adjustments of the exercises were incorporated into the OEP+MI group according to both the OEP protocol and the participant's motivation to change. In the collaborative meeting, the structure of the OEP and the flexibility of MI were combined to enhance the participant's own motivation for exercise behaviour change. The session began with open-ended questions, affirmations, reflective listening and summaries (OARS).⁸⁶ Throughout each session, the underlying principles of MI were present. Each session was designed to take approximately 1 hour, equal to the OEP group.

To monitor the exercise, the participants sent in an exercise diary every month. The control group received standard care, meaning written recommendations for fall prevention, which were given to all three groups.

4.4 Data collection

Data collection took place from October 2012 to May 2016. The feasibility of the randomized controlled study was investigated in the first study, in which the process, resources and management were assessed.¹⁰¹ In this study, two questionnaires were developed: one with reference to the PTs conducting the measurements, and the other concerning the PTs conducting the treatment, resulting in a total of 12 PTs. Since there were two experimental groups, some of the questions only referred to the PTs who administered the OEP+MI treatment. The questionnaires contained response options on a numeric rating scale (NRS) and dichotomous responses of yes/no or positive/negative. The questionnaires also provided space to add comments related to the answers. A median rate of eight on the NRS scale and a minimum of 80% positivity for the dichotomous answers was set as the limit for acceptable feasibility.

In addition to the feasibility measures, twelve semi-structured individual interviews of the participants in the OEP+MI group were conducted. In these interviews, the participants were encouraged to describe their experiences of participating in the exercises and to share their experiences with exercising in their daily lives (study II).

All the participants in the RCT were measured and tested by an independent PT who was blinded to the participant's group at baseline and at 12 weeks after randomization.

4.4.1. Measurements

In addition to the questionnaires distributed to the first 45 participants in study I, the measures used to control for feasibility were physical performance, balance and fall self-efficacy at 12 weeks (Table 2).

A total of five effect measures were assessed at baseline and at the 12-week follow-up in study III. They included physical performance, balance, fall self-efficacy, handgrip strength, activity level and readiness to change (only at baseline). An overview of the measurements included in studies I, III and IV is presented in Table 2.

Table 2. Overview of measurements used in studies I, III and IV

Measurements	Study I	Study III	Study IV
SPPB	X	X	
Mini-BESTest	X	X	
FES(S)	X	X	X
Jamar hand grip		X	
Frändin/Grimby activity scale		X	X
RTC			X
Self-monitoring measurements			
Fall calendar	X	X	
Exercise diary		X	X
Questionnaires for feasibility	X		

SPPB=Short Physical Performance Battery, FES(S)=Falls Efficacy Scale-Swedish version, RTC=Readiness to Change

Physical performance was measured using the Short Physical Performance Battery (SPPB) to evaluate lower extremity functioning, i.e., standing balance, gait speed, and repetitive chair stands.¹⁰² With 12 points and a minimum score of 0 points for the worst performance, the tasks are graded on a 4-point scale. The test is reported to be predictive of disability and the risk of falls¹⁰³ and has good test-retest reliability.¹⁰²

Balance was measured using the Mini-BESTest, which includes 14 different tasks evaluated according to four subscales. All the tasks were graded from 0-2 points, with a total maximum score of 28 points. Zero indicates the lowest level of balance in each task, and 2 indicates the highest level.¹⁰⁴ The test has a high test-retest reliability and inter-rater reliability.¹⁰⁵

Confidence in the ability to perform various daily activities without falling was measured using the Swedish version of the Falls Efficacy Scale FES(S).¹⁹ The instrument has 13 items rated on a 0-10 scale, with a maximum total score of 130. On this scale, 0 represents the lowest level of self-efficacy, and 10 represents the highest. The test has high internal reliability¹⁰⁶ and test-retest reliability.¹⁰⁷

Handgrip strength was measured using the Jamar hand grip dynamometer. This test is a good measure of general body strength.¹⁰⁸ The test has shown excellent test-retest reliability for grip strength measurement.¹⁰⁹

Physical activity level was measured using the Frändin/Grimby activity scale, in which people estimate their activity on a 6-point scale. The scale considers activities that are typically performed during both the winter and summer seasons. The scale has been shown to be valid for assessing physical activity.¹¹⁰

Motivation to change exercise behaviours was measured using two questions on the Readiness to Change (RTC) for exercise, rated on scales from 1-10, where 10 represents high readiness to change.¹¹¹ This measurement was only assessed at baseline.

4.4.1.1 Self-monitoring measurements

Exercise adherence was monitored using an exercise diary that was filled in by the participants and followed up by a responsible PT every month for three months (12 weeks) and at one year (52 weeks). The acceptable amount of exercise adherence in study III was set to a minimum of 24 sessions (two times per week); the same standard was set for walks. This amount was considered appropriate to accommodate the participants' age and possible upcoming events in their lives. In study IV, acceptable adherence was set to a minimum of 104 exercise occasions (two times per week) over 52 weeks; the same standard was set for walks. The participants were divided into adherent (exercise frequency >104 or more) or non-adherent (exercise frequency < 104) groups for exercise and for walks.

Fall frequency was reported with a fall calendar during the 12-week study period (study I and III). The control group was also followed up for fall events by two independent PTs who did not participate in any of the interventions. The fall calendars were sent by post every month to the PT. Current recommendations for reporting falls are via a fall calendar reported to a responsible practitioner.¹¹²

4.5 Randomization

All the participants were randomized to one of three groups after baseline measurements. The participants were randomly allocated in variable blocks of 3, 6, 9, and 12 participants to one of three groups. The random allocation sequence was generated by a statistician independent from the research group. Numbered envelopes were handled by two independent researchers who did not participate in any of the interventions. Group allocations were only revealed to the PT who conducted the treatment.

4.6 Data analysis

4.6.1 Statistics

The statistics used in the thesis are listed in Table 3. Data are presented as the mean and SD for continuous variables and the median, min-max and range for ordinal variables.

Odds ratios (ORs) were determined with 95% confidence intervals (CIs), and p-values $\leq .05$ were considered statistically significant. Levene's test was used to control for homogeneity of variance, skewness and kurtosis to determine whether the data were normally distributed. An intention-to-treat analysis was complemented with a per-protocol analysis where dropouts and non-adherent participants were excluded (in study III).

