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EFFECTIVENESS OF THE LEBED METHOD THERAPEUTIC INTERVENTION ON PHYSICAL STABILITY AMONG ELDERLY INDIVIDUALS IN KAKAMEGA COUNTY

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ABSTRACT

Background. In Kenya, falls among individuals over 60 years of age are a major concern. Despite physical activity being known to reduce fall risks, existing studies face challenges like high drop-out rates and limited exercise types. The Lebed Method, a dance program originally developed for breast cancer survivors by Sherry Lebed Davis, has shown potential to improve physical and emotional well-being. This study aimed to explore its effectiveness in improving physical stability among the elderly in Kakamega County.

Methods. The study involved a community-based randomized control trial with 30 participants aged 60 and older, selected based on low social support scores. They were divided into intervention and control groups, meeting specific inclusion criteria. Baseline functional stability (mobility and balance) was assessed by Timed Up and Go (TUG), Berg Balance Scale (BBS) scores, gait speed time, and de Morton Mobility Index (DEMMI) score. To ensure the reliability of the study, biases such as selection, performance, detection, attrition, and reporting biases were addressed. Changes in physical stability between the groups were analyzed using the Analysis of Covariance, accounting for baseline differences, while within-group changes were evaluated using the dependent sample t-test. The threshold for statistical significance was set at $p < 0.05$.

Results. The findings showed that the intervention group improved significantly in physical stability compared to the control group. Specifically, notable enhancements were observed on TUG times ($p < .001$, $\eta p^2 = 0.53$, $d = 3.38$), BBS scores ($p < .001$, $\eta p^2 = 0.64$, $d = 1.97$), gait speed ($p < .001$, $\eta p^2 = 0.65$, $d = 1.99$) and DEMMI score ($p < .001$, $\eta p^2 = 0.38$, $d = 1.94$).

Conclusions. The intervention significantly improved mobility and balance among participants, demonstrating the effectiveness of the Lebed method for elderly individuals. Future research could explore specific components of dance-based therapy that contribute to functional mobility and balance improvements.

Keywords: *Kenya, Accidental Falls, Lebed Movement Therapy, Physical stability, elderly*

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INTRODUCTION

Population aging refers to the trend where the elderly (60 years and older) comprise an increasing proportion of a country's total population (Kenya National Bureau of Statistics [KNBS], 2017; United Nations Population Division [UNPD], 2015). In Kenya, the elderly population is expected to reach 9.6% by 2050, significantly impacting healthcare expenses (UNPD, 2015). As of 2019, the elderly made up 6% of Kenya's population, with Kakamega County recording 85,872 individuals aged

65 and above (KNBS, 2019). The physical well-being of this demographic often declines with age, leading to falls and related injuries (Zhao et al., 2018; Rubenstein, 2008). Falls are defined as unintentional descents to the ground and are common among the elderly, often leading to significant health consequences (Yoshida, 2019; Lamb et al., 2005). The prevalence and severity of falls in this age group have been well-documented, with studies indicating a fall rate of 20% to 40% among the elderly (Gale et al., 2016; El Sayed et al., 2023). These falls can result in injuries like fractures, increasing both societal costs and healthcare system strain (Tuminah et al., 2016; Morrison et al., 2013; Rivera-Torres & Severance, 2022). The economic burden of falls on the elderly is substantial. In the United States, direct medical costs for fall-related deaths and injuries in those aged 60 and older are estimated at $200 million and $19 billion, respectively (Florence et al., 2018; Stevens et al., 2006). Fractures account for a significant portion of these costs; without effective interventions, these expenses are projected to grow (Burns et al., 2016).

Research has highlighted both internal and external factors contributing to falls. Internal factors include physiological changes and pathological disorders, while external factors might be environmental obstacles (Pengpid & Peltzer, 2018; Saunders, 2022). Impaired balance, often due to muscle weakness or inactivity, is a key internal cause (Callis, 2016). Predictors of future falls include previously diagnosed mobility and balance deficits (Patwardhan, & Solanki, 2023; Turner et al., 2018). Various interventions have been researched to prevent falls among the elderly. These include Tai Chi, physiotherapy, and obstacle courses, but their real-life applicability is often limited (Moawd et al., 2022; Van Hanegem et al., 2014). The World Health Organization emphasizes regular exercise for the elderly, but many do not engage in sufficient physical activity due to factors like chronic health conditions and fear of injury (Thomas et al., 2019; Bull et al., 2020; Veldhuijzen van Zanten et al., 2015).

Elderly individuals often face challenges in adhering to exercise programs. These challenges include chronic health conditions, fear of injury, social isolation, and a lack of motivation (Nelson et al., 2007; Chandrasekaran et al., 2021). Cross-sectional surveys have identified several barriers to physical activity among the elderly. These include fear of injury (Yarmohammadi et al., 2019; Tinetti et al., 1994), lack of motivation often exacerbated by social isolation, depression, and a perceived lack of enjoyment (Hasan et al., 2023; Netz et al., 2005), and limited social support (Shankar et al., 2011). Other significant obstacles are the lack of access to appropriate exercise facilities, financial constraints, and transportation difficulties (Costello et al., 2011).

The literature indicates that physical activity notably improves intrinsic physiological parameters in the elderly, thereby reducing falls (Thomas et al., 2019). Nevertheless, high attrition rates persist, and most research has concentrated on only two exercise modes (aerobic and resistant) without sufficient follow-up, leaving unanswered questions about the most sustainable and beneficial exercise modalities (Di Lorito et al., 2020). Traditional exercises like aerobic and resistance training have low acceptance among the elderly due to fears of falling and health concerns (Douka et al., 2019; Sherrington et al., 2017). This, therefore, makes it difficult to be sustained by the elderly despite their overwhelming advantage.

Dance-based therapies offer an alternative to traditional exercises. They have shown promise in improving physical health and are increasingly being incorporated into elderly care regimens (Koch et al., 2019; Hwang & Braun, 2015).

Evidence is accumulating that suggests dance-based physical exercise might improve adherence and, as a result, balance, and so be a valuable technique in lowering the risk of falling in the elderly (Rodríguez & Paris-Garcia, 2022; Hewitt et al., 2018). However, the lack of proper structure, details of intensity, duration and lack of clear description of the intervention make them difficult to replicate (Franco et al., 2016). Veronese et al.'s (2017) study on dance therapy's safety and efficacy in reducing falls and fear of falling presents a positive outlook. However, the study's methodology could be critiqued for potential biases in participant selection or the dance therapy's intensity and duration.

