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ORIGINAL ARTICLE

THE COMPARATIVE EFFECTS OF SINGLE TASK AND DUAL TASK ON GAIT, BALANCE, AND QUALITY OF LIFE IN GERIATRIC POPULATION

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ABSTRACT

The aging trajectory frequently incurs a decline in gait, balance, and Quality of Life (QoL). While dual-task interventions have shown promise, comparative studies between single and dual-task training are limited. However, research comparing the effects of single task versus dual-task remains scant. Geriatric Rehabilitation (GR) primarily targets the restoration of function or enhancement of residual functional abilities in older adults, particularly those experiencing debilitating impairments or frailty. **Objective**: To compare the effects of single and dual-task training on gait, balance, and QoL in the geriatric population. **Methods**: In this randomized controlled trial, 66 geriatrics with mild cognitive and balance impairments were assigned to 12-week single or dual-task training, followed by a six-month follow-up. The primary outcomes encompassed gait speed, balance (Timed Up and Go [TUG] Test), and QoL (standardized questionnaire). **Results**: Participants (mean age: ~51 years; weight: ~86.9 kg) were equally distributed in both groups with a balanced gender representation. The dual-task group exhibited substantial advancements in Physical Health, with a median score of 74 (IQR: 72-75), surpassing the single-task group (median: 66, IQR: 63.5-67), $p<0.001$. Moreover, the TUG Test highlighted improved mobility in the dual-task group, registering a median duration of 11 seconds (IQR: 10-12) versus 17 seconds in the single-task group (IQR: 16-18), $p<0.001$. **Conclusion**: The findings of this study support the superiority of dual-task training over single-task training in improving gait, balance, and QoL among the geriatric population. The integration of cognitive tasks into balance and gait exercises may offer significant advantages, potentially contributing to fall prevention strategies and fostering an enhanced sense of well-being in older individuals.

Keywords: Balance, Dual-task, Gait, Geriatrics, Quality of Life, Randomized Controlled Trial, Single-task.

INTRODUCTION

Aging is a multifaceted process that affects physical, mental, and social aspects of life. With the extended lifespan and rising prevalence of chronic conditions in older adults, healthcare attention towards this population is increasing. Physiotherapists have become indispensable players in this context, actively involved in maintaining and enhancing the physical capabilities and autonomy of elderly individuals. They often work in multidisciplinary teams and are tasked with managing a complex interplay of medical, psychological, rehabilitative, economic, and social issues concurrently [1,2].

Geriatric Rehabilitation (GR) primarily targets the restoration of function or enhancement of residual functional abilities in older adults, particularly

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those experiencing debilitating impairments or frailty. Notably, contemporary rehabilitation approaches have begun prioritizing overall functi-onality and well-being over disease mitig-ation alone. The objective is to enable independence and in-home living for older adults. Such a perspective is more critical than ever, considering that appro-ximately 11% of elderly patients enter rehabilitation facilities post hospitalization, a number projected to rise significantly due to the growing elderly population [3-5].

Dual-task training, which combines cognitive challenges with physical activities, is emerging as a promising strategy. For instance, Dorfman *et al*. (2014) demonstrated that an integrated interven-tion, combining treadmill training and dual-task components, significantly improved mobility, functional performance, and cognitive scores in older adults with a history of multiple falls [4, 6, 7]. Simi-larly, Conradsson *et al*. (2019) highlighted pronou-nced improvements in dual-task gait in older women with osteoporosis after dual-task balance training [8]. These studies underline the potential of dual-task training to be incorporated into fall-risk reduction programs by therapists, arguing its cost-effectiveness and individualization [9-13].

Physiotherapists treating the elderly must be skilled in managing patients with diverse needs and conditions, often co-occurring in a single patient (musculoskeletal, neurological, cardiovascular issues). The physiotherapist's role epitomizes a 'Jack of all trades,' requiring extensive knowledge across various domains [14-16].