A power calculation based on the SPPB, which was the main outcome variable in study III, was performed. An estimated small meaningful change was set to .5, with a standard deviation (SD) of 1.5 in the SPPB.^{113,114}

A one-way analysis of variance power analysis was performed with PASS version 13.0.8, resulting in a total of 155 participants. Since we had access to 175 participants, they were all included in the analysis.

A binary logistic regression model was used to analyse the association of the independent variables with the dependent variables in study IV. The independent variables were as follows: treatment group, readiness for change, fall self-efficacy and physical activity level. The independent variables were divided according to a low or high median score, and the dependent variables was divided into two categories according to the accepted level of adherence to exercise and walks. All data analyses were performed using IBM SPSS statistics, version 19 and 20.

Table 3. Statistics used in studies I, III and IV

Statistics	Study I	Study III	Study IV
Descriptive statistics			
Number (n), (%)	X	X	X
Median, (min-.max), (range)	X		X
Mean, standard deviation (SD)		X	X
Statistical analyses			
One-way analysis of variance power analysis		X	
Levene's test		X	
Fishers' exact test	X	X	
Chi-squared test		X	
Kruskal Wallis test	X	X	
Wilcoxon signed-rank test	X		
Spearman's rank correlation			X
Effect size, ($r=Z/\sqrt{n}$)	X		
Paired sample t-test		X	
General linear model, repeated measures (Tukey's post hoc comparison)	X		
One-way ANOVA (Scheffe's test)		X	
Binary logistic regression model			X

The qualitative data in study II were analysed using conventional content analysis¹¹⁵. The process of analysis was inductive, and categories and subcategories were generated from the interview text. All transcripts (a total of 104 pages) were thoroughly read several times. The meaning units, codes and categories were discussed among the authors during the analysis. Quotations were used to illustrate the trustworthiness of the text. The quotations were translated by a professional translator with extensive knowledge of both the Swedish and English languages.

4.6.2 Treatment fidelity

All the PTs who delivered the OEP and OEP+MI treatments attended meetings before the study began and during the study period. Some minor adjustments to the OEP were incorporated into the agreement, and a consensus was reached regarding how the programme would be administered and delivered by all PTs.

All the PTs in both intervention groups followed the study protocol thoroughly and registered the patients' exercise during home visits. All the PTs who performed the MI were experienced and familiar with this programme. In addition, the PTs who worked with the participants in the OEP+MI group received three days of instruction in MI with two Motivational Interviewing Network of Trainer (MINT) instructors before the study began and three booster sessions during the study period to ensure their confidence in the use

of MI. Control coding during the study was performed at the Motivational Interviewing Coding Laboratory (MIC lab) in Sweden to ensure the MI quality. Quality was rated on a five-point Likert scale in which 0 represents low MI spirit and 5 is high MI spirit.¹¹⁶ The average score was 3.8.

4.7 Ethical considerations

This study followed the 1964 Helsinki Declaration concerning human rights, informed consent and appropriate procedures involving the treatment of human participants in research. The study was approved by the regional ethics committee in Uppsala, Dnr. 2012/147. The participants received no compensation for their participation.

5. Results

A total of 335 participants were invited to participate in the trial. Of the 158 excluded participants, eight did not meet the inclusion criteria (Figure 2). The baseline characteristics and measurements for the whole group are presented in Tables 4 and 5. The mean age was 83 years, and 70% were women.

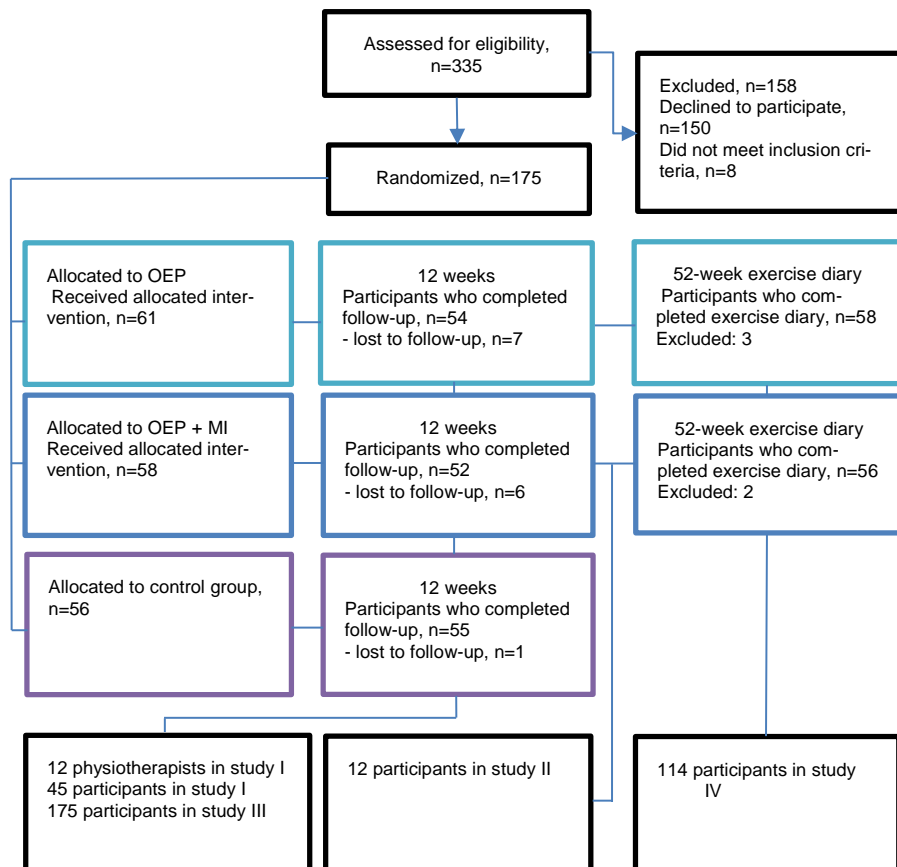


Figure 2. Participants included in the four studies

Table 4. Baseline characteristics of the total study sample (studies I-IV)

