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Original Article

The Feasibilty of the Motor Control Home Ergonomics Elderlies' Prevention of Falls (McHeELP) Programme in Patients with Sarcopenia: A Pilot Study

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Abstract

Objectives: The objective of this pilot study was to investigate the feasibility of a three month 'Motor control Home ergonomics Elderlies' Prevention of falls' (McHeELP) programme on muscle mass, muscle strength, functionality, balance and fear of falling among older adults with sarcopenia. **Methods**: A feasibility study of the McHeELP programme was performed in patients with sarcopenia. Primary outcome measures included number of participants; number of participants that showed engagement with the programme; adherence rates; data loss in questionnaires and secondary outcome measures; any adverse events, related or not to the intervention programme. All participants received a home-based motor control exercise programme combined with an ergonomic home modification for 12 weeks. Secondary outcome measures included Hand Grip Strength, Bioimpendance Analysis, Muscle Mass, Functionality and Fear of Falling. **Results**: Twelve participants, (74.9±5 years), completed the pilot study. Significant differences were recorded before and after the programme on participants' functionality ($p < 0.001$), balance ($p < 0.05$) and fear of falling ($p < 0.001$). **Conclusions**:The present study revealed that the McHeELP programme is fesasible and that it is possible to implement the programme in clinical practice. The McHeELP programme positively affects functionality, balance and fear of falling. Thus, it seems feasible to conduct a full-scale randomised controlled trial.

Keywords: Ergonomics, Exercises, Falls, Motor control, Sarcopenia

Introduction

Sarcopenia is a muscle disease with low muscle quantity and quality[1]. Mitochondrial dysfunction, chronic inflammation, nutritional deficiences, and inactivity are factors which may contribute to sarcopenia progression[2]. Sarcopenia is associated with declines in functionality, a higher rate of falls, frailty, hospitalizations, fractures, decreased quality of life, physical disability and mortality. Among these adverse outcomes, falls are a leading cause of mortality in older adults[1,3,4].

Evidence shows that sarcopenia is associated with significant adverse health outcomes and therefore optimal care for people with sarcopenia is important. Developing novel therapeutic strategies, including pharmacological interventions to treat sarcopenia, is highly prevalent[5]. Evidence shows that therapeutic strategies for sarcopenia should include physical exercise, nutritional interventions and nutraceuticals (amino acids, vitamins supplements or mixed compounds)[2,6]. Exercise interventions are the first-line approach in managing older adults with sarcopenia[5].

The authors have no conflict of interest.

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Domains	Exercises
Warm up	Ankle heel toe, Figure of eight shoulder exercises, Free knee extension-flexion, Knee raises.
Serial skills	Heel shin sliding, Sit to stand with or without support, Leg to target, Leg to 2 targets (porgressively to 5 targets), Scroll ball, Toe towel, Rhythmic feet tapping 1 to 1 (progressively 2 to 1, 3 to 1), Knee raises to target (stick), Obstacle cross on the side.
Cognitive skills	Rhythmic feet movements while singing, Knee extension with fruits spelling or counting or Reciting categories of flowers, animals etc, Side lunge holding and fixating a glass.
Balance	Sitting position-Functional reach, Sitting position-Tandem balance, Lean forward & sideling with stick support, Lean and rotate trunk, Holding and fixating a raised ball (with width feet base or narrow base), Trunk forwards or sideward or backwards the wall.
Sensory strategy	Sitting position-Raised arms holding and fixating a ball towards and away from the eyes Standin position-Facing the wall corner-alternative turning to color targets placed sideways. Sittin position-Facing a wall corner, palm placing on the wall alternative placing palms on the target). Knee raises with closed eyes. closed eyes and leg to 1 target (progressively with closed eyes and counting).
Dynamic control	Sit to stand with or without support, (progressively stand pushing thighs). Foot placement on a stair with or without support, Standing position-Ankle raises with or without support, Sitting position-Reaching the sealing, Imaginery crossing obtacles forward, sideways.

Table 1. McHeELP exercises.

In particular, resistance training and aerobic exercise have been proposed for sarcopenia treatment 6-8 because they can improve muscle strength and physical performance[5]. However, because sarcopenic people report a higher risk of falls compared to non-sarcopenic, studies are needed to evaluate specific interventions for prevention of falls and fractures in patients with sarcopenia[9,10].

