

The impact of a comprehensive physical, mental and spiritual programme on fall risk, physical fitness and blood pressure in elderly residents of nursing homes: An RCT Study

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ABSTRACT

As bodily functions decline, older people encounter various challenges in physical, mental and social well-being, for example risk of falls, hypertension and depression. Physical exercise is among the most recommended solutions to address the issues faced by the elderly. This study aimed to evaluate a holistic programme incorporating diverse physical exercises (aerobic exercise, muscle strength, flexibility), combined with mental and spiritual practices (breathing relaxation and gratitude) in reducing fall risk, enhancing physical fitness, and regulating blood pressure, in elderly residents of nursing homes. The study employed a Cluster Randomised Controlled Trial design in Surakarta, Indonesia. Seventy-one participants were randomly assigned to either the intervention group (n=42) or control groups (n=29). The intervention group engaged in the programme three times per week, for 60 minutes per session, over 16 weeks. The control group continued their routine activities, including sunbathing or other relaxing pursuits.

In the fall risk variable, the intervention group exhibited a higher mean score than the control group, specifically 49.79 ± 2.70 compared to 46.21 ± 3.16 , $p=0.05$, while for physical fitness, 60.24 ± 7.65 compared to 49.57 ± 11.66 , $p=0.05$. Concerning systolic blood pressure, the mean value for the intervention group was 146.11 ± 20.07 , while the control group was 148.59 ± 23.20 , $p = 0.63$. The intervention group recorded a mean value of 84.10 ± 13.75 for diastolic blood pressure, whilst the control group recorded 86.25 ± 9.83 , $p = 0.98$.

This research underscored the influence of SPIRIT programme on reducing fall risk and enhancing physical fitness in elderly nursing home residents, although it is not effective in lowering blood pressure. Elderly people in nursing homes and communities can consider the SPIRIT programme as an attempt to prevent non-communicable diseases. Additional research is recommended to explore the impact of this programme on the blood pressure of older people.

Key words:

Community Health Nursing, fall risk, physical fitness, blood pressure, nursing home

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INTRODUCTION

Older people experience a degenerative process, which, if overlooked, can result in specific health-related concerns.¹ According to research that used data from the Indonesia Family Life Survey fifth wave (IFLS-5) in 2014-2015, elderly people in Indonesia experienced falls-related injury in the last two years at a rate of 12.8%.^{2,3} The prevalence of sarcopenia (decline in muscle mass and strength) in the community is up to 33%, with the majority occurring in long-term care homes.⁴ Risk factors of sarcopenia include nutritional disorders, reduced physical activity, the side-effects of medication, bone and joint disorders, nerve disorders, cancer, together with liver and kidney issues.⁵ Other problems include hypertension, which is a significant health issue, specifically in developing countries, as 1 in 3 adults suffers from hypertension.⁶

One approach to addressing the needs of the elderly is to place them in nursing homes that provide 24-hour functional support and care.⁷ However, while residing in nursing homes, the elderly still experience various health issues, specifically non-communicable diseases like hypertension,⁸ depression, diabetes mellitus, dementia and congestive heart failure.⁹ Falls in older people occur three times more frequently in nursing homes than in the community.¹⁰ Older people in nursing homes, particularly those experiencing weakness, typically engage in less physical activity due to the fear of falling, experience a decline in muscle mass and strength (sarcopenia), and struggle to meet their daily living needs.¹¹ In addition, older people residing in nursing homes have higher psychosocial problems and lower problem-solving abilities compared to those living at home.¹²

Increasing physical activity is one solution to addressing non-communicable diseases.¹³ Meta-analysis results demonstrate that aerobic exercise can lower

blood pressure.¹⁴ Exercise programmes for nursing home residents and older people living in the community have also been proven to enhance activities of daily living, balance, physical activity levels, physical performance, self-efficacy related to falls, well-being, cognitive function,¹⁵ physical function (muscle strength, flexibility and balance), as well as mental well-being (self-esteem and depression), immune system,¹⁶ blood pressure,¹⁷ besides fall risk.^{18,19} Meta-analysis results from 69 studies on physical exercise for older people who suffer from hypertension confirm that physical exercise can reduce the average systolic blood pressure.²⁰ Exercise using giant board games can increase physical activity among nursing home residents.²¹