Participants	Total	OEP	OEP+MI	Control
	n=175	n=61	n=58	n=56
<i>Age, mean (SD)</i>	83 (4.7)	83 (5.0)	84 (4.1)	82 (4.7)
<i>Gender, (%)</i>				
Female	70	67	69	73
<i>Education level, (%)</i>				
Elementary school	43	48	40	43
Secondary school/girls' school	14	13	10	18
High school/trade school	18	18	21	14
University	25	21	29	23
<i>Marital status, (%)</i>				
Married	37	41	38	30
Unmarried	12	12	14	11
Widowed	48	46	43	55
Cohabiting	3	2	5	4
<i>Falls during the past year, (%)</i>				
No	58	61	51	63
<i>Walking aid, (%)</i>				
Yes	92	92	90	95
<i>Help in daily living, (%)</i>				
No	56	57	57	54
Yes, from relatives/friends	19	23	17	18
Yes, from home help services/private firm	25	20	26	29

OEP=Otago Exercise Programme, MI=motivational interviewing

Table 5. Baseline measurements of the total study sample (studies I-IV)

Measurements	Total n=175	OEP n=61	OEP+MI n=58	Control n=56
SPPB, (0-12) <i>mean (SD)</i>	7.7 (2.4)	7.9 (2.4)	7.7 (2.5)	7.5 (2.5)
MINI-BESTest, (0-28) <i>mean (SD)</i>	15.6 (5.2)	15.8 (5.0)	15.3 (5.5)	15.8 (5.3)
FES (S), (0-130) <i>mean (SD)</i>	102.1 (23.8)	104.0 (21.7)	102.6 (23.1)	99.5 (26.8)
Jamar, (kg) <i>mean (SD)</i>				
Right	24.5 (7.8)	25.0 (8.5)	24.1 (7.7)	24.4 (7.3)
Left	23.0 (7.3)	23.6 (8.0)	22.5 (7.1)	23.0 (6.8)
Frändin/Grimby, (1-6) <i>mean (SD)</i>	2.8 (.8)	2.9 (.7)	2.7 (.7)	2.9 (.8)
RTC, (1-10) <i>mean (SD)</i>				
Committed to exercise	7.1 (2.1)	7.0 (2.3)	7.1 (1.8)	7.2 (2.2)
Confident to perform exercise	7.1 (2.0)	7.0 (2.2)	7.1 (1.7)	7.2 (1.9)

SPPB=Short Physical Performance Battery, FES(S)=Falls Efficacy Scale-Swedish version, RTC=Readiness to Change, *SD*=standard deviation

5.1 Feasibility and experiences regarding intervention with behavioural change support

The overall feasibility of the randomized controlled study was acceptable (Table 6). All but two questions reached the limit of acceptable feasibility. The two questions that did not meet the limit set for feasibility were the use of an MI guide (7/10) and whether the exercise was performed as planned (73%; Table 6).

In addition, the experiences of the 12 participants in the OEP+MI group during their first three months in the study were examined (study II). Their experiences were summarized in four main categories: facilitators of exercise in everyday life, the importance of support, perceived gains from exercise, and existential aspects of exercise. The main categories had 11 subcategories, which are presented in Table 7. Daily routines were determined to be important for all activities in daily life, according to the participants.

If I'm out there cooking food, I take the chance to do it (exercise) — walk a few rounds like this. I always do it in the morning when I get out of bed because then I know I've gotten it out of the way for the day, so later I just have the walk to do.

The participants also expressed the importance of support for reinforcing exercising.

I think that there's someone who cares about you and can help you, who you connect with, so to speak; that's been very positive, I think.

[She] has a lot of empathy and she isn't demanding; she sees her patient's potential or whatever you call it.

Other factors the participants expressed were beliefs in their ability to perform different activities, thus reflecting their self-efficacy. Consequently, everyday functioning was positively affected.

However, now I can stand up without holding onto the edge of the table, and I think I've become more functionally capable.

The participants expressed some existential thoughts about life and death. The exercise gave them purpose and hope, helping them strive for an extended active life.

And of course, it's inevitable being so old, you think about death; I do it almost constantly. You know perfectly well that you're going to die, but still, you don't want to.

Table 6. Participating PTs' ratings and answers regarding measurement (n=4) and treatment (n=8) feasibility in study I

Questions for measurement feasibility, n=45	Median (min-max)	Percentage
To what extent was the demographic questionnaire filled in? (scale 0-10)	9 (0-10)	
Where were the tests performed? Home/public location?		82/18
Did the physical tests work as planned? yes/no		87/13
How important do you think it was that the tests were carried out according to the instructions? (scale 0-10)	9 (7-10)	
Resources		
How long was the measurement session, in minutes?	90 (60-90)	
Management		
Did you have the right competence to perform the measurements? yes/no		100
How did you perceive your own motivation to perform the measurements? (scale 0-10)	10 (5-10)	
Questions for treatment feasibility, n=30 (based on the treated participants)		
Process		
How did you perceive the participants' attitude towards the treatment? positive/negative		90/10
How did the OEP protocol work? (scale 0-10)	9 (7-10)	
For the MI group only, n=16		
How well did the MI guide work? (scale 0-10)	7 (5-10)	
Resources		
How long was the treatment session, in minutes?	60 (30-90)	
Management		
Did you have the right competence for the OEP? yes/no		100
How was your own motivation for the OEP? (scale 0-10)	9 (6-10)	
Questions for the MI group only, n=16		
Did you have the right competence for the MI part of the treatment? yes/no		82/18
How was your own motivation for the MI part? (scale 0-10)	10 (8-10)	
Was the exercise carried out as planned? yes/no		73/27
How well did the OEP work in the home environment? (scale 0-10)	9 (8-10)	
How well did the individual adjustment of the OEP work? (scale 0-10)	8 (4-10)	
Did adherence to reporting the exercise diary work? yes/no		97/3
Were there any health risks during treatment? Yes/no		0/100
Obstacles/advantages to performing the intervention in the home environment?	Prerequisite for participation, applicable, time, external factors	
Four areas emerged:		

OEP=Otago Exercise Programme, MI=motivational interviewing

Table 7. Categories and subcategories in study II

Categories	Subcategories
Facilitators of performing exercise in everyday life	<ul style="list-style-type: none"> • The importance of regular daily routines • Personal exercise goals • Supportive environmental factors • Easily accessible exercises
The importance of support	<ul style="list-style-type: none"> • Support from the physiotherapist • Self-monitoring of exercise
Perceived gains from exercise	<ul style="list-style-type: none"> • Physical gains • Functional gains
Existential aspects of the exercise	<ul style="list-style-type: none"> • Emotional experiences • Awareness of fragility and needs • Thoughts and reflections on ageing

5.2 Effect of and adherence to exercise with or without motivational interviewing

The effect measures of the intervention revealed no statistically significant differences between the study groups of either the feasibility study (study I) or the main RCT (study III) at 12 weeks of follow up. In the feasibility study, 40 participants were followed up at 12 weeks; in study III, 161 participants were followed up at 12 weeks (Table 8). The per-protocol analysis (n=146) revealed results similar to those of the intention-to-treat analysis in study III.

