Study Protocol with Statistical Analysis Plan

Impact of "SI Kumbang" Gymnastics Exercise on Physical Performance and Immunity in the Elderly

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Abstract

Background: The most common issue associated with aging is frailty, which has a significant impact on the physical performance and immunity of older adults. Exercise is the primary modality in medical rehabilitation. The Indonesian Strong and Balanced Healthy Exercise (SI Kumbang) gymnastic exercise is a newly designed exercise model developed by researchers, which is a type of low-impact aerobic exercise with moderate intensity. SI Kumbang exercises are performed three times a week for 30 minutes over a period of 12 weeks. The main basis of these exercises is foot movements that follow a rhythm, with the feet rotating in sequence in the four cardinal directions.

Objective: This study aimed to evaluate and compare the impact of SI Kumbang gymnastic exercises and Bugar Lansia gymnastic exercise programs on physical performance dan immunity in elderly.

Methods: A randomized single-blind clinical trial involved 66 elderly participants aged 60–70 years, divided into SI Kumbang (n=33) and Bugar Lansia (n=33) groups. Each group exercised three times weekly for 12 weeks. Outcomes measured for physical performance were cardiorespiration endurance using Six-Minute Walk Distance (6MWD), strength muscle using handgrip JAMAR, balance using Short Physical Performance Battery (SPPB), physical activity using Physical Activity Scale for the Elderly (PASE). Outcomes measured for immunity were inflammasome using Caspase-1 and IL-18. Data were analyzed using SPSS 29.0 tests with significance set at $p<0.05$.

Results: Physical performance in elderly showed, SI Kumbang group had significantly impact in cardiorespiration endurance (6MWD) ($p=0.005$) and physical activity (PASE) ($p=0.001$). However, there was no significant impact on strength muscle (handgrip JAMAR), and balance (SPBB). Immunity in elderly

showed, both group there were no significant in inflammasome Caspase-1 (p=0,055) and IL-18 (p=0,255).

Conclusion: In conclusion, SI Kumbang gymnastic exercise group has more significant impact in terms of physical performance, particularly in enhancing cardiorespiration endurance and physical activity rather than Bugar Lansia gymnastic exercise group. And there is no difference in physical performance aspects such as muscle strength, balance, and immunity aspects as Caspase-1 and IL-18 in the elderly.

Keywords: elderly, physical performance, immunity, SI Kumbang exercise gymnastics.

INTRODUCTION

The number of people in the world who are 60 years of age or older is currently increasing, making up nearly 7% of the community. In both industrialized and emerging nations, the number of elderly people is increasing quickly. In 2020, 727 million people worldwide were 65 years of age or older.[1] The number of elderly people in Indonesia has increased significantly over the past 50 years. During this period, the proportion of elderly people in Indonesia has doubled compared to the previous period. In 2021, the proportion of elderly people reached 10.82%, or approximately 29.3 million people. This figure indicates that Indonesia has entered a phase of an aging population structure, marked by the proportion of people aged 60 and over in Indonesia exceeding 10% of the total population. In fact, according to projections from the Central Statistics Agency (BPS), by 2045, the number of elderly people in Indonesia is estimated to reach almost one-fifth of the total population and is expected to continue to increase.[2]

The most common issue associated with aging is frailty, which has a significant impact on the physical performance and immunity of older adults. Furthermore, skeletal muscle mass and strength decline with age, thereby diminishing physical autonomy. This decrease raises the chance of illness, disability, and functional limitations—all of which are referred to as frailty—which have an adverse effect on one's physical, mental, and social well-being.[5] Reduced muscle strength, endurance, and physiological function are common characteristics of physically frail older persons, which raises their risk of poor health outcomes, functional decline, hospitalization, and death.[3]

A key component of medical rehabilitation is exercise, which serves as the foundation for efficient treatment to stop pre-frail from becoming frail. Exercise training can enhance walking speed and physical performance in pre-frail older subjects, according to systematic reviews and meta-analyses. The advantages of many types of exercise, both at home and in groups, have been investigated for senior citizens.[6,7]