While exercise provides many benefits, the results revealed by various other studies conclude that physical exercise has no impact on blood pressure in the elderly in long-term care who have a sedentary lifestyle.²² A meta-analysis concluded that exercise programmes do not significantly prevent falls among the elderly in nursing homes, necessitating further research.²³ However, this particular meta-analysis involved only a small number of studies. Physical exercise does not always yield positive results in physical fitness and cognition.²⁴ This study involved the general population aged >55 years. An intervention involving muscle strength exercises alone could not reduce diastolic blood pressure in the elderly, but combined aerobic and resistance exercise can reduce both systolic and diastolic blood pressure.²⁵ The research findings offer valuable insights into determining the type of exercise for the elderly. Previous studies also report that multifactorial, multidisciplinary interventions over 12 months could not reduce the incidence of falls among frail, older people aged over 70.²⁶

Despite variable research findings, various programmes are still offered to the public to address non-communicable

diseases. Unfortunately, only a fraction of the population takes advantage of these specific programmes.^{27,28} The reasons include lack of motivation, inadequate facilities, physical limitations, insufficient information, fear of injury, health issues, time constraints, in addition to costs.^{29,30} A further reason is the challenge related to maintaining adherence to exercise, essentially for the elderly.³¹ Furthermore, the elderly are frequently confronted by physical and psychological challenges when exercising.³² Preventive efforts to control non-communicable diseases, such as hypertension are rarely carried out in Indonesia, even though it is acknowledged that hypertension is a major factor in cardiovascular diseases.³³

To address the above issues, a new and varied exercise programme is required so that participants do not become easily bored and remain highly motivated.³⁴ Physical exercise should include various components, including aerobic activities, muscle strength, flexibility, and balance,^{35,36} with the aim of providing further benefits. Therefore, relaxation and meditation activities must be incorporated to enhance the mental well-being of the elderly.³⁷

The research team has designed a new programme to improve the health of residents in nursing homes known as the SPIRIT programme. The word spirit is derived from the Bahasa word "semangat" meaning spirit. The SPIRIT programme is comprehensive, involving physical and mental-spiritual exercises to train older people without specific illnesses based on recommendations for physical activities for the elderly.³⁷⁻³⁹ The SPIRIT programme includes physical and mental-spiritual exercises, including elderly gymnastics, stationary cycling, walking, muscle strength exercises, balance training, flexibility, breathing relaxation and gratitude techniques. Stationary bicycles

were a popular sport during the pandemic.⁴⁰ Walking is an easy and safe activity that has the benefit of preventing disease,⁴¹ whereas gymnastics is a light-moderate physical activity that combines muscle strength, balance and mobility training.⁴² Breathing relaxation and gratitude techniques were chosen because they are the most practical and easy to perform,⁴³ and for the reason that they can have a positive impact.⁴⁴

The SPIRIT programme has received approval from sports and psychological experts. This research aims to assess the effectiveness of the SPIRIT programme on fall risk, physical fitness and blood pressure in elderly residents in nursing homes. The research has been registered under ISRCTN 13989556.

METHOD

This research used a two-arm cluster randomised controlled trial design, from August to November 2022 in five nursing homes in Surakarta, Central Java, Indonesia. 71 participants were randomly divided into intervention (42 participants) and control groups (29 participants). The intervention group joined in a comprehensive programme (physical, mental and spiritual activities) three times a week, for 60 minutes per session, over 16 weeks. The control group followed their usual routine activities, for instance sunbathing or other leisurely activities, without regular physical exercise or as part of a waiting list.