Physical performance showed significant improvement within groups for the OEP+MI and control group in both the feasibility study (study I) and study III (Table 8).

Balance performance was unchanged within the groups both in both the feasibility study (study I) and the main RCT (study III); consequently, there was no difference among the groups.

Fall self-efficacy showed significant improvement within the OEP+MI group and the control group in both the feasibility (study I) and study III (Table 8).

Jamar handgrip on the left side improved significantly within the OEP+MI group in study III (Table 8).

Activity level showed significant within-group improvement in the OEP+MI group in study III (Table 8).

Falls were reported in the feasibility study (study I) by eight participants, who reported a total of 10 falls during their first twelve weeks in the study: two participants from the OEP group, three from the OEP+MI group and three from the control group. A total of 29% (45) of the participants from the main

RCT (study III) experienced at least one fall accident during the 12-week study period, resulting in a total of 74 falls. There were 19 falls reported by 15 participants (31%) in the OEP group, 38 falls reported by 18 participants in the OEP+MI group (33%) and 17 falls reported by 12 participants (22%) in the control group.

Table 8. Outcome measures in study III: within and between group comparison (n=161 total; OEP, n=54; OEP+MI, n=52; control, n=55)

Outcome measure	Baseline Mean (SD)	12 weeks Mean (SD)	Within-group comparison <i>P</i>	Between-group comparison <i>P</i>
<i>SPPB (0-12)</i>				
Between groups				.67
Within OEP	7.9 (2.5)	7.9 (2.8)	.84	
Within OEP+MI	8.0 (2.4)	8.3 (2.6)	.04	
Within control group	7.6 (2.5)	8.2 (2.6)	.03	
<i>Mini-BESTest (0-28)</i>				
Between groups				.82
Within OEP	15.8 (5.2)	15.8 (5.7)	.80	
Within OEP+MI	15.8 (5.5)	16.4 (6.0)	.21	
Within control group	16.0 (5.2)	16.2 (4.7)	.48	
<i>FES (S) (0-130)</i>				
Between groups				.35
Within OEP	103.3 (21.3)	103.8 (22.1)	.53	
Within OEP+MI	103.0 (22.6)	109.5 (18.4)	.02	
Within control group	100.2 (26.5)	106.2 (20.6)	.03	
<i>Handgrip right, kg</i>				
Between groups				.58
Within OEP	24.7 (8.7)	25.3 (8.7)	.66	
Within OEP+MI	24.4 (7.5)	25.1 (7.0)	.17	
Within control group	24.4 (7.7)	23.9 (7.4)	.20	
<i>Handgrip left, kg</i>				
Between groups				.76
Within OEP	23.4 (7.9)	23.9 (7.7)	.62	
Within OEP+MI	22.4 (7.2)	23.3 (6.7)	.03	
Within control group	23.0 (6.8)	22.9 (7.2)	.85	
<i>Frändin/Grimby (1-6)</i>				
Between groups				.41
Within OEP	2.9 (.7)	3.0 (.6)	.28	
Within OEP+MI	2.7 (.6)	2.9 (.6)	.02	
Within control group	3.0 (.8)	2.8 (.5)	.23	

SPPB=Short Physical Performance Battery, FES(S)=Falls Efficacy Scale-Swedish version, OEP=Otago Exercise Programme, MI= motivational interviewing, *p*=*p*-value, significant value ≤ .05

5.2.1 Adherence

Exercise adherence was considered high, especially at the 12-week follow-up (study III), for both exercise groups. Over the 52 weeks, the mean frequency for exercising was more than two times per week (Figure 3) throughout the exercise period for the two exercise groups (n=114).

The exercise frequency presented in Figure 3 is the mean of the total number of exercise occasions per week for all participants. Among the participants who adhered to exercise, 27% reported not exercising during the 52-week period for various reasons (Figure 4). Among the 45% of participants who did not meet the set goal of adherence, the underlying causes of absence were varied and are reported in Figure 5.

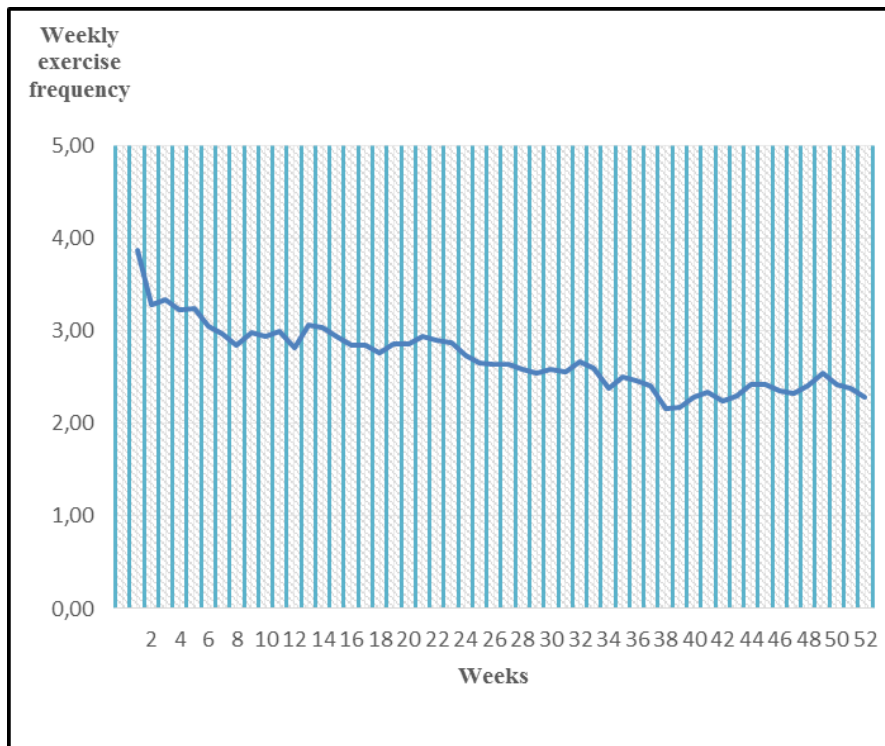


Figure 3. Mean exercise frequency per week based on the participants in the exercise groups (n=114) over 52 weeks (study IV)

