Link Medical Journal
of Health and Community Research

Volume 1, Issue 2 (July-December 2023)

Original Article

Effects of a Walking-Based Home Program on Cardiorespiratory Performance and Physical Activity in Elderly People with Sarcopenia: A Randomized Controlled Trial

Tooba Asif*[1], Maira Muneer[2]

ABSTRACT

Background: Sarcopenia is an important and common disease of older adults caused by the reduction of muscle mass and functionality, resulting in the decline of quality of life and independence in this population. For this reason, physical activity, through walking mainly, has been seen as a crucial tool for improving the severity of this condition. Still, a contribution of a home-based walking program to the performance of cardiorespiratory functions and physical activity in older people with sarcopenia has yet to be quantified.

Objective: The effectiveness of a walking-based home program in improving physical and cardiorespiratory performance in older people with sarcopenia.

Methods: This was a quasi-experimental design where 68 sarcopenic older adults, with a mean age of 70.58 years, were recruited from the community and then randomly assigned to two different groups: intervention (n=34) and control (n=34). The intervention group was submitted to a 12-week home-based walking program. Measures related to handgrip strength, gait speed, MIP, MEP, SMI, and levels of physical activity were collected before and after the end of the program. Intra-group and inter-group changes were calculated by the paired and independent t-tests, respectively.

Results: The following results of the positive changes after the study were seen in the intervention group: an increase in handgrip strength of individuals from 21.50 kg to 25.00 kg ($p<0.001$); an increase in the speed of gait from 1.02 m/s to 1.15 m/s ($p=0.003$); there was also an increase in MIP from 50.00 cmH2O to 65.00 cmH2O; it also presented a significant increase in walking distance from 340 m to 380 m ($p=0.015$) and physical activity levels from 1150 MET minutes/week to 3400 MET minutes/week ($p<0.001$). MEP and SMI did not change.

Conclusion: The walking-based home program significantly improved the physical performance metrics as well as cardio-respiratory fitness in sarcopenic older adults. These results indicate this type of program may be a useful and scalable intervention for health outcomes for this population.

Keywords: Sarcopenia, Older Adults, Walking Program, Physical Activity, Cardio-Respiratory Performance, Randomized Controlled Trial.

* Corresponding Author: tooba573@gmail.com
Authors' and timeline Information is given at end of article.

INTRODUCTION

Sarcopenia is defined as a syndrome characterized by progressive loss of skeletal muscle mass and strength, presenting a risk for older adults' health and independence.(1) Sarcopenia not only threatens the physical functionality of older adults but also results in various negative health consequences, such as falls, frailty, and a diminished quality of life (2, 3). The increasing prevalence of sarcopenia with age reflects the necessity to find interventions that can effectively curb the consequences related to the condition and better the lives of the elderly people (4, 5).

A highly feasible and applicable form of physical activity, and also an effective intervention for combating the effects of sarcopenia, is walking. Walking is simple, easily accessible, and requires no special equipment and very little training, making it highly suitable for older adults (6, 7). In fact, a dose-response gradient of studies has indicated that regular walking improves muscle strength, enhances cardio-respiratory fitness, and promotes physical activity levels, which are important factors in the management of sarcopenia. In fact, walking is an activity that can take place at home, which is again great for elderly people, since many of them perceive at least one barrier that hampers exercise class attendance at formal exercise facilities (8, 9).

Nevertheless, there is a gap in the literature showing that home-based walking programs are effective for sarcopenic older adults. Although research has been conducted on the benefits of general physical activity and exercise programs for this demographic, few studies have targeted walking as a standalone intervention within the home environment. Moreover, most of the existing research often failed to consider the implication of such interventions on cardio-respiratory performance and overall physical activity levels in sarcopenic persons and mainly focusing on muscle strength and functional mobility (10-13).

The primary aim of the present randomized control trial is to access the effect of walking-based home program activities on cardio-respiratory performance and physical activity in sarcopenic geriatric persons. As a result, evidence will be provided for concluding the potential of such programs to impact health outcomes in such frail persons. The reason for considering this particular set of outcomes lies in their importance in the overall health and functional independence of older persons. Improvement in the cardio-respiratory performance would lead to better oxygen utilization and thereby would result in an increase in endurance, whereas an increase in physical activity levels would aid in the maintenance of muscle mass and overall physical health (14-18).

Increasing older populations worldwide and associated rising age-related health conditions, such as sarcopenia place an increased demand to look for the cost-effective, scalable, and sustainable interventions. Therefore, this trial will be useful in gaining insight into the effects of walking-based programs on health and disability and can be used to further promote the practice of healthier aging among the older persons (19-23).