Aerobic exercise is one type of exercise that can help stop muscle loss. The heart and lungs must work harder during aerobic exercise to meet the increased demand for oxygen. Dance-style rhythmic movements use the aerobic energy system to work major muscles while adhering to the chosen music. This creates rhythmic patterns, duration, and continuity that are intended to enhance and sustain bodily performance. Exercises that utilize dance movements is aerobic exercise performed through low-impact dance moves. If performed consistently for 30 to 60 minutes, the leg movements simply consist of variants of walking on the spot rather than many hops, making it safe for beginners and people of all ages and preventing knee and back injuries.[8]

Numerous physical exercise regimens have been created to address the deterioration of functional capacity in the elderly. Among these are the SI Kumbang and Bugar Lansia gymnastic exercises, which are planned workouts intended to enhance general physical function, strength, and mobility. There is, however, little data comparing the efficacy of these two therapies. Bugar Lansia gymnastic exercise is one form of exercise that is appropriate for senior citizens in Indonesia. Seniors can benefit from Bugar Lansia, a mild, simple, and non-strenuous type of exercise. Bugar Lansia is a set of organized, consistent physical exercises that preserve and enhance mobility, which enhances quality of life.[9] Bugar Lansia is a moderate-intensity exercise known to have a positive effect on improving functional movement in the elderly through assessments.[10]

Additionally, Indonesia offers a wide range of well-liked modern dances that are appropriate for moderately strenuous exercise. One such dance is the Poco-Poco dance, which evolved into the gymnastics exercise of SI Kumbang. This local culture-based gymnastics is quite simple to execute and offers several health advantages, including increased blood vessel elasticity, circulation, oxygen intake,

balance, coordination, and muscle strength. SI Kumbang gymnastics exercise is ideal for senior citizens due to its distinctive low-impact motions and music, which can enhance physical fitness.[15,19] Elderly quality of life is often improved by moderate-intensity gymnastics training, which also delays the beginning of various diseases. In addition, this activity can help maintain optimal cardiorespiration endurance, muscle strength, balance, physical activity and immunity. [11] In order to ascertain whether intervention offers more advantages for geriatric health, immunity and physical performance in elderly groups, this study compares the effects of SI Kumbang gymnastics exercise and Bugar Lansia gymnastics exercise on physical performance and immunity in the elderly.

METHODS

This study was designed as a randomized clinical trial with allocation concealment and single blinding to assess how the "SI Kumbang" gymnastic exercise and the "Bugar Lansia" gymnastic exercise model affected physical performance and immunity in elderly. In cooperation with the Rehabilitation Medicine Polyclinics, the 12-week intervention took place at the Ahmad Dahlan Indoor Hall of RS Islam Jakarta Pondok Kopi, East Jakarta, between April until September 2025. According to the FI-40 score, the target demographic was made up of senior citizens who were categorized as robust and pre-frail. Patients who visited the Rehabilitation Medicine Polyclinics at RS Islam Jakarta Pondok Kopi during the study period were included in the accessible population.

Female participants between the ages of 60 and 70 who met the following inclusion criteria were categorized as pre-frail (FI-40 score > 0.08 < 0.25) or robust (FI-40 score ≤ 0.08) and had a body mass index (BMI) between 18.5 and 24.9. Participants had to have managed diabetes mellitus (GDS ≤ 120 mg/dL) and blood pressure (≤130/80 mmHg) without taking any drugs that affected heart rate. Only those who were willing to participate, able to adhere to the study procedures, and had not been enrolled in any organized exercise program in the previous three months were included. Chronic heart or lung conditions, chronic conditions that cannot be reversed (e.g., cancer or chronic renal disease), diabetes complications in the extremities, motor impairment (MMT < 5), knee pain, lower limb deformities

(genu varus/valgus), and hand deformities were among the exclusion criteria. Dropouts were defined as those who did not finish the study, missed more than six workouts, or had negative outcomes linked to the intervention.