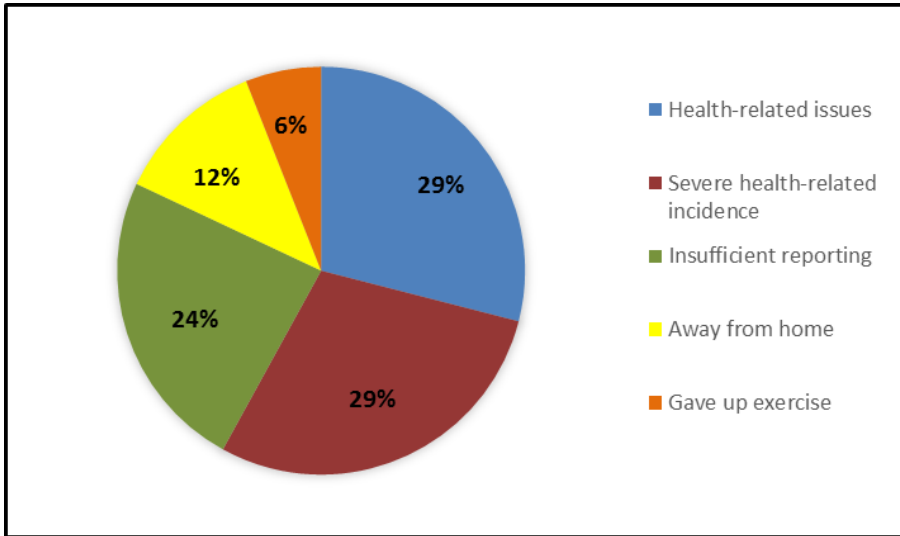


Figure 4. Causes of absence from exercise among the adherent participants at the 52-week follow-up (n=17) in study IV

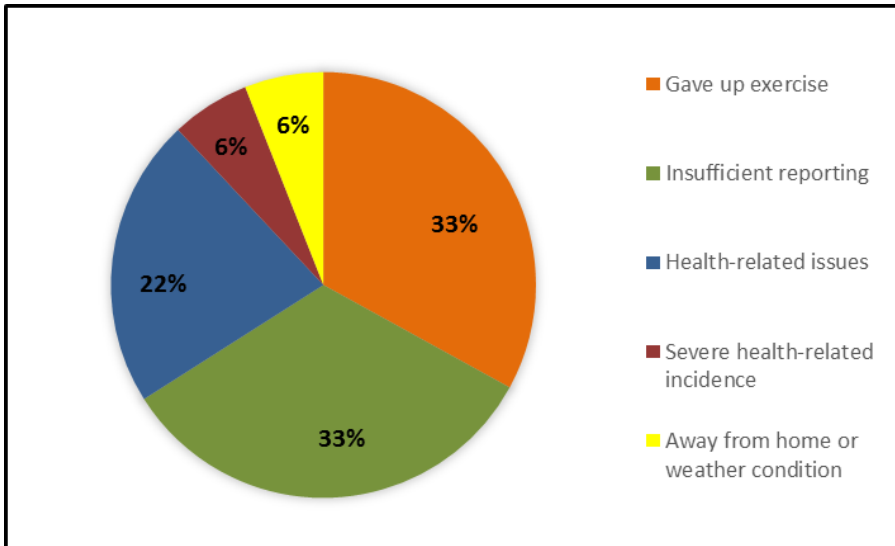


Figure 5. Causes of absence from exercise for the non-adherent participants at the 52-week follow-up (n=38) in study IV

In study IV, behavioural factors associated with adherence to exercise included previous physical activity habits and intervention with behavioural aspects (Table 9). The prediction model included four independent variables, including group belonging, readiness to change, fall self-efficacy and activity level. The prediction model explained 13.1% of the variance in exercise adherence. Additionally, the only significant factor associated with adherence to walks were previous physical activity habits, and the prediction model explained 22.5% of the variance in adherence to walks (Table 10).

Table 9. Logistic regression model showing independent variables independently associated with adherence to exercise in study IV

Predictors	<i>B</i>	OR	95% CI for OR
Group OEP (n=58), OEP+MI (n=56)	.90*	2.47	1.11-5.49
RTC			
Committed to exercise	.03	1.03	.82-1.30
Confident to exercise	.04	.97	.73-1.23
FES(S)	.08	1.08	.48-2.41
Frändin/Grimby, activity scale	1.22*	3.39	1.38-8.32
Age	-.04	.96	.57-1.61
Gender	-.44	.64	.76-1.23

Nagelkerke R^2 .131, *B*=beta value, OR=odds ratio, CI=confidence interval (95% CI), * $p < .05$, OEP=Otago Exercise Programme, MI=motivational interviewing, RTC=Readiness to Change, FES(S)=Falls Efficacy Scale-Swedish version

Table 10. Logistic regression model showing independent variables independently associated with adherence to walks in study IV

Predictors	<i>B</i>	OR	95% CI for OR
Group OEP (n=58), OEP+MI (n=56)	.47	1.59	.70-3.62
RTC			
Committed to exercise	-.11	.90	.70-1.15
Confident to exercise	-.02	.98	.76-1.27
FES(S)	.13	1.14	.49-2.64
Frändin/Grimby, activity scale	1.81*	6.11	2.34-15.94
Age	.32	1.37	.81-2.34
Gender	.08	1.09	.44-2.69

Nagelkerke R^2 .225, *B*=beta value, OR=odds ratio, CI=confidence interval (95% CI), * $p < .05$, OEP=Otago Exercise Programme, MI=motivational interviewing, RTC=Readiness to Change, FES(S)=Falls Efficacy Scale-Swedish version

5.2.1.1 Self-monitoring

In the main RCT (study III), the acceptable amount of exercise (two times per week) was accomplished by 81% of the participants. The proportions in the OEP group and the OEP+MI group were 77% and 84%, respectively. Walks were completed two times per week by 67% of the participants - 70% in the OEP group and 64% in the OEP+MI group - at the 12-week follow-up.