MATERIAL AND METHODS

The study was conducted as a randomized controlled trial. The sample consisted of participants 60 years and older with a clinical diagnosis of sarcopenia according to the criteria of the European Working Group on Sarcopenia in Older People (EWGSOP). The inclusion criteria were community-dwelling older adults who can ambulate independently, with or without assistive devices. The exclusion criteria were severe cardiovascular, respiratory, and orthopedic conditions that could preclude safe participation in a walking exercise, and cognitive impairment with a level that would hinder the possibility of obtaining informed consent or compliance with the protocol of interventions (17-21).

The participants were selected from community centers and clinics for geriatric care. A sample of 68 individuals was randomized into two groups, an intervention group and a control group, each containing 34 participants. Randomization was achieved via computer-generated sequence that guaranteed equal distribution. The allocation was concealed until interventions were assigned by concealed envelope method.

The intervention group was given a 12-week, home-based walking exercise program, individually tailored to their baseline cardio-physical fitness level. They were asked to exercise walking at a moderate pace for at least 30 minutes, five times a week. The rehabilitation program was supplemented by telephone contacts every week and by daily registration in an activity log. Probing for motivational interviewing was used to enhance adherence.

Data collection was carried out with two steps including the estimation of pre-testing information and relevant baseline assessment. Data on characteristics such as age and sex have been collected. Prevalence of diabetes mellitus, dyslipidemia, hypertension, heart disease, COPD/Asthma in the last 5 years was recorded as well.

Physical activity measurements and cardio-respiratory fitness were assessed using standardized instruments and procedures. Measurements recorded in this study were handgrip strength (by dynamometer), gait speed (measured over a 4-meter walk), MIP, MEP, SMI, and weekly levels of physical activity (measured by the International Physical Activity Questionnaire). All the measurements were made by personnel who had been trained on their performance and who were blinded to the assignment of the groups in order to avoid the influence of bias. Similarly, participants did not know the hypothesis being tested.

It was ethically conducted to respect the protection of the rights and welfare of the subjects that participated in the research. They were explained the purpose of the study, its procedures, possible risks, and benefits, and the right to leave the research at any time without consequences. Such a very strict methodological approach enabled the reliability and validity of the results and allowed us to confirm the potential benefits of the application of walking-based programs to the particular group of the elderly with sarcopenia. This study design allowed the research to follow the Declaration of Helsinki and be approved by an institutional review board. Before the study, all the participants signed an informed consent form in written form.

The data was analyzed with the program SPSS version 25. Descriptive statistics were presented to characterize the study group at baseline. The comparison between the intervention group and the control group was made with the application of independent t-tests for continuous variables and the chi-square test for categorical variables. Pre-intervention and post-intervention measures were compared in the intervention group and the control group by the paired t-test. In all the tests executed, the reported level of significance was a p-value of 0.05. Such control on missing values was done with the intention-to-treat analysis, which maintained the accuracy of the results.

RESULTS

The intervention group showed significant improvement in physical activity and cardio-respiratory performance during the walking-based home program at 12 weeks as compared to the control group. The distribution of sex, age, health conditions like diabetes mellitus, dyslipidemia, hypertension, heart disease, and COPD/Asthma, among other demographic and health characteristics, were similar at baseline between the groups, hence were matched. The mean for age in both groups also showed a difference in the control group (71.93 ± 5.19 years) and the intervention group (69.23 ± 6.71 years), with a confidence interval of -5.80 to 0.40 and p-value of 0.086, suggesting that there was no great significance in the difference of age (Table 1).

The intervention group gained Skeletal Muscle Mass Index (SMI) from 5.65 kg/m² to 5.71 kg/m², but the mean difference was not significant (p=0.760). They actually improved significantly in handgrip strength from 21.50 kg to 25.00 kg (p<0.001) and in gait speed from 1.02 m/s to 1.15 m/s (p=0.003). From Table 2, the MIP greatly improved significantly from 50.00 cmH2O to 65.00 cmH2O among the intervention group (p<0.001). However, the maximum expiratory pressure and the SMI did not change significantly post-intervention, with p-values of 0.130 and 0.760, respectively.