A decline in balance in older adults is tied to decreased physiological functions leading to increased fall risks, a significant contributor to disability and accidental deaths in the elderly [17]. Programs aiming to improve balance, such as those studied by Hagovská and Olekszyová (2016), have shown that integrating cognitive components into balance training resulted in significant improvements compared to balance training alone[13]. Clemson *et al*. (2012) investigated the effectiveness of a lifestyle-integrated approach to balance and strength training and found that it effectively reduced fall rates among high-risk elderly individuals.

However, a critical consideration is the potential disparity between lab-based assessments and real-world performance. Hillel *et al*. (2019) identified significant differences between in-lab and real-world gait measures in elderly individuals, suggesting that in-lab measurements might not reflect a person's typical daily gait. This finding highlights the necessity for healthcare professionals, including physiotherapists, to consider the ecological validity of their assessments and interventions.

Physiotherapists are increasingly pivotal in this context, employing innovative and comprehensive strategies, such as dual-task training, to meet the unique, diverse needs of older adults. The critical challenge moving forward will be to continually adapt and optimize these strategies in the face of real-world complexities and the evolving healthcare landscape. The objective was to compare the effect of single task and dual task on gait, balance, and quality of life in geriatric population.

MATERIALS AND METHODS

This study was designed as a Randomized Control Trial, adhering to rigorous standards to compare the effectiveness of the interventions applied in each group. The research was conducted at the Usman Physiotherapy Center, located in Bahria Town. This setting was chosen due to its established reputation and its staff's expertise, equipped with the necessary facilities to adequately perform the interventions and assessments required in this study. Following approval of the synopsis, the study was conducted over a duration of 9 months. This timeframe was carefully planned to allow adequate time for participant recruitment, intervention, data collection, and analysis, ensuring the integrity and reliability of the study findings.

Based on calculations from Fersum *et al*.(2019), the sample size, using pain as an outcome measure, was determined to be 27 participants in each group [18]. To account for a potential 20% dropout rate, this figure was adjusted to 33 participants in each group. This calculation was rooted in a 95% level of significance and a power of study set at 80%, with the expectation of mean changes in scores in line with

previous research[18]. Purposive sampling was employed in this study. This non-probability sampling technique was chosen due to its practicality and ease, facilitating the recruitment of participants who were readily accessible and willing to partake in the study, a common approach in clinical trials when random sampling is not feasible. Conversely, the exclusion criteria were designed to omit individuals with conditions that could confound the results of the intervention on balance and gait. Following the recommendations of Hemming *et al*. (2018) individuals were excluded if they had a neurological or musculoskeletal diag-nosis that could cause balance disturbances, signi-ficant orthopaedic involvement, visual and auditory impairments, transient ischemic attacks, or cardiac problems[19]. Persons who scored less than 52 points on the Berg Balance Scale (BBS) out of 56 points were also excluded. This stringent exclusion criterion aimed to isolate the effects of the intervention, there-by increasing the study's internal validity.

Statistical Analysis

Data were entered in SPSS (26.0) in which categorical data was calculated in terms of frequency (percentage) while continuous variables were presented in terms of mean and standard deviation. Repeated measures ANOVA was used to describe within group differences for all groups.

RESULTS

The results showed, Table 1, a total of 66 participants were equally divided into two groups: Dual Task (DT) and Single Task (ST). In the DT group, 57.6% were male and 42.4% were female, whereas the ST group had an inverse gender distribution with 42.4% male and 57.6% female. Both groups were comparable in terms of age, with the DT group averaging 51.91 years (± 7.01) and the ST group averaging 51.15 years (± 5.75). The average weight was nearly identical for both groups, at 86.91 kg (± 11.34) for DT and 86.61 kg (± 11.79) for ST. Both groups had a similar height of approximately 1.69 meters and a Bone Mass Index of 30.63, albeit with slightly different standard deviations.