A dance-based treatment for adults with physical limitations called The Lebed Method (TLM) 2002 has recently been the focus of research with promising results (Rodríguez & Paris-Garcia, 2022; Sandel et al., 2005). The Lebed Method, also known as Healthy Steps, is a therapeutic dance and movement program initially developed to enhance the quality of life for breast cancer survivors. This program, created by Sherry Lebed Davis, incorporates dance movements and exercises designed to address the physical and emotional challenges breast cancer patients and survivors face. It has been demonstrated to improve quality of life, restore shoulder range of motion, reduce lymphedema, and improve body image and shoulder function in breast cancer survivors (Healthy Steps | Evidence-Based Cancer Control Programs, n.d.).

The sustainability of the Lebed Method lies in its ability to satisfy the basic psychological needs for autonomy, competence, and relatedness (Fernández-Espínola et al., 2023; Ryan & Deci, 2000). By meeting these needs, the Lebed Method is expected to foster a sense of volition and willingness to engage in the activity, promoting sustainability. Furthermore, if people love what they do, they are more likely to remain physically active and consistent (Davis et al., 2021).

The Lebed Method has been researched for its efficacy in reducing the risk of falls in the elderly. A study by Krampe et al. (2010) showed that the Lebed therapeutic intervention improved balance and gait among elderly individuals. However, the lack of details regarding the study's methodology (ecological validity), lack of age-matched instructors, clear description of the control group, and lack of assessment of psychological components create gaps that our current study intends to fill.

Therefore, this study aims to investigate the effectiveness of The Lebed method therapeutic intervention on physical stability among elderly individuals in Kakamega County. This study contributes to the existing body of knowledge and could potentially inform interventions aimed at reducing falls among the elderly.

METHODS

Study Setting and Recruitment

The study examined the Lebed Method's impact on elderly residents of Kakamega County, Kenya, using a well-planned approach. Conducted in an accessible open compound, the setting was chosen for its real-life applicability. Participants were recruited through community engagement initiatives, involving local organizations and leaders to identify and invite eligible individuals, ensuring a representative sample. The recruitment strategy aimed to incorporate diverse socio-economic backgrounds, excluding individuals from community centers or senior living facilities, to maintain ecological validity and foster participant trust. This study was conducted in Kakamega County from 3rd April 2023 to 24th July 2023.

Research Design

A pre-test/post-test randomized controlled trial (RCT) design, considered the gold standard for establishing cause-and-effect relationships, was used. Randomization controlled for confounding factors and minimized selection bias, allowing for comparison with a control group.

Study Population, Inclusion, and Exclusion Criteria

The study was conducted with volunteers from the community according to the eligibility criteria. Criteria were established to ensure participant safety and study validity. The study's inclusion criteria specified that participants must be 60 years or older, be able to provide informed consent and demonstrate independence in daily activities. Additionally, they must be able to participate in physical performance and functional assessments, individuals not already engaged in structured exercise programs or interventions, and have the capability to stand, with or without minimal assistance. Social support and motivation were also key factors; thus, participants were assessed using the Multidimensional Scale of Perceived Social Support (MSPSS). Those with lower scores on the MSPSS were deliberately selected for inclusion in both the intervention and control groups to examine the impact of social support levels on the study's outcomes. The study excluded individuals under the age of 60, those with cognitive impairments preventing informed consent or active participation, and participants with severe mobility limitations or significant dependency on daily activities. Additionally, individuals with medical conditions that could impede safe participation in physical activities or assessments, those already enrolled in other clinical trials or interventions, and patients from community centers or senior living facilities were excluded to eliminate performance bias and where it could be difficult to blind the control group to the intervention, those who refused to participate, and individuals engaged in structured exercise programs were also excluded from the study. (Figure 1).

Sampling Design and Sample Size Determination

A combination of purposive, random, and snowballing sampling was used. Stratified sampling ensured balanced representation, and randomization was done through a Randomization Complete Block Design (RCBD). In this study, the blocks were created based on factors such as the order in which they consented and their gender. Each block was then further subdivided based on the characteristic of health status, with individuals assigned unique identification numbers within these subdivisions. The computer-generated random number generator was employed within each stratum to select participants. This stratified sampling technique allowed for the preservation of a proportional representation of participant characteristics across the intervention and control groups (Figure 1). A sample size G-Power, based on desired statistical power, significance level, effect size, and the study's design. Using a large effect size (Cohen's d) of 0.8, a significance level (α) of 0.05, and aiming for a statistical power of 80% ($1 - \beta = 0.80$) in a two-sided test for an independent samples t-test, the calculated sample size required per group is approximately 15.

Data Collection

Baseline assessments were followed by randomization. The intervention group underwent the Lebed Method sessions, while the control group engaged in daily exercise routines.

The study was structured into distinct phases over several weeks to evaluate the effects of The Lebed Method (TLM) on participants. Initially, in weeks 1–3, pre-intervention assessments were conducted to measure stability, range of motion, and fear of falling, followed by the random allocation of participants into intervention and control groups. The TLM intervention was then implemented during weeks 4–16, with the intervention group attending three 45-minute weekly sessions. The control group did not participate in TLM activities during this time. Weeks 17 to 19 allowed for makeup sessions to ensure full participation. Post-intervention measurements were taken in week 20, assessing balance, mobility, and fear of falling, with incentives provided to participants who completed the post-testing. This structured timeline facilitated a thorough analysis of TLM's impact on participants' well-being, ensuring the study's scientific integrity and the reliability of its findings. Finally, after the experiment, from weeks 21 to 33, the control group received the TLM intervention, mirroring the earlier intervention group's experience. This was to ensure they also benefitted from the TLM for ethical purposes.

Lebed Method

The Lebed Method, a dance-based therapy, was used for its holistic approach to well-being, targeting physical, mental, and emotional health. The intervention spanned 12 weeks, with flexible scheduling for TLM sessions.

The program included 36 sessions, three times a week, each lasting about an hour, with music playing a crucial role in creating an enjoyable atmosphere. Initially guided by a certified instructor, participants later led the sessions themselves, promoting autonomy. The program featured structured sessions with warm-ups, various dance routines targeting different muscle groups improving balance, and cool-down periods. Music tempo varied systematically over the weeks to progressively increase the physical challenge, starting with slow tempos (60-80 BPM) and peaking at high tempos (110-120 BPM) before returning to moderate tempos (90-100 BPM) in the final weeks. The dance routines, designed to improve flexibility, balance, coordination, cardiovascular fitness, and muscle strength, were repeated to build confidence, with each accompanied by specific music and movements targeting holistic well-being improvements. The program was done in a group setting to take advantage of group dynamics of socialization to enhance enjoyment.

The program began with the Welcome Dance to the song "Malaika," using basic steps for warm-up, socialization, and relaxation. Subsequent dances, set to various songs like "Jambo Bwana" and "Sina Makosa," include movements that enhance flexibility, balance, coordination, and cardiovascular fitness, while strengthening core and abdominal muscles. For example, the Limbo Rock and Twist and Shout routines focus on limbo moves and twists to improve joint mobility and posture. The Merengue and Salsa dances promote cardiovascular endurance and socialization through steps that require coordination and flexibility. An African Beat routine incorporates stomping and swaying to improve cardiovascular fitness and joint mobility. The program also includes Weighted Dances with handheld weights or resistance bands to strengthen muscles and improve overall fitness. It concluded with a Cool-down and Goodbye routine to emphasize relaxation, flexibility, and well-being.

