

# Impact of the fall prevention Otago Exercise Programme on pain among community-dwelling older adults: a short- and long-term follow-up study

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**Background:** Pain is a major public health issue among community-dwelling older adults, with a prevalence of 45–80%. In addition to being strongly associated with reduced physical function, loss of independence, psychological distress, lower quality of life, and risk of earlier death. Recent research has also found that pain in older adults is associated with a higher risk of falls, which itself is another major health concern. Long-term and high-intensity pain are predictors of chronic pain and pain-related disability. Therefore, establishing an evidence-based intervention that can reduce both pain and falls in older adults is of high importance.

**Purpose:** This study aimed to investigate whether a home-based fall-preventive exercise-program can reduce pain in the target population over both the short and long term.

**Patients and methods:** This was a quasi-experimental study with a 1-group pretest-posttest design. We included 119 participants who had participated in a recent 2-year fall prevention intervention in a randomized controlled trial. The intervention included exercises based on the Otago Exercise Programme (OEP), an individually tailored and prescribed program that involves home-based exercises supervised by a physiotherapist. Pain was measured using an item from the EuroQol-5D questionnaire.

**Results:** Pain was significantly reduced from baseline ( $n=119$ ) at 3 ( $n=105$ ,  $p=0.003$ ), 12 ( $n=96$ ,  $p=0.041$ ), and 24 ( $n=80$ ,  $p=0.028$ ) months following the commencement of OEP-based exercises.

**Conclusions:** These results indicate that the OEP could be a suitable evidence-based program for both pain management and fall prevention among community-dwelling older people who live with pain and are at a higher risk of falling. Our study highlights an effective technique for better pain management and fall prevention in older adults.

**Keywords:** elderly, pain management, physical therapy, randomized controlled trial

## Introduction

Some kind of pain problem is reported in 45–80% of community-dwelling older adults, with the prevalence of pain among older people expected to increase as the population continues to age. The prevalence of pain is particularly high among older women, those who live alone, and those who are dependent on formal or informal care to manage their everyday lives.<sup>1–3</sup> The most common pain type among older people is musculoskeletal pain due to the high rate of musculoskeletal disorders in later life.<sup>1</sup>

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Living with pain as an older adult is associated with poorer health, reduced physical function, impaired mobility, loss of independence, depression, social isolation, lower quality of life, and early death.<sup>4,5</sup> Moreover, living with a high degree of pain severity, daily pain, or widespread musculoskeletal pain is a known risk factor for developing pain-related disability and chronic pain among older people.<sup>6,7</sup> Recent research has highlighted that chronic pain, particularly musculoskeletal pain, among community-dwelling older adults is also associated with falls. A systematic review showed that older adults with pain are more likely to have fallen in the past year and are at a higher risk of falling again than those without pain,<sup>8,9</sup> with approximately one-third of older adults over the age of 65 years experiencing a fall every year. As with pain, falls are associated with functional decline, disability, lower quality of life, and mortality.<sup>10,11</sup>

From a clinical perspective, understanding the relationship between pain and falls in older adults is of high relevance, though unfortunately, pain is still under-diagnosed, under-assessed, and under-treated despite its negative impact on daily life and quality of life.<sup>1</sup> Ideally, decreasing pain and falls among this population would ultimately promote active aging.<sup>12</sup> Decreasing the prevalence of pain and falls is also relevant from a societal perspective as they contribute to a high economic burden on the healthcare system and society.<sup>13</sup>

One of the most powerful interventions for decreasing and preventing pain is physical activity and exercise, with the American Geriatric Society and other researchers advocating the use of physical activity and exercise interventions to prevent and reduce pain and pain-related problems, such as falls, in older adults.<sup>1,14,15</sup> In particular, individually tailored exercise programs that include strength, balance, and endurance exercises have been shown to prevent and reduce falls among older people.<sup>15</sup> An example of such a program is the Otago Exercise Programme (OEP), which has been rigorously evaluated and shown to increase balance and strength, as well as decrease fall rates and risk of death.<sup>17,18</sup>