At the 52-week follow-up (study IV), an exercise frequency of two times per week was accomplished by 55% of all exercising participants (Table 11), with 46% in the OEP group and 64% in the OEP+MI group. The walks were completed two times per week by 50% of the participants, 46% in the OEP group and 54% in the OEP+MI group (Table 11).

A total of 72% of the participants completed 12 months of exercise diaries. The proportions within the groups were 67% of the OEP group and 77% of the OEP+MI group (Table 11). The total duration for which exercise diaries were completed ranged from 1 month to 12 months.

Table 11. Proportions of participants who completed exercise diaries per month during the exercise year and exercise/walking at the one-year follow up in study IV

Completed exercise diary, (%)	Total n=114	OEP n=58	OEP+MI n=56
1 month	100	100	100
2 months	97	95	100
3 months	90	86	93
4 months	86	81	91
5 months	86	81	91
6 months	86	81	91
7 months	86	81	91
8 months	84	79	89
9 months	82	76	88
10 months	77	72	82
11 months	75	69	82
12 months	72	67	77
Exercising a minimum of 2 times per week for 52 weeks, (%)	55	46	64
Walking 2 times per week for 52 weeks, (%)	50	46	54

OEP=Otago Exercise Programme, MI=motivational interviewing

6. Discussion

6.1 Main findings

The results of the four studies are integrated into the framework presented in Figure 6. Examples are provided for some of the results to clarify how they are connected when using a behavioural medicine approach based on this framework. The concepts of SCT include individual, environmental and behavioural aspects (Figure 6). Examples of the individual aspect include physical and psychological functions, such as the perception of being stronger and having improved balance and confidence in performing the exercises independently. Examples of the environmental aspect include the home context, available exercises and access to a PT. Examples of the behavioural aspect include adhering to exercise, perceiving exercise as “easy” and “fun”, and thinking about extending one’s ability to lead an active life in old age.

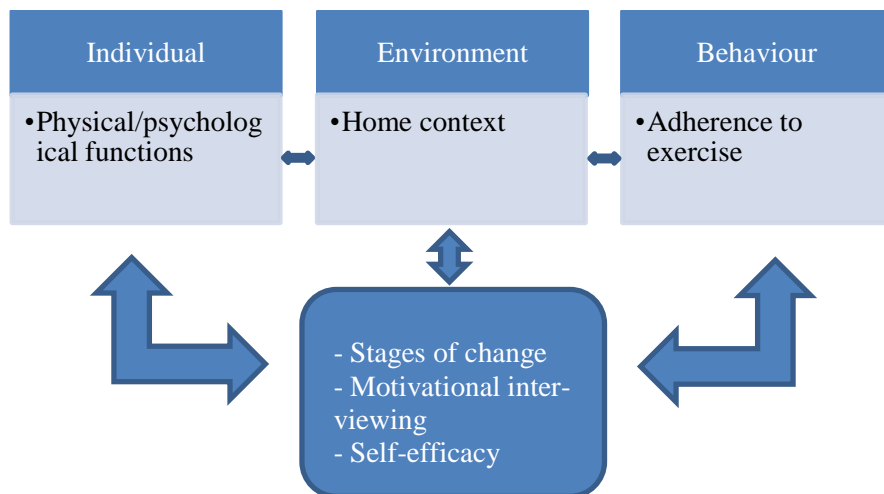


Figure 6. Social cognitive theory integrating the stages of change, motivational interviewing and self-efficacy

The feasibility determined in study I from the PTs perspective was evaluated based on processes, resources and management and revealed the main issue concerning how to perform the planned exercise and use an MI guide. These procedures were important for the further methodological improvement of the ongoing study III. From the perspective of the older participants, the inclusion of monitored exercises in everyday life and daily routines was important. The participants in the OEP+MI group experienced greater strength and improved physical functioning and had hopeful expectations of an extended active life. In addition, a PT provided meaningful support for changing exercise behaviours, including adapting the exercises to individual circumstances.

In the short-term, there were no significant differences between the study groups after 12 weeks of regular exercise. However, within the OEP+MI group, significant improvement in physical performance, fall self-efficacy, activity levels and handgrip strength were observed. Significant improvement was also observed within the control group in terms of physical performance and fall self-efficacy.

Adherence to the exercise program was high in both exercise groups, which suggested that the programme was suitable for this particular sample of older adults exercising at home over a short-term assessment period. In the long-term, the behavioural factors of being physically active and obtaining behavioural support (i.e., through MI) were significantly associated with adherence to the exercise programme independently of one another. To address the comprehensive problem of fall accidents, new knowledge is needed to establish a preventive exercise programme in an elderly population with an evident risk of falls.

For the elderly individual, a target-oriented exercise programme is the most effective fall-preventive action.²⁶ Formulating, conveying, and providing support for such individualized programmes are obvious tasks in physiotherapy.¹¹⁷ The structure and simplicity of the exercises that were used in these studies were accepted by this sample of older people, and the exercise programme could be integrated into their daily lives. Access to a PT with knowledge of the importance of behavioural factors in relation to exercise adherence also provided a valuable contribution.

This knowledge could be valuable when planning and acting to improve health care for older people, and thus, the obtained knowledge contributes to new understanding in the research area of health and welfare.

6.2 Risk of falling

The continuous increase in fall rates and the risk of falls in the elderly population has been identified as a major health problem globally, and efforts to prevent falls have been implemented in a variety of ways.²⁶

None of the participants reported any fall accidents while exercising over the 12-week intervention. In total, 29% of the 175 participants reported falls (31% from the OEP group, 33% from the OEP+MI group and 22% from the control group). The changes in physical activity patterns resulting from exercising in the OEP and OEP+MI groups may have contributed to an increased risk of falls. It has been suggested that physical activity levels, regardless of the intensity of the activity, tend to increase the fall risk in older adults,¹¹⁸ a phenomenon that may have been reflected by the number of falls reported by participants in the exercise groups.

