

Original Article

Feasibility of a novel Judo4Balance – fall preventive exercise programme targeting community-dwelling older adults

Marina Arkkukangas^{1,2,3}, Karin Strömqvist Bååthe⁴, Julia Hamilton⁵, Anna Ekholm¹, Michail Tonkonogi⁴

¹Research and Development in Sörmland, Sweden; ²Department of Physiotherapy, School of Health, Care and Social Welfare, Mälardalen University, Västerås, Sweden; ³Department of Neuroscience, Physiotherapy, Uppsala University, Uppsala, Sweden; ⁴School of Education, Health and Social Studies, Department of Medicine, Sport and Fitness Science, Högskolan Dalarna, Falun, Sweden; ⁵Sabbatsbergs Department of Geriatric Medicine, Region Stockholm, Stockholm, Sweden

Abstract

Objectives: It is of utmost importance to investigate risk factors for falls and learning techniques for falling safely. Therefore, the aim of this study was to assess the feasibility of a novel judo-inspired exercise intervention for community-dwelling older adults. **Methods:** We included 28 participants, 60–88 years of age, in this study. In three different settings, the feasibility of carrying out a full-scale study was evaluated by the following: the study process, resource management and scientific aspects. The outcome measures evaluated were physical performance, fall related self-efficacy and fall techniques (backwards and forwards) among the older adults. **Results:** The intervention was judged to be feasible in the different settings used in this study. Some changes regarding duration of the intervention were suggested as being important. Significant improvements were seen in the selected outcome measures, physical performance ($p=.030$) and fall techniques ($p<.001$). A corresponding difference was not found for fall related self-efficacy ($p=.113$). **Conclusions:** This study confirms the judo inspired exercise programme, Judo4Balance, to be a feasible intervention for active older adults. This study will provide a safe and thoroughly planned protocol for the planned study and provides indication of appropriate setting depending on the target group.

Keywords: Older adults, Exercise, Fall accidents, Fall injury, Self-efficacy

Introduction

Falls are by far the most common injury sustained by older adults and in most countries around the world older people have highest death rates arising from a fall^{1,2}. An individual's fall risk is highly dependent on the number of risk factors, and both the least active and the most active older adults have an increased risk of having a fall^{3,4}.

Some of the physiological functions of the body that might be weakened due to ageing and inactivity are muscle and balance functions⁵. It is well documented that a combination of these factors increases the risk of falling^{6,7}. Low falls self-efficacy has been associated with the reduction and avoidance of activities. This means in turn that inactivity limits daily activities, decreasing physical functioning and falls self-efficacy⁸. This shows the importance of including actions aiming to strengthen fall-related self-efficacy in fall prevention interventions.

Most fall prevention programmes, which include balance and strength training in order to reduce fall risk, rarely

contain components of fall self-management such as getting up and down from the floor and a safe falling strategy in different directions⁹⁻¹¹. However, these actions have been suggested as being important for inclusion in fall prevention programmes, and some available evidence on getting up from the floor is presented and suggested to potentially decrease the fear of falling¹².

To address known aspects of strength, balance and learning to get up and down from the floor safely, a specific

The authors have no conflict of interest.

Corresponding author: Marina Arkkukangas, Research and Development in Sörmland, Drottninggatan 16B, 63217, Eskilstuna Sweden

E-mail: marina.arkkukangas@fou.sormland.se

Edited by: Dawn Skelton

Accepted 6 July 2020

judo inspired exercise programme has been developed called Judo4Balance. A team of medical professionals also holding a black belt in judo developed the programme. The choice of using judo as an inspiration for the programme was because of the components balance, strength and landing strategies used in judo, which are also important components in fall prevention programmes¹³⁻¹⁵. To our knowledge, Judo4Balance is the only investigated exercise programme for this age group aimed at preventing falls, including both strength and balance exercises as well as safe falling strategies/techniques.

In addition, research have shown that adherence/attendance rates in exercise programmes are higher when exercise is provided on a group level, held in a local facility and supervised¹⁶. Therefore, in this study, the group-based intervention took place in three different settings: a district healthcare centre, workplace setting and in a local community judo club's facility.