The short- and long-term effects (ie, at 3, 12, and 24 months following the start of intervention) of the OEP on community-dwelling persons over 75 years of age were recently investigated in a fall prevention study by a research group at Mälardalen University and Uppsala University.<sup>19,20</sup> The participants in this randomized controlled trial (RCT) exercised in accordance with the fall-preventive OEP either with or without motivational

interviewing (MI).<sup>21</sup> The addition of MI, which is a collaborative conversation that includes open-ended questions, affirmations, reflective listening, and summaries aimed at developing the individual's own motivation to change, was used to promote behavioral change.<sup>21</sup> The RCT found no significant outcome differences between engaging in the OEP with and without MI after 1 year of exercise; therefore, the intervention groups were merged for subsequent analyses.<sup>22</sup> It was also found that 55% of the participants remained adherent to the exercise program at least 2–3 times per week for 12 months.

However, the effect of OEP-based exercise on pain is still unknown, and there remain no evidence-based guidelines for pain-preventive exercise among older adults<sup>16</sup> despite the importance of establishing an intervention that reduces both pain and falls in community-dwelling older people. Hence, the aim of this study was to use data from the aforementioned RCT to investigate whether the OEP can reduce pain in the target population of older adults in both the short and long term.

## Methods

### Ethical considerations

The RCT from which data for the present study were drawn was approved by the Regional Ethics Committee of Uppsala, Sweden (Dnr 2012/147) and was carried out in accordance with the 1964 Declaration of Helsinki. Verbal and written information about the study were provided to participants, who all provided written and oral consent prior to data collection. The participants were guaranteed confidentiality and reassured that their participation was voluntary and that they could withdraw from the study at any time without needing to state their reasons. They received no compensation for their participation in the RCT.

### Study design

This was a quasi-experimental study with a 1-group pretest-posttest design within a larger study investigating the impact of the fall-preventive OEP on community-dwelling older adults.<sup>20</sup>

### Participants and setting

This study included 119 participants who completed an exercise intervention in the previous RCT.

Older persons above 75 years of age who had contacted health care centers or the municipality to acquire

walking aids or home care were asked by physical therapists (PTs), occupational therapists, or care managers to participate in an RCT. Patients were included if they were able to walk independently and understand written and oral information in Swedish, and excluded if they received regular physical therapy due to injury and/or illness, were in terminal care, or scored  $<25$  on the Mini-Mental State Examination.<sup>23</sup>

All qualified participants were evaluated and tested at their home or a health care center at baseline and at 3, 12, and 24 months following the start of intervention by an independent PT blinded to group allocation (OEP either with or without MI). The participants were randomly assigned in variable blocks of 3, 6, 9, and 12. The primary outcome of the RCT was physical function as measured by the Short Physical Performance Battery. A detailed description of the recruitment process, inclusion and exclusion criteria, assessment methods, and exercise intervention are presented in a previous paper.<sup>20</sup> The RCT study was registered at clinicaltrials.gov under NCT01778972.

## Intervention

The intervention used in the RCT was a 1-year exercise intervention that included exercises based on the OEP. The OEP is an individually tailored and prescribed exercise program that involves the performance of home-based exercises supervised by a PT.<sup>18</sup> The exercises were individually adjusted by a PT during 6 home visits with 3 additional follow-up telephone calls over 12 months, and addressed balance, endurance, and strength with weight cuffs used to increase strength. During the home visits, the PT followed an OEP-based protocol to determine the structure and progression of the individually tailored exercises, which progressed along 4 levels of difficulty.<sup>18</sup> Balance exercises progressed from “hold on” as the easiest level to “no support” as the most difficult level. Examples of exercises that the participants performed include up on toes, back on heel, knee bends, heel to toe stands/walking and standing up from a sitting position, and sitting down slowly. The intervention exercises were complemented with additional walks on the days between exercise days and were closely supervised during the home visits. Each exercise session lasted approximately 30 mins.

Exercise adherence was monitored using an exercise diary completed by the participants and was followed up during home visits over the 12 months of the intervention. Participants either sent their diaries to the responsible PT

monthly by mail or had it collected during home visits. The participants' exercise habits during the second year of follow-up were unknown.