The control group

The control group played a crucial role in the study by serving as a baseline for comparing the effects of The Lebed Method (TLM) intervention. Unlike the intervention group, this group did not participate in TLM sessions but received guidance and motivation to lead an active lifestyle, including recommendations for various physical activities such as walking, swimming, light aerobics, and stretching exercises. Willing members were also offered a three-month gym membership. The objective was to isolate the specific benefits of the TLM intervention from the general advantages of physical activity. Participants in the control group were educated about the health benefits of regular physical activity, particularly in reducing fall risk factors and promoting healthy aging. They received personalized advice on setting physical activity goals, managing their time for regular exercise, and the importance of proper warm-up, cool-down techniques, and hydration. Throughout the study, they were regularly encouraged to maintain an active lifestyle through targeted communications, enabling a detailed evaluation of TLM's unique impact on fall risk factors in elderly individuals compared to general physical activity.

Measurements and Instruments

In the study, mobility and functional status of elderly individuals were assessed using several validated tools. The de Morton Mobility Index (DEMMI), as described by de Morton et al. (2008), was employed to evaluate participants' mobility through tasks involving walking, transfers, and balance. Participants' performance on each task was scored according to standardized criteria, with the total DEMMI score reflecting their overall mobility and functional abilities.

Gait speed was measured by instructing participants to walk over a specified distance of 10 meters at their customary pace (Stuck et al., 2020). Individuals walked a defined distance at their usual pace. Timing devices captured the duration it took for each participant to cover the distance. The time taken to cover this distance was recorded with a stopwatch, and gait speed was calculated by dividing the distance by the time, resulting in a metric of meters per second (m/s). This measurement has been validated (Kim et al., 2016)

The Timed Up and Go (TUG) test, a method outlined by Podsiadlo and Richardson (1991), quantified the time required for an individual to stand up from a chair, walk a distance of 3 meters, turn around, walk back to the chair, and sit down.

Additionally, the Berg Balance Scale (BBS), developed by Berg et al. (1992), was administered to assess balance and fall risk. This scale consists of tasks that evaluate an individual's ability to maintain balance under various conditions. Each task was scored, and the aggregate of these scores provided a comprehensive assessment of the participant's balance and stability.

These assessments were conducted with an emphasis on reliability and validity, utilizing standardized procedures and ensuring inter-rater reliability. In the study, to ensure the integrity and objectivity of the assessments, examiners were blinded to the group assignment of each participant. This blinding procedure was implemented to prevent any potential bias in the evaluation of mobility, functional status, and balance outcomes. The BBS's intraclass correlation coefficient (ICC) was 0.82, indicating strong agreement among assessors on balance performance, while the ICC for the DEMMI was 0.78, showing substantial agreement on mobility and functional abilities.

The DEMMI, TUG, BBS, and the gait speed test were all assessed at baseline and post-intervention in both control and intervention groups after 12 weeks.

Confounding Variables and Mitigation Strategies

The study identified and controlled for confounding variables such as age, gender, comorbidities, medications, baseline levels, social support, and motivation. Strategies like specific inclusion criteria, Randomization Complete Block Design (RCBD), and the use of standardized scales were implemented to mitigate these effects. To ensure external validity and minimize biases like selection, performance, detection, attrition, and reporting bias, the study employed strategies like randomization, assessor blinding, regular follow-ups, and transparent reporting.

Data Analysis

The data underwent comprehensive analysis using descriptive statistics, ANCOVA, dependent sample t-tests, and linear regression analyses. Effect sizes were computed to assess practical significance, and a significance threshold of $p < 0.05$ was applied. These analytical methods aimed to provide a nuanced understanding of the intervention's impact on fall risk factors.

Ethics

The study prioritized ethical and logistical considerations, ensuring adherence to autonomy, clinical equipoise, and justice principles. Ethical approval was sought from the Institutional Scientific and Ethical Review Committee (ISERC) and the National Commission for Science, Technology, and Innovation (NACOSTI). (License No. NACOSTI/P/22/21946; Applicant identification number 856318). Participants were fully informed about the study's objectives, procedures, risks, and benefits, and their consent was obtained. The study emphasized voluntary participation, with the option for participants to withdraw at any time without repercussions. The principle of clinical equipoise ensured fair treatment for all participants, avoiding bias in favor of either the control or intervention group. In line with the Belmont Report, the study maintained fairness in distributing research burdens and benefits. Logistically, participant selection was unbiased, and cultural sensitivities were respected. Academic integrity was upheld through proper citation of sources. Participant safety was paramount, with adaptations in dance therapy exercises for varying physical abilities and proactive measures for addressing potential adverse events. The study's design and execution demonstrated a strong commitment to ethical standards and participant well-being.