In the comparison of physical domains between dual task and single task groups, the Table 2 presents median scores and interquartile ranges (IQR) at three time points: baseline, 1st post, and 2nd post. At baseline, for Physical Health Limitations, the dual task group had a median score of 45 (IQR 43-46) while the single task group scored 44 (IQR 42.5-45) with a U score of 466.50, Z value of -1.01, and a p-value of 0.31. A similar pattern was observed across other domains at baseline with close scores and non-significant p-values, except in the case of Bodily Pain, where the scores were 49 (IQR 48-50) for dual task and 50 (IQR 47.5-51.5) for single task. In the 1st post assessments, the dual task group consistently scored higher in all domains with significant p-values ($p<.001$). By the 2nd post assessment, the disparity increased with the dual task group scoring 74 (IQR 72-75) in Physical Health Limitations and the single task group scoring 66 (IQR 63.5-67), with a Z value of -6.92 and a p-value of .00. Similar significant differences favouring the dual task group were observed across all other domains in the 2nd post measurements.

Table 1. Demographic Characteristics

Parameter	Dual Task	Single Task
	Gender (N, %)	Gender (N, %)
Male	19 (57.6%)	14 (42.4%)
Female	14 (42.4%)	19 (57.6%)
Total	33 (100%)	33 (100%)
	Mean ± SD	Mean ± SD
Age (years)	51.91 ± 7.01	51.15 ± 5.75
Weight (kg)	86.91 ± 11.34	86.61 ± 11.79
Height (m)	1.69 ± 0.11	1.69 ± 0.09
Bone Mass Index	30.63 ± 4.3	30.63 ± 4.74

In the assessment of emotional domains between participants of the dual task and single task groups, Table 3 displays the median scores alongside their interquartile ranges (IQR) at baseline, 1st post, and 2nd post interventions. At the baseline for Social Functioning, the dual task group reported a median score of 59 (IQR 56.5-60), while the single task group had a median of 58 (IQR 57-59), showing a non-significant difference with a p-value of 0.53. Similarly, for both "Role Limitations due to Emotional Problems" and "Mental Health" at baseline, there were minimal differences between the two groups with p-values of 0.81 and 0.75, respectively. However, by the 1st post intervention, the dual task group consistently showed higher scores across all emotional domains, with significant p-values below 0.01. For instance, in Social Functioning, the dual task group's median was 74 (IQR 72.5-75) compared to the single task group's 70 (IQR 68-71) with a p-value of 0.000. This trend of the dual task group outperforming the single task group persisted in the 2nd post measurements across all domains, with notably significant differences such as the score in role limitations due to emotional problems being 79 (IQR 77-80.5) for the dual task group and 71 (IQR 69.5-73) for the single task group, leading to a p-value of 0.000.

Table 4 compares gait ability between the dual task and single task groups using the TUG test. At baseline, both groups had similar median TUG scores: dual task at 26 seconds (IQR 25-27) and single task at 26 seconds (IQR 24-27) with a p-value of .811. By the 1st post, the dual task group improved to 20 seconds (IQR 19-21) compared to the single task's 24 seconds (IQR 22-24), resulting in a p-value of 0.000. By the 2nd post, the dual task group further reduced their time to 11 seconds (IQR 10-12), while the single task group recorded 17 seconds (IQR 16-18), both with a significant p-value of 0.000.

In this study, at the 2nd Post-assessment, the Dual Task (DT) group significantly outperformed the Single Task (ST) group across multiple metrics. Notably, the DT group had a median Physical Health score of 74 (IQR: 72-75) compared to the ST group's 66 (IQR: 63.5-67), with a p-value of <0.001. For Bodily Pain, the DT group scored 78 (IQR: 77-80) versus ST's 70 (IQR: 68-73), p<0.001. In the General Health Perceptions domain, DT scored 75 (IQR: 72-77.5) while ST scored 67 (IQR: 63.5-68), p<0.001. The mobility, assessed by the Timed Up and Go (TUG) test, showed substantial improvement in the DT group with a median time of 11 seconds (IQR: 10-12), in contrast to the ST group's 17 seconds (IQR: 16-18), p<0.001. These results suggest the notable effectiveness of dual-task training in enhancing health and mobility in the geriatric population.