The aim of this feasibility study was to assess the feasibility of an intervention including a judo-inspired exercise programme, Judo4Balance. Feasibility will be addressed by evaluating: A) the study process, resources, management and scientific aspects and B) the effects of the intervention programme on physical performance, fall related self-efficacy and falling techniques.

Methods

The design of this study was a descriptive feasibility investigation of a larger planned trial. The checklist of pilot studies from Thabane et al was used with focus on feasibility¹⁷.

Participants and recruitment

This study aimed to include three small groups of participants since the highly challenging exercise program needed close monitoring and support. A thumb rule of including 12 participants per group in pilot studies have been suggested¹⁸. A total of 28 available participants accepted participation in this feasibility study during the recruitment period September 2018 to May 2019. Older adults over 60 years of age were asked to participate and each participant was provided a written informed consent form before participating. The participants received no compensation for participating in the study.

Inclusion criteria were being over 60 years of age, ability to understand written and verbal Swedish language, and being mobile.

This study covers three different locations for recruitment to the present study, and the intervention was 10–16 weeks depending on the setting and participants.

Local Health Care Centre (n=11). A convenience sample was used performed at a local healthcare centre, which recruited patients who were referred to the 16-week training programme by physiotherapists for pilot testing. This programme was extended in time from 10-weeks due to

uncertainty of how much time was needed to build strength and balance as well as to learn the falling techniques. The exercise programme was led by a physiotherapist, with a black belt in judo working at the health clinic.

Local Judo Club (n=7). Participants were recruited by advertising in social media. The intervention lasted 15 weeks.

Older adults (+60 years and still working age) at workplace (n=10). A convenience sample was used at a workplace setting, where the 10-week intervention was introduced.

Intervention

A total of two test leaders (judo instructors) performed all the measurements in the study and a total of six judo instructors, including the two test leaders, led the exercise program, in pairs of two for each one of the three locations. All judo instructors had a black belt in judo and a specific education in teaching the Judo4balance programme to the older adults.

All sessions in the intervention involved strength, balance training, rising from the floor and falling technique. Participants trained for 45–60 minutes, once a week for 10–16 weeks, depending on the setting. However, the Judo4Balance exercise was provided according to the three-block progression of the programme and the only difference was the number of sessions. Strength training included simple functional exercises focusing on the legs and core. Balance training contained dynamic exercises focusing on different subsystems and dual tasks. Getting up and down from the floor exercises were repeated during each workout from both abdominal and back positions. Techniques for falling backward, sideways and forward were taught according to the programme's progression plan.

The progression can be described in three main blocks.

- 1) Practicing basic falling techniques (e.g. getting up and down from the floor) and strength exercises; body awareness; mobility training; building up load resistance in muscles, tendons, joints and skeletons as well as exercises to train balance by performing movements that are not usually carried out in everyday life activities.
- 2) Continuing falling techniques and strength exercises; increasing load in strength exercises; challenging balance and coordination ability; greater range of movements in exercises, possibly power in exercises; continuing to build up load resistance in muscles, tendons, joints, and skeletons.
- 3) Training in ability to develop power (fast power); power in strength exercises; more advanced training in fall techniques; challenging one's balance, coordination, and dual tasks with increased difficulty.

Measurements

Feasibility was measured by close monitoring and evaluating the feasibility by; A) process, resources,

Setting	Health Care Centre (16-weeks)	Judo facility (15-weeks)	Workplace (10-weeks)
Age (mean)	74	71	63
Women/men	11/0	7/0	6/4
Sample size	11	7	10
Dropouts	4	3	-
Adverse adverts	0	0	0
Exercise sessions (mean)	13.7	10.5	8.0
Intervention	16-weeks	15-weeks	10-weeks

Table 1. Overall description of the intervention.

management and scientific aspects 17 and B) the effects of the intervention on physical performance, falls self-efficacy and techniques for falling safely.