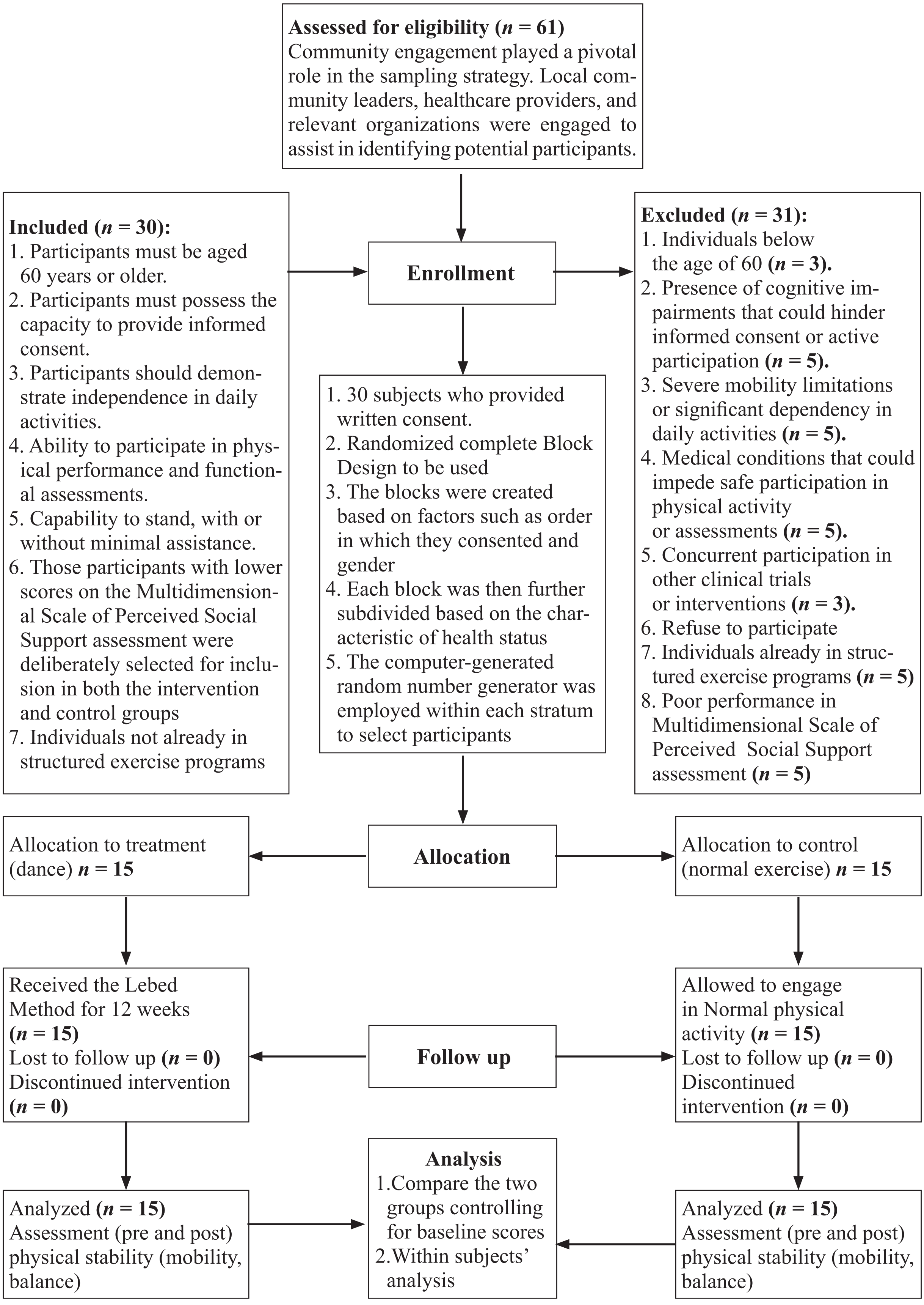

Figure 1. *Allocation and randomization of study participants (adapted from CONSORT 2010 flow diagram)*

RESULTS

The sociodemographic and baseline characteristics of the study's participants, divided into control and intervention groups, were analyzed to understand the distribution of gender, marital status, education level, occupation, and history of falls. The gender distribution was nearly equal across both groups, with females constituting 53.3% of the total participants and males 46.7%, showing no significant difference in gender distribution between groups (Chi-square *p*-value = 1.0). Marital status varied, with the majority being married (60%), though differences between groups were not statistically significant (*p*-values 0.19). Education levels were predominantly primary (66.7%), with a fairly even split between groups, and occupation types varied, with the largest group being retired (43.3%). The history of falls showed a mixed distribution, with no significant difference between groups (*p*-value = 0.19), indicating a varied but comparably distributed sample in terms of sociodemographic and baseline health characteristics. In summary, the sociodemographic characteristics and baseline health information of participants in the control and intervention groups showed a diverse but balanced distribution across various categories, including gender, marital status, education level, occupation, and history of falls. Chi-square analyses indicated no significant differences between the groups, suggesting a well-matched baseline for comparing the intervention outcomes (Table 1).

Table 1. *Sociodemographic characteristics of study participants*

Sociodemographic characteristics		Total		Group				Chi-square *p*-value
				Control (*n* = 15)		Intervention (*n* = 15)		
		n	%	n	%	n	%	
Gender	Female	16	53.3%	8	53.3%	8	53.3%	1.0
	Male	14	46.7%	7	46.7%	7	46.7%	
Marital Status	Divorced	2	6.7%	2	13.3%	0	0.0%	0.19
	Married	18	60.0%	7	46.7%	11	73.3%	
	Widowed	10	33.3%	6	40.0%	4	26.7%	
Education Level	Primary	20	66.7%	9	60.0%	11	73.3%	0.44
	Secondary	10	33.3%	6	40.0%	4	26.7%	
Occupation	Business	5	16.7%	3	20.0%	2	13.3%	0.41
	Farmer	8	26.7%	2	13.3%	6	40.0%	
	Housewife	4	13.3%	2	13.3%	2	13.3%	
	Retired	13	43.3%	8	53.3%	5	33.3%	
History of Falls	Never	10	33.3%	5	33.3%	5	33.3%	0.19
	Once	12	40.0%	8	53.3%	4	26.7%	
	Twice	8	26.7%	2	13.3%	6	40.0%	

The baseline summary statistics for pre-intervention measures across two groups–intervention and control–highlight no differences in mobility, balance, and gait speed. The Pre-Timed Up and Go (TUG) test results show the intervention group with a slightly higher mean time of 16.33 seconds and less performance variability than the control group's mean time of 16.13 seconds. Despite these differences, the *p*-value of 0.32 indicates no statistically significant difference between the groups in this measure. In balance assessment through the Pre Berg-Balance Scale (BBS) Score, the intervention group demonstrates a marginally better average balance score (40.13) with less variability than the control group (39.07), yet the difference is not statistically significant (*p*-value of 0.67). Pre-Gait speed measurements reveal the intervention group has a marginally faster average speed (0.75 m/s) with less variability compared to the control group (0.70 m/s), but again, the statistical comparison yields a *p*-value of 0.43, suggesting the observed differences are not statistically significant. The baseline Pre-DEMMI (De Morton Mobility Index) scores reveal that the intervention group had a higher average score (69.47) with less variability in performance, indicated by a standard deviation of 5.44, compared to the control group, which had a lower average score (66.93) and greater variability (standard deviation of 7.74). Despite these differences, the *p*-value of 0.38 indicates no statistically significant difference between the groups in this measure (Table 2).

Table 2. *Baseline summary statistics for measures by group*

Measures	*M*	*SD*	*P*	SE_M	Min	Max	Skewness	Kurtosis
Pre-TUG (seconds)								
Intervention	16.33	1.88	0.32	0.48	13.00	19.00	-0.17	-1.07
Control	16.13	2.59		0.67	12.00	20.00	-0.10	-1.40
Pre BBS-Score								
Intervention	40.13	6.98	0.67	1.80	30.00	50.00	0.04	-1.52
Control	39.07	8.19		2.11	25.00	50.00	-0.31	-1.32
Pre-Gait speed (m/s)								
Intervention	0.75	0.06	0.43	0.02	0.60	0.84	-0.83	0.34
Control	0.70	0.10		0.03	0.52	0.85	-0.35	-1.06
Pre DEMMI score								
Intervention	69.47	5.44	0.38	1.40	60.00	80.00	0.05	-0.57
Control	66.93	7.74		2.00	52.00	83.00	0.32	0.09

Note: Timed Up and Go (TUG), Berg-Balance Scale (BBS), DEMMI (De Morton Mobility Index

Timed Up-and-go (TUG) test

Table 3 outlines the findings from a two-tailed paired sample *t*-test aimed at evaluating the disparities between the pre-intervention Timed Up-and-go (TUG) test time and the post-intervention TUG test time for both the intervention and control groups. The paired samples *t*-test yielded a highly significant difference between the pre-and post-intervention TUG test times ($t = 13.10$, $p < .001$). The calculated Cohen's d value of 3.38 indicates a substantial effect, signifying that the Lebed Method intervention led to a significant improvement in mobility and functional ability for participants in the intervention group.