Intervention

Programme Development

The development of the programme began with interviews with the elderly residents and caregivers regarding their preferred physical and mental-spiritual activities in the nursing home. Subsequently, the researcher developed a programme called "SPIRIT." The

programme was validated and approved by sports and psychology experts from the Universitas Sebelas Maret in Surakarta. The programme was piloted in one nursing home outside the research population with the following results: 86% participant attendance, no participants withdrew, and no serious incidents occurred during the study. These various parameters were crucial for evaluating the feasibility of an intervention⁴⁵.

Programme Implementation

The SPIRIT programme consisted of group-based physical exercises, breathing relaxation and gratitude sessions. These sessions took place three days a week in the morning, each lasting for 60 minutes with moderate intensity. They included aerobic exercises, strength training, balance exercises and flexibility exercises. The aerobic exercises were varied and could involve stationary cycling, walking in the nursing home, or gymnastics for older people. These activities were alternated on different days to prevent people from becoming bored. Each session started with warm-up exercises and ended with a cool-down period.

After approximately 20 minutes of aerobic exercise, the elderly participants were given a 5-minute break before proceeding with balance exercises (e.g., walking in a straight line, heel-to-toe, step aerobics), muscle strength exercises (e.g., lifting a 1 kg dumbbell, sit-to-stand, hip extension, leg curl), along with flexibility exercises (active range of motion exercises, stretching exercises), each lasting approximately 10 minutes. Breathing relaxation and gratitude exercises were conducted concurrently for 10 minutes after the physical exercise. During this session, the elderly closed their eyes, breathed slowly through the nose, exhaled via the mouth and relaxed all muscles from their legs to their face.

Three students from the Faculty of Sports at Universitas Sebelas Maret and one caregiver in each nursing home underwent

intensive training until they fully understood the SPIRIT programme and were prepared to become instructors. Caregivers also served as field coordinators responsible for reporting participant conditions and the progress of the study to the researcher. To enhance participant compliance with the intervention, instructors were tasked with supervision, providing positive reinforcement at the end of each exercise session, addressing exercise-related obstacles and maintaining attendance records.

Control Group

The control group consisted of nursing home residents who did not engage in regular and planned physical activities, such as sunbathing or watching television.

Participants

The study was conducted in the city of Surakarta, Central Java, Indonesia, considering Surakarta is a city that is deemed to be friendly for older people.⁴⁶ Participants were recruited from nursing homes that agreed to participate in the study (5 out of 9). The subjects were older people from five nursing homes who met the following inclusion criteria: aged ≥ 60 years, able to communicate effectively, willing to undergo the intervention, had been living in the nursing home for a minimum of three months, had a Katz Index of Activities of Daily Living score of A, indicating independence in bathing, dressing, toileting, cleaning genitalia, transferring, controlling bowel and bladder movements, eating⁴⁷ and had obtained permission from the management at each nursing home.

Exclusion criteria included: visual and hearing impairments, blood pressure $> 180/100$ mmHg and oxygen saturation $< 95\%$. Participants were still allowed to continue their prescribed medical treatment if any, from a doctor.

Recruitment and eligibility

The research was conducted in five nursing homes in Surakarta, Indonesia. Participant recruitment was carried out through the nursing home administrators. After obtaining permission from the nursing home administrator, participants willing to participate underwent a health examination by healthcare professionals to determine their eligibility for the study. If there were any restrictions from healthcare

professionals regarding physical activities, the participant was not included in the study. After identifying participants who met the criteria, the researcher provided information pertaining to the study to each of the participants. Participants willing to participate signed the consent form witnessed by the nursing home caregivers. The recruitment process is illustrated in Figure 1.