6.3 Physical activity and exercise

General physical activity decreases with age,^{64,119} as reflected by the observation that few older people achieve the recommended levels of physical activity.¹²⁰

The results of this thesis imply that the OEP appealed to the participants. At baseline, 70% of the participants reported performing at least 2-4 hours of light physical activity per week, which could be one factor contributing to their positive reception of the intervention at both the 12-week and 52-week follow-up (studies I, III and IV). In addition, the willingness to participate in the study indicated that the participants had some basic interest in exercising when the study started. In this respect, the study sample can be considered restricted and not necessarily representative of all individuals in the corresponding age group.

The absence of significant differences in outcomes between the three study groups at the 12-week follow-up (studies I and III) can be explained by the limited duration of the exercise period. Improvements in physical functions after exercise based on the OEP have been reported to occur after a training period of 6 to 12 months.³ In addition, the twice-per-week exercise frequency was one time less per week than prescribed in the original OEP protocol. The study could also have been underpowered.

General guidelines suggest that exercise should be undertaken for at least two or three hours per week in older adults when the goal is to prevent falls.⁴⁶ ⁴⁵ In studies III and IV, the minimum exercise frequency of two times per week plus walks at least two times per week was considered appropriate due to the study population's age and the possibility of upcoming life events. This frequency is commonly used as an acceptable training dosage when exercise is prescribed for older adults.^{47,121} However, since walking is included in the Frändin/Grimby activity scale,¹¹⁰ the finding in study IV that physical activity positively predicted adherence to walks was not unexpected.

Being physically active has also been identified as a positive predictor of short-term adherence to exercise.⁶⁴ However, this implies that older people

with a low physical activity level need support to achieve high adherence to an exercise programme.

6.4 Fall prevention exercise performed at home

Home-based exercise programmes have been presented as a convenient alternative for community-dwelling older people.^{47,54} The home-based exercise programme used in these studies was considered suitable for this particular sample of older people by both the participants and the PTs involved in the treatment (study I). Overall, the feasibility of performing this intervention, which constitutes exercise with or without support for behavioural change, was acceptable for performance in the home environment.

For some participants, the possibility of exercising at home was a prerequisite for participation (study II), which correlates well with the target group with limited mobility. The possibility of exercising at home might also be important for adherence to the prescribed exercise.^{26,64,122} Health-related circumstances in older people's lives, however, may interfere with the planned exercise; this could be considered a natural phenomenon that is expected in an older persons' life. It has been highlighted that exercising in the home environment develops complicity in providing sufficient amount of exercise to gain the desired effect,⁴⁵ which was probably reflected in the modest effect results presented in study I and III. The exercise might not have been sufficiently challenging to produce an immediate effect; furthermore, the follow-up time was also short.

The OEP+MI group continued to improve significantly in all outcome variables except balance performance in both studies I and III, and improvements in physical performance and fall self-efficacy were also noted in the control group. This phenomenon might be explained by the "Hawthorn effect": namely, that the simple fact of being observed is likely to result in improvements.¹²³ However, corresponding changes did not occur in the OEP group.

Exercise for balance improvement can be difficult to make sufficiently challenging and must progress gradually and at an individualized rate for participants to experience improvement.^{47,124,125} Balance exercises performed in a supervised clinical setting have shown to be effective over the short-term in people aged 60-75 years,¹²⁶ and the OEP seems to be more effective for improving balance when performed in a group setting than in-home.¹²⁷ This finding emphasizes the challenge of self-training¹²⁴ and confirms that goal attainment is even more difficult when exercises are performed in the home setting.

In this study, the exercise had to be performed within a safe and comfortable margin. There is a need for the development of safe, secure and effective exercises that can be performed in the home environment. The safety margin of the OEP was judged to be high in the RCT (study III), which could explain the absence of improvement in the participants' balance performance.

6.5 Reinforcing adherence

Adherence to exercise programmes is generally low in older people,⁶⁴ but it is crucial for attaining improvement.

A short-term follow-up can provide important information concerning how older people can change their behaviours and incorporate exercise into their daily routines. Participants in the OEP+MI group expressed being inspired by the PT, which increased their self-determination and confidence in performing the exercise (study II). However, the presence of a PT may not be essential when prescribing OEP and may not be available for all older people.¹²⁸ In study II, the elderly people still highly valued the meetings with the PT, which may be important, especially when striving for exercise behaviour change.

The participants also described the value of setting goals, which facilitates behavioural changes and is in direct accordance with MI principles.⁸⁹ The participants in the OEP+MI group (study II) reported that experiencing increased strength, improved physical functioning and hope for an extended active life in old age were motivating factors and important for engagement in exercise.

Moreover, exercise combined with comprehensive behavioural change interventions has been shown to have some positive effects on coronary risk factors, including physical fitness, among middle-aged people (30-60 years old).¹²⁹ Lovibond et al. highlighted that feedback and self-monitoring of the target behaviour were of value when including behavioural aspects in a treatment regimen.¹²⁹ This phenomenon was also reflected in study II as important for participants performing exercise with behaviour change support. Considering the importance of self-monitoring for behavioural change according to Lovibond et al., the exercise diary functioned as a reminder that facilitated the regular performance of exercise by the participants in study II. The exercise diary was completed by 77% of the participants in the OEP+MI group over the one-year exercise period in study IV, which implies that an exercise diary can be a suitable alternative when including behavioural aspects in a treatment regimen.

Adherence to exercise was high in both the OEP and OEP+MI groups, especially at the 12-week follow-up in study III. Furthermore, in study IV, two factors were associated with long-term adherence: physical activity habits and whether the exercise programme was combined with MI.

For older people with a low level of physical activity, support for behavioural change might be important when exercise is introduced. It might be considered intuitive that an older person with an established regular physical activity regimen would more easily accept and adhere to new recommended exercises and be receptive to behavioural change strategies. However, adherence to exercise tends to decline over time,⁶⁴ and treatment with behavioural components might help the individual become aware of both hindrances and supporting factors and thus strengthen their self-management ability.

6.6 Motivational interviewing to support exercise behaviour change

Behavioural medicine in physiotherapy has a positive effect on exercise adherence, living with chronic pain and improving self-efficacy to positively influence reduced levels of activity limitations for older individuals.^{70,92} Behavioural aspects are, however, not automatically included in traditional physiotherapy,⁹² and some difficulties are associated with the integration of behavioural support in physiotherapy. This was confirmed in study I, despite the experience, prior knowledge and education of the PT.