A sample size of 33 people per group was determined. The study supervisor oversaw the use of a basic randomization program to carry out the random allocation. The Sequentially Numbered, Opaque, Sealed Envelope (SNOSE) technique was used to guarantee allocation concealment. Outcome assessors were subjected to single blinding; they were not told about group allocations and were not allowed to look for relevant information. The “SI Kumbang” and "Bugar Lansia" gymnastics exercise regimens were part of the intervention groups. For 12 weeks in a row, both therapies included three 30-minute sessions per week. Participants received adaption sessions to acquaint themselves with the workout regimens throughout the first week. The Borg Scale was utilized to track intensity.

The Six-Minute Walk Distance (6MWD) for cardiorespiratory endurance, and handgrip strength muscle measured using a handgrip JAMAR. The Physical Activity using Physical Activity Scale for the Elderly (PASE) questionnaire, the balance using Short Physical Performance Battery (SPPB) were among the outcome measures and the immunity aspect using inflammasome marker Caspase-1 and IL-18. The research team reviewed patient logbooks at the beginning of each week to track adverse effects such weariness, shortness of breath, pain, or dizziness. At RS Islam Jakarta Pondok Kopi, every suspected adverse event was swiftly assessed, and any required medical attention was given. Every adverse event was reported to the ethics committee of the institution.

Data analysis was performed using SPSS 29.0 tests with significance set at $p<0.05$. Descriptive summaries of the sample characteristics were provided. Prior to analysis, the normality of the data was checked. Dependent t-tests were used to compare pre intervention and post intervention score in the SI Kumbang and Bugar Lansia groups for normally distributed outcomes (6MWD, handgrip, SPPB, PASE, Caspase-1, IL-18); the Wilcoxon test was used to assess non-normal data. Independent t test or Mann-Whitney U test is used for compared the effectiveness of the two interventions (Δ score). A p-value of less than 0.05 was deemed significant.

RESULT

A total of 66 elderly participants in the study, divided into the "SI Kumbang" and "Bugar Lansia" gymnastic exercise group. Table 1 summarizes the baseline characteristics of the subjects. Both groups have similar characteristics.

Table 1. Baseline Characteristics

Characteristics	Si Kumbang (n=33)	Bugar Lansia (n=33)
Age (years), mean (SD)	65,25 (3,25)	65,14 (2,99)
Body Mass Index, mean (SD)	23,5 (22,7)	22,95 (21,6 – 24,2)
Normal	31 (86,1)	31 (86,1)
Overweight	5 (13,9)	5 (13,9)
Gender, n (%)		
Female	36 (100,0)	36 (100,0)
Living History, n (%)		
Alone	8 (22,2)	5 (13,9)
Husband	25 (69,4)	30 (83,3)
Childs	2 (5,6)	1 (2,8)
Siblings	1 (2,8)	0 (0)
Educational Background, n (%)		
No Education	1 (2,8)	2 (5,6)
Primary	2 (5,6)	5 (13,9)
Secondary	5 (13,9)	3 (8,3)
High School	16 (44,4)	14 (41,7)
University	12 (33,3)	11 (30,6)
Comorbid		
Diabetes Mellitus	8 (22,2)	3 (8,3)
Hypertension	10 (37,8)	11 (30,6)
Use of Diabetes Mellitus Medication	8 (23,2)	3 (5,6)
Use of Hypertension Medication	10 (37,8)	11 (30,6)

SD (standard deviation)

Baseline characteristics of clinical outcomes of physical performance and immunity in elderly prior to intervention. Both groups are similar except for IL-18, which will be adjusted using ANCOVA analysis.