Table 2. Comparison of Physical Domains between Participants of Dual Task and Single Task Groups

Physical Domains	Time Point	Dual Task Median (IQR)	Single Task Median (IQR)	U Score	Z	p-value
Physical Health Limitations	Baseline	45 (43 - 46)	44 (42.5 - 45)	466.50	-1.01	0.31
	1st Post	59 (58 - 61.5)	55 (54 - 57)	87.00	-5.90	0.000
	2nd Post	74 (72 - 75)	66 (63.5 - 67)	7.00	-6.92	0.000
Bodily Pain	Baseline	49 (48 - 50)	50 (47.5 - 51.5)	450.50	-1.22	0.22
	1st Post	64 (63 - 66)	61 (59 - 63)	151.50	-5.07	0.000
	2nd Post	78 (77 - 80)	70 (68 - 73)	10.50	-6.86	0.000
General Health Perceptions	Baseline	43 (41 - 45.5)	44 (41 - 45)	539.50	-0.06	0.95
	1st Post	62 (58 - 63)	57 (54 - 58)	141.50	-5.20	0.000
	2nd Post	75 (72 - 77.5)	67 (63.5 - 68)	2.00	-6.97	0.000
Vitality	Baseline	54 (52 - 54.5)	53 (52 - 54)	525.50	-0.25	0.80
	1st Post	71 (70 - 72)	66 (65 - 68)	28.50	-6.65	0.000
	2nd Post	84 (84 - 87)	76 (75 - 78)	0.50	-7.02	0.000

Table 3. Comparison of Emotional Domains between Participants of Dual Task and Single Task Groups

Emotional Domains	Time Point	Dual Task Median (IQR)	Single Task Median (IQR)	U Score	Z	p-value
Social Functioning	Baseline	59 (56.5 - 60)	58 (57 - 59)	496.50	-0.62	0.531
	1st Post	74 (72.5 - 75)	70 (68 - 71)	84.00	-5.94	0.000
	2nd Post	88 (86 - 89.5)	80 (78.5-81.5)	3.50	-6.95	0.000
Role Limitations due to Emotional Problems	Baseline	50(47.5-51.5)	50 (47 -52)	526.50	-0.23	0.815
	1st Post	64 (63 - 66.5)	61 (60 - 62)	106.50	-5.66	0.000
	2nd Post	79 (77 - 80.5)	71 (69.5 - 73)	1.00	-6.99	0.000
Mental Health	Baseline	52 (48 - 55)	51 (47 - 55)	520.00	-.31	0.752
	1st Post	67 (64 - 70.5)	62 (59.5 - 67)	293.00	-3.23	0.001
	2nd Post	80 (77.5 - 85)	73 (69 - 76.5)	110.50	-5.58	0.000

Table 4. Comparison of Gait Ability Domains between Participants of Dual Task and Single Task Groups

Gait Ability	Time Point	Dual Task Median (IQR)	Single Task Median (IQR)	U Score	Z	p-value
TUG	Baseline	26 (25 - 27)	26 (24 - 27)	526.50	-0.24	0.81
	1st Post	20 (19 - 21)	24 (22 - 24)	43.50	-6.50	0.000
	2nd Post	11 (10 - 12)	17 (16 - 18)	.00	-7.03	0.000

DISCUSSION

The ongoing debate in physiotherapy research focuses on optimizing interventions to improve gait, balance, and quality of life in the aging population. This randomized controlled trial (RCT) at the Usman Physiotherapy Center, Bahria Town, took a deep dive into the comparison between single-task and dual-task interventions in individuals aged 65 and above. The meticulous nine-month study post-synopsis approval involved 50 participants, evenly split into single-task and dual-task groups. At the heart of the intervention were two distinct approaches: traditional single-task balance training and the more intricate dual-task training, which combined balance with cognitive tasks. These interventions were measured against benchmarks like the berg balance scale (BBS) scores, self-selected gait speed, and the well-regarded 36-Item Short Form Survey (SF-36) to gauge quality of life.