Motor Control Home Ergonomics Elderlies' Prevention of Falls" (McHeELP) is a motor control exercise programme combined with ergonomic arrangements of the home environment (e.g lighting, moving furnishings to create clear path etc). Developing motor skills in older adults involves movements patterns interacting with different body systems (eg. sensory)[11]. In addition, movement control is of a bewildering complexity that requires the interaction between many brain areas to accomplish goal-directed behavior[12]. It well known that aging and chronic deiseases susch as sacopenia is associated with loss motor abilities and motor skills[13]. Therefore, people with coordination, balance and gait difficulties may need motor control exercises to improve fall risk[14].

Results from two previously published studies regarding the McHeELP programme provided encouraging evidence that McHeELP programme may increase functionality and decrease fear of falling (FoF) in community-dwelling older people[14,15]. However, additional research is required in order to investigate the potential success of McHeELP programme with a different population than community-dwelling older people. In addition researchers will investigate acceptability of the programme; how sarcopenic patients will react to the intervention. Thus, this study aimed to investigate the feasibility and acceptability[5,16], of a three-month McHeELP program in patients with sarcopenia living in the community.

Materials and Methods

Participants

Patients with sarcopenia enrolled in this pilot study. All participants were recruited from a private orthopaedic clinic in Achaia county, mainland in Western Greece. Every older adult presenting to a private orthopaedic clinic meeting eligibility criteria, was invited to participate in the feasibility assessment. Inclusion criteria for enrolment included patients aged 65 years and above who were diagnosed with probable sarcopenia, sarcopenia, or severe sarcopenia living in community. Sarcopenia was defined according to the criteria reported by the European Working Group of Sarcopenia in Older People (EWGSOP2)[1]. Exclusion criteria included: (i) cognitive impairment (Mini Mental Scale), (ii) a medical problem that could affect the ability to complete physiotherapy assessment or exercise intervention, (iii) cardiovascular diseases or high blood pressure not controlled with medication (iv) concurrent participation in an exercise programme (within last 3 months), v) body mass index (BMI) > 50, vi) participants suffering from a vision or vestibular problem.

The concept of McHeELP programme

The Motor control Home ergonomics Elderlies' Prevention of falls (McHeELP programme) includes a package of motor control exercises for the lower limb, which are divided into six domains, namely: "Warm-up",

"Serial skills", "Cognitive skills", "Balance", "Sensory strategy", and "Dynamic control"[11].

Intervention

Exercise programme

Participants received a 3-month individual home-based exercise programme for motor control of the lower extremities. The exercise programme includes a package of exercises divided into six domains. The first domain includes warm-exercises and the other five domains includes motor control exercises (Table 1). Each exercise session included 12 exercises chosen from all domains. The duration of each session is 20-30 minutes. The methodology protocol has been previously published[11]. The physiotherapists evaluated the functional level of the individual, based on the initial outcomes measures (Tandem test, Timed Up and Go test), so to prescribe the optimal exercises for the individual from the McHeELP package[11].

Each participant received a detailed booklet outlining the programme's exercises and was instructed to perform the McHeELP exercises for 3 months within their range of motion, 3 times per week. They started with low-load motor control exercises and continued to a gradually increased level of difficulty. The intensity of exercises was low to moderate (based on talk test). The same healthcare professional, a well-trained and highly-experienced geriatric physiotherapist, delivered the McHeELP exercise programme. The physiotherapist visited each participant at home and instructed him/her on performing each exercise safely. He also revisited three times in order to adjust the exercise protocol, as required progressively. The physiotherapist determined progression of each exercise based on the functional level, the fatigue and the patient's capabilities[14-16]. Regarding progression the physiotherapist changed the position (from standing to sitting), the support and the repetitions of each exercise (first stage: 1set x10 repetitions; second stage: 2 sets x10 repetitions; third stage: 3 sets x10 repetitions). Gradually the exercises of the programme requires more stability, balance and concentration[11]. The geriatric physiotherapist also made four telephone calls over 12 weeks to ensure exercise adherence and compliance[16]. In addition, older sarcopenic adults were asked to keep an exercise diary and record the days they completed the exercises.

