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Do Single Middle-Aged Individuals Show Superior on Lower Extremity Function Compared to Married Counterparts? A Study on Early Health and Skills Indicators for Pre-frail Elderly

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ABSTRACT

Background: Elderly individuals who understand the physiological changes associated with aging, such as decreased muscle mass, reduced bone density, and altered metabolic rates, will likely be more attuned to their personal needs. The pre-elderly group's susceptibility to depression stems from the sensitivity of health-related fitness components to individuals who are widowed and living alone, as well as those who lack socioeconomic resources and have poor health. **Objectives**: The purpose of this study is to compare the fitness components of pre-elderly groups who are getting close to their golden years living alone without partner, with those of elderly people who still have partners so that they can collaborate to survive together even though their children live in different places. **Methods:** This study is a one-shot case study that is part of a pre-experimental study designed to identify the elements that cause a decline or increase in the number of elderly widows and individuals who are still living in couples as a result of their daily workout habits. Using aerobic endurance instruments (2-minute step test), muscular strength and endurance (30-second arm curl and 30-second chair stand tests), flexibility (back stretch and chair sit-and-reach tests), and balance ability (8-foot up-and-go tests and one-leg stance with eyes open tests), this study measures cardiorespiratory endurance, muscle strength, muscular endurance, flexibility, balance, and body composition. In the meantime, a flexible metal tape measure and a skin-marking pen were employed to measure the circumference of the thighs and waist. The first step in data analysis was a normality test. Following that, the results of an ANOVA calculation were compared to determine how fit pre-elderly individuals who were still living with their partners were compared to those who lived alone as pre-elderly. **Results:** As demonstrated by the low capacity of the lower extremities in the pre-elderly group that still has partners, pre-elderly individuals who live alone due to the divorce or death of their partners are stronger ($0.015 < 0.05$), in terms of health and skills related fitness components in the pre-elderly group. With the exception of people with the highest educational background, differences in educational background have no bearing on one's capacity and inclination to move. **Conclusion:** The pre-elderly who live with spouses, according to the data currently available, is not prepared to deal with becoming a senior. Aging can lead to decreased health and function, although physical activity can prevent and treat frailty. Strength training is often recommended for seniors in order to improve functional autonomy and quality of life. Seniors' physiological health depends on several factors, including living with a partner or alone. The recent study shows that older people living alone are stronger in physical fitness health areas. When engaging with pre-elderly groups, the primary goals of all trainers are to control the movement habits of the elderly and increase the emphasis of training on strength, balance, flexibility, and endurance in order to better equip them for living in their senior years. Additional research suggestions focus on longitudinal surveillance of pre-elderly active activity over five to ten years to prepare their motor component abilities for longevity.

Key words: Pre-elderly, Pre-frail Elderly, Widow, Elder With Spouse, Fitness Components, Health-related, Skills-related

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INTRODUCATION

The aging process correlates with a deterioration in health and functional ability, and physical exercise has been identified as an effective intervention for the prevention and management of physical frailty (Fernández-García et al., 2020). Older individuals who are aware of the implications of aging will prioritize their own needs more thoughtfully. Healthy older adults have proportional physiques, no obesity, a normal waist circumference, and visceral fat (Ito et al., 2019), and their daily meals of nutritious food determines these issues. The pre-elderly population requires innovative exercise modalities to address the challenges of aging, including balance training (Gao et al., 2019), strength development (Ribeiro et al., 2020), flexibility enhancement (Mekari et al., 2020), and cardiovascular fitness (Villareal et al., 2017).

The Indonesian population census indicates a total of 270.20 million individuals, with the baby boomer group, now nearing old age, comprising 11.56% of the overall population (Medawati et al., 2020). The benchmark age for the old is established at over 60 years according to Indonesian law from Ministry of Health of the Republic of Indonesia, but rules in industrialized nations often commence at 65 years and above (Nelson et al., 2007; Sherrington et al., 2011). Among the 11.56% of the old population in Indonesia, 52.80% reside in metropolitan areas, while the remainder inhabit rural regions, with younger elderly individuals predominantly represented in the 60-69 age bracket. The pre-elderly demographic is defined as individuals aged 45 to 59 years, reported by Central Bureau of Statistics of Indonesia (Medawati et al., 2020). The Special Region of Yogyakarta, where this study was conducted, has the highest proportion of elderly individuals in Indonesia, comprising 14.50%. Consequently, Yogyakarta serves as a representative sample for elderly data that can facilitate the initiation of changes aimed at enhancing the quality of life for the elderly.