Table 2. Baseline Characteristics of Physical Performance and Immunity in Elderly before Intervention

Variabel	Si Kumbang (n=33)	Bugar Lansia (n=33)
The Six-Minute Walk Test (6MWT) (meters), median (IR)	344,75 (293,75 - 376,5)	353 (311,25 – 375,75)
Handgrip strength (kg), mean (SD)	16,11 (3,30)	16 (3,39)
Skor *The Short Physical Performance Battery (SPPB),* median (RIK)	9 (9 – 11)	9 (8,25 – 10,75)
Skor *The Physical Activity Scale for the Elderly (PASE),* mean (SD)	19,31 (2,73)	20,67 (3,97)
CASPASE-1, mean (SD)	52251,52 (26750,02)	56129 (25767,23)
IL-18, median (IR)	186,77 (136,37 – 295,03)	279,56 (190,67 – 438,45)

IR (interquartile range); SD (standard deviation)

The impact of the SI Kumbang group and Bugar Lansia group gymnastic exercise interventions on physical performance and immunity are displayed in Table 3. SI Kumbang group had significantly impact in cardiorespiration endurance (6MWD) (p=0.005) and physical activity (PASE) (p = 0.001). However, there was no significant impact on strength muscle (handgrip JAMAR) (p=0,136), and balance (SPBB) (p=0,194). Immunity in elderly showed, both group there were no significant in inflammasome Caspase-1 (p=0,055) and IL-18 (p=0,327). For IL-18, adjustment was performed using the ANCOVA test (p=0.255).

Table 3. Impact Of "SI Kumbang" Exercise and "Bugar Lansia" on Physical Performance and In Elderly Analysis

Variables	"SI Kumbang" group (n=33)	"Bugar Lansia" group (n=33)	p	Adjusted
	Δ	Δ		
The Six-Minute Walk Distance (6MWD) (meter)	81 (57,25 – 119,5) [d]	54 (25 – 76,5) [d]	0,005 [d]	

Handgrip strength (kg)	1,14 (2,69) [c]	2,06 (2,27) [c]	0,136 [c]	
The Short Physical Performance Battery (SPPB)	3 (1 - 3) [b]	2 (0 - 3) [b]	0,194 [d]	
The Physical Activity Scale for the Elderly (PASE)	5,39 (4,38) [c]	1,16 (5,26) [c]	0,001 [c]	
Caspase-1	-38945,33 (27628,63) [c]	-24957,94 (30423,15) [c]	0,055 [c]	
IL-18	-0,03 (-44,28 – 30,84)	10,41 (-26,9 – 47,32)	0,327 [d]	0.255 [e]

[a] Normally distributed variables presented as mean ± Std. Deviation; [b] Non-normally distributed variables presented as Median (range); [c] Independent t test; [d] Mann-Whitney U test; [e]Adjusted with ANCOVA analysis

DISCUSSION

This study is the first to test the new SI Kumbang gymnastics exercise. Randomization has been performed, and the baseline demographic and clinical characteristics of the two groups are not different, except for IL-18, which shows a difference and is adjusted using ANCOVA.

From the clinical baseline data, the clinical picture of 6MWD, balance, and physical activity is less than normal. This illustrates the condition of elderly people who are generally inactive or sedentary in Indonesian society, that these three physical performances have indeed declined in elderly people entering the age of 60-70 years. In general, they will experience a decline in physical condition and health, especially in healthy elderly people who are inactive in sports, sedentary, or with various chronic diseases.[26]

Other studies analyzed the relationship between sedentary time and physical endurance in elderly. They compared 83 older adults aged 60-87 years. Physical activity (light, moderate, or vigorous) and sedentary time were assessed using ActiGraph® GT1M Accelerometers (Fort Walton Beach, FL, USA). The Senior

Fitness Test assesses five physical fitness components (aerobic endurance, muscular strength, agility/dynamic balance, flexibility, and BMI), and includes six tests: 6-min walk distance (meters); chair stand test (repetitions/30 s); arm curl test (repetitions/30 s); 2.44 m up and go test (seconds); chair sit and reach test (centimeters); and back scratch test (centimeters). Regarding physical endurance, when compared to the inactive group, the active group achieved higher average results on aerobic endurance (6 min walk distance), upper and lower limb strength (arm curl and chair stand test, respectively), agility/dynamic balance. Elderly people are more likely to experience frailty, which many of us mistakenly believe to be a natural aspect of aging. It might be challenging to diagnose frailty in daily life and to differentiate between frailty syndromes and the normalcy associated with age vulnerabilities.[27]

