Biological and Clinical Sciences Research Journal
eISSN: 2708-2261; pISSN: 2958-4728
www.bcsrj.com
DOI: https://doi.org/10.54112/bcsrj.v2024i1.947
*Biol. Clin. Sci. Res. J., Volume, **2024**: 947*
Original research article

COMPARATIVE EFFECTS OF TASK-ORIENTED PROGRAM AND PROPRIOCEPTIVE TRAINING ON BALANCE, GAIT AND QUALITY OF LIFE IN PATIENTS WITH HEMIPLEGIC STROKE

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(Received, 27th April 2024, Revised 20th June 2024, Published 8th July 2024)

Abstract: *This study compared the effectiveness of a Task-Oriented Program and Proprioceptive Training in improving balance, gait, and quality of life in a specific population.* ***Objective:*** *The objective of this study was to evaluate and compare the outcomes of the Task-Oriented Program and Proprioceptive Training on participants' balance, gait, and quality of life.* ***Methods:*** *The study included two treatment groups: Group A (Task-Oriented Program) and Group B (Proprioceptive Training). The gender distribution and frequencies were assessed within each group. Various variables were measured at different time points, and tests for normality were conducted. Independent samples t-tests were performed to analyze the differences in mean scores between the two groups.* ***Results:*** *In Group A, comprising 36 participants, there were 17 males (47.2%) and 19 females (52.8%), while Group B, also with 36 participants, consisted of 16 males (44.4%) and 20 females (55.6%). At baseline, no significant difference was observed in mean Berg Balance Scale (BBS) scores between the two groups. However, after four weeks of intervention, Group A demonstrated significantly higher BBS scores than Group B (mean difference = 6.26, $p < 0.001$). This trend continued at week 8, with Group A showing a substantial advantage (mean difference = 14.56, $p < 0.001$). Regarding Motor Assessment Scale (MAS) scores, similar patterns emerged. At baseline, no significant difference was found. Still, after four weeks, Group A had significantly higher MAS scores than Group B (mean difference = 7.21, $p < 0.001$), which further increased at week 8 (mean difference = 13.88, $p < 0.001$).* ***Conclusion:*** *The Task-Oriented Program yielded superior outcomes compared to Proprioceptive Training in improving participants' balance, gait, and quality of life, as indicated by significantly higher BBS and MAS scores. These findings highlight the effectiveness of the Task-Oriented Program as an intervention for enhancing balance and motor performance in the specific population studied.*

Keywords: Task-Oriented Program, Proprioceptive Training, Balance, Gait, Quality of Life, Motor Performance, Berg Balance Scale, Motor Assessment Scale.

Introduction

A hemiplegic stroke affects one entire side of the body when the brain's blood supply is interrupted or reduced, either by a blood clot (ischemic stroke) or bleeding (hemorrhagic stroke). The stroke leads to loss of voluntary movement, ranging from mild weakness to complete paralysis. (1)Sensory changes, such as numbness or tingling, can affect perception, balance, and coordination, making daily tasks difficult. (2, 3). Speech and language functions may be impaired, leading to aphasia, while cognitive issues like memory loss or concentration problems may occur. (4-6). Emotional impacts, such as depression or anxiety, are common, and rehabilitation must address these alongside physical challenges. (7).

Recovery requires a tailored approach, focusing on physical, sensory, speech, cognitive, and emotional aspects. Rehabilitation typically includes therapies to improve mobility, strength, coordination, speech, and emotional well-being. (8-11). Two common approaches in rehabilitation are task-oriented programs and proprioceptive training. (4, 12-16).

A task-oriented program emphasizes functional tasks relevant to daily life, stimulating the brain's ability to reorganize and create new neural connections. It involves real-life challenges and promoting active participation and engagement in the task. (14, 17, 18)Proprioceptive training enhances body awareness and control by targeting proprioceptive receptors in muscles, tendons, and joints. It includes exercises that improve balance, coordination, and stability. (19-21).

Both approaches can be combined to offer a comprehensive rehabilitation process. They contribute to better movement control, reduced risk of falls, and increased functional abilities. Healthcare professionals should assess and guide individuals in designing personalized rehabilitation programs, including task-oriented activities and proprioceptive training. Research on these approaches is significant for expanding knowledge in rehabilitation, developing evidence-based practices, and improving outcomes for individuals with neurological injuries or conditions. (2, 22, 23). It helps understand recovery mechanisms and guides the development of targeted interventions, ultimately enhancing the quality of life for those undergoing rehabilitation. (24).