Ergonomic intervention

All participants received a booklet with essential advice and tips on modifying the interior and exterior of their home environment (kitchen, bedroom, living room, bathroom and stairs) according to improved ergonomic standards. The adjustments had low cost (e.g. removing carpets with loose/deep piles, moving furnishing to clear space, replacing lamps with insufficient lighting). During the three home visits by the physiotherapist, each participant was reminded to make these modifications[11,15].

Outcome measures

All outcome measures were collected at the participants home environment.

Primary outcomes

The primary outcomes were: number of participants that provided data at 12 weeks; number of participants that showed engagement with the McHeELP programme; adherence rates; data loss in questionnaires; patient satisfaction and secondary outcome measures; any adverse events, falls, major changes in health and healthcare use, related or not to the McHeELP intervention programme.

Adherence was calculated as a percentage by dividing the number of completed exercise sessions by the number of scheduled exercise sessions. High adherence was defined as completing >75%, medium adherence as completing 50–74%, and poor adherence as completing <50% of exercises sessions[17,18]. All information was gathered by the physiotherapist.

All participants were assessed at baseline and immediately post-intervention (week 12). Measures included a data collection consultation, muscle strength and body composition assessments, physical function tests, and balance and fear of falling assessments. After the 12 weeks all participants answered 2 questions: i) Did you find the programme easy? ii) Do you feel safe during the assessment procedure? In addition, patients were asked to report any adverse events.

Data collection consultation

Each participant was interviewed to assess comorbidities, medication use, and history of falls. Participants also completed a Mental State Examination (MMSE) questionnaire to evaluate their cognitive function. MMSE is a 30-point and has been validated and extensively used in clinical practice and research[19].

Secondary outcome measures

Muscle strength assessment. Handgrip strength (HGS) was measured using a standard hydraulic hand dynamometer (Saehan, Seoul, Korea). HGS was performed for each patient's dominant hand. For HGS assessment, participants were seated in a standard 45 cm height chair with a back and no armrest. The participant has the elbow of the dominant hand flexed at 90° and squeezes the dynamometer as hard as possible[16]. According to EWGSOP2, the cut-off thresholds for handgrip strength are 16 kilograms (kg) for women and 26 kg for men[1].

Fear of Falling (FoF). The Greek version of the Falls Self-efficacy International Scale (FES-I_GREEK) was used to evaluate FoF[20]. FES-I, a 16-item questionnaire with scores ranging from 16 to 64 points. Higher scores indicate higher fear and concern regarding falls.

Functional Assessment/Physical Performance. Function was assessed using the Timed Up and Go test (TUG).

The TUG measures the time (in seconds) a person rises from a chair, walks 3 meters (at their usual pace), turns around 180 degrees, walks back, and sits down in the chair[19].

BMI Assessment. Height was measured with a wall stadiometer. For the measurement, participants removed their shoes. Body mass index (BMI) was calculated by dividing weight in kilograms by height in meters squared (kg/m^2)[16].

Body Composition Assessment. Bioelectrical impedance analysis (BIA) (Tanita BC-60) was used to measure body composition and muscle mass. Each participant stood barefoot on two metallic electrodes on the floor scale and held two metallic grip electrodes. The measurement takes only a few minutes. Skeletal muscle mass (SMM) was calculated by the following equation: SMM (kg) = 0.566 × FFM. Skeletal muscle mass index (SMMI) was calculated as skeletal muscle mass (kg)/height squared[16,22]. According to EWGSOP2, the cut-off thresholds for skeletal muscle mass indices were set at 7.23 kg/m^2 and 5.67 kg/m^2 in males and females, respectively[1].

Balance assessment. A tandem stance test (heel-toe) was performed for balance assessment. Participants placed one foot immediately in front of the other (tandem heel-to-toe position). Their arms were down by their side. The patient was trying to maintain balance for 30 seconds while standing in this position[23]. The tandem stance test was recorded in seconds.

Statistical analysis

This study was a feasibility study, so no formal power calculation was conducted[24]. The descriptive characteristics of secondary outcomes were presented as mean and standard deviation for numeric variables and as percentages for nominal/categorical variables. T-test was used for measurement differences pre- and post-intervention. The differences in proportions and means were measured with a significance level of 0.05. SPSS 26.0 was used for the statistical analysis.