## Measurements

### Pain

Pain was assessed using the EuroQol-5D (EQ-5D), a standardized measure of health-related quality of life. The questionnaire comprises the 5 dimensions of mobility, self-care, usual activities, pain, and anxiety/depression, and has been shown to be reliable and valid<sup>24</sup> and effective in detecting small changes in chronic diseases.<sup>25</sup> For the purposes of the RCT, patients were asked to answer 1 independent item assessing pain with the following answer options: “I have no pain or discomfort,” “I have moderate pain or discomfort,” and “I have extreme pain or discomfort.” Participants selected 1 option according to their experience at the time of answering the questionnaire.

### Fear of falling

Participants' fear of falling was assessed with a yes/no question.

### Physical activity

The participants' baseline level of physical activity, including housekeeping activities, was measured using the Frändin-Grimby activity scale.<sup>26</sup> This scale, which has been validated in older adults,<sup>27</sup> includes 6 levels of physical activity as follows: (1) hardly any physical activity, (2) mostly sitting, sometimes a walk, and light household activities, (3) light physical exercise for around 2–4 hrs a week, (4) moderate exercise for 1–2 hrs a week, (5) moderate exercise for at least 3 hrs a week, and (6) hard or very hard regular exercise several times a week, where physical exertion is high. Participants indicated the level that best described how physically active they were in everyday life.

### Adherence

Adherence to the exercise program was defined as performance of the program at least 2 times per week during the RCT. This was considered appropriate for the participants' age and allowed upcoming personal events to be accommodated.

## Statistical analysis

Descriptive data were collected and compiled, with categorical data presented as frequency and percentage and ordinal data as median and range (min-max). Changes over time (pre-post) were analyzed using the Wilcoxon signed-rank

**Table 1** Baseline characteristics of the study sample (n=119)

Characteristics	Total n=119
Age median (min-max) (q1-q3)	84 (75-96) (80-86)
Gender, % women	68
Walking aid, %	91
Previous falls, % no	57
Afraid of falling, % yes	54
Activity level during the past 6 months, % (n)	
Mostly sedentary	37 (31)
Light physical effort	69 (58)
More strenuous exercise 1-3 h/week	13 (1)

test. Data analysis was performed using IBM SPSS statistics version 20, with statistical significance set at  $p < 0.05$ .

## Results

Patient baseline characteristics are presented in Table 1. The median age was 84 years, almost all participants used some kind of walking aid, and more than half of the participants had a history of falls and/or were afraid of falling. The participants were physically active between 2 and 4 hrs per week, which included walking and various housekeeping activities.

Regarding adherence, 55% of the 119 participants exercised 2-3 times per week for 12 months.

A descriptive result over self-rated pain based on the question from EQ-5D is shown in Table 2.

The results for the EQ-5D question showed a significant decrease in pain from baseline to 3 months ( $p=0.003$ ), to 12 months ( $p=0.041$ ) and at 24 months ( $p=0.028$ ) see Table 3.

## Discussion

Reducing pain is of high importance as untreated pain is a risk factor for developing chronic pain and pain-related disability among older adults.<sup>7</sup> To our knowledge, however, no study has evaluated the effect of OEP-based exercise on pain. Therefore, we believe that this study provides valuable and interesting new knowledge to both researchers and health care providers regarding pain management and fall prevention in older adults.

**Table 3** Wilcoxon signed-rank test on self-rated pain of the study sample for the total group

	3 months	12 months	24 months
Baseline, n=119	0.003	0.041	0.028
3 months, n=105	X	1.00	0.827
12 months, n=96	1.00	X	0.637
24 months, n=80	0.827	0.637	X