Research from India indicated that 13.6% of 30,639 senior individuals residing alone suffered from depression (Srivastava et al., 2021), which subsequently diminished their inclination towards physical exercise (L. Lin et al., 2019). The research indicated a susceptibility to depression among senior individuals who were widowed and residing alone, as well as those with limited socio-economic implies and poor health (Srivastava et al., 2021). Conversely, data indicated that elderly individuals participating in a year-long group exercise program, with physical assessments conducted every four months, exhibited an overall younger look during the initial four months compared to those who discontinued due to illness, inactive, time limitations, diminished interest or motivation, and transportation difficulties (Tomioka et al., 2019). This phenomenon generates a significant risk for depression across pre-elderly and elderly populations, encompassing young, middle-aged, and seniors (Gouveia et al., 2017). As individuals aging and experience a rise in BMI, their capacity for dynamic stabilization and balance significantly diminishes (Gao et al., 2019). This is associated with a rise in the weight of the elderly, despite the diverse factors influencing food consumption. In Japan, a nutritious Japanese diet is inversely associated with waist circumference and visceral fat levels in middle-aged and elderly Japanese males (Sawada et al., 2017). The pre-elderly demographic need assistance to mitigate the danger of falls, which will likely escalate when the elderly are oblivious to the significance of mobility and exercise (Sawada et al., 2017). Falls constitute a primary source of harm among the aged population. Hence, obesity is correlated with an increased risk of falls.

Most studies focus exclusively on the relationship between fitness components and health in the elderly; however, preliminary research is necessary to assess the degree to which older fitness facilitates daily physical activities in later life. Nevertheless, the pre-elderly demographic is overlooked as it is perceived as still productive and healthy. This marks the commencement of forecasting the future conduct of the elderly population in regard to aging (Fernández-García et al., 2020). Conversely, it is common to see circumstances where seniors exhibit vulnerabilities such as osteoporosis and restricted mobility from a pre-elderly stage. Exercise and physical training may prevent disease and injury, reduce functional loss and impairment, and mitigate the progression and symptoms of current cardiovascular, pulmonary, and metabolic problems (Frankel et al., 2006). There is a deficiency in awareness regarding the implementation of exercise programs to avert frailty in the pre-elderly demographic (Lai et al., 2021). The pre-elderly population should engage in physical exercise to mitigate susceptibility risk; nevertheless, they frequently exhibit a lack of motivation (Kellenaers et al., 2023). Additionally, the aging process significantly escalates the incidence of detraining (Fernández-García et al., 2020). For the past twenty years, research has indicated the need for integrated exercise programs and enhanced adherence among older adults (Frankel et al., 2006). However, this area of study remains in progress, characterized by inconsistent positive trends and ongoing debates regarding the merits and drawbacks of each new exercise model. This study aims to examine the prevalence of pre-elderly individuals nearing old age who their partners have left, and to evaluate their fitness components in comparison to elderly individuals who maintain a living together despite their children residing in different locations. This study aims to assess the strength and fitness of the pre-elderly group to ensure their independence in performing physical activities once approaching the age of 60 and above.

METHODS

Research Design

This research comprises explanatory case study focuses on an exploration of the diverse conditions observed in pre-frail senior individuals, with or without spouses, explained by disparities in health and skill-fitness components, aimed at identifying the causal elements influencing elderly widows and couples regarding fluctuations in their daily physical work habits. To assess the fitness level of the pre-elderly cohort in order to examine the initial state of the elderly prior to a more rapid onset of metabolic loss associated with aging.

Subjects

The participants were classified as pre-elderly, aged between 49 and 59 years. The subject selection method involved multiple stages of screening, as illustrated in the subsequent figure. Implementing the Slovin formula to determine sample size with a margin of error of 0.05 and a population of 173, the required sample size (n) at least 120 subjects for initial recruitment subjects. This study involves a sample surpassing this threshold, totaling 156 participants included in the screening, alongside multiple stages of absorption and data fulfillment factors, a total of 41 pre-elderly individuals were recruited, with a large effect size of approximately 0.8, a probability of type I error value of 0.05, and 75% power, the recommended sample size by G*Power 3.1 was 36. All recruited subjects willingly and fullfill all requirements for data analysis (Table 1), then voluntary to accomplish all fitness assessment tools.