A) Process, resources, management and scientific aspects

Process

Overall, the process aspect deals with feasibility of the processes that are key to the success of the main study, including recruitment rates and dropouts.

Resources

This aspect evaluates the steps that need to take place as part of the main study, including assessing time and resource problems that can occur during the main study.

Management

Management mainly deals with feasibility of the location, in this case three different locations for performing the intervention: a) local healthcare centre, b) local Judo Club, c) older adults (+60 years) at workplace setting.

Scientific

This aspect covers, among other topics, the safety of the intervention and identifying suitable target group.

B) Effect measures

Outcomes for physical performance and fall-related self-efficacy and fall techniques were collected using the following measures:

Short Physical Performance Battery (SPPB)¹⁹ was used to assess the physical performance in the lower extremities and includes strength, balance and walking items. The scale scores range from 0 to 12 points. A total score of 12 represents the best performance. The SPPB has shown to predict the risk of falls in adults over the age of 60. The test has shown good test-retest reliability^{20,21}.

Falls Efficacy Scale-Swedish version (FES-S)²² was used to measure the self-confidence in the ability to perform various daily activities without falling. The instrument consists of 13 items. Each item is rated from 0 to 10, with a maximum score of 130 points, which represents

the highest level of self-efficacy. FES-S has been shown to have high test-retest reliability²³.

Since there are no previously known tests for the evaluation of fall techniques, two tests have been developed to test the acquired skills for falling backwards as well as falling forwards in a safe setting, with progressive difficulty. These tests are also planned to be further validated in a future planned study. The tests were graded on a 0–4 scale.

Falling backwards: The person is asked to lay down on his/her back on the mat, lift the head up from the mat and to stand up again. If successful, he/she scores one point.

The next step is to sit up on the mat on one's buttocks and fall backwards. If successful, he/she scores two points. The next step is to fall backwards safely from a squatting position (three points), and the final step is to fall safely from a standing position, which results in four points if done correctly.

Falling Forwards: A similar progression is made for the forward breakfall strategies: laying on the stomach, falling from the knees, a squatting position, and falling from a standing position (rolling or "cat breakfall") without any harmful manoeuvres equals four points.

Statistics

The feasibility was analysed using descriptive statistics, and the data were presented as frequencies, means, medians, min–max and percentages. For the outcome measures, non-parametric methods were used for all the measurements. To test the difference between the baseline and the follow-up, Wilcoxon Signed Ranks Test was used (two related samples). Two-tailed p-values were used with a critical significance level of 0.05.

The analyses were performed using the statistical programme SPSS 22.0 for Windows (SPSS Inc., Chicago, IL).

Ethics

The study was conducted in accordance with the Declaration of Helsinki and was approved by the Ethical Committee of the Uppsala Region (Dnr 2018/239).

Outcomes	Median (pre) (min- max)	Median (post) (min-max)	Proportions of participants that improved	P-value
FES-S (0–130)	120 (94-130)	127 (86-130)	51 %	.133
SPPB (0–12)	11 (6-12)	11 (8-12)	38 %	.030
Fall techniques backward (0–4)	1 (0-4)	4 (0-4)	71 %	< .001
Fall techniques forward (0–4)	1 (0-2)	2 (0-4)	75 %	< .001

Note FES-S= Falls efficacy scale-Swedish version, SPPB= Short Physical Performance Battery; bold figures indicate a significant value ≤ 0.05 .

Table 2. Medians, proportions and results from the Wilcoxon rank sum test for all measurements (n=21).

Results

The results are presented according to feasibility measures and outcome measures used in the study. The overall description of the intervention is presented in Table 1.

Feasibility measures

A) process, resources, management and scientific aspects and B) effects of the intervention on physical performance, fall related self-efficacy and techniques for falling safely.

Process

A total of 28 older adults participated in the intervention at the three different settings. A total of 21 participants completed follow-up measures. The two main reasons for not attending for the follow-up tests were ill health and being out of town. A total of 25% dropouts was also judged to be acceptable for the study.