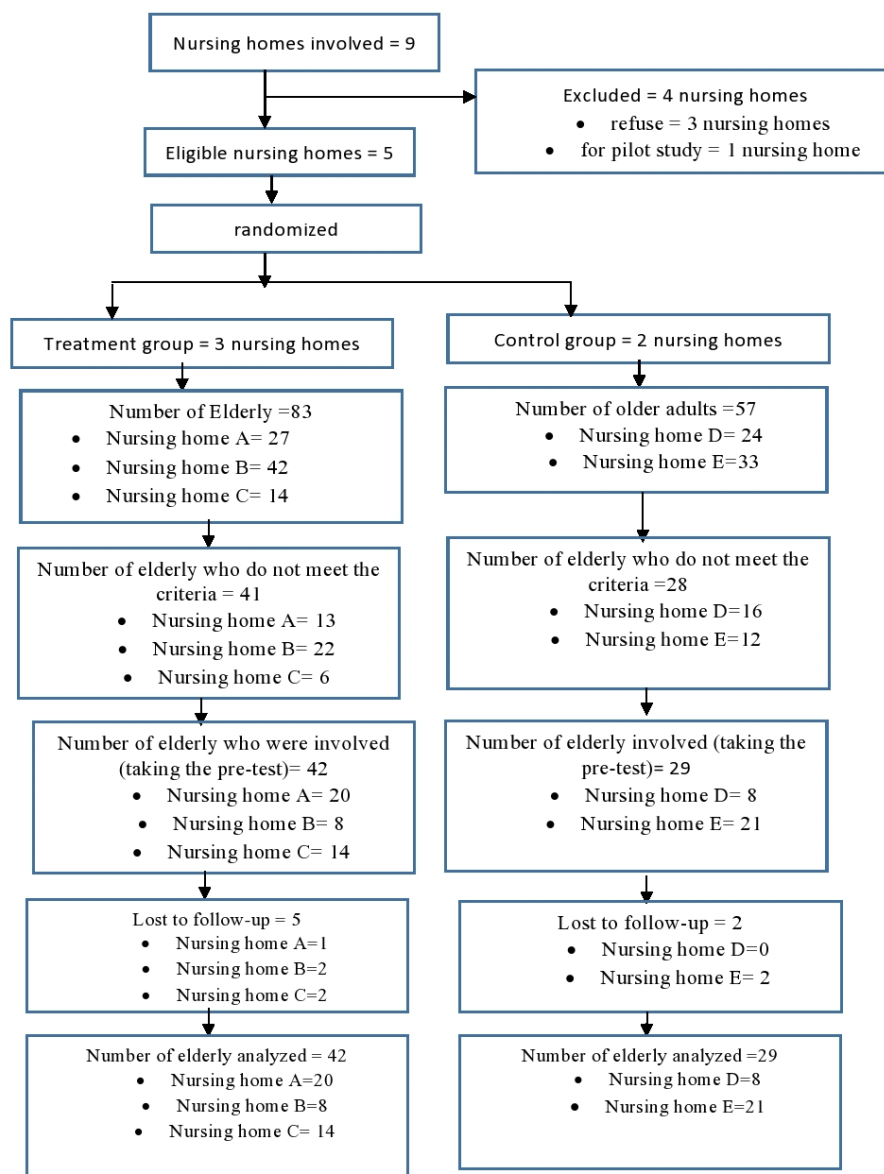


Figure 1. Flow diagram of the participants

The researcher used G Power software to calculate the minimum sample size (<https://g-power.apponic.com/>). Based on a similar study that had been conducted⁴⁸, the researcher used α error = 0.05, power = 0.8 and effect size = 0.7. The sample size calculation using G Power software determined a minimum sample size of 68 older people. The researcher increased the number of participants to account for potential subject attrition, resulting in a sample size of 71 older people in this study.

Data Collection

Data collection was conducted at each nursing home. All participants were assessed using the same methods, measurements and equipment one week before and after the intervention (in the 16th week). The measurements were taken by nurses from the Annisa Husada Clinic in Surakarta, who were trained in the measurement procedures and unaware of the group allocation. The variables and measurements used included:

a. Fall Risk

Participants were asked to perform 14 activities as per the instructions in the Berg Balance Scale Test⁴⁹, with each activity scored from 0-4. The lowest score was 0, whilst the highest score was 56. A higher score indicates a lower risk of falling. The Berg Balance Scale Test is a valid and reliable method for assessing the risk of falling in older people in nursing homes⁵⁰.