Instruments

The instruments tested in this study involve cardiorespiratory endurance, muscular strength, muscular endurance, flexibility, balance, and body composition, utilizing aerobic endurance assessments (2-minute step test), muscular strength and endurance evaluations (30-second arm curl and 30-second chair stand tests), flexibility measurements (back stretch and chair sit-and-reach tests), and balance assessments (8-foot up-and-go tests and one-leg stance with eyes open tests) (Y. T. Lin et al., 2020). Thigh and waist circumference measurements were obtained using a flexible metal tape measure and a pen appropriate for marking the skin. Height and weight measurements with Omron Karada Scan HBF-375).

Data Analysis

The data analysis began with a normality test, then assessing the fitness comparison between pre-elderly individuals who remained with their partners and those who lived alone, utilizing ANOVA calculation results for comparison. The Pearson Correlation statistical analysis was conducted to determine the strength of the relationship between health-related fitness component variables (lower extremity function, arm strength, cardiorespiratory fitness, lower and upper body flexibility, power, speed, agility, and dynamic balance) and the variables of height, weight thigh circumference and waist circumference. All data sets were analysed using IBM SPSS Statistics 27.

Table 1. Pre-elderly characteristics

Components	Groups	
	Widow (*n*=13)	**Married (*n*=28)**
Age (years)	55.23 ± 3.70	54.80 ± 3.16
Height (cm)	151.67 ± 6.18	154.07 ± 3.91
Weight (kg)	60.90 ± 10.62	63.55 ± 9.55

RESULTS

This study showed a significant result in lower extremity function between pre-elderly individuals living alone and those with spouse ($0.015 < 0.05$), as illustrated in Table 2. Based on significant data, pre-elderly living alone exhibited greater self-confidence and autonomy compared to those living with a partner, because lower extremity function have a crucial role for daily activities, such as walking (moving from one place to another). Overall, other health-related abilities did not demonstrate significant differences; however, data trends and average values indicated that pre-elderly individuals living alone surpassed their counterparts with spouses across all aspects. This outcome provides an important reminder to all pre-elderly groups, as it calls for careful consideration of whether they are prepared for their body and health when approaching their senior years. These findings can be a reference to the elderly population.

Identification about fitness and anthropometric capabilities was determined by examining educational background, highlighting variations among pre-elderly individuals with elementary school (Table 4), junior high school (Table 5), and senior high school/Bachelor/Diploma (Table 6) qualifications. Significant differences were identified entirely within the pre-elderly group of senior high school/Bachelor/Diploma graduates, as indicated by the overall data (Table 6). This finding did not extend to the pre-elderly group of elementary and junior high school graduates, although similar trends were observed among three education background analyses. Meanwhile, for health and skills-related fitness, it is recognized that there are no significant disparities.

DISCUSSION

The fundamental elements of an exercise program—strength, endurance, balance, and flexibility—are crucial for equipping the pre-elderly population with the motor skills necessary for daily activities (Frankel et al., 2006). Over the past twenty years, extensive research has examined these components within clinical settings, highlighting the importance of understanding how exercise impacts older adults. Recent studies have emphasized that various instrumental factors, such as cardiorespiratory endurance, muscle strength, mus-

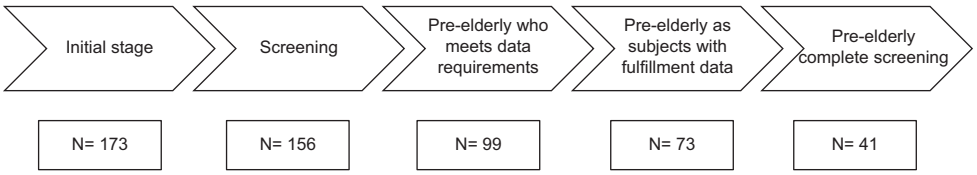

Figure 1. Phases of older adults' recruitment

Table 2. One-way ANOVA allows for comparing widows and married individuals.