According to this study, elderly physical performance significantly improved because of both SI Kumbang and Bugar Lansia gymnastic exercise. Both groups showed substantial within-group improvements in the 6MWD, the same direction with a study by Casanova et al, which showed higher 6MWD values in the group that regularly performed aerobic exercise, with a 6MWD range of 380–782 meters. The impact of age on 6MWD became substantial at ≥60 years of age.[28]

Significant variations in 6MWD can be explained by the gender, age, height, and weight of respondents. Degenerative diseases also increase with age, and even "apparently healthy" elderly people who are eager to participate in physical training sessions exhibit a wide range of health statuses.

Furthermore, a meta-analysis by Azimkhani et al. shows that endurance, aerobic, and combination exercise programs significantly improve cardiorespiratory endurance in older adults; the level of improvement depends on the intensity, duration, and adherence to the exercise program.[29] Given the advanced age of the participants and the relatively short duration of the study intervention, these significant differences may be attributed to adequate exposure to training for improving cardiorespiratory endurance over 12 weeks, resulting in detectable physiological changes. Harber et al. emphasize that while improvement often requires sustained commitment to exercise therapy, accurate assessment of cardiorespiratory endurance, such as continuously increasing distance covered,

provides important insights into overall health and mortality risk.[30]

This study shows that there is no significant difference between the muscle strength of the SI Kumbang exercise group and the Bugar Lansia exercise group as measured by handgrip strength. Handgrip strength is a valid and simple measure of our total body muscle strength. Grgic et al. support this by finding that an aerobic exercise regimen can increase muscle strength depending on the intensity of the exercise, duration, and type of exercise movements and exercise load required for significant hypertrophy and muscle strength changes.[31] In the SI Kumbang exercise, a 0.5 kg barbell weight was given to the hands, which did not significantly affect muscle strength improvement compared to the Bugar Lansia exercise, which did not use barbell weights in the hands. Therefore, further studies are needed on the weight of the barbell and the type of movements that involve the core muscles or large muscles more to optimize muscle strength improvement.

The results of the balance difference analysis with SPPB scores show that there is no significant difference between the two exercise groups. SPPB is valid, reliable, responsive, and measures physical function in the elderly population. A change of 0.5 points on the SPPB is considered small but significant, while a change of 1 point is considered substantial. Lu et al. highlight the significance of aerobic exercise in maintaining or improving physical function by emphasizing the predictive validity of the SPPB and physical performance measures in identifying older adults at higher risk of falling over time. Both exercise programs showed an improvement in balance after exercise, and the two programs showed similar results.[32] Ansai et al. provided aerobic exercise to elderly individuals for 16 weeks and found no significant difference between exercise and balance and the risk of falling because the elderly require a combination of multi-component muscle movements. [33]

Physical activity in this study was significant for the SI Kumbang exercise group. In the elderly population, PASE scores were closely related to their functional abilities and overall health status. Higher PASE scores are often associated with better mobility, increased muscle strength, and a reduced risk of chronic diseases. According to Ayvat et al., PASE is a sensitive tool for identifying physical inactivity in the elderly population and successfully distinguishes between

active and inactive elderly individuals.[34] The significant difference in PASE scores between the SI Kumbang exercise group and the control group in this study likely reflects the interaction between environmental, social, and daily behavioral factors that influence increased physical activity among the elderly outside of exercise activities. The increase in the average PASE score in the SI Kumbang exercise group shows a promising trend that could lead to a significant increase in physical activity levels and better functional health outcomes.