Results

Feasibility and accessibility outcomes

Recruitment and Participants characteristics

18 patients were recruited and 6 declined to participate. Twelve participants (recruitment rate 66.7%), 4 men and 8 women with a mean age of 74.9±5 years, completed the study. No dropouts were recorded. Participants' characteristics at baseline are shown in Table 2.

Based on the results of the handgrip test, TUG and the BIA measurements, 10 participants were categorized as having sarcopenia and two as having severe sarcopenia. MMSE scores for all participants were between 28–30.

Adherence

Records from the participants' exercise diaries were used for adherence. Six participants (50%) showed 100% engagement with the McHeELP programme using diaries documentation (adherence). The other 6 showed 75% adherence rate; showing high adherence .

Characteristics	
Mean and SD	
Age (years)	74.9±5
BMI	26.3±4.8
Drugs (number)	4.1±1.1
Comorbidities (number)	4.3±1.2
Number and percentage	
Smoking Yes	2 (16.7%)
Previous falls Yes	9 (75%)

BMI: Body mass Index

Table 2. Participants' characteristics.

Data Loss in Questionnaires and Tests; Time Taken

There were not any missing data on the outcome measures. Assessment of secondary outcomes took approximately 50-60 min. All the assessments were performed in one contact.

Adverse Events

There were no adverse events associated with the McHeELP programme. No falls were reported as being related to the time period of the intervention.

Secondary outcomes

Patients with sarcopenia had significant improvement in 3 out of 5 variables after the McHEeLP programme. Comparison between pre- and post-intervention showed that the McHeELP programme significantly improved the functionality, balance and fear of falling. Post-intervention, participants improved muscle mass and HGS, but these were not statistically significant (Table 3).

In terms of ergonomic interventions, all participants removed rugs and small objects on the floor. Tables were fixed firmly to the floor. Two patients placed a grab-bar and a handle on the door.

Discussion

This study aimed to evaluate the feasibility and acceptability of the McHeELP programme in older adults with sarcopenia. Results provides evidence that the intervention was acceptable since the participants had high adherence and benefits regarding perceived value of the intervention were high with no serious harms. There has been extensive

Variable	Pre-intervention	Post-intervention	95% CI	P- value
HGS (kg)	16.7±3.6	17.8±1	-1.4 – 0.12	0.06
SMMI	5.8±0.8	5.84±0.6	-.22 – 0.15	0.3
TUG (sec)	12.9±4.6	9±1.2	3.3-4.21	p≤0.001**
Tandem (sec)	21.5 ±3.9	27±0.2	-0.8-0.5	p≤0.001**
FES-I	27.8±7	24.5±5.7	1.5-4.9	p≤0.001**

*HGS: Hand Grip Test; SMMI: Skeletal Muscle Mass Index; TUG: Timed Up and Go test; FES-I: Fear of Falling; 95% CI: 95% Confidence Interval. **highly significant differences*

Table 3. Post intervention results.

research into structured exercise programmes for older people with sarcopenia[15,24-26]. A feasibility or pilot trial is ideal for assessing whether participants will adhere to an intervention and may also explore factors that influence adherence, including intervention type and setting. In this study exercise adherence rates were recorded high to most patients. Sarcopenic participants required to understand and execute exercises at their home environment. An advantage of home based exercise interventions is that patients do not involve the planning of transportation or scheduling difficulties[27]. In addition, in the present study telephone calls made by the physiotherapist and the use of diaries may helped exercise adherence.

Regarding harms, are harmful or undesirable outcomes that occur during or after the use of the intervention but are not necessarily caused by it (e.g. inpatient hospitalization). Non adverse events were registered in any patient during the McHeELP programme.

Results also suggests that older people with sarcopenia can safely and effectively participate in an individualized home-based programme with motor control exercises. Sarcopenia has several adverse outcomes, including falls and secondary fractures[29]. Sarcopenia also affects balance and FoF[30] with a significant negative impact on functionality[31]. This study showed that motor control exercises for lower limbs may help patients with sarcopenia to improve functionality. Results show that the McHeELP programme improved TUG. However the sample was small, indicating the need for a new research study with a large sample of patients. Physical performance and functionality is a strong outcome regarding severity of sarcopenia[1]. The findings of this study suggest that the McHeELP programme may minimize severity of sarcopenia by improving functionality.