Resources

The estimated time to complete the assessments was 45 minutes per participant, and all measurements were judged to be appropriate for evaluating the outcomes. The transportation of the puzzle crash mats was time consuming and judged to be a bit inconvenient, except in the local judo club setting where the mats were already permanently on the floor.

Management

Local Health Care Centre

Since this group was already in contact with health care professionals for various health related problems it was assumed that this group needed more support to progress during the exercise program. Therefore, the longer intervention of 16 weeks performed at the healthcare centre that was in the original plan deemed the most suitable. However, it was determined that the length of the 16-week training provided at the local healthcare centre could be reduced in the future study by four weeks and still provide effective training because of the progress made among the participants in each session. A total of seven women completed the follow-up measures.

Local Judo Club

Interest for participating in this type of training provided at the local judo club was high among the older adults, especially among the more active and healthy older adults. However, this group was the smallest group due to inconvenience in time to participate in the testing. General information and social media campaigns seem to be working to attract participants. Despite the small group included in this study, a long waiting list of interested older adults was registered at the local judo club. It was determined that the length of the 15-week training at the local judo club could be reduced by three weeks and still achieve effective training. The availability of study equipment was judged to be a huge advantage for feasibility. A total of four women completed the follow-up measures

Older adults (+60 years) at workplace

A total of 10 older adults participated in the Judo4Balance programme at the workplace for 10 weeks. This setting was deemed to be appropriate when targeting a broader age group; however, the number of adults over age 60 is limited at one single workplace.

Scientific Aspects

The need of closely supervising during the exercise in the group visiting health care, and the use of local healthcare centre for the Judo4Balance training group seems the most viable option. These groups are also more dependent on well trained group leaders and need other inclusion criteria than in this study. However, no injury was reported during the actual training sessions in any of the groups. Overall, some natural reasons for not completing the programme because of injury or illness were noted. Reason for non-attendance at follow-up (n=7) was being out of town (n=3) and illness (n=4); therefore, it was suggested to plan for scheduling follow-ups immediately post intervention to ensure not losing measures because of travelling as well as giving the possibility to schedule a second follow up session if the illness is just temporary at the first schedule follow up date.

Outcome measures

The primary outcomes are displayed in Table 2. Significant improvements were seen in all measures except for FES-S, see Table 2. Proportions of participants who improved are presented in Table 2, and all measures displayed improvements at follow-up: SPPB by 38%, FES-S by 51% and fall techniques were improved among the participants by 71% for fall techniques backward and 75% forward, n=21.

Discussion

A challenge when planning novel interventions is feasibility of the planned intervention¹⁷. This study focused on the study process, resources, management and scientific aspects as well as getting an indication of the effects on physical performance, fall-related self-efficacy and fall techniques among the participating older adults.

In this study, the different settings showed valuable information about pros and cons for planning the set up for the study. The most time effective setting was at the local judo setting. Advantages of using the local judo setting included availability of judo instructors and transportation of equipment needed for the exercise sessions. However, this was the smallest group included in this study; nonetheless, many older adults expressed an interest in participating in the study but due to time constraints were not tested in this pilot study. The participants had different conditions for participation. Discussions in the research group were that at the healthcare centre the participants needed more supervision and were deemed to be more fragile.

The risk of falling among men and women in the age range of 55-65 at the workplace have been reported to be 1.8-2.5 times higher compared to their counterparts in their 20s²⁴. Since falling among older adults is associated both with functional decline and higher fall risk at work, preventive efforts at the workplace should be addressed²⁴. In addition, facilitators in a workplace setting such as social influence and the environmental context have previously shown to be important for engaging employees in physical activity²⁵. However, at the workplace, the participants are depending on the employer to gain approval for participation, and the age group over 60 is expected to be limited at each workplace when planning for a larger study at work.

The length of the intervention was also discussed, and a time period of 12 weeks was suggested to be appropriate since the supervision, instructions and the simplicity of the programme were judged to be sufficient for learning in this study and also confirmed in previous research²⁶.

Adherence was acceptable, and previous research have shown that adherence is generally higher in supervised programmes than unsupervised¹⁶.