b. Physical Fitness

Subjects performed the two-minute step test procedure. The number of steps that could be lifted to the mid-point between the knee and the waist was counted⁵¹. A higher score indicates better physical fitness. This test has the advantage of not requiring a spacious area, takes approximately two minutes, and does not require expensive equipment⁵². A systematic review determined that this test is valid and reliable for measuring the

physical fitness of older people and patients with cardiovascular disorders⁵³.

c. Blood Pressure

Subjects' systolic and diastolic blood pressure was measured in the brachial artery with the participant seated, with their arms resting on the table at heart level, feet on the floor, and taken after a minimum rest of five minutes. Digital blood pressure monitors were used for measurements as they are practical⁵⁴. This device had been calibrated by the Ministry of Health of the Republic of Indonesia.

Randomisation and blinding

Subject allocation in this study employed cluster randomisation, with five nursing homes as the clusters. The placement of clusters in the intervention and control groups can be viewed online at <https://id.rakko.tools/tools/59/>. Blinding was applied to the group allocation results. The researcher maintained confidentiality by not disclosing to the intervention providers and data assessors which nursing homes were in the treatment and control groups.

Ethic and Data Security

The researcher obtained ethical approval for the study from the Research Ethics Committee of the Faculty of Medicine, Universitas Sebelas Maret Surakarta, with approval number 88/UN27.06.6.1/KEP/EC/2021. The participants signed the consent form with the caregiver after receiving a detailed explanation related to the study and being given an opportunity to ask questions. Each participant was assigned a numerical code. Only the research team were aware of the subject's code.

Data Analysis

The researcher used the Intention To Treat (ITT) analysis method as it is recommended for RCT designs⁵⁵. The first step involved testing the normality of the data. Subsequently, a test was conducted to

assess differences within groups using the paired T-test and between the intervention and control groups using the independent T-test.

The effect size was calculated for statistically significant variables using Hedges' g

(<https://www.socscistatistics.com/EffectSize/default3.aspx>). Effect size was categorised as follows: small (≤ 0.20), medium (0.5), and large (0.80)⁵⁶. In this study, seven participants withdrew. Five subjects in the treatment group did not undergo post-test measurements due to relocation (one participant), being ill for more than three weeks and unable to participate in the intervention (two participants), withdrawing from the study (two participants). Concerning the control

group, two participants were ill for more than three weeks. Missing data were addressed by imputation, with the mean value imputed for numerical data⁵⁷.

RESULTS

a. Participant Characteristics

At the beginning of the study, 71 older people from five nursing homes were divided into two groups: treatment group and control group. The treatment group consisted of three nursing homes with 42 participants, while the control group comprised two nursing homes with 29 older people. Participant characteristics are presented in Table 1 below:

Table 1. Participant characteristics in the intervention and control group

No	Characteristics	Intervention group n=42 n(%)	Control group n=29 n(%)	p value
1.	Age (year)			
	60-74	26(61)	23(79)	0.06
	75-85	12(29)	6(21)	
	>85	4 (10)	0(0)	
2.	Duration of stay (month)			0,62
	≥ 24	26(62)	16(55)	
	<24	16(38)	13(45)	
3.	Gender			0.39
	Male	2(5)	3(10)	
	Female	40(95)	26(90)	
4.	Education			0,08
	Low	19(45)	24(83)	
	Middle	18(43)	5(17)	
	High	5(12)	0(0)	
5.	Comorbid			0,78
	with	11(26)	9(31)	
	without	31(74)	20(69)	

n: number of participants; p: significant (0.05)

Based on the difference test, it was determined that there were no significant differences in terms of age, length of stay,

gender and comorbidities between the two groups, as indicated by p-values > 0.05 .