Overall, the results from the present study are encouraging, indicating that the performance of OEP-based exercises for 12 months is associated with a significant reduction in pain from baseline at 3, 12, and 24 months. Our results also indicate that even a smaller amount of exercise (2-3 times per week) was effective for pain management. This is particularly promising as older adults generally have low physical activity levels, which places them at higher risk of developing functional decline and additional chronic diseases. Our OEP-based intervention may help reduce these risks by promoting easily achievable but effective levels of physical activity and exercise among the target population. Support from a PT and the exercises themselves may also lead to decreased use of pain medication, which is of high clinical relevance as some pain medications are associated with a higher risk of falls.<sup>15</sup> It should be noted, however, that the combination of pharmacological and non-pharmacological treatment and interventions remains the evidence-based recommendation for pain management in older adults. Furthermore, in some cases, optimal pharmacological treatment is a prerequisite for the best possible performance and management of everyday activities, including the non-pharmacological interventions of exercise and physical activity.<sup>1</sup>

Since pain for many older adults is life-long, interventions need to be adhered to effectively in the long term.<sup>1</sup> The adherence rate of 55% in our study indicates that the program was fairly accepted by the study population, demonstrating that the OEP can be effective not only in terms of pain reduction but also in terms of encouraging long-term compliance. This is of high clinical interest given that older persons generally have low adherence to

**Table 2** Self-rated pain of the study sample at baseline, 3, 12, and 24 months

Outcome	Baseline, n=119	3 months, n=105	12 months, n=96	24 months, n=80
I have no pain or discomfort (%)	18 (15)	31 (29)	25 (26)	25 (31)
I have moderate pain or discomfort (%)	99 (83)	71 (68)	68 (71)	51 (64)
I have extreme pain or discomfort (%)	2 (3)	3 (3)	3 (3)	4 (5)

exercise programs and therefore do not achieve any results from exercise interventions.<sup>28</sup> The OEP may be particularly advantageous in terms of compliance as it is a home-based program, enabling older adults living with pain and mobility limitations to more easily participate in physical activity and exercise.<sup>3</sup> This is helpful as older people living with pain express strong wishes to be more physically active despite struggling with their pain,<sup>3</sup> and can in turn assist with the prevention of falls and other negative consequences associated with pain and falls in older adults.<sup>17,22</sup>

Our study is particularly strong as it included a well-defined population of community-dwelling older adults. In addition, the study population seems to be representative of the target population with regard to age, sex, and fall frequency, which points to the external validity of the study. However, comparing our results to those of other similar studies on exercise proved to be difficult. Although Hasegawa et al<sup>29</sup> had similar results in their study, their exercise program consisted of balance and lower body resistance exercises 3 times per week. Cederbom et al<sup>30</sup> also showed in a feasibility study that older women living with chronic musculoskeletal pain and who were dependent on support to manage their everyday lives could improve their physical activity level and management of daily life activities following a 12-week behavioral medicine-based intervention. However, improvement regarding pain severity and pain-related disability could not be shown. Assuming that the present study is the first to investigate the effect of the OEP on pain, our results are even more important as they provide novel insights in this specific research area.

Despite these insights, there are some potential limitations to consider. It could be argued that our combination of two different intervention groups (OEP alone and OEP with MI intervention) may have affected our analyses. However, since no significant differences were reported between these groups,<sup>22</sup> we recognized that a merged group would provide more rigorous data for analysis. The small sample size could also be viewed as a limitation to our study. Nevertheless, the knowledge that our study provides can be used in future studies to further explore the use of the OEP in preventing and reducing pain and pain-related disability in community-dwelling older adults. Finally, the measurement of pain could have been performed using more specific methods; however, the EQ-5D is commonly used both clinically and in research to assess health-related quality of life in the target population.

## Conclusion

The results of this study indicate that performance of OEP-based exercises can reduce pain in community-dwelling older adults in both the short and long term. As such, the OEP could be a suitable evidence- and home-based program for both pain management and fall prevention in the target population who are at a higher risk of falls. Similar studies with a larger sample size are warranted to better understand the effects of OEP-based exercises on pain.

## Data availability

Raw data are available from Dr Marina Arkkukangas at [marina.arkkukangas@fou.sormland.se](mailto:marina.arkkukangas@fou.sormland.se) upon request.

## Disclosure

The authors declare that there are no conflicts of interest.

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