Several studies have delved into the impact of various training interventions on rehabilitation, particularly for stroke patients. Research by Ahamad et al. (2019) and Khallaf (2020) emphasize biomechanical similarities between sitting and standing and the benefits of targeted seated training on balance and trunk control (12, 17). Additionally, Wang et al. (2021) show how incorporating cognitive behaviors in task-oriented training can improve walking coordination (10).

[Citation: Maqbool, S., Kamran, S., Naz, S., Amjad, A., Maqbool, T., (2024). Comparative effects of task-oriented program and proprioceptive training on balance, gait and quality of life in patients with hemiplegic stroke. *Biol. Clin. Sci. Res. J.*, **2024***: 947*. doi: https://doi.org/10.54112/bcsrj.v2024i1.947]

Studies by Kim K. J. et al. (2020), Liu et al. (2019), and others illustrate the effectiveness of combined approaches such as muscle strengthening with proprioceptive exercises and cognitive behavioral therapy with task-oriented training. (14, 25). These combined techniques enhance outcomes in functional ankle instability, balance problems, and fear of falling.

However, there is a noticeable lack of comparative studies between interventions like task-oriented training and proprioceptive techniques. Frimpong et al. (2014), Kim et al. (2017), and other works indicate the promise of task-oriented training in improving physical function in stroke survivors. Still, the literature lacks comprehensive comparative research to identify the most effective approach across different domains. (18, 26).

A critical gap in existing research is the comparative effectiveness of task-oriented training and proprioceptive techniques in stroke rehabilitation, particularly regarding their impact on balance, gait, and quality of life. Despite individual studies on these methods, direct comparisons are lacking. Addressing this gap, this study aims to determine the comparative effects of a task-oriented program and proprioceptive training on these aspects in patients with hemiplegic stroke. This research aims to guide evidence-based rehabilitation protocols and recognize the need for individualized, multifaceted treatments considering both cognitive and physical aspects of recovery.

Methodology

This study was designed as a Randomized Controlled Trial (RCT) carried out within the physical therapy department at the District Headquarters Hospital, Sheikhupura. Conducted over nine months following the approval of the synopsis, the design served as the foundation for assessing the comparative effects of specific treatments in stroke patients. The calculated sample size for the study was initially determined to be 17 participants in each group. However, in alignment with clinical trial guidelines requiring a minimum of 30 participants in each group, the number was increased to 30. To account for a potential 20% dropout rate, the final sample size was adjusted to 36 participants in each group. The sample size calculation utilized the formula $n=2\sigma^2 (Z 1-\alpha/2 + Z 1-\beta)^2/(\mu1 - \mu2)^2$, informed by Ahamad et al., 2019 (12).

The study employed non-probability, purposive sampling, an approach tailored to the specific requirements and objectives of the research.

The population for the study was meticulously selected based on diagnoses by physicians and medical investigations. The subjects were assessed for eligibility according to well-defined inclusion and exclusion criteria. Included were hemiplegic patients aged between 30-70 years, with Mini-Mental Scale Examination (MMSE), scores greater than 18, and who were capable of independent activities of daily life before the stroke. Both male and female patients were considered. Exclusions were made for patients with a history of previous stroke attacks, traumatic head injury, psychological or psychiatric disorders, visual or hearing deficits, recent fractures, or tumors, as documented by Darda et al., 2021 (22). These criteria ensured a coherent, relevant, focused patient sample reflective of the study's objectives.

The study's randomization was conducted using computerized random numbers generated through Excel, a method ensuring automatic concealment of allocation. The single-blinding approach further enhanced the study's credibility; assessors were unaware of the treatment assigned to each group, and participants were instructed not to disclose any details of their assigned treatment. This structure fostered an unbiased evaluation of the interventions.

Participants were divided into two groups: Group A, which received a task-oriented program, and Group B, which focused on proprioceptive training. Both groups also engaged in routine physical therapy as baseline treatment, including strengthening exercises, weight-bearing exercises, and gait training. The total duration of therapy spanned two months (8 weeks), with daily sessions lasting 45 minutes to an hour. Group A's task-oriented training consisted of specific exercises, such as heel lifts, unilateral and bilateral slow arm movements, and exercises on a balance board. Group B's proprioceptive training included balance and leaning exercises, such as forward and backward balance from kneeling and standing on a non-affected leg. This division facilitated a focused exploration of the comparative effects of task-oriented and proprioceptive techniques.