Table 3. *Two-tailed paired samples t-test for the difference between pre-TUG and post-TUG*

Groups	Pre-TUG (seconds)		Post TUG (seconds)		*t*	*p*	*d*
	M	*SD*	*M*	*SD*			
Intervention	16.33	1.88	8.54	1.15	13.10	< .001	3.38
Control	16.13	2.59	14.13	2.71	7.65	.31	-

Note. N = 15. Degrees of Freedom for the t-statistic = 14. d represents Cohen's d

The ANCOVA analysis initially examined the effect of the group variable and found it to be highly significant concerning post-intervention TUG test times. The sum of squares (SS) attributed to the group variable is computed at 101.68, with one degree of freedom (df). The resulting *F*-statistic is 30.35, yielding a *p*-value of less than .001. The effect size (ηp^2) is substantial at 0.53, underscoring a noteworthy effect. This underscores that the group variable, representing the intervention and control groups, substantially influences post-intervention TUG test times (Table 4; Figure 2).

Table 4. *Analysis of co-variance table for post-TUG by group*

Term	*SS*	*df*	*F*	*p*	ηp²
Group	101.68	1	30.35	< .001	0.53
Pre-TUG (seconds)	30.66	1	9.15	.005	0.25
Residuals	90.45	27			

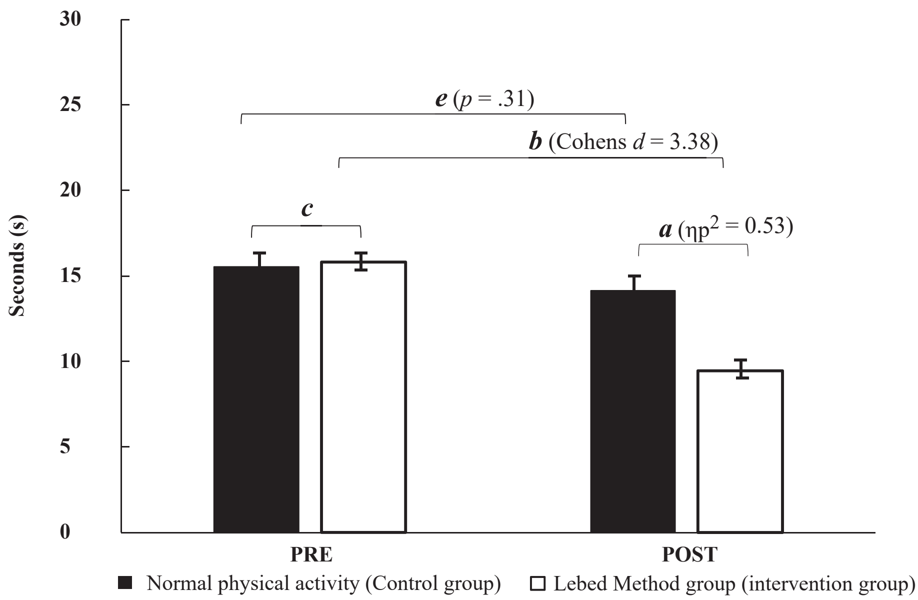

Figure 2. *Changes in timed up and go (seconds) before (PRE) and after (POST) exercise using normal exercise (n = 15) versus Lebed method (n = 15).*

Note: PRE: pre-intervention. POST: post-intervention. Values are means ± SE. a: p < .001 between normal PA group and Lebed method group (post intervention). b: p < .001* significant difference from PRE in the intervention. c: no difference in pre-intervention normal exercise group and Lebed method group e: p =.31 no differences in control group between pre and post*

Berg Balance Scale (BBS)

Table 5 introduces a paired sample t-test designed to unveil the differences in participants' Berg Balance Scale (BBS) scores before and after the Lebed Method intervention, offering valuable insights into the intervention's impact on participants' balance and stability. In the intervention group, the analysis revealed a substantial disparity between their pre-intervention BBS scores (mean = 40.13, *SD* = 6.98) and post-intervention BBS scores (mean = 54.07, *SD* = 2.81). The computed *t*-statistic for this comparison is -7.64, yielding a $p < .001$. The substantial effect size (*d*) of 1.97 underscores a significant improvement in balance and stability due to the Lebed Method intervention for participants in this group.

Table 5. *Two-tailed paired samples t-test for the difference between BBS score and post-BBS score*

Group	Pre BBS score		Post BBS score		*t*	*p*	*d*
	M	*SD*	*M*	*SD*			
Intervention	40.13	6.98	54.07	2.81	-7.64	< .001	1.97
Group	39.07	8.19	40.80	3.63	-2.67	.18	-

Note. N = 15. Degrees of Freedom for the t-statistic = 14. d represents Cohen's d.

Table 6 delves into a covariate analysis that illuminates the post-Berg Balance Scale (BBS) scores categorized by group, providing valuable insights into how participants' initial BBS scores (pre-BBS scores) might affect their subsequent postintervention BBS scores, all within the context of the Lebed Method. The analysis prominently showcases the significant influence of group membership on post-BBS scores, as evidenced by a robust *F*-statistic of 47.37 and a remarkably low *p*-value of less than .001. This outcome underscores that the group to which participants belong substantially impacts their post-BBS scores. The effect size (ηp^2) is notably high at 0.64, signifying that a considerable proportion of the variance in post-BBS scores can be attributed to the group factor (Figure 3).