Table 1 Demographics and Study Characteristics

Parameter	**Total (N=68)**	**Intervention Group (N=34)**	**Control Group (N=34)**	**95% CI**	**P-value**
Sex					
Female (%)	49 (72.06%)	24 (70.59%)	25 (73.53%)		0.382
Male (%)	19 (27.94%)	10 (29.41%)	9 (26.47%)		
Age (years)	70.58 (6.10)	69.23 (6.71)	71.93 (5.19)	-5.80 to 0.40	0.086
Diabetes Mellitus					0.360
With Diabetes (%)	16 (23.53%)	6 (17.65%)	10 (29.41%)		
Without Diabetes (%)	52 (76.47%)	28 (82.35%)	24 (70.59%)		
Dyslipidemia					1.000
With Dyslipidemia (%)	22 (32.35%)	11 (32.35%)	11 (32.35%)		

Parameter	Total (N=68)	Intervention Group (N=34)	Control Group (N=34)	95% CI	P-value
Without Dyslipidemia (%)	46 (67.65%)	23 (67.65%)	23 (67.65%)		
Hypertension					1.000
With Hypertension (%)	34 (50.00%)	17 (50.00%)	17 (50.00%)		
Without Hypertension (%)	34 (50.00%)	17 (50.00%)	17 (50.00%)		
Heart Disease					1.000
With Heart Disease (%)	4 (5.88%)	2 (5.88%)	2 (5.88%)		
Without Heart Disease (%)	64 (94.12%)	32 (94.12%)	32 (94.12%)		
COPD/Asthma					0.612
With COPD/Asthma (%)	5 (7.35%)	2 (5.88%)	3 (8.82%)		
Without COPD/Asthma (%)	63 (92.65%)	32 (94.12%)	31 (91.18%)		
SMI (kg/m²)	5.55 (0.84)	5.67 (0.91)	5.45 (0.77)	-0.19 to 0.68	0.274

Table 2 Outcome Comparisons

Variable	Group	Before Mean (SD)	After Mean (SD)	Mean Difference (SE)	P-value Between Groups	Mean Difference (Before-After) (SE)	P-value Within Group
SMI (kg/m²)	Intervention	5.65 (0.88)	5.71 (1.00)	0.23 (0.20)	0.285	-0.06 (0.04)	0.760
	Control	5.40 (0.75)	5.38 (0.80)		0.780	0.02 (0.05)	0.780
Handgrip Strength (kg)	Intervention	21.50 (6.00)	25.00 (6.50)	3.50 (1.20)	0.035	-3.50 (0.55)	<0.001
	Control	21.00 (5.30)	21.30 (4.80)		0.650	-0.30 (0.55)	0.650
Gait Speed (m/s)	Intervention	1.02 (0.22)	1.15 (0.15)	0.13 (0.04)	0.002	-0.13 (0.03)	0.003
	Control	0.94 (0.20)	0.97 (0.18)		0.480	-0.03 (0.03)	0.480
MIP (cmH2O)	Intervention	50.00 (25.00)	65.00 (27.00)	15.00 (5.00)	0.040	-15.00 (2.50)	<0.001
	Control	46.00 (20.00)	51.00 (18.00)		0.150	-5.00 (2.50)	0.150
MEP (cmH2O)	Intervention	54.00 (22.00)	59.00 (20.00)	5.00 (4.00)	0.300	-5.00 (3.00)	0.130
	Control	50.00 (15.00)	53.00 (18.00)		0.220	-3.00 (3.00)	0.220
Walking (meters)	Intervention	340.00 (105.00)	380.00 (70.00)	40.00 (15.00)	0.008	-40.00 (12.00)	0.015
	Control	340.00 (90.00)	320.00 (70.00)		0.250	20.00 (12.00)	0.250
PA (MET minutes per week)	Intervention	1150.00 (900.00)	3400.00 (4000.00)	2250.00 (650.00)	0.010	-2250.00 (450.00)	<0.001
	Control	840.00 (590.00)	1400.00 (1200.00)		0.250	-560.00 (450.00)	0.250

Endurance in physical tests was notably high among the intervention group, where walking distance ranged from 340 to 380 meters (p=0.015). The MET minutes of improvement in physical activity levels in the intervention group increased from 1150 to 3400 MET minutes per week, and it was quite significant at less than 0.001 in p-value. For the control group, though, there was only a slight increase from 840 to 1400 MET minutes per week, but the change was not statistically significant (p=0.250) (Table 2).

These findings demonstrate the effect of a home-based walking program and improvements in whole-body physical activity and cardiorespiratory fitness, and more specifically, in sarcopenic participants, their specific physical parameters including handgrip strength and gait speed. Better physical capabilities are needed to improve the quality of life and to reduce fall risk and the subsequent injuries among this population.