Table 2. Mean different within groups, between group and effect size

Variabel	Experiment group			Control group		Between group		
	Mean \pm SD		p value	Mean \pm SD		p value	p value	
	Pre n=42	Post n=42		Pre test n=29	Post test n=29		Pre test	Post test
Fall risk	48.98 \pm 2.70	49.79 \pm 2.70	0.00	47.86 \pm 2.72	46.21 \pm 3.16	0.00	0.09	0.00
Systolic Blood pressure	148.07 \pm 17.07	146.10 \pm 20.07	0.12	150.0 \pm 22.53	148.59 \pm 23.20	0.60	0.68	0.63
Diastolic Blood pressure	88.58 \pm 14.92	84.10 \pm 13.76	0.00	86.10 \pm 14.40	84.03 \pm 13.0	0.23	0.49	0.99
Physical fitness	51.64 \pm 5.44	60.26 \pm 7.64	0.00	49.38 \pm 6.70	49.59 \pm 11.67	0.93	0.12	0.00

n: number of participants; SD: Standard Deviation; p: significant (0.05)

The post-test results in Table 2 confirmed significant differences in the fall risk and physical fitness variables but not in the systolic and diastolic blood pressure variables. At the end of the study, in terms of the fall risk variable, the treatment group had a significantly better mean score compared to the control group, with scores of 49.79 ± 2.70 compared to 46.21 ± 3.16 . Regarding the physical fitness variable, the treatment group had a better mean score than the control group, with a respective score of 60.24 ± 7.65 compared to $49.57 \pm$

11.66 . Both variables demonstrated significant differences ($p = 0.001$).

In relation to the systolic blood pressure variable, there were no significant differences, with the treatment group having lower average values than the control group, with mean values of $146.11 \text{ mmHg} \pm 20.07$ and $148.59 \text{ mmHg} \pm 23.20$ ($p = 0.63$). Similarly, for the diastolic blood pressure variable, the treatment group exhibited lower average values than the control group, with mean values of 84.10 ± 13.75 and 86.25 ± 9.83 ($p = 0.98$).

Table 3 Effect size between group

Variabel	Effect size
Fall risk	1.2
Physical fitness	1.1

The effect size of the SPIRIT programme on the fall risk and physical fitness variables can be seen in Table 3. The effect sizes are 1.2 and 1.1 respectively, which fall into the large category.

DISCUSSION

The SPIRIT programme increased the Berg Balance Scale Test score in the treatment group significantly ensuring that older people in the treatment group had a

lower risk of falling than the control group, likewise with physical fitness. The results revealed that there were significant differences both within groups and between groups ($p=0.05$). An effective programme for reducing the risk of falls in the elderly is the one that involves regular physical exercise of 150-300 minutes every week, and with multi-components, including cardiopulmonary endurance, balance, strength and flexibility training⁵⁸. This physical activity must be planned, structured and undertaken according to

professional recommendations.^{38,59,60} The SPIRIT programme meets these requirements. These results can be obtained for the reason that balance, strength and flexibility training can help maintain posture, thereby reducing the risk of falls.⁶¹ The results of the review of 29 articles also concluded that a combination of aerobic activity, muscle strength, flexibility and balance combined with relaxation and meditation could improve physical and mental health and prevent the risk of falls, notably in the elderly.³⁷

The key to the success of an exercise programme lies in participant compliance, considering that the intervention was carried out over a relatively long period. The conclusions of the systematic review regarding the key factors influencing older people's compliance with physical activity include exercise characteristics, involving multidisciplinary professionals, supervision, new technology, participant characteristics, participant knowledge and expectations, avoiding injury and pain, as well as integration into daily life. These factors also include daily support, communication and feedback from peers and staff, monitoring progress on exercise results, self-efficacy, together with the participant's active role and goals.⁶² Researchers have taken these recommendations into account to maintain participant compliance. The research results demonstrate that compliance with the programme is extremely high, confirming that this programme can be implemented.⁴⁵

These results are consistent with the meta-analysis of 21 selected articles investigating the effect of physical exercise on the incidence of falls in older people in care facilities, which concluded that physical exercise reduced the risk of falls and recurrent falls.⁶³ These results are also in accordance with the findings of a systematic review, which concluded that

combined exercise programmes were more effective than single exercises in preventing the risk of falls.²³ However, it should be remembered that physical exercise programmes in the form of walking exercises should not be prescribed to frail, older people who already experience balance problems or decreased muscle strength because this will result in falls.⁶⁴