Fitness Components	**Instruments**	**Groups**		**Sig.**
		Widow (*n*=13)	**Married (*n*=28)**	***p*-value**
Lower extremity function	Chair stand test	20.38 ± 4.62	17.50 ± 3.52	0.015*
Arm strength	Arm curl	22.85 ± 3.71	21.54 ± 3.23	0.257
Cardiorespiratory	2-minutes step test	114.85 ± 17.01	111 ± 13.87	0.447
Lower body flexibility	Chair sit and reach	5.96 ± 6.15	7.32 ± 7.19	0.367
Upper body flexibility	Back scratch test	-6.23 ± 5.81	-3.07 ± 8.27	0.103
Power, speed, agility and dynamic balance	8 Foot up and go test	6.36 ± 1.11	6.82 ± 1.82	0.634
Anthropometry	Thigh circumference	89 ± 8.64	88.50 ± 11.44	0.928
	Waist circumference	102 ± 3.22	100.50 ± 8.12	0.676

*significant difference (*p*-value<0.05)

Table 3. Age, thigh and waist circumference correlation between widows and elder with partners

Variables Independent	**Variables Dependent**	**r**	**Sig. (2-tailed)**
Age (*n*=41)	Chair stand test	0.069	0.666
	Arm curl	0.073	0.649
	2-minutes step test	0.088	0.584
	Chair sit and reach	-0.004	0.980
	Back scratch test	-0.156	0.330
	8 Foot up and go test	-0.050	0.756
Thigh circumference (*n*=16)	Chair stand test	-0.269	0.313
	Arm curl	0.363	0.167
	2-minutes step test	0.528	0.035*
	Chair sit and reach	-0.376	0.151
	Back scratch test	-0.0.73	0.788
	8 Foot up and go test	0.160	0.555
Waist circumference (*n*=16)	Chair stand test	-0.065	0.812
	Arm curl	0.250	0.351
	2-minutes step test	0.297	0.264
	Chair sit and reach	0.113	0.676
	Back scratch test	-0.161	0.551
	8 Foot up and go test	0.114	0.675

*significant difference (*p*-value<0.05)

Table 4. Analysis of fitness components based on elementary school background between widows and individuals with partners

Fitness Components	**Instruments**	**Groups**		**Sig.**
		Widow (*n*=2)	**Married (*n*=7)**	***p*-value**
Lower extremity function	Chair stand test	18.50 ± 0.70	17.57 ± 3.64	0.500
Arm strength	Arm curl	23.50 ± 0.70	22.86 ± 2.91	0.776
Cardiorespiratory	2-minutes step test	98 ± 8.48	112.14 ± 14.45	0.241
Lower body flexibility	Chair sit and reach	7.5 ± 7.78	8.42 ± 6.50	1
Upper body flexibility	Back scratch test	-0.5 ± 3.53	0.143 ± 3.13	0.881
Power, speed, agility and dynamic balance	8 Foot up and go test	5.71 ± 1.68	6.97 ± 1.65	0.380
Anthropometry	Thigh circumference	-	-	-
	Waist circumference	-	-	-

Table 5. Analysis of fitness components based on junior high school background between widows and individuals with partners

Fitness Components	Instruments	Groups		Sig.
		Widow (*n*=6)	Married (*n*=6)	*p*-value
Lower extremity function	Chair stand test	19.17 ± 2.97	18.50 ± 5.95	0.469
Arm strength	Arm curl	22.50 ± 5.32	20.17 ± 2.04	0.339
Cardiorespiratory	2-minutes step test	120 ± 19.46	106.33 ± 19.02	0.247
Lower body flexibility	Chair sit and reach	4 ± 6.60	7 ± 3.84	0.335
Upper body flexibility	Back scratch test	-4.91 ± 5.88	-7 ± 4.69	0.296
Power, speed, agility and dynamic balance	8 Foot up and go test	6.84 ± 1.08	6.92 ± 0.86	0.873
Anthropometry	Thigh circumference	91.33 ± 7.5	88.67 ± 12.23	0.862
	Waist circumference	101 ± 1.52	104 ± 8.38	0.743

Table 6. Analysis of fitness components based on senior high school/Bachelor/Diploma background between widows and individuals with partners

Fitness Components	Instruments	Groups		Sig.
		Widow (*n*=5)	Married (*n*=14)	*p*-value
Lower extremity function	Chair stand test	22.60 ± 6.58	17.07 ± 2.30	0.034*
Arm strength	Arm curl	23 ± 2.34	21.57 ± 3.77	0.443
Cardiorespiratory	2-minutes step test	115.40 ± 13.93	113.57 ± 11.26	0.772
Lower body flexibility	Chair sit and reach	7.70 ± 5.76	6.57 ± 8.90	0.964
Upper body flexibility	Back scratch test	-10.10 ± 4.12	-1.07 ± 7.51	0.014*
Power, speed, agility and dynamic balance	8 Foot up and go test	6.05 ± 0.93	6.80 ± 2.29	0.622
Anthropometry	Thigh circumference	87 ± 1.41	90.60 ± 6.42	0.490
	Waist circumference	105 ± 2.82	99.80 ± 5.16	0.251