The decrease in Caspase-1 levels in both groups indicates that the exercise intervention successfully reduced inflammatory activity in older adults associated with inflammasomes. These results are in line with a systematic review by Bautmans et al., which found that various types of exercise, especially those combining resistance and aerobic components, can reduce Caspase-1 and other proinflammatory cytokines such as IL-1β, IL-6, and IL-18, thereby altering the inflammatory profile of older adults. The downregulation of inflammasome signaling pathways is demonstrated by the reduction in Caspase-1, a crucial enzyme that activates cytokines from the IL-18 family.[35] Although there were no differences in changes between the two exercise groups.

Following exercise intervention, IL-18 levels did not decrease because the analysis of the process pathway showed that caspase-1 activation requires various processes to produce a decrease in IL-18, that activated caspase-1 will cleave the same tetrapeptide site in pro-IL-18. The crystal structure of the caspase-1 and pro-IL-18 complex reveals a two-site (binary) substrate recognition mechanism, a catalytic pocket that binds the tetrapeptide, and a unique exosome that critically recognizes GSDMD10 and binds to a specific structure formed jointly by the propeptide sequence and the post-cleavage site in pro-IL-18. This binary recognition is also used by caspase-1 to process pro-IL-18; structural deviations around the exosite underlie its inability to target rationally designed pro-IL-18. The structure of pro-IL-18 displays an autoinhibitory interaction between the propeptide and the post-cleavage site region, preventing recognition by the IL-18Rα receptor.[35]

Caspase-1 cleavage induces substantial conformational changes in IL-18 to generate two critical receptor binding sites and establishes IL-18 as a lipopolysaccharide-activated caspase-1 target. This finding represents a paradigm

shift in the understanding of noncanonical inflammasome-mediated defense and the function of IL-18 in immunity and disease. Thus, many important roles in the process of IL-18 reduction, which targets IL-18, are likely caused by gaps caused by the involvement of cytokines and other proteins in the signaling pathways of various inflammatory diseases other than IL-18. In this study, there were patients undergoing treatment for diabetes mellitus who may have influenced the increase in IL-18 in the two exercise groups. Chronic muscle injury in diabetes mellitus and the elderly can also cause an increase in IL-18. Although it was stated that 9 weeks of exercise could reduce IL-18 levels, the 12-week exercise intervention in this study was not able to reduce IL-18 levels. Another factor that could explain the lack of significant differences was that subjects were not prohibited from traveling outside the city and were not isolated during the exercise intervention.[35]

CONCLUSION

Both SI Kumbang and Bugar Lansia gymnastic exercises improved physical performance in older adults, as shown by significant gains in cardiorespiration endurance and physical activity in elderly. And there is no difference in physical performance aspects such as muscle strength, balance, and immunity aspects as Caspase-1 and IL-18 in the elderly.

These study results indicate that although both exercise modalities are effective in enhancing physical performance in elderly, SI Kumbang appears to provide superior benefits, particularly in improving cardiorespiration endurance and physical activity in elderly.

REFERENCES

1. Ageing and health [Internet]. World Health Organization. 2022 [cited 2023 Sep 16]. Available from: https://www.who.int/news-room/fact-sheets/detail/ageing-and-health
2. Kemenkes. Indonesia Health Profile 2018 Kemenkes RI. Health Statistics. 2018.
3. Lau LK, Tou NX, Jabbar KA, Tang JY, Gao J, Ding YY, et al. Effects of Exercise Interventions on Physical Performance and Activities of Daily Living in Oldest-Old and Frail Older Adults: A Review of the Literature. Am J Phys Med Rehabil [Internet]. 2023 Oct 1 [cited 2025 Sep 15];102(10):939–

49. Available from: https://journals.lww.com/ajpmr/fulltext/2023/10000/effects_of_exercise_interventions_on_physical.16.aspx