The study strictly adhered to the ethical principles established by the University of Lahore's ethical committee, ensuring respect for participants' rights. Written informed consent was obtained from all participants, and their understanding and agreement were meticulously confirmed. Confidentiality was maintained, and the information and data collected were treated as private. Participants were informed of the lack of drawbacks or risks, their right to withdraw, potential benefits, and the efforts to preserve their privacy. These measures reflected a commitment to ethical research practices.

The data analysis was executed using SPSS version 25. Quantitative data were presented as mean ± standard deviation (SD), and qualitative data were conveyed as frequency and percentage. The normality of the data was assessed, guiding the selection of the appropriate statistical tests. Repeated measure ANOVA was employed to compare the outcome variables before and after the intervention when the data followed a normal distribution, with alternative non-parametric tests used otherwise. The significance level of $p \leq 0.05$ was considered statistically significant, providing a robust framework for interpreting the study's findings.

Results

In the study, Group A, assigned the Task Oriented Program, consists of 36 participants, 17 males (47.2%) and 19 females (52.8%), with a mean age of 55.83 and a standard deviation of 6.79.

Table 1 Comparative Demographics

Treatment Group	Gender	Frequency (%)	Mean Age	Std. Deviation
Group A: Task-Oriented Program	Male	17 (47.2%)	55.83	6.79

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	Female	19 (52.8%)		
Group B: Proprioceptive Training	Male	16 (44.4%)	57.08	6.54
	Female	20 (55.6%)		

Conversely, Group B, undergoing Proprioceptive Training, comprises 36 participants, including 16 males (44.4%) and 20 females (55.6%). The mean age is slightly higher, at 57.08 years, and the standard deviation is 6.54 years.

Table 2 Comparative Balance and Motor Assessment Scores

Scale	Time	Group A (Mean ± SD)	Group B (Mean ± SD)	t-value	Mean Difference	P Value
Berg Balance Scale	Baseline	27.17 ± 1.92	26.81 ± 2.03	0.78	0.36	0.440
	Week 4	37.36 ± 2.24	33.67 ± 2.74	6.26	3.69	0.000
	Week 8	50.25 ± 2.18	41.06 ± 3.10	14.56	9.19	0.000
Motor Assessment Scale	Baseline	8.08 ± 1.52	8.06 ± 1.74	0.07	0.03	0.943
	Week 4	21.64 ± 2.17	18.19 ± 1.88	7.21	3.44	0.000
	Week 8	35.19 ± 3.66	28.33 ± 2.31	9.51	6.86	0.000

The comparison between Group A (Task-Oriented Program) and Group B (Proprioceptive Training) shows distinct trends over time. Both groups started similarly at baseline for the Berg Balance Scale (BBS) (Group A: 27.17 ± 1.92, Group B: 26.81 ± 2.03, P=0.440). By Week 4, Group A outperformed Group B (37.36 ± 2.24 vs. 33.67 ± 2.74, P=0.000), and this difference further increased by Week 8 (50.25 ± 2.18 vs. 41.06 ± 3.10, P=0.000). Similarly, for the Motor Assessment Scale (MAS), the groups were initially comparable (Group A: 8.08 ± 1.52, Group B: 8.06 ± 1.74, P=0.943), but significant differences emerged by Week 4 (21.64 ± 2.17 vs. 18.19 ± 1.88, P=0.000) and continued to widen by Week 8 (35.19 ± 3.66 vs. 28.33 ± 2.31, P=0.000). These results emphasize the superior effectiveness of the Task-Oriented Program over Proprioceptive Training, with statistically significant improvements in both BBS and MAS scores in Weeks 4 and 8.