*significant difference (*p*-value<0.05)

cle endurance, flexibility, balance, and body composition, significantly influence an individual's overall happiness (Lin et al., 2020). Specifically, assessments of aerobic endurance (measured by the 2-minute step test), muscular strength and endurance (evaluated through the 30-second arm curl and 30-second chair stand tests), flexibility (assessed via back stretch and chair sit-and-reach tests), and balance ability (determined by the 8-foot up-and-go test and one-leg stance with eyes open test) have shown a strong correlation with improved happiness levels. Furthermore, a study conducted in Hawaii involved annual assessments over three years for a structured elderly group. Previous study (Lin et al., 2020) has linear perspective with recent results study in general. On the other hand, previous study evaluated same variables include lower extremity function, arm strength, and combined capabilities in power, speed, agility, and dynamic balance using chair stands, arm curls, and the up-and-go test. The results demonstrated that participants' physical performance improved after four months of training. Notably, this enhancement was maintained for eight months and continued to show benefits in the control group for up to one year (Tomioka et al., 2019). According to these two types of research, fitness component variables have a major impact on the health and motor skills of pre-frail seniors. The current research also found that pre-elderly individuals who live alone and those who are still with a partner have different risks and should be specifically examined in the supporting components, as the findings indicate that independent pre-frail elderly individuals possess greater strength than their partnered counterparts.

Another recent experiment involving robots and the elderly included 12 pre-elderly participants who engaged in activity under three distinct conditions: (1) no music during the exercise, (2) music selected by the robot, and (3) music chosen by the participants themselves. The findings indicated that participants preferred the exercise facilitated by the robot trainer when accompanied by music. Furthermore, the music genre required individualization, and the outcomes regarding the autonomy of choice (robot versus individual) were unclear; still, the majority favored the robot selecting the music (Kellenaers et al., 2023). This is highly pragmatic, yet the utilization of robots remains taboo in many countries; however, it demonstrates that digitization is deeply embedded and delivers substantial outcomes. Conventional strength training remains widespread among pre-elderly populations due to its established efficacy in facilitating weight loss. A combination of aerobic and strength training is particularly effective in enhancing the motor abilities of obese elderly individuals (Sawada et al., 2017; Villareal et al., 2017), especially when conducted under supervision for a specific amount of time (Villareal et al., 2017). This approach is supported by well-documented skeletal muscle

adaptations (Miller et al., 2021). Studies advocate for Tai Chi as a means to enhance muscle training, encompassing both strength and endurance (Lan et al., 2000), nonetheless, its practice remains relatively unknown in Indonesia. Pre-elderly individuals are more habituated to low-impact aerobic exercise routines, characterized by minimal explosive movements and yoga practices (Supratmanto & Kushartanti, 2018). Ignorance, unawareness, and indifference among pre-elderly and elderly populations regarding the important role of physical activity in the elderly phase require support from family and healthcare systems to enhance active behavior in older adults (Wolff et al., 2020), a recommendation that has been advocated for many years ago (Shanas, 1979; Stoltz et al., 2004).

It is generally considered that strength training continues to be an influential intervention that can potentially improve seniors' functional capacity and quality of life (Ribeiro et al., 2020). According to the World Health Organization's recommendations for older individuals, they should engage in at least two sessions of strength training each week and three sessions of cardiovascular exercises (World Health Organization, 2020). On the other hand, due to the fact that pre-frail older people have a variety of specific requirements, the optimum workout routine for them differs greatly. Considering that a significant number of elderly people struggle with conditions such as sarcopenia, which is defined by a loss of muscular mass and strength (Granic et al., 2019; Pinheiro et al., 2015), making strength training particularly beneficial. cardiovascular health may be improved by the use of a variety of modalities, including aerobic activities capacities (Cadore et al., 2014). A moderate effort is adequate; the most important thing is the capacity to move independently, which makes a favorable contribution to functional (Lai et al., 2021). Increasing dynamic stability through activities such as walking is another important factor in reducing the number of falls that occur among obese seniors. According to studies, increased stability has a substantial correlation with a reduction in the number of falls (Gao et al., 2019 Among pre-elderly populations, combining strength training with aerobic exercise has been shown to be useful in reducing the risk of falling and alleviating pain (Sawada et al., 2017; Villareal et al., 2017). For this reason, senior people need to participate in a complete fitness program that incorporates both strength training and aerobic activities in order to preserve their general health and keep their functional independence.