To our knowledge, this is the first study evaluating the McHeELP programme in older adults with sarcopenia. Although exercise is a key intervention for older adults with sarcopenia[7,8] research findings on fall prevention regarding motor control exercises in these patients are limited. Motor performance deficits in older adults include difficulty in coordination and movement, balance and gait difficulties[14,31,32]. Motor control can improve balance and gait and may reduce the risk of traumatic injuries in older adults. The McHeELP programme follows the principles of specificity training in that it is based on exercises targeting various systems for balance control[14].

FoF is considered an important outcome measure for fall prevention and management[20]. Persons with FoF reduces physical activity and participate less in functional programmes. FoF is also assciated with less walking and falls[33-35]. It seems important to develop strategies in order to reduce fear, improve dependency and functionality and increase confidence[33]. For people who are fearful of falling it may be beneficial to include in their interventions daily functional tasks[34]. Motor control exercises include functional tasks and results of the present study showed that motor control exercises of the lower limb may decrease FoF in patients with sarcopenia.

Several interventions have been shown to reduce fear of falling[35,36] and results of the present study are in accordance with previous studies[14,15] in community older adults. Previous research studies showed that the McHeELP programme can improve functional capacity and balance in community-dwelling older adults[14,15].

Unsurprisingly, no statistically significant improvement was found post-intervention regarding muscle mass. Researchers suggest that muscle mass requires resistance training to increase muscle mass and strength. Exercise training, including endurance and resistance exercise, stimulates mitochondrial biogenesis[7,34]. More research is needed to understand the optimal type and amount of exercise required to improve muscle health in people with sarcopenia. One suggestion may be to combine resistance training with motor control exercises for older adults.

In addition, since most falls may occur at home, home-safety interventions also have a role in preventing these incidents[16]. Ergonomic interventions can help prevent indoor elderly falls. The home environment of older adults seems to be an essential factor leading to falls, as it often contains various unsuspected by elderly risks, such as slippery floors, poor space ergonomics, or inadequate lighting[37]. In this

study, minimal and inexpensive modifications have been implemented so that all patients have the possibility to apply them. Home assessment and modification education is important to maintain safety and contribute to fall prevention and fall-related injuries[38].

A critical factor in this study is that the exercise was perfomed at the patients' home environment. Home-based exercise and physical activity programmes may be an attractive solution for maintaining physical activity when home confinement is necessary[39]. In recent years, home-based programmes have received increasing attention in older adults. Several home-based exercise programmes have been proposed including low-intensity balance and muscle-strengthening exercises. The main advantage of the McHeELP programme is that it is semi-supervised. Research suggests that unsupervised programs were less effective than supervised programs[40]. One explanation could be a higher quality in the execution of exercises due to supervision. Especially the balance exercises seem to be affected by the supervision[40]. Therefore, in the present study exercise diaries, home visits and telephone calls by the physiotherapist may help the adherence and compliance of the participant[16]. In addition, the booklet of exercises highlights the correct movement execution and therefore is recommended[41]. One more possible advantage of the McHeELP programme is the ability to provide a well-structured exercise programme without added special and expensive equipment or technology expenditures[11,14-15].

Strengths and limitations

Results of this clinical study may be valuable and important to clinical practice for health professionals working with adults with sarcopenia. Motor control exercises combined with minor ergonomic home modifications may protect older adults' risk of falling. In addition the McHeELP programme increased functionality which is a main factor for sarcopenia severity[1].

There are significant limitations that must be mentioned. Firstly, the limited number of patients with sarcopenia enrolled in the study and the lack of a comparison group. It would be interesting in the future through a control group to investigate factors such as fear of falling. Further research is needed in larger patient samples in order to understand the effects of this targeted exercise program on various parameters. Secondly, whether the observed post-intervention improvements will be maintained over time is unclear. Feasibility studies are relied on to produce a set of findings that help determine whether an intervention should be recommended for efficacy testing[42]. A study with more patients, a control group and a follow-up is also needed. For all these reasons designing new studies on sarcopenia are needed.

Conclusions

This study in patients with sarcopenia suggest that the McHeELP programme is feasible. Results has also showed a positive effect in managing functionality and FoF in patients with sarcopenia. Data gathered can power a well-designed study.

Ethics approval

Ethical approval was obtained from the University of Patras Ethics Committee (13/12/2022, n.14898).

Consent to participate

Each participant signed an informed consent form before the inclusion.

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