The impact of the intervention on suggested outcomes in this study, physical performance and fall techniques, was judged to be appropriate and showed significant improvements. Since decreased physical performance with age is known to be associated with the risk of future falls, this measure was of high interest to explore²⁷. Learning

techniques for falling were a novel approach and provided insight to the possibility of learning these techniques. Thus, these results are of great interest for further studies including the relationship with known physiological and psychological risk factors for falls. In addition, it is of great interest to study fall-related self-efficacy since there is a known association with risk of falls and fall-related injuries²⁸. The results on FES-S displayed no significant improvements in the analysis; however, over 50% of the participants showed improvements on the measure, which indicates there is a benefit in further exploring this measure in the larger planned study.

Limitations

Some limitations must be noted due to the variation in age, setting, intervention period and sample size. Also, the results of the outcome measures must be interpreted with caution and need to be further investigated in a larger randomised controlled trial. However, the results were deemed to serve a great purpose and will be used in the further planning of the upcoming study. There was no comparison to a control group in this feasibility study. However, since the exercise programme contains advanced exercise and falling techniques, the main interest was to explore the programme in a small group of active older adults prior to implementing a large-scale study,

Conclusions

This study confirms that the judo inspired exercise programme, Judo4Balance, is a feasible and accepted intervention for older active adults, and hence applicable in a larger planned study. This study will provide a safe and thoroughly planned protocol for the larger planned study. Important aspects of time, setting, adherence and safety will be considered in the future planning. Moreover, this study highlights the importance of performing feasibility studies prior to larger studies. In addition, the measures of physical performance and fall techniques indicate the effectiveness of these functions in the intervention. The measure of fall-related self-efficacy needs to be further investigated since the intervention had little or no impact on fall-related self-efficacy in this study. This study confirms the feasibility of the intervention and shows that a larger trial is needed to further validate our findings.

Funding

This work was supported by the AFA Insurance, a non-profit organisation owned by Sweden's labour market parties.

Authors' contributions

MA wrote the first draft of the manuscript and KSB, JH and MT especially contributed to drafting the introduction and results in manuscript. AE performed the statistical analysis in the manuscript. All authors have made a substantial contribution to the manuscript and have been involved in drafting the manuscript. All authors read and approved the final manuscript.