Table 6. *Analysis of co-variance table for post-BBS score by group*

Term	*SS*	*df*	*F*	*p*	ηp^2
Group	514.56	1	47.37	< .001	0.64
Pre BBS score	2.07	1	0.19	.666	0.01
Residuals	293.26	27			

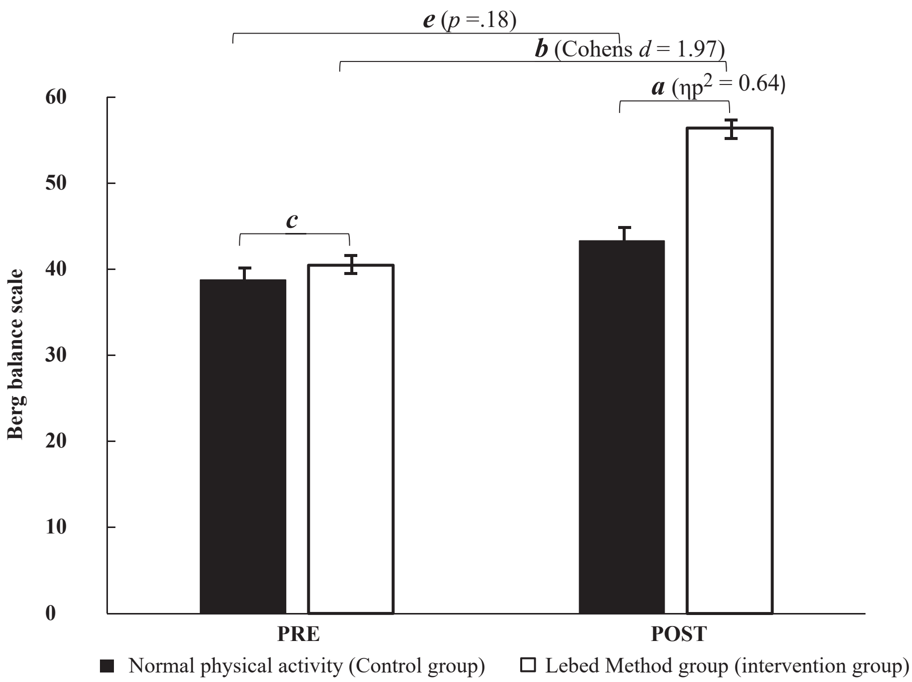

Figure 3. *Changes in Berg balance scale before (PRE) and after (POST) exercise using normal exercise (n = 15) versus Lebed method (n = 15).*

Note: PRE: pre-intervention. POST: post-intervention. Values are means ± SE. a: p < .001 between normal PA group and Lebed method group (post intervention). b: p < .001* significant difference from PRE in the intervention. c: no difference in pre-intervention normal exercise group and Lebed method group e: p =.18 no differences in control group between pre and post*

Gait speed

The paired samples t-test computed a remarkably significant difference between pre- and post-intervention gait speeds (t = -7.70, p < .001). This notable effect is captured by Cohen's *d*-value of 1.99, signifying a substantial impact. These findings indicate that the Lebed Method intervention led to a noteworthy enhancement in gait speed for participants in the intervention group. (Table 7).

Table 7. *Two-tailed paired samples t-test for the difference between pre-gait speed and post-gait*

Groups	Pre gait Speed (m/s)		Post gait (m/s)		*t*	*p*	*d*
	M	*SD*	*M*	*SD*			
Intervention	0.75	0.06	0.94	0.07	-7.70	< .001	1.99
Control	0.70	0.10	0.74	0.09	-3.00	.10	-

Note. N = 15. Degrees of Freedom for the t-statistic = 14. d represents Cohen's d

The ANCOVA analysis (Table 8) yields highly significant findings, emphasizing the substantial influence of the group variable on postintervention gait speed. The sum of squares (SS) attributed to the group factor is prominently noted as 0.23, with one degree of freedom (df). This results in a notably substantial *F*-statistic of 49.55 and a *p*-value of less than .001. The calculated effect size (ηp^2) of 0.65 indicates a large effect, underscoring a significant distinction in post-intervention gait speed between the intervention and control groups. (Figure 4).

Table 8. *Analysis of co-variance table for post gait by group*

Term	*SS*	*df*	*F*	*p*	ηp^2
Group	0.23	1	49.55	< .001	0.65
Pre gait speed (m/s)	0.06	1	12.76	.001	0.32
Residuals	0.13	27			

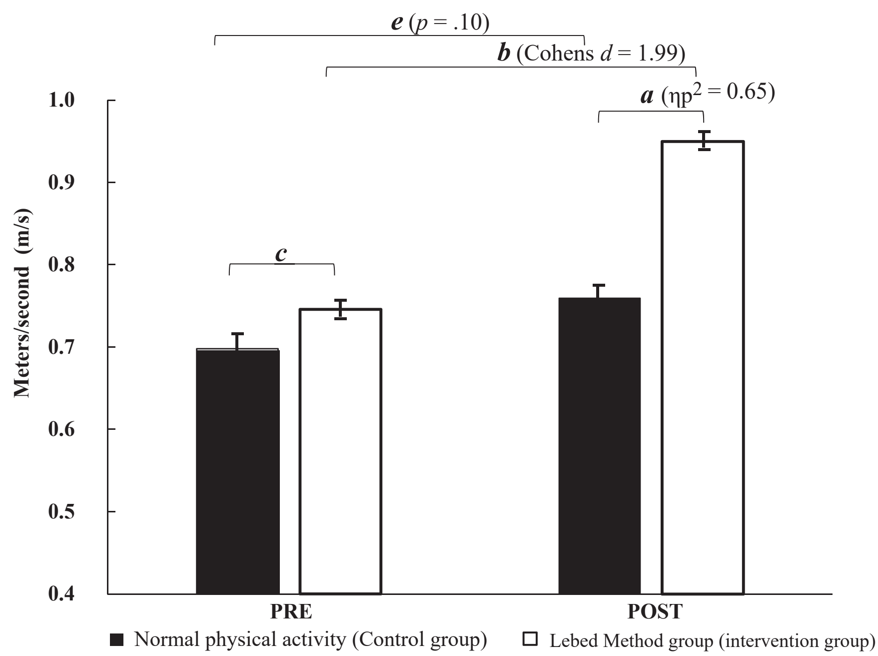

Figure 4. *Changes in Gait speed (Meters/second) before (PRE) and after (POST) exercise using normal exercise (n = 15) versus Lebed method (n = 15).*

Note: PRE: pre-intervention. POST: post-intervention. Values are means ± SE. a: p < .001 between normal exercise group and Lebed method group (post intervention). b: p < .001* significant difference from PRE in the intervention. c: no difference in pre-intervention normal exercise group and Lebed method group e: p = .10 no differences in control group between pre and post*

de Morton Mobility Index (DEMMI)

The paired samples *t*-test yielded a significantly substantial difference between the pre-and post-intervention DEMMI scores (t = -7.50, p < .001). This marked effect is illuminated by Cohen's *d* value of 1.94, signifying a substantial impact. These findings suggest that the Lebed Method intervention led to noteworthy enhancements in functional mobility and capabilities for participants in the intervention group (Table 9).

Table 9. *Two-tailed paired samples t-test for the difference between DEMMI score and post-DEMMI score*

Groups	Pre DEMMI-Score		Post DEMMI-Score		*t*	*p*	*d*
	M	*SD*	*M*	*SD*			
Intervention	69.47	5.44	87.50	8.48	-7.50	< .001	1.94
Control	66.93	7.74	70.83	9.65	-4.14	.091	-

Note. N = 15. Degrees of Freedom for the t-statistic = 14. d represents Cohen's d

The ANCOVA analysis (Table 10) notably highlights the highly significant influence of the group variable on post-intervention DEMMI scores. The sum of squares (SS) attributed to the group factor is reported as 1,019.73, with one degree of freedom (df). This results in a considerably significant *F*-statistic of 16.30 and a *p*-value of less than .001. The effect size (ηp^2) calculated at 0.38 signifies a substantial effect, emphasizing a noteworthy distinction in post-intervention DEMMI scores between the intervention and control groups (Figure 5).