Aging inevitably leads to diminishing health and functional capacity; however, physical exercise stands out as an effective tool against frailty's onset and progression (Fernández-García et al., 2020). Strength training emerges as a prime recommendation for boosting functional autonomy and enhancing life quality in older adults (Ribeiro et al., 2020). Specific determinants influencing physiological changes include lifestyle choices such as cohabiting vs living solo; studies indicate solitary elders tend toward stronger physiologic profiles across multiple domains (Tomioka et al., 2019). The current study indicates that, from the perspective of physical fitness health components, elderly individuals living alone exhibit greater strength in various aspects. The comparative results reveal both significant and non-significant findings, yet a trend towards better conditions appears among the elderly who live alone. The risk of a negative connection for older individuals living alone is markedly elevated concerning the mental health component (Gouveia et al., 2017). Alongside other factors, including participation in regular physical activity, enhanced physical performance in the elderly correlates with more youthful and a reduced number of chronic diseases (Tomioka et al., 2019). A study conducted in Japan revealed that seafood and alcohol consumption did not significantly impact waist circumference and visceral fat in the elderly (Ito et al., 2019). However, it emphasized that a healthy diet can mitigate increases in waist circumference and visceral fat, particularly in the context of the elevated malnutrition risk associated with a BMI classified as overweight or obese (Bahat et al., 2012), despite this study addressing an area that remains largely unexplored (see Table 3). To further enhance the effectiveness of exercise programs tailored for older adults, a multimodal approach is recommended. This includes structured sessions that focus on functional resistance training alongside aerobic activities to improve overall fitness levels and reduce fall risks. For instance, programs may incorporate tests such as the back stretch and chair sit-and-reach tests for flexibility and the 8-foot up-and-go test for balance ability. These assessments not only help in tracking progress but also ensure that participants engage in activities that are both enjoyable and beneficial. Moreover, evidence suggests that regular participation in such structured exercise regimens can significantly improve physical fitness components, ultimately fostering greater independence and enhancing life satisfaction among older adults. By emphasizing a comprehensive approach to fitness that includes strength training, aerobic conditioning, and balance exercises, we can better support the aging population in maintaining their health and functional capabilities as they transition into later life stages.

CONCLUSION

Pre-elderly individuals living alone due to spouse break or death have greater fitness components associated with skills in the elderly demographic, as indicated by the diminished lower extremity capabilities in the pre-elderly group who lived with partners. Variations in educational background exhibit very little influence on the capacity and inclination to move, with the exception of those possessing the greatest levels of education. The pre-elderly group with partners is unprepared to confront the challenges of aging. The primary objectives for trainers working with pre-elderly groups are to regulate movement patterns and to enhance training emphasis on strength, balance, flexibility, and endurance, thereby better equipping individuals for facing the obstacles of aging. Future research needs to focus on five to ten years of longitudinal assessments of the active behaviors of the pre-elderly population to guarantee their motor skills are sufficiently ready for the demands of aging.

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ETHICAL APPROVAL

The study was approved by Ethics Commission, Directorate of Research and Community Service, Universitas Negeri Yogyakarta (Ref No. T/21.2/UN34.9/KP.06.07/2024) and carried out under the guidelines of the Declaration of Helsinki for human research.

DATA AVAILABILITY

The data presented in this study are available on request from the corresponding author.

AUTHOR CONTRIBUTIONS

Conceptualization, RM, PaS and PriS. Methodology, RM, and PaS. Software, RM, Investigation, RM, and RS. Manuscript writing, RM. Visualization, PaS, PriS, and RS. Supervision, PaS, BEO, and GE. All authors have read and approved the final versions of the manuscripts.