References

- World Health Organisation. WHO global report on falls prevention in older age. Geneva: World Health Organization; 2007.
- Hartholt KA, Lee R, Burns ER, van Beeck EF. Mortality From Falls Among US Adults Aged 75 Years or Older, 2000-2016 2019. *JAMA* 2019;321(21):2131-2133.
- Tinetti ME, Gordon C, Sogolow E, Lapin P, Bradley EH. Fall-Risk Evaluation and Management: Challenges in Adopting Geriatric Care Practices. *Gerontologist* 2006;46(6):717-725.
- Kelsey JL, Procter-Gray E, Hannan MT, Li W. Heterogeneity of Falls Among Older Adults: Implications for Public Health Prevention. *Am J Public Health* 2012;102(11):2149-2156.
- Gillespie LD, Robertson MC, Gillespie WJ, et al. Interventions for preventing falls in older people living in the community. *Cochrane Database Syst Rev* 2012.
- Nosraty L, Jylhä M, Raittila T, Lumme-Sandt K. Perceptions by the oldest old of successful aging, Vitality 90+ Study. *J Aging Stud* 2015;32:50-58.
- Rubenstein LZ. Falls in older people: epidemiology, risk factors and strategies for prevention. *Age Ageing* 2006;35:37-41.
- Jung H, Shin HH, Choi YW, Kim KM. The relationship between fall efficacy and activity level in older adults. *Phys Occup Ther Geriatr* 2015;33(1):53-63.
- Sherrington C, Fairhall NJ, Wallbank GK, Tiedemann A, Michaleff ZA, Howard K, Clemson L, Hopewell S, Lamb SE. Exercise for preventing falls in older people living in the community. *Cochrane Database of Systematic Reviews* 2019;1.
- Han L, Yang F. Strength or power, which is more important to prevent slip-related falls? *Hum Mov Sci* 2015;44:192-200.
- Skelton A, Dinan SM. Exercise for falls management: Rationale for an exercise programme aimed at reducing postural instability. *Physiotherapy Theory and Practice* 1999;15(2):105-120.
- Leonhardt R, Becker C, Groß M, et al. Impact of the backward chaining method on physical and psychological outcome measures in older adults at risk of falling: a systematic review. *Aging Clin Exp Res* 2020.
- Groen BE, Weerdesteijn V, Duysens JJ. Martial arts fall techniques decrease the impact forces at the hip during sideways falling. *Biomech* 2007;40(2):458-62.
- Agostinho MF, Philippe AG, Marcolino GS, Pereira ER, Busso T, Candau RB, Franchini E. Perceived training intensity and performance changes quantification in judo. *J Strength Cond Res* 2015;29(6):1570-7.
- Franchini E, Del Vecchio, FB, Matsushique, KA, and Artitoli, GG. Physiological profiles of elite judo athletes. *Sports Med* 2011;41:147-166.
- Lacroix A, Hortobágyi T, Beurskens R1, Granacher U. Effects of Supervised vs. Unsupervised Training Programs on Balance and Muscle Strength in Older Adults: A Systematic Review and Meta-Analysis. *Sports Med* 2017;47(11):2341-2361.
- Thabane L, Ma J, Chu R, et al. A tutorial on pilot studies: the what, why and how. *BMC Med Res Methodol* 2010;10:1
- Julious, S.A. Sample size of 12 per group rule of thumb for a pilot study. *Pharm Stat* 2005;4: 287-291.
- Guralnik JM, Simonsick EM, Ferrucci L, et al. A short physical performance battery assessing lower extremity function: association with self-reported disability and prediction of mortality and nursing home admission. *J Gerontol* 1994;49(2):85-94.
- Gawel J, Vengrow D, Collins J, Brown S, Buchanan A, Cook C. The short physical performance battery as a predictor for long term disability or institutionalization in the community dwelling population aged 65 years old or older. *Phys Ther Rev* 2013;17(1):37-44.
- Guralnik, JM, Ferrucci L, Pieper CF, Leveille SG, Markides KS, Ostir GV, Studenski S, Berkman LF, Wallace RB. Lower extremity function and subsequent disability: consistency across studies, predictive models, and value of gait speed alone compared with the short physical performance battery. *J Gerontol A Biol Sci Med Sci* 2000;55(4):221-31.
- Hellström K, Lindmark B, Wahlberg B, Fugl-Meyer AR. Self-efficacy in relation to impairments and activities of daily living disability in elderly patients with stroke: a prospective investigation. *J Rehabil Med* 2003;35(5):202-207.
- Hellström K, Lindmark B. Fear of falling in patients with stroke: a reliability study. *Clin Rehabil* 1999;13(6):509-517.
- Fallolyckor på arbetet. Mars 2018. www.afaforsakring.se/globalassets/forebyggande/analys-och-statistik/arbets-skaderapporten/ovriga-rapporter-om-arbets-skador-och-sjukfranvaro/f6345_delarapport_fallolyckor.pdf
- Garne-Dalgaard A, Mann S, Bredahl TVG, Stochkendahl MJ. Implementation strategies, and barriers and facilitators for implementation of physical activity at work: a scoping review. *Chiropr Man Therap* 2019;27:48.
- Rivera-Torres S, Fahey TD, Rivera MA. Adherence to Exercise Programs in Older Adults: Informative Report. *Gerontol Geriatr Med* 2019;5:2333721418823604.
- Lauretani F, Ticinesi A, Gionti L, et al. Short-Physical Performance Battery (SPPB) score is associated with falls in older outpatients. *Aging Clin Exp Res* 2019;31:1435-1442.
- Hellström K, Sandström M, Heideken Wågert P, et al. Fall-Related Self-efficacy in Instrumental Activities of Daily Living is Associated with Falls in Older Community-Living People. *Phys Occup Ther Geriatr* 2013;31(2):128-139.