4. Kusumah HT, Akbar IB, Tursina A. The Effect of Gymnastics in The Healthy Elderly on Physical Fitness and Cognitive Function in Indonesia Elderly Institutional of West Java Province. RSF Conference Proceeding Series: Medical and Health Science [Internet]. 2022 Jan 26 [cited 2025 Sep 15];1(1):127–34. Available from: https://www.academia.edu/69480291/The_Effect_of_Gymnastics_in_The_Healthy_Elderly_on_Physical_Fitness_and_Cognitive_Function_in_Indonesia_Elderly_Institutional_of_West_Java_Province

5. Niyazi A, Mir E, Ghasemi Kahrizsangi N, Mohammad Rahimi N, Fazolahzade Mousavi R, Setayesh S, et al. The effect of functional exercise program on physical functioning in older adults aged 60 years or more: A systematic review and meta-analysis of randomized controlled trials. Geriatr Nurs (Minneap). 2024 Nov 1;60:548–59.

6. Setiawan C, Ramadhani AN, Rahayu UB. Effectiveness of Low-Impact Aerobic Exercise to Improve Cardiorespiratory Fitness and Quality of Life in Elderly. Althea Medical Journal [Internet]. 2025 Mar 30 [cited 2025 Sep 15];12(1):44–50. Available from: https://journal.fk.unpad.ac.id/index.php/amj/article/view/3756

7. Kuswari, M; Setiawan B. Frekuensi Senam Aerobik Intensitas Sedang Berpengaruh Terhadap Lemak Tubuh Pada Mahasiswi IPB. J Gizi Pangan. 2015;

8. Macintosh BR, Keir DA, Weir JM, Drum SN, Macintosh BR. What Is Moderate to Vigorous Exercise Intensity ? 2021;12(September).

9. Sulistyo FA, Kusnadi NI, Indriani N, Simangunsong NS. PENGARUH SENAM LANSIA TERHADAP RESIKO JATUH PADA LANSIA. Jurnal Ilmiah Wijaya [Internet]. 2023 [cited 2025 Sep 15];15(1). Available from: https://www.jurnalwijaya.com/index.php/jurnal/article/view/233

10. Stern G, Psycharakis SG, Phillips SM. Effect of High-Intensity Interval Training on Functional Movement in Older Adults: A Systematic Review and Meta-analysis. Sports Med Open. 2023;9(1):1–19.

11. Higgins, Elsawy. Rehabilitation Medicine Instalation West Java Province Mental Hospital. 2018;

12. Amanzio M, Palermo S. Editorial : Physical and Cognitive Frailty in the Elderly : An Interdisciplinary Approach. 2021;12(June):10–2.

13. Elezi B, Abazaj E, Kasa M, Topi S. Prevention of Frailty in the Elderly through Physical Activity and Nutrition. 2020;6(1).

14. Gessal J, Utari W. Latihan fisik pada frailty syndrome.

15. Creighton RM, Paradis KF, Blackburn NE, Tully MA. Group-Based Physical Activity Interventions Targeting Enjoyment in Older Adults : A Systematic Review. 2022;113–29.

16. Komatsu H, Yagasaki K, Saito Y, Oguma Y. Regular group exercise contributes to balanced health in older adults in Japan : a qualitative study. 2017;1–9.

17. Kanamori S, Takamiya T, Inoue S. Group exercise for adults and elderly : Determinants of participation in group exercise and its associations with health outcome. 2015;4(4):315–20.

18. Docherty S, Harley R, McAuley JJ, Crowe LAN, Pedret C, Kirwan PD, Siebert S MN. The effect of exercise on cytokines: implications for musculoskeletal health: a narrative review. BMC Sports Sci Med Rehabil. 2022;

19. Timmermans K, Vaneker M, Scheffer GJ, Maassen P, Janssen S, Kox M, et al. Soluble urokinase-type plasminogen activator levels are related to plasma cytokine levels but have low predictive value for mortality in trauma patients ☆. J Crit Care. 2015;30(3):476–80.

20. Giovannini S, Onder ÃG, Liperoti ÃR, Russo ÃA, Carter C, Capoluongo E, et al. Interleukin-6, C-Reactive Protein, and Tumor Necrosis Factor-Alpha as Predictors of Mortality in Frail, Community-Living Elderly Individuals. 2011;1679–85.