REFERENCES

Bahat, G., Tufan, F., Saka, B., Akin, S., Ozkaya, H., Yucel, N., Erten, N., & Karan, M. A. (2012). Which body mass index (BMI) is better in the elderly for functional status? *Archives of Gerontology and Geriatrics*. https://doi.org/10.1016/j.archger.2011.04.019

Cadore, E. L., Pinto, R. S., Bottaro, M., & Izquierdo, M. (2014). Strength and endurance training prescription in healthy and frail elderly. *Aging and Disease*, *5*(3), 183–195. https://doi.org/10.14336/AD.2014.0500183

Fernández-García, Á. I., Gómez-Cabello, A., Moradell, A., Navarrete-Villanueva, D., Pérez-Gómez, J., Ara, I., Pedrero-Chamizo, R., Subías-Perié, J., Muniz-Pardos, B., Casajús, J. A., & Vicente-Rodríguez, G. (2020). How to improve the functional capacity of frail and pre-frail elderly people? Health, nutritional status and exercise intervention. the EXERNET-elder 3.0 project. *Sustainability (Switzerland)*, *12*(15). https://doi.org/10.3390/SU12156246

Frankel, J. E., Bean, J. F., & Frontera, W. R. (2006). Exercise in the Elderly: Research and Clinical Practice. *Clinics in Geriatric Medicine*, *22*(2), 239–256. https://doi.org/10.1016/j.cger.2005.12.002

Gao, X., Wang, L., Shen, F., Ma, Y., Fan, Y., & Niu, H. (2019). Dynamic walking stability of elderly people with various BMIs. *Gait and Posture*. https://doi.org/10.1016/j.gaitpost.2018.11.027

Gouveia, É. R. Q., Gouveia, B. R., Ihle, A., Kliegel, M., Maia, J. A., i Badia, S. B., & Freitas, D. L. (2017). Correlates of health-related quality of life in young-old and old–old community-dwelling older adults. *Quality of Life Research*, *26*(6). https://doi.org/10.1007/s11136-017-1502-z

Granic, A., Hurst, C., Dismore, L., Davies, K., Stevenson, E., Sayer, A. A., & Aspray, T. (2019). Milk and resistance exercise intervention to improve muscle function in community-dwelling older adults at risk of sarcopenia (MIlkMAN): protocol for a pilot study. *BMJ Open*, *9*(10), e031048. https://doi.org/10.1136/bmjopen-2019-031048

Ito, T., Kawakami, R., Tanisawa, K., Miyawaki, R., Ishii, K., Torii, S., Suzuki, K., Sakamoto, S., Muraoka, I., Oka, K., & Higuchi, M. (2019). Dietary patterns and abdominal obesity in middle-aged and elderly Japanese adults: Waseda Alumni's Sports, Exercise, Daily Activity, Sedentariness and Health Study (WASEDA'S Health Study). *Nutrition*. https://doi.org/10.1016/j.nut.2018.05.029

Kellenaers, M., Tetteroo, D., & Barakova, E. (2023). Influence of Music on Enjoyment of Pre-Frail Elderly While Doing Physical Exercises with a Robot Coach. *Springer Proceedings in Advanced Robotics*, *26*. https://doi.org/10.1007/978-3-031-22731-8_11

Lai, X., Bo, L., Zhu, H., Chen, B., Wu, Z., Du, H., & Huo, X. (2021). Effects of lower limb resistance exercise on muscle strength, physical fitness, and metabolism in pre-frail elderly patients: a randomized controlled trial. *BMC Geriatrics*, *21*(1). https://doi.org/10.1186/s12877-021-02386-5

Lan, C., Lai, J. S., Chen, S. Y., & Wong, M. K. (2000). Tai Chi Chuan to improve muscular strength and endurance in elderly individuals: A pilot study. *Archives of Physical Medicine and Rehabilitation*, *81*(5), 604–607. https://doi.org/10.1053/mr.2000.3849

Lin, L., Lo, M. S. W., Yang, N.-H., & Li, G.-J. (2019). Different Exercise Training on Reaction Time In Older Adults With Mild Cognitive Impairment. *Medicine & Science in Sports & Exercise*. https://doi.org/10.1249/01.mss.0000561139.91510.3f

Lin, Y. T., Chen, M. C., Ho, C. C., & Lee, T. S. (2020). Relationships among leisure physical activity, sedentary lifestyle, physical fitness, and happiness in adults 65 years or older in Taiwan. *International Journal of Environmental Research and Public Health*, *17*(14). https://doi.org/10.3390/ijerph17145235

Medawati, R., Haryanto, J., & Ulfiana, E. (2020). Analysis of Successful Aging Factors in Elderly People Who Work as Farmers. *Indonesian Journal of Community Health Nursing*. https://doi.org/10.20473/ijchn.v5i1.18704.