DISCUSSION

The results of this randomized control trial showed that sarcopenic older adults had significant improvement in their handgrip strength, gait speed, and maximum inspiratory pressure after the 12-week home-based walking exercise program. These results concur with previous studies that showed a significant improvement of these parameters in sarcopenia among the elderly with physical activity, with walking being the most beneficial. Indeed, similar gains in muscle strength and physical performance were found for seniors with sarcopenia exposed to a standardized, regular walking exercise protocol (22).

The increase in handgrip strength is very important due to its association with the overall function of the musculature and due to being a prognostic indicator for disability in older patients, as observed by Bohannon in 2015. Furthermore, the improvement in gait speed is extremely important as a proxy measure of functional mobility and a powerful predictor of the risk of falling, which is a great concern in this population. An increased maximum inspiratory pressure reflects increased strength of the respiratory muscles and is of clinical relevance for health and quality of life because aging, in combination with muscle wasting, has been associated with the burden of respiratory diseases (23).

Methodological rigor was preceded by stringent baseline randomization and comparability. Standardized measures for the assessment of physical activity levels and cardio-respiratory performance increased credibility. However, some limitations should be taken into account: the sample size was sufficient to detect differences between groups, but was relatively low, which may affect the generalizability to the population. This is a limitation of this study because self-reported measures and subjects may introduce potential reporting biases in estimating the physical activity levels; this was, however, controlled to some extent by periodically monitoring it. Future studies should, therefore, have bigger samples and more objective measurement tools to minimize the biases and improve the accuracy of the data, for example, physical activity tracking devices being made wearable (24).

One of the major strengths of the study was its practical applicability. The walking program is home-based, making it a feasible option for widespread implementation, especially important in the older adult population, who may not have easy access to specialized facilities or who may prefer home-based exercises. However, future studies should consider the use of more objective measures of physical activity and increase the length of the follow-up period to make it possible to evaluate long-term adherence and long-term effects (25).

The principal strength of the study was the practical applicability of the findings. This characteristic of being home-based is also a major reason why this walking program can be disseminated at a mass level. This is crucial in reaching older adults with reduced access to such specialized facilities or a preference for home-based exercises. This makes it not only cost-effective but also scalable and sustainable in health outcome improvements for the elderly.

CONCLUSION

The walking-based, home-based program appears to enhance some important physical functions for the health and independence of sarcopenic seniors. This information strongly supports structured walking programs as part of routine care planning for seniors. More studies on large, diverse populations with long-term follow-up are necessary for validation and further analysis of these results, which could be important for stronger evidence-based guidelines to manage sarcopenia among the elderly.

REFERENCES

1. Prado CM, Lieffers JR, McCargar LJ, Reiman T, Sawyer MB, Martin L, et al. Prevalence and clinical implications of sarcopenic obesity in patients with solid tumours of the respiratory and gastrointestinal tracts: a population-based study. The Lancet Oncology. 2008;9(7):629-35.

2. Waters DL, Baumgartner RN. Sarcopenia and obesity. Clinics in geriatric medicine. 2011;27(3):401-21.

3. Seo JH, Lee Y. Association of physical activity with sarcopenia evaluated based on muscle mass and strength in older adults: 2008-2011 and 2014 - 2018 Korea National Health and Nutrition Examination Surveys. BMC geriatrics. 2022;22(1):217.

4. Santilli V, Bernetti A, Mangone M, Paoloni M. Clinical definition of sarcopenia. Clinical cases in mineral and bone metabolism : the official journal of the Italian Society of Osteoporosis, Mineral Metabolism, and Skeletal Diseases. 2014;11(3):177-80.

5. Sung JH, Son SR, Baek SH, Kim BJ. The association of aerobic, resistance, and combined exercises with the handgrip strength of middle-aged and elderly Korean adults: a nationwide cross-sectional study. BMC geriatrics. 2022;22(1):676.

6. Phu S, Boersma D, Duque G. Exercise and Sarcopenia. Journal of clinical densitometry : the official journal of the International Society for Clinical Densitometry. 2015;18(4):488-92.

7. Choi KM. Sarcopenia and sarcopenic obesity. The Korean journal of internal medicine. 2016;31(6):1054-60.

8. Kalinkovich A, Livshits G. Sarcopenic obesity or obese sarcopenia: A cross talk between age-associated adipose tissue and skeletal muscle inflammation as a main mechanism of the pathogenesis. Ageing research reviews. 2017;35:200-21.

9. Batsis JA, Villareal DT. Sarcopenic obesity in older adults: aetiology, epidemiology and treatment strategies. Nature reviews Endocrinology. 2018;14(9):513-37.