Table 10. *Analysis of co-variance table for post-DEMMI score by group*

Term	*SS*	*df*	*F*	*p*	ηp^2
Group	1,019.73	1	16.30	< .001	0.38
Pre DEMMI-Score	621.48	1	9.94	.004	0.27
Residuals	1,688.85	27			

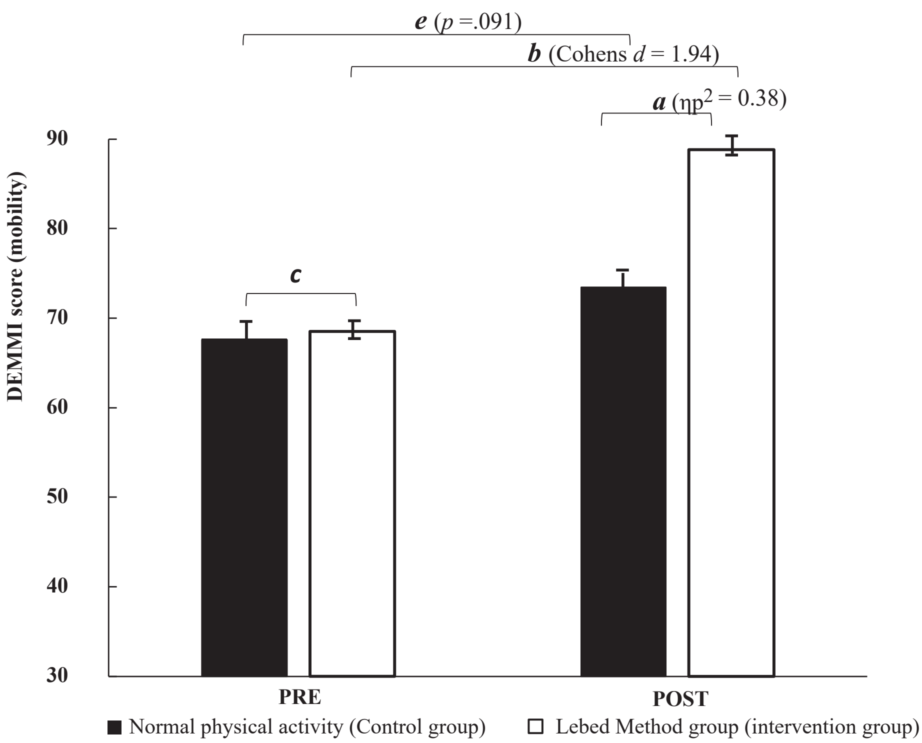

Figure 5. *Changes in de Morton mobility index before (PRE) and after (POST) exercise using normal exercise (n = 15) versus Lebed method (n = 15).*

Note: PRE: pre-intervention. POST: post-intervention. Values are means ± SE. a: p < .001 between normal PA group and Lebed method group (post intervention). b: p < .001* significant difference from PRE in the intervention. c: no difference in pre-intervention normal exercise group and Lebed method group e: p = .091 no differences in control group between pre and post*

DISCUSSION

This study aimed to explore the effectiveness of an intervention in improving physical stability among the elderly in Kakamega County. In this randomized controlled trial, we explored the effects of the Lebed Method on elderly participants, finding significant enhancements in key metrics such as Timed Up and Go (TUG), Berg Balance Scale (BBS), De Morton Mobility Index (DEMMI), and gait speed when compared to a control group. These results underscore the potential benefits of the intervention in improving mobility and balance among the elderly

Effect on Timed Up and Go (TUG)

The statistical outcomes showed a significant reduction in the meantime taken to complete the TUG test in the intervention group after the therapy intervention. In contrast, the control group's mean TUG test time remained relatively stable. This substantial decrease in TUG test time in the intervention group is highly statistically significant, as the paired samples *t*-test indicated. Additionally, the effect size, measured using Cohen's d, demonstrates a large effect, further emphasizing the clinical significance of the findings. The observed reduction in TUG test time among the elderly participants following the Lebed dance movement therapy intervention aligns with several previous studies that have examined the positive impact of dance-based interventions on functional mobility and fall risk in older adults. Our findings are consistent with findings from the literature.

Dance therapy has been recognized for its potential to improve balance, strength, coordination, and overall physical fitness, factors that are essential in reducing fall risk among the elderly (Stathi et al., 2022; Gretebeck et al., 2019; Glauber et al. et al., 2018). A study by Stathi et al. (2022) reported that a 12-month physical activity and behavior maintenance program significantly improved lower limb physical functioning in older adults at risk of mobility limitations. Similarly, the study by Gretebeck et al. (2019) demonstrated that functional exercise training positively impacted mobility in older adults with diabetes and related comorbidities. A study by Glauber Sá Brandão et al. (2018) emphasized the benefits of a well-structured home exercise program in enhancing functional mobility and quality of life in sedentary elderly individuals. The consistency between our findings and these studies underscores the potential of dance-based interventions, like the Lebed dance movement therapy, in improving physical function and reducing fall risk among the elderly.

While our study's results are generally consistent with the existing literature on the positive effects of physical activity and dance-based interventions on the elderly's functional mobility, there are some notable differences. Notably, the control group in our study did not exhibit any significant changes in TUG test time over the intervention period, which contrasts with findings from other studies (Stathi et al., 2022; Gretebeck et al., 2019). One possible reason for this inconsistency could be the specific characteristics of our control group, as well as the duration and intensity of the intervention. It is essential to consider that the control group in our study may have had different baseline physical fitness and fall risk levels compared to those in other studies. Additionally, the duration of the Lebed dance movement therapy intervention and the frequency of sessions may have contributed to the observed differences in outcomes. Another factor to consider is our study's social and cultural context, conducted among the elderly in Kakamega. Cultural variations, lifestyle factors, and environmental conditions unique to this population may influence the outcomes differently compared to studies conducted in other regions. In conclusion, our study provides evidence that the Lebed dance movement therapy intervention significantly improves functional mobility, as measured by the TUG test, among the elderly in Kakamega. The findings are consistent with existing literature on the positive effects of dance-based interventions on physical function in older adults.

