



Functional and Clinical Outcomes of a Conventional Rehabilitation Program in Hemiplegic Patients Across Different Age Groups



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ABSTRACT

This study aimed to assess the impact of a conventional rehabilitation program on functional status and clinical outcomes in hemiplegic patients from different age groups. This retrospective study analyzed outpatient records of stroke patients treated at a private secondary-level healthcare facility in Türkiye between 2020 and 2024. Collected data included demographics, the Barthel Index, the Modified Ashworth Scale (MAS), Brunnstrom stages, range of motion (ROM), and manual muscle test scores. Statistical analyses were conducted using IBM SPSS Statistics for Windows, Version 25.0, and a p-value < .05 was considered statistically significant. A total of 97 patients were included and divided into two age groups.

Group 1 had a mean age of 55.31 ± 5.89 years, and Group 2 had a mean age of 71.20 ± 5.11 years. Gender distribution was equal in Group 1, while males predominated in Group 2. Group 1 showed significantly greater improvements in Barthel Index scores ($p = .002$), selected ROM measurements ($p = .031$), and muscle strength measures. No statistically significant differences were observed between groups in Brunnstrom stages or MAS scores, although both groups demonstrated clinical improvements. Conventional physiotherapy enhanced functional independence in both age groups, with more marked improvements in younger patients. These findings highlight age as a potentially influential factor in rehabilitation outcomes.

KEYWORDS: Stroke, Hemiplegia, Rehabilitation, Functionality, Age Factors

KEY PRACTITIONER MESSAGE

1. Conventional physiotherapy improved functional independence in hemiplegic patients across age groups, with greater gains in younger patients (45–64 years) than in older patients (65–82 years) on the Barthel Index.
2. Both age groups improved after rehabilitation; however, between-group differences favored younger patients in functional independence and hip flexion range of motion.
3. Rehabilitation programs for hemiplegic patients should be individualized according to age and functional stage, as age may influence rehabilitation outcomes.

INTRODUCTION

According to the World Health Organization (WHO), stroke is defined as a clinical syndrome characterized by the sudden onset of focal cerebral dysfunction lasting more than 24 hours, caused by a disruption in cerebral blood flow in the absence of an identifiable non-vascular origin (Çoban et al., 2023). The incidence of stroke increases with age, doubling every decade after the age of 45, with over 70% of all cases occurring in individuals above 65 years (Kelly-Hayes, 2010). Each year, approximately 15 million people experience a stroke, and in developed countries, it remains the third leading cause of mortality (Banihani et al., 2024). As one of the foremost causes of acquired adult disability, stroke can lead to significant physical and psychological impairments, substantially diminishing individuals' quality of life and social participation (de Sire et al., 2022; Leblebici et al., 2023). Depending on the lesion site, a wide spectrum of deficits may arise—including impairments in language, cognition, sensation, and motor function—with hemiplegia being among the most frequently observed functional impairments (Çoban et al., 2023).

Moderate to severe disability develops in 20–40% of post-stroke patients, presenting as hemiparesis, spasticity, dysphagia, gait disturbances, and loss of independence in daily activities (de Sire et al., 2022). Neurological recovery is most prominent

within the first 1 to 3 months, though improvements may continue—albeit at a slower pace—up to 6 or even 12 months in a subset of individuals. Prognosis is shaped by demographic factors such as age, sex, and ethnicity (Delen & Çiçek, 2022). While age, sex, race, and family history are non-modifiable risk factors, modifiable contributors include hypertension, diabetes, cardiovascular diseases, hyperlipidemia, and smoking. Ischemic strokes constitute approximately 80% of all cases and generally carry a more favorable prognosis in younger individuals (Leblebici et al., 2023). Women, despite experiencing fewer strokes overall, tend to be affected at older ages and often exhibit poorer functional outcomes with prolonged hospital stays (Delen & Çiçek, 2022). A timely, well-coordinated, and multidisciplinary rehabilitation process is critical for optimal motor recovery. Conventional rehabilitation involves physical, occupational, and speech therapies; however, suboptimal therapy duration or limited patient engagement may hinder functional restoration. In recent years, technology-assisted rehabilitation strategies have gained traction as promising modalities to enhance mobility and functional independence in stroke survivors (Malik et al., 2022).