The PTs providing the MI were well motivated to use the MI in combination with prescribing exercise, but the MI guide was limiting and additional meetings with the MINT trainer to support MI skills were requested by the PTs rather than only using the MI guide. This result supports previous findings concerning the use of an MI manual as ineffective, too restrictive and not recommended for use in collaborative conversation.¹³⁰ MI skills have shown to be sustained over time if supervision, coaching and feedback sessions are provided regularly.¹³¹ The PTs were familiar with the MI and had experience using it before this project was initiated. Nevertheless, the feasibility study showed that they demanded more support for the MI part of the intervention in addition to the three-day education session prior to the study start.

In addition, the participants expressed the value of the collaborative conversation with the PT when prescribing the exercise (study II). This is an important point to consider when MI is applied in clinical practice. PTs might not be confident in using behavioural medicine techniques, and thus training and supervision are needed for clinical applications.

In older adults, the initiation, performance and maintenance of behavioural changes are important factors when introducing exercise. Ageing is often associated with decreased motives for engaging in physical activities, and the unavoidable deterioration in many physical functions are a barrier and a hindrance.³⁵ Therefore, behavioural techniques that are effective for younger adults may not be effective for older adults.³⁴ These age-related aspects of behavioural medicine in physiotherapy must be highlighted in future studies.¹³² Further development and implementation of behavioural medicine in physiotherapy are recommended in future research.

6.7 Methodological limitations and considerations

The RCT included in this thesis was reported according to the CONSORT statement,⁹⁵ which at the study's start was considered appropriate. An alternative way to report an RCT is the Non-Pharmacologic Treatment Interventions method with an extension to CONSORT for complex interventions. Complex

interventions involve several components, such as difficulties related to descriptions, standardization, and reproduction. Still, the reporting of the present RCT was judged to be appropriate and included many of the aspects found in the extension of CONSORT.

In the evaluation of feasibility (study I), the two questionnaires were not psychometrically evaluated, which might have biased the results. These questionnaires were estimated to have limited possibilities for different interpretations; thus, they were judged as acceptable to use. The questions' ability to capture the concepts, resources, management and processes, however, was not elucidated.

Additionally, the short-term follow-up did not allow for conclusions regarding the effect of the programme on falls (study III). Twelve weeks is a short time to evaluate the effect of exercises or behaviour changes. Although the effects of the exercise could not be determined at that time point, the short-term study provided information concerning the effectiveness of the exercise in the home setting, whether the elderly participants adhered to the exercise and self-monitoring and whether there were any injuries related to participation in the programme. At this point, regular and primary contact with the PTs had been phased out, which was also a motive for performing the evaluation 12 weeks after inclusion in the study.

The study may also have been underpowered since there was a higher dispersion of the SPPB variable (SD 2.6) in study III compared with the SD used in the power calculation (SD 1.5).^{113,114} The similarities of the exercise programmes and the improvements noted in the control group were also limitations because these factors probably contributed to the difficulties in detecting differences between the groups.

Since there is no consistent way to measure adherence in terms of treatment effects, the number of exercise occasions during the study period was adopted in this thesis. This can be judged as a limitation since absence from exercising was included in the calculation of adherence during the study period; however, this was still considered appropriate with respect to the life events of older people, which can contribute to difficulties in evaluating adherence.

Some ethical considerations were also addressed. All personal data, test forms, questionnaires and recorded conversations were coded and stored in safe and locked storage, and only the researchers had access to the information. When presenting the results, no identification of the individual participants was possible.

The exercises took a large amount of time to perform. The time required for the exercise, however, did not exceed the recommended physical activity duration of 30 minutes per day. The risk of injury while exercising was addressed thoroughly via oral and written information regarding the exercises and providing safety advice. Instructions, follow-up and the gradual progression of the exercise were provided by a licensed PT with expertise in assessing appropriate exercise doses for elderly people with variable health statuses.

7. Conclusion

The use of the behavioural medicine approach in physiotherapy provides the opportunity to include behavioural support, which is important for planning, performing and enabling adherence to exercise in both the short and long term. The physiotherapists perceived the Otago Exercise Programme with or without support from motivational interviewing as suitable for performing at home.

When older people included exercise in their everyday life and daily routines, they experienced greater strength, improved physical functioning and hope for an extended active life. In addition, a physiotherapist provided meaningful support during the processes by adapting the exercises to individual circumstances.

From the short-term perspective, there were significant improvements within the group that received exercise combined with motivational interviewing in terms of increased physical performance, fall self-efficacy, activity levels and handgrip strength. Significant improvements were also observed within the control group in terms of physical performance and fall self-efficacy, corresponding differences did not occur in the OEP group without MI. After 12 weeks of regular exercise, there were no significant differences between the study groups.

After one year of exercising two times per week, physical activity habits and exercise supported by motivational interviewing were associated with adherence to the exercise programme.

7.1 Clinical implications

These studies demonstrate how a fall preventive exercise programme with the addition of behavioural support can be realized in a target group of people over 75 years of age living at home. The fall-preventive Otago Exercise Programme with or without motivational interviewing was well accepted both by the older people and the physiotherapists for performance at home. These findings supply valuable knowledge when planning exercise regimens for older people, including safety issues in the home environment.

Support in the home environment and monitoring of the exercise are important factors, according to the participants in the group that received exercise supported with motivational interviewing. This finding supports the value

of self-monitoring via an exercise diary when prescribing exercise for older people.

When exercising at least two times per week, a high activity level and additional support for behavioural changes were associated with exercise adherence. Elderly people with low activity habits probably require special attention and support to overcome barriers to performing regular exercise.

7.2 Future research and implementation of fall prevention exercises at the municipal level

This thesis highlights the need for further knowledge. The OEP with or without MI still needs to be evaluated in a larger study sample to investigate the effects and adherence in community-dwelling older people. Future research and municipality-level recommendations are as follows:

- Further evaluation of the addition of MI to physiotherapy when introducing exercise programmes for people aged 75 years or older
- Further investigation of how to optimize the OEP for people aged 75 years or older
- Identification of which populations benefit the most from fall prevention exercise programmes with support for behaviour change
- Identification of behavioural factors to include in treatment when striving for long-term exercise effects and adherence
- Measurements of exercise adherence, frequency, continuity and circumstances in older people's lives must be considered. A standard measurement of adherence need to be developed.

8. Tack

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