Effect on Berg Balance Scale (BBS)

Our analysis revealed a significant improvement in balance among the participants who underwent the Lebed dance movement therapy intervention, as indicated by the Berg

Balance Scale (BBS) scores. This improvement was highly statistically significant with a large effect size. This suggests that sustained and consistent targeted physical activity among the elderly leads to improved balance. Humira Ehrari et al. (2020) emphasized the importance of enjoyable and social exercise programs for enhancing balance and physical activity in older adults. This result is consistent with several previous studies that have investigated the impact of exercise programs on balance in elderly populations. Sitthiracha et al. (2021) found that a progressive step marching exercise program significantly improved balance ability in the elderly. Similarly, the study conducted by Brahmbhatt and Megha Sheth (2019) demonstrated that an exercise program led to a significant improvement in balance and lower limb function among elderly participants. Sañudo et al. (2019), found that flywheel resistance exercise training improved postural stability and mobility in older adults.

However, it is worth acknowledging the inconsistency in our findings. The noted methodological differences (intervention) could explain the inconsistencies in findings. A study by Sonthikul et al. (2021) compared core stabilization exercise (CSE) and active video gaming (AVG) as interventions for improving dynamic balance in elderly individuals. While AVG showed better effectiveness in dynamic balance and reaction time, CSE increased core and lower limb muscle strength. Lebed dance movement therapy involves rhythmic and coordinated movements, which may engage different aspects of balance compared to traditional core stabilization exercises.

Gait speed

Our results indicate a significant improvement in gait speed in the intervention group following the Lebed dance movement therapy intervention. This substantial increase in gait speed suggests that the Lebed dance movement therapy had a positive impact on the gait performance of the elderly participants. The substantial effect size further emphasizes the clinical significance of the improvement in gait speed within the intervention group. This suggests that the Lebed dance movement therapy intervention has the potential to substantially lead to faster gait speed. The improvement in gait speed may be associated with reduced fall risk, as Adam et al., 2023 described. The observed improvement in gait speed aligns with the findings of several studies included in our literature review. A study by Mohammadian et al. (2019) found that a balance training program resulted in significant improvements in gait speed among older adults. Similarly, the study by Lee (2020) reported improvements in gait ability following virtual reality gait training among older individuals. These findings suggest that various forms of physical activity interventions, including dance movement therapy, can lead to enhanced gait performance in the elderly.

In contrast to the intervention group, the control group exhibited only a marginal improvement in gait speed. While this improvement was not statistically significant, it is worth noting that the control group did not receive the dance therapy intervention. A study by Loh et al. (2022) suggested that a 6-week exercise intervention was inadequate to improve gait speed among older adults. This difference indicates that dance movement therapy may indeed be more effective than other forms of exercise. This underscores the importance of structured interventions, such as dance movement therapy, in achieving meaningful improvements in gait speed among the elderly.

However, it is worth acknowledging the inconsistency in our findings with research from other authors. This inconsistency may be attributed to differences in the nature and intensity of the interventions. A study by Wolf et al. (2020) found that multicomponent exercise training improved gait ability but did not result in a significant increase in gait speed among older women. Lebed dance movement therapy incorporates dance, rhythm, and music elements, which could engage participants both physically and emotionally, potentially leading to more pronounced improvements in gait speed.

Effect on de Morton Mobility Index (DEMMI)

Our findings indicate a statistically significant improvement in DEMMI scores among the intervention group following the Lebed dance movement therapy intervention. This improvement is supported by a large effect size. In contrast, the control group showed a smaller increase in DEMMI scores, although this change was not statistically significant. These results align with several previous studies in the field of exercise and physical activity interventions for older adults. A study by Wadsworth and Sally Lark (2020) investigated the effects of Whole-Body Vibration (WBV) exercise on frail elderly individuals. While their focus was on a different type of intervention, they reported significant improvements in functional mobility. Wadsworth and Lark's study observed enhanced physical function among older adults, suggesting the potential benefits of structured exercise programs. Ferreira et al. (2018) explored the effects of a 12-week exercise training program on institutionalized frail elderly individuals. While their focus was on different types of exercise programs, they reported improvements in speed and agility.

Interestingly, our results are inconsistent with findings from various studies. A Life Study Investigators (2018) study examined the effects of a long-term, structured physical activity program on frailty in older adults. They did not find a significant reduction in frailty risk over the study period. The inconsistencies could be attributed to differences in intervention duration and intensity. Our study focused on a dance movement therapy program of shorter duration (12 weeks), while the Life Study spanned over 2 years. The intensity and nature of the exercise may also vary, potentially influencing the outcomes. Additionally, differences in participant characteristics, such as baseline frailty status, could contribute to the inconsistent results. The significant improvement in DEMMI scores among the intervention group in our study underscores the potential benefits of the Lebed dance movement therapy intervention for reducing fall risk factors among the elderly in Kakamega. These findings suggest that community-based dance therapy programs could be a valuable addition to fall prevention strategies for older adults.

Limitation

The study outlines several limitations, including the geographic specificity of participants and the homogeneity in age and health status, which could affect the generalizability of the findings. Efforts were made to counter these through detailed participant selection criteria and by emphasizing the study's relevance to the targeted demographic. The challenge of blinding due to the intervention's nature was approached by utilizing objective outcome measures and statistical controls to mitigate bias. Additionally, the scarcity of literature on fall prevention in African contexts was countered by adapting international findings to the local cultural setting of Kakamega County. The study did not explore the adverse effects of the intervention in both groups, such as pain, discomfort, difficulty in comprehension, or assimilation, which is also a limitation of the study. Another limitation of the study is that it offered a 3-month membership to the control group but did not go further to find out the activities those who accepted the offer participated in nor gather data on the same. Despite these limitations, the study employed strategic measures to enhance its validity and provide insightful conclusions on the Lebed Method's efficacy in fall prevention among the elderly, underlining a commitment to research integrity and generating contextually relevant knowledge.

CONCLUSION & RECOMMENDATION

The results from various assessments, including the Timed Up-and-go (TUG) test, Berg Balance Scale (BBS), Gait Speed, and de Morton Mobility Index (DEMMI), demonstrate the significant impact of the Lebed Method intervention on improving physical stability among elderly individuals. The intervention group showed marked improvements in mobility, balance, gait speed, and functional abilities, as evidenced by substantial differences in pre- and post-intervention scores across these measures. These enhancements, validated by statistically significant *t*-test and ANCOVA analyses, highlight the effectiveness of the Lebed Method in positively influencing various aspects of physical performance in the elderly, underlining its potential as a beneficial intervention in geriatric care. Further research could delve into the specific components of dance-based therapy that contribute most to functional mobility and balance improvements. Identifying the key elements that drive these enhancements can inform the design of targeted interventions that maximize fall prevention outcomes.

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DECLARATIONS

Ethics Approval

Ethical clearance was obtained from the Masinde Muliro University of Science and Technology Ethics Committee. Consent.

Competing interest

The authors declare that they have no competing interests.

Disclaimer

The findings and conclusions presented in this manuscript are those of the authors and do not necessarily reflect the official position of Masinde Muliro University.

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