21. Rugbeer N, Ramklass S, Mckune A, Van Heerden J. The effect of group exercise frequency on health related quality of life in institutionalized elderly. Pan Afr Med J. 2017;

22. Chetty L, Ramklass SS, Mckune AJ. The effects of a structured group exercise programme on functional fi tness of older persons living in old-age homes. 2018;

23. Dewinta, Nastiti A, Khamndiniyati N, Mega, P L, Aprilia. Pengaruh Senam Poco-Poco Untuk Melawan Demensia. Jurnal Psikostudia Universitas Mulawarman. 2015;

24. Enisah E, Lugina G, Ernawati D, Puspita DR, Rachmawati E, Noviantari F, et al. The Effect of Aerobics and Poco-poco Gymnastics to Physical Energy

Distribution on Schizophrenia Patients: A Systematic Review. Journal Of Midwifery And Nursing. 2019;7(2):45–50.

25. Sekarsari S, Defi IR. Original Article Correlation between Handgrip Strength, Mobilization Function , Physical Activity Level , and Muscle Mass in Community-Dwelling Elderly in Bandung , West Java Province , Indonesia. 2018;1–5.

26. Kurniadi, A. L. (2024, Mei 31). *The right exercise for seniors: Maintaining health and quality of life.* Gadjah Mada University Academic Hospital. https://rsa.ugm.ac.id/olahraga-yang-tepat-untuk-lansia-menjaga-kesehatan-dan-kualitas-hidup/

27. Silva, F. M. *et al.* The sedentary time and physical activity levels on physical fitness in the elderly: A comparative cross sectional study. *Int J Environ Res Public Health* 16, 1–11 (2019

28. Casanova, C. *et al.* The 6-min walk distance in healthy subjects: Reference standards from seven countries. *European Respiratory Journal* 37, 150–156 (2011).

29. Azimkhani A, Kasraei R, Sabeti H, Almasoodi A. The Effect of Aerobic, Resistance, and Combined Exercise Training on Cardiorespiratory Fitness in Healthy People Aged 60 years and Over: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. Biol Res Nurs [Internet]. 2025 Nov 12 [cited 2025 Oct 9]; Available from: https://journals.sagepub.com/doi/10.1177/10998004251348605

30. Harber, M. P. *et al.* Assessing cardiorespiratory fitness in clinical and community settings: Lessons and advancements in the 100th year anniversary of VO2max. *Prog Cardiovasc Dis* 83, 36–42 (2024).

31. Grgic, J., Schoenfeld, B. J., Orazem, J. & Sabol, F. Effects of resistance training performed to repetition failure or non-failure on muscular strength and hypertrophy: A systematic review and meta-analysis. *J Sport Health Sci* 11, 202–211 (2022).

32. Lu F, Liu X, Li J, Sun X, Jiang S. Predictive value of different physical performance assessment methods for falls in older adults: a 3-year longitudinal study in China. Eur Geriatr Med [Internet]. 2025 Jun 1 [cited 2025 Oct 9];16(3):891–7. Available from: https://link.springer.com/article/10.1007/s41999-025-01184-1

33. Ansai, J. H., Aurichio, T. R., Gonçalves, R., & Rebelatto, J. R. (2016). Effects of two physical exercise protocols on physical performance related

to falls in the oldest old: A randomized controlled trial. *Geriatrics & gerontology international*, *16*(4), 492-499.

34. Ayvat, F., Doğan, M. & Ayvat, E. Detecting inactivity in aging populations: the discriminative potential of the physical activity scale for the elderly. *BMC Public Health* 25, (2025).

35. Bautmans I, Salimans L, Njemini R, Beyer I, Lieten S, Liberman K. The effects of exercise interventions on the inflammatory profile of older adults: A systematic review of the recent literature. Exp Gerontol. 2021 Apr 1;146:111236.

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