Mekari, S., Neyedli, H. F., Fraser, S., O'brien, M. W., Martins, R., Evans, K., Earle, M., Aucoin, R., Chiekwe, J., Hollohan, Q., Kimmerly, D. S., & Dupuy, O. (2020). High-intensity interval training improves cognitive flexibility in older adults. *Brain Sciences*. https://doi.org/10.3390/brainsci10110796

Miller, R. M., Bemben, D. A., & Bemben, M. G. (2021). Skeletal muscle adaptations following 80 weeks of resistance exercise in older adults. *Journal of Geri-*

atric Physical Therapy. https://doi.org/10.1519/JPT.0000000000000302

Nelson, M. E., Rejeski, W. J., Blair, S. N., Duncan, P. W., Judge, J. O., King, A. C., Macera, C. A., & Castaneda-Sceppa, C. (2007). Physical activity and public health in older adults: Recommendation from the American College of Sports Medicine and the American Heart Association. *Circulation*, *116*(9), 1094–1105. https://doi.org/10.1161/CIRCULATIONAHA.107.185650

Pinheiro, P. A., Carneiro, J. A. O., Coqueiro, R. S., Pereira, R., & Fernandes, M. H. (2015). "Chair stand test" as simple tool for sarcopenia screening in elderly women. *The Journal of Nutrition, Health & Aging*, *November*. https://doi.org/10.1007/s12603-015-0621-x

Ribeiro, A. S., Nunes, J. P., & Schoenfeld, B. J. (2020). Selection of Resistance Exercises for Older Individuals: The Forgotten Variable. *Sports Medicine*. https://doi.org/10.1007/s40279-020-01260-5

Sawada, S. S., Tanimoto, M., Gando, Y., Murakami, H., Kawakami, R., Tsuda, H., Saito, H., Blair, S. N., & Miyachi, M. (2017). Effects of Combined Aerobic and Resistance Training. *Medicine & Science in Sports & Exercise*. https://doi.org/10.1249/01.mss.0000516908.86409.6c

Shanas, E. (1979). The family as a social support system in old age. *Gerontologist*, *19*(2), 169–174. https://doi.org/10.1093/geront/19.2.169

Sherrington, C., Tiedemann, A., Fairhall, N., Close, J. C. T., & Lord, S. R. (2011). Exercise to prevent falls in older adults: an updated meta-analysis and best practice recommendations. *NSW Public Health Bulletin*, *22*(3–4), 78–83. https://doi.org/10.1071/nb10056

Srivastava, S., Debnath, P., Shri, N., & Muhammad, T. (2021). The association of widowhood and living alone with depression among older adults in India. *Scientific Reports*, *11*(1). https://doi.org/10.1038/s41598-021-01238-x

Stoltz, P., Udén, G., & Willman, A. (2004). Support for family carers who care for an elderly person at home - A systematic literature review. *Scandinavian Journal of Caring Sciences*, *18*(2), 111–119. https://doi.org/10.1111/j.1471-6712.2004.00269.x

Supratmanto, D., & Kushartanti, B. M. W. (2018). Pengaruh senam aerobik dan yoga terhadap rasio lingkar pinggang panggul dan tingkat depresi pada wanita primenopause. *Jurnal Keolahragaan*, *6*(2), 172–183. https://doi.org/https://doi.org/10.21831/jk.v0i0.20616

Tomioka, M., Braun, K. L., Wu, Y. Y., Holt, K., Keele, P., Tsuhako, L., & Yago, J. (2019). Twelve-Month Retention in and Impact of Enhance®Fitness on Older Adults in Hawai'i. *Journal of Aging Research*, *2019*. https://doi.org/10.1155/2019/9836181

Villareal, D. T., Aguirre, L., Gurney, A. B., Waters, D. L., Sinacore, D. R., Colombo, E., Armamento-Villareal, R., & Qualls, C. (2017). Aerobic or Resistance Exercise, or Both, in Dieting Obese Older Adults. *New England Journal of Medicine*. https://doi.org/10.1056/nejmoa1616338

Wolff, J. L., Freedman, V. A., Mulcahy, J. F., & Kasper, J. D. (2020). Family Caregivers' Experiences with Health Care Workers in the Care of Older Adults with Activity Limitations. *JAMA Network Open*. https://doi.org/10.1001/jamanetworkopen.2019.19866

World Health Organization. (2020). WHO Guidelines on physical activity, sedentary behaviour. In *World Health Organization*. https://doi.org/10.1136/bjsports-2020-102955