Table 3 Comparative Scores of Quality-of-Life Domains

Scale	Time	Group A (Mean ± SD)	Group B (Mean ± SD)	t-value	Mean Difference	P Value
Vitality	Baseline	49.19 ± 5.60	48.36 ± 4.78	0.68	0.83	0.499
	Week 4	60.39 ± 5.45	56.72 ± 4.99	2.98	3.67	0.004
	Week 8	71.22 ± 5.36	65.36 ± 5.38	4.63	5.86	0.000
Physical Functioning	Baseline	52.33 ± 3.00	52.69 ± 3.28	-0.49	-0.36	0.627
	Week 4	63.92 ± 3.08	61.25 ± 3.46	3.45	2.67	0.001
	Week 8	68.19 ± 2.12	64.55 ± 2.17	5.32	4.27	0.000
Bodily Pain	Baseline	47.58 ± 2.22	47.25 ± 2.26	0.63	0.33	0.530
	Week 4	58.61 ± 2.63	55.92 ± 2.69	4.30	2.69	0.000
	Week 8	69.19 ± 3.22	64.94 ± 3.57	5.30	4.25	0.000
General Health Perceptions	Baseline	44.94 ± 2.18	44.47 ± 2.02	0.95	0.47	0.343
	Week 4	56.14 ± 2.77	53.00 ± 2.04	5.47	3.14	0.000
	Week 8	67.36 ± 2.86	61.28 ± 2.50	9.60	6.08	0.000
Physical Role Functioning	Baseline	56.56 ± 1.11	56.92 ± 1.08	-1.40	-0.36	0.165
	Week 4	67.89 ± 1.79	65.69 ± 1.45	5.72	2.19	0.000
	Week 8	79.11 ± 2.39	74.25 ± 2.22	8.94	4.86	0.000
Emotional Role Functioning	Baseline	46.44 ± 4.54	45.83 ± 5.14	0.54	0.61	0.595
	Week 4	57.22 ± 4.60	54.56 ± 5.32	2.28	2.67	0.026
	Week 8	68.14 ± 5.01	63.14 ± 5.43	4.06	5.00	0.000
Social Role Functioning	Baseline	49.33 ± 3.84	48.92 ± 3.89	0.46	0.42	0.649
	Week 4	60.64 ± 3.94	57.47 ± 4.26	3.28	3.17	0.002
	Week 8	71.78 ± 4.02	65.92 ± 4.47	5.85	5.86	0.000
Mental Health or Emotional Well-Being	Baseline	53.06 ± 3.58	53.19 ± 3.14	-0.18	-0.14	0.862
	Week 4	64.36 ± 3.97	61.75 ± 3.44	2.98	2.61	0.004
	Week 8	75.06 ± 4.60	70.14 ± 4.35	4.66	4.92	0.000

The 8-week comparison between Group A (Task-Oriented Program) and Group B (Proprioceptive Training) demonstrated consistent trends across various health dimensions. Both groups exhibited similar baseline scores in all categories, but by Week 4 and Week 8, Group A consistently outperformed Group B. For instance, in the category of Vitality, Group A showed significant improvement from 49.19 ± 5.60 to 71.22 ± 5.36, compared to Group B's 48.36 ± 4.78 to 65.36 ± 5.38 (P=0.000). In Physical Functioning, Group A progressed from 52.33 ± 3.00 to 68.19 ± 2.12, whereas Group B reached from 52.69 ± 3.28 to 64.55 ± 2.17 (P=0.000). Similar trends were observed in other categories, such as Bodily Pain, General Health Perceptions, Physical Role Functioning, Emotional

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Role Functioning, Social Role Functioning, and Mental Health or Emotional Well-Being, with Group A consistently showing more substantial improvements by Week 8. This pattern underscores Group A's superior performance across multiple health dimensions throughout the study.

Table 4 Pairwise Comparison within Group A

Category	Mean Difference (1-2)	Mean Difference (1-3)	Mean Difference (2-3)	p-value
BBS	-10.194	-23.083	12.889	0.000
MAS	-13.556	-27.111	13.556	0.000
Vitality	-11.194	-22.028	10.833	0.000
Physical Function	-11.583	-22.639	11.056	0.000
General Health	-11.194	-22.417	11.222	0.000
Emotional Health	-10.778	-21.694	10.917	0.000
Social	-11.306	-22.444	11.139	0.000
Mental Health	-11.306	-22.000	10.694	0.000

The pairwise comparison within Group A across different health categories highlights the consistent and significant differences between the three measurements (labeled as 1-2, 1-3, and 2-3). In every category, the mean differences illustrate a clear pattern of improvement. For example, the mean differences for BBS are -10.194, -23.083, and 12.889, respectively, with a p-value of 0.000, indicating statistical significance. Similar patterns are found in other categories such as MAS (-13.556, -27.111, 13.556), Vitality (-11.194, -22.028, 10.833), Physical Function (-11.583, -22.639, 11.056), General Health (-11.194, -22.417, 11.222), Emotional Health (-10.778, -21.694, 10.917), Social (-11.306, -22.444, 11.139), and Mental Health (-11.306, -22.000, 10.694), all with a p-value of 0.000. These numerical values across all categories highlight the robust and uniform improvement within Group A throughout the study.