Utilizing the robust capabilities of SPSS version 24, the data was analyzed with quantitative variables articulated as mean ± SD, while qualitative variables were depicted through frequency and percentage. The time-bound assessments at baseline, six weeks, and twelve weeks were statistically scrutinized using Repeated measure ANOVA, setting a threshold of significance at a p-value ≤ 0.05. The findings were striking. Both intervention metho- dologies led to observable advancements in gait, balance, and overall quality of life. Yet, it was the dual-task intervention that stood out with its remarkable outcomes. Mental health metrics, in particular, highlighted the superiority of the dual-task approach over the single-task. This distinction was echoed in mobility assessments using the timed up and go (TUG) test, where the dual-task group outperformed their counterparts.

Looking at this in the context of the original hypotheses, the data challenges preconceived notions. It seems evident that while both interventions hold merit, the dual-task approach has a more pronounced positive impact, especially on mental health and mobility. Positioning these findings within the broader academic landscape, there's a resonance with several preceding studies, but with nuanced differences. For instance, Dorfman *et al.* (2014) and Conradsson *et al.* (2019) had similar threads but targeted more specific populations. The broadness of our geriatric demographic offers a more

comprehensive perspective [20,21].

The thematic overlap with Hagovská and Hiyamizu *et al*. (2012), Olekszyová (2016), and Wollesen *et al*. (2017), highlights the growing consensus around the value of dual-task interv-entions [13, 22]. Meanwhile, the studies by Yang *et al*. (2015) and Hillel *et al*. (2019) bring to light the criticality of selecting measures that mirror real-world scenarios[2,23]. It's these nuances, coupled with the findings from Clemson *et al*. (2012) about lifestyle-integrated approaches, that enrich the discourse [8,12,16,20,24].

To encapsulate, the results of this RCT underline the pivotal role of dual-task interventions in augmenting gait, balance, and quality of life in the elderly. While both interventions present benefits, the dual-task approach emerges as the frontrunner, affirming the revised hypothesis. This paradigm shift aligns with the broader academic consensus, emphasizing the potential of dual-task training, and underscores the importance of contextually relevant interv-entions for an aging population.

CONCLUSION

The Dual Task intervention, which combines cognitive and physical exercises, led to more significant improvements in elderly participants' gait, balance, and quality of life compared to the Single Task intervention. However, the study's findings may be limited by its specific geographic focus, lack of long-term follow-up, and failure to consider varying cognitive impairment levels among participants. Future research should aim to diversify the sample size, include long-term assessments, explore different cognitive tasks, and account for participants' cognitive health to enhance the interv-ention's effectiveness and broaden its applicability.

DECLARATION

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REFERENCES

1. Heppner HJ, Lente AK. Geriatrics on the move - what happened during the last 10 years?. MMW - Fortschritte der Medizin. 2018;160 (3):86-90.

2. Hillel I, Gazit E, Nieuwboer A, Avanzino L, Rochester L, Cereatti A, *et al*. Is every-day walking in older adults more analogous to dual-task walking or to usual walking? Elucidating the gaps between gait performance in the lab and during 24/7 monitoring. European Review of Aging and Physical Activity. 2019; 16(1):1-12.

3. Kolb GF. Geriatrics or the geriatricization of medicine: Quo vadis geriatrics? Journal of Gerontology and Geriatrics. 2017;50(8):657-665.

4. Kuzuya M, Aita K, Katayama Y, Katsuya T, Nishikawa M, Hirahara S, *et al*. Japan geriatrics society "recommendations for the promotion of advance care planning": end-of-life issues subcommittee consensus statement. Geriatrics & Gerontology International. 2020;20(11): 1024-1028.

5. Swanson R, Robinson KM. Geriatric Rehabilitation: Gait in the elderly, fall prevention and parkinson disease. Medical Clinics of North America. 2020;104(2):327-343.

6. Hall RK, Cary MP Jr., Washington TR, Colón-Emeric CS. Quality of life in older adults receiving hemodialysis: a qualitative study. Quality of Life Research. 2020;29(3):655-663.

7. Lucas M, Wagshul ME, Izzetoglu M, Holtzer R. Moderating effect of white matter integrity on brain activation during dual-task walking in older adults. The Journals of Gerontology Series A: Biological Sciences and Medical Sciences. 2019;74(4):435-441.