Table 2 explains that the mean score from the two-minute step test after completing the intervention in this study was 60.24 ± 7.65 in the treatment group and 49.57 ± 11.6 in the control. Older people are acknowledged to have good physical fitness if the two-minute step test score is more than 60 times per minute.⁵¹ These results indicate that the SPIRIT programme can maintain physical fitness in older people in nursing homes. A creative dance programme that combines physical activity and creative dance among older people in Korea also provides better physical fitness results in contrast to older people who do not participate in dance.⁶⁵ Similar results were also reported in Portugal.⁶⁶ A different study with a physical activity-based intervention in older people in nursing homes also increased the distance covered in a six-minute walking test.⁶⁷ Similarly, the same result was achieved in research using yoga intervention in older people in Australia.⁶⁸ Weight training has been proven to inhibit decreasing muscle mass and strength due to ageing, improving general health.⁶⁹ Physical fitness implies that it is easier for the elderly to undertake daily activities in nursing homes, such as visiting places of worship or cleaning a room.

Results in the control group demonstrated lower physical fitness results and a higher risk of falls. Older people who do not engage in regular physical activity and lead a sedentary lifestyle will experience decreased physical fitness and a greater risk of falls.⁷⁰ The failure of older

people to improve their physical fitness can also be caused by the inability to increase the circulation of IgF-1 (Insulin Growth Factor), which plays a role in stimulating the formation of growth hormone in cell growth.²⁴

Regarding the blood pressure variable, the SPIRIT programme reduced the average systolic pressure in the treatment group after the intervention, from 148 mmHg to 146 mmHg, and the diastolic pressure from 88 mmHg to 84 mmHg. However, statistical calculations present insignificant differences ($p>0.05$). Moreover, older people generally have a decrease in physical activity, that results in low levels of nitric oxide, a compound produced by the endothelium, which can act as a strong vasodilator that plays a role in reducing hardening of the arteries and thus also affecting blood pressure.⁷¹ The aging process causes hardening of the blood vessels (atherosclerosis), increasing peripheral resistance and reduced physical activity, thereby reducing nitric oxide levels. These factors mentioned previously cause high blood pressure in the elderly.^{72,73}

The lack of influence of the SPIRIT programme on systolic and diastolic blood pressure may be related to the number of subjects with hypertension, the exercise period and the number of subjects. Until now there has been no standard period in relation to physical exercise (both frequency, intensity and duration) that can be accepted by groups of older people²⁵. Research comparing moderate and high-intensity physical exercise on the blood pressure of older people in nursing homes exhibited significant differences in the high-intensity group but not in the medium-intensity group⁷⁴. The number of research subjects who already have hypertension also influences the study's final results.²²

RESEARCH LIMITATIONS

This research was conducted during the COVID-19 pandemic, when the

government established strict health protocols, especially involving the elderly as research subjects. Not all nursing home managers gave permission to perform the research, reducing the number of subjects involved. The research team anticipated this issue by limiting the number of instructors and ensuring that interaction time with the elderly was more effective. Researchers and related parties prepared the SPIRIT programme, which is extremely viable and does not cause injury to the elderly.

CONCLUSION

The SPIRIT programme for older people in nursing homes effectively reduces the risk of falls and increases physical fitness. Nonetheless, it is not effective in reducing systolic and diastolic blood pressure. The follow-up to this research is that older people in nursing homes need to increase physical, mental and spiritual activity, via the SPIRIT programme, with the aim of fulfilling their physical needs, for instance their activities of daily living, emotional and spiritual needs, such as visiting places of worship, all of which have an impact on improving quality of life. The researchers experienced limitations due to social distancing regulations related to the pandemic, which had an impact on the number of nursing homes involved and the lack of flexibility in implementing the programme.

RECOMMENDATIONS

Further research is desirable on the benefits of this programme on the blood pressure of older people by considering subject characteristics, intensity and duration of intervention, involving more participants, both in nursing homes and in the community.

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