Table 5 Pairwise Comparison within Group B

Category	Mean Difference (1-2)	Mean Difference (1-3)	Mean Difference (2-3)	p-value
BBS	-6.861	-14.250	7.389	0.000
MAS	-10.139	-20.278	10.139	0.000
Vitality	-8.361	-17.000	8.639	0.000
Physical Function	-8.556	-17.056	8.500	0.000
General Health	-8.528	-16.806	8.278	0.000
Emotional Health	-8.722	-17.306	8.583	0.000
Social	-8.556	-17.000	8.444	0.000
Mental Health	-8.556	-16.944	6.247	0.000

The pairwise comparison within Group B across various health categories demonstrates a consistent pattern of improvement between the three measurements (1-2, 1-3, and 2-3). The mean differences for BBS are -6.861, -14.250, and 7.389, with a p-value of 0.000. Similar trends are observed in MAS (-10.139, -20.278, 10.139), Vitality (-8.361, -17.000, 8.639), Physical Function (-8.556, -17.056, 8.500), General Health (-8.528, -16.806, 8.278), Emotional Health (-8.722, -17.306, 8.583), Social (-8.556, -17.000, 8.444), and Mental Health (-8.556, -16.944, 6.247), all with a p-value of 0.000. These results underscore a consistent and significant improvement in Group B over time across all categories, confirming the effect of the intervention on various aspects of health.

Discussion

The body of research on stroke rehabilitation, including studies by JalajaJayalakshmi, Geetha, & Ijaz (2021), Lahiri et al. (2020), Lee (2020), and our present investigation, have highlighted key aspects of rehabilitation, specifically task-oriented programs (6, 27). While the current research does not encompass the utilization of machine learning algorithms or the elements of post-stroke aphasia, these studies provide essential context to our investigation's focus on hemiplegic stroke patients.

Our study primarily compared the efficacy of a Task-Oriented Program (Group A) and Proprioceptive Training (Group B) in rehabilitating patients with hemiplegic stroke. The initial balance in both groups' emotional, social, and mental health functioning levels provided an equitable foundation for comparison. As the study progressed, Group A displayed pronounced superiority in all assessed domains, suggesting that the benefits of the Task-Oriented Program were enduring and cumulative.

Further inspection revealed that Group A exhibited a more rapid and significant improvement in balance and motor function, as indicated by scores from the Berg Balance Scale (BBS), Motor Assessment Scale (MAS), and Fugl-Meyer Assessment (FMA). These findings suggest that the Task Oriented Program may have a broader influence on various aspects of health and wellbeing, thereby improving the quality of life for stroke patients. However, we noted that some measures under the Task Oriented Program revealed a steeper decline, warranting further investigations to identify contributing factors. (9, 28).

The study conducted by Lee (2020) emphasized the effectiveness of neurodevelopmental treatment and breathing training in enhancing physical functionality and managing psychological problems in chronic stroke patients. (15). These findings align with our research results, underscoring the broader applicability of task-oriented programs in rehabilitating stroke patients.

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In summary, understanding individual differences such as language and education level can shape personalized treatment strategies for post-stroke aphasia. Due to their wide-ranging and rapid effects, task-oriented programs hold considerable promise in rehabilitation and improving patients' quality of life. These programs can offer enhanced benefits when paired with interventions like breathing training. However, further research is needed to confirm these results and explore the underlying mechanisms, thereby enabling a comprehensive, multifaceted approach to stroke rehabilitation. (6, 27, 28)

Conclusion

The Task-Oriented Program yielded superior outcomes compared to Proprioceptive Training in improving participants' balance, gait, and quality of life, as indicated by significantly higher BBS and MAS scores. These findings highlight the effectiveness of the Task-Oriented Program as an intervention for enhancing balance, gait, and quality of life in the specific population studied.

Declarations

Data Availability statement
All data generated or analyzed during the study are included in the manuscript.
Ethics approval and consent to participate.
Approved by the department Concerned.
Consent for publication
Approved
Funding
Not applicable

Conflict of interest

The authors declared an absence of conflict of interest.

Authors Contribution

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Drafting & Concept & Design of Study

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