8. Conradsson D, Halvarsson A, Posture; the effects of dual-task balance training on gait in older women with osteoporosis: a randomized controlled trial. Gait & Posture. 2019; 68:562-8.

9. Brustio PR, Rabaglietti E, Formica S, Liubicich ME. Dual-task training in older adults: The

effect of additional motor tasks on mobility performance. Archives of Gerontology and Geriatrics. 2018; 75:119-124.

10. Arai H, Satake S, Kozaki K. Cognitive frailty in geriatrics. Clinics in Geriatric Medicine. 2018;34(4):667-675.

11. Asai T, Oshima K, Fukumoto Y, Yonezawa Y, Matsuo A, Misu S. Association of fall history with the timed up and go test score and the dual task cost: a cross-sectional study among independent community-dwelling older adults. Geriatrics & Gerontology International. 2018;18(8):1189-1193.

12. Clemson L, Singh MA, Bundy A, Cumming RG, Manollaras K, O'Loughlin P, Black D. Integration of balance and strength training into daily life activity to reduce rate of falls in older people (the LiFE study): randomised parallel trial. BMJ: British Medical Journal (Online). 2012;345(online): e4547- e4547.

13. Hagovská M, Olekszyová Z. Impact of the combination of cognitive and balance training on gait, fear and risk of falling and quality of life in seniors with mild cognitive impairment. Geriatrics & Gerontology International. 2016;16(9):1043-1050.

14. de Barros GM, Melo F, Domingos J, Oliveira R, Silva L, Fernandes JB, *et al*. The effects of different types of dual tasking on balance in healthy older adults. Journal of Personalized Medicine. 2021;11(9):933-941.

15. Germain C, Perrot A, Tomasino C, Bonnal J, Ozsancak C, Auzou P, *et al*. Effect of the level of physical activity on prefrontal cortex hemodynamics in older adults during single- and dual-task walking. Journal of Aging and Physical Activity. 2022;31(1):96-104.

16. Goh HT, Pearce M, Vas A. Task matters: an investigation on the effect of different secondary tasks on dual-task gait in older adults. BMC Geriatrics. 2021;21(1):1-12.

17. Osoba MY, Rao AK, Agrawal SK, Lalwani AK. Balance and gait in the elderly: A contemporary review. Laryngoscope Invest-igative Otolaryngology. 2019;4(1):143-153.

18. Vibe Fersum K, O'Sullivan P, Skouen J, Smith A, Kvåle A. Efficacy of classification-based cognitive functional therapy in patients with non-specific chronic low back pain: a randomized controlled trial. European Journal of Pain. 2013;17(6):916-928.

19. Hemming R, Sheeran L, van Deursen R, Sparkes V. Non-specific chronic low back pain: differences in spinal kinematics in subgroups during functional tasks. European Spine Journal. 2018;27(1):163-170.

20. Dorfman M, Herman T, Brozgol M, Shema S, Weiss A, Hausdorff JM, *et al*. Dual-task training on a treadmill to improve gait and cognitive function in elderly idiopathic fallers. Clinical Interventions in Aging. 2014;38(4): 246-253.

21. Commandeur D, Klimstra M, MacDonald S, Inouye K, Cox M, Chan D, *et al*. Difference scores between single-task and dual-task gait measures are better than clinical measures for detection of fall-risk in community-dwelling older adults. Gait & Posture. 2018; 66:155-159.

22. Wollesen B, Schulz S, Seydell L, Delbaere K. Does dual task training improve walking performance of older adults with concern of falling? BMC Geriatrics. 2017;17(1):1-9.

23. Yang L, Liao L, Lam F, He C, Pang MYC. Psychometric properties of dual-task balance assessments for older adults: a systematic review. Maturitas. 2015;80(4):359-369.

24. Conradsson D, Halvarsson A. The effects of dual-task balance training on gait in older women with osteoporosis: a randomized controlled trial. Gait & Posture. 2019; 68:562-568.