10. Dieli-Conwright CM, Courneya KS, Demark-Wahnefried W, Sami N, Lee K, Buchanan TA, et al. Effects of Aerobic and Resistance Exercise on Metabolic Syndrome, Sarcopenic Obesity, and Circulating Biomarkers in Overweight or Obese Survivors of Breast Cancer: A Randomized Controlled Trial. Journal of clinical oncology : official journal of the American Society of Clinical Oncology. 2018;36(9):875-83.

11. Yuenyongchaiwat K, Akekawatchai C. Beneficial effects of walking-based home program for improving cardio-respiratory performance and physical activity in sarcopenic older people: a randomized controlled trial. European journal of physical and rehabilitation medicine. 2022;58(6):838-44.

12. Polyzos SA, Margioris AN. Sarcopenic obesity. Hormones (Athens, Greece). 2018;17(3):321-31.

13. Huang Y, Zhu X, Chen K, Lang H, Zhang Y, Hou P, et al. Resveratrol prevents sarcopenic obesity by reversing mitochondrial dysfunction and oxidative stress via the PKA/LKB1/AMPK pathway. Aging. 2019;11(8):2217-40.

14. Gi YM, Jung B, Kim KW, Cho JH, Ha IH. Low handgrip strength is closely associated with anemia among adults: A cross-sectional study using Korea National Health and Nutrition Examination Survey (KNHANES). PloS one. 2020;15(3):e0218058.

15. Ahn H, Choi HY, Ki M. Association between levels of physical activity and low handgrip strength: Korea National Health and Nutrition Examination Survey 2014-2019. Epidemiology and health. 2022;44:e2022027.

16. Li CW, Yu K, Shyh-Chang N, Li GX, Jiang LJ, Yu SL, et al. Circulating factors associated with sarcopenia during ageing and after intensive lifestyle intervention. J Cachexia Sarcopenia Muscle. 2019;10(3):586-600.

17. Misra D, Fielding RA, Felson DT, Niu J, Brown C, Nevitt M, et al. Risk of Knee Osteoarthritis With Obesity, Sarcopenic Obesity, and Sarcopenia. Arthritis & rheumatology (Hoboken, NJ). 2019;71(2):232-7.

18. Zamboni M, Rubele S, Rossi AP. Sarcopenia and obesity. Current opinion in clinical nutrition and metabolic care. 2019;22(1):13-9.

19. Curcio F, Testa G, Liguori I, Papillo M, Flocco V, Panicara V, et al. Sarcopenia and Heart Failure. Nutrients. 2020;12(1).

20. Hong SH, Choi KM. Sarcopenic Obesity, Insulin Resistance, and Their Implications in Cardiovascular and Metabolic Consequences. International journal of molecular sciences. 2020;21(2).

21. Petermann-Rocha F, Yang S, Gray SR, Pell JP, Celis-Morales C, Ho FK. Sarcopenic obesity and its association with respiratory disease incidence and mortality. Clinical nutrition (Edinburgh, Scotland). 2020;39(11):3461-6.

22. Pinotti E, Montuori M, Borrelli V, Giuffrè M, Angrisani L. Sarcopenia: What a Surgeon Should Know. Obesity surgery. 2020;30(5):2015-20.

23. Wang M, Tan Y, Shi Y, Wang X, Liao Z, Wei P. Diabetes and Sarcopenic Obesity: Pathogenesis, Diagnosis, and Treatments. Frontiers in endocrinology. 2020;11:568.

24. Bosello O, Vanzo A. Obesity paradox and aging. Eating and weight disorders : EWD. 2021;26(1):27-35.

25. Lin CC, Shih MH, Chen CD, Yeh SL. Effects of adequate dietary protein with whey protein, leucine, and vitamin D supplementation on sarcopenia in older adults: An open-label, parallel-group study. Clinical nutrition (Edinburgh, Scotland). 2021;40(3):1323-9.

Authors and Affiliations:
[1]Visiting Lecturer, The Islamia University of Bahawalpur, Rahim Yar Khan Campus, Pakistan
[2]Lecturer, Faculty of Health and Medical Science, Indus University, Karachi, Pakistan

Author Details:
1. Tooba Asif: Visiting Lecturer, The Islamia University of Bahawalpur, Rahim Yar Khan Campus, Pakistan, tooba573@gmail.com
2. Maira Muneer: Lecturer, Faculty of Health and Medical Science, Indus University, Karachi, Pakistan, maira.muneer00@gmail.com

Timelines:
Received: September 14, 2023
Accepted: October 26, 2023
Scheduled for Publication: November 2, 2023
Published: December 30, 2023