This study aims to evaluate the impact of a conventional rehabilitation program on functional status and clinical outcomes in hemiplegic patients

across different age groups who received treatment at a private secondary-level healthcare institution in Türkiye between January 2020 and September 2024. The overarching objective is to elucidate age-related differences in rehabilitation effectiveness, thereby contributing evidence-based insights to the existing body of literature and supporting the development of age-specific rehabilitation strategies.

METHOD

Study Type

This study was a retrospective, observational study based on the review of patient medical records of individuals treated at a private secondary-level hospital in Türkiye. Prior to data collection, ethical approval was obtained from the Ethics Committee for Human Research of a foundation university (decision number 06, dated November 5, 2024), along with formal institutional permission.

Clinical and functional outcomes were extracted from standardized physiotherapy evaluation forms recorded at two time points: before the initiation of the conventional rehabilitation program (pre-treatment) and after the completion of the rehabilitation program (post-treatment). The rehabilitation program consisted of structured outpatient physiotherapy sessions delivered as part of routine clinical care, and data collection did not involve any additional interventions beyond standard practice.

Study Group and Procedures

A reference study reported a high effect size ($r = .7398$) (Chung, 2014). However, assuming a more conservative effect size ($r = .3$), power analysis indicated that a minimum of 111 participants would be required to achieve 80% statistical power at a 95% confidence level. Although this threshold was not met, following the exclusion of records that did not meet the inclusion criteria, a total of 97 participants were deemed eligible for analysis. The data were retrospectively collected from patient records within the specified time frame. During screening, participants were included based on age eligibility and the condition that they had received a structured rehabilitation program consisting of at least 20 sessions with similar therapeutic content. Subjects were categorized into two age-based groups: Group 1 (G1), aged 45–64 years ($n = 48$), and Group 2 (G2), aged 65–89 years ($n = 49$). The age threshold of 65 years was selected because individuals aged 65 years and older are generally classified as the geriatric population in clinical research.

As part of the conventional rehabilitation program, interventions were tailored to the individual needs of each patient and included passive, active-assistive, and active range of motion exercises; strengthening exercises; gait training; balance exercises; and neurodevelopmental techniques (such as Proprioceptive Neuromuscular Facilitation).

All participant evaluations were conducted by experienced physiotherapists working in the same clinic, following a standardized protocol. The sessions were held five times per week, with each session lasting 60 minutes.

The inclusion criteria for this study comprised individuals aged 45 to 89 years who were diagnosed with hemiplegia following a unilateral cerebrovascular accident (CVA) and received outpatient physiotherapy at a private secondary-level healthcare hospital in Türkiye. The selected age range was chosen to include both middle-aged individuals and the geriatric population who had experienced stroke.

Only those who had undergone a conventional rehabilitation program consisting of a minimum of 20 and a maximum of 30 sessions were included. Exclusion criteria involved a history of multiple strokes, the presence of malignancy, and cases in which manual muscle testing could not be performed due to severe spasticity.

Data Collection Instruments

In addition to demographic characteristics, the following clinical assessment tools were used pre- and post-treatment:

- Barthel Index for evaluating functional independence
- Modified Ashworth Scale (MAS) for assessing muscle spasticity

- Brunnstrom Motor Recovery Stages for Each of the three segments: upper extremity, lower extremity and hand
- Range of motion (ROM) measured with a universal goniometer
- Manual Muscle Testing (MMT) for muscular strength assessment

Barthel Index

The Barthel Index, a validated tool for assessing functional independence in older adults and stroke populations, evaluates 10 domains: bowel and bladder control, grooming, toileting, feeding, transfers, mobility, dressing, stair use, and bathing (Ocagli et al., 2021). Scores vary between 0 and 100, where higher values reflect a higher level of independence (dos Santos Barros et al., 2022).

Modified Ashworth Scale (MAS)

This scale is used to grade muscle spasticity (Vidmar et al., 2023), and scores are interpreted as follows (Harb & Kishner, 2023):

A score of 0 indicates normal muscle tone with no increase.

1: Reflects a slight rise in tone, noticeable as a brief catch and release or mild resistance at the end of the range of motion.

1+: Represents a mild elevation in tone, where a catch is followed by minimal resistance throughout less than half of the movement range.

2: Indicates a more pronounced increase in tone

over most of the movement range, though the limb remains easily movable.

3: Denotes a significant rise in tone, making passive motion challenging.

4: Describes a rigid limb, fixed in either flexion or extension.

Brunnstrom Motor Recovery Stages (Upper Extremity)

The Brunnstrom scale is one of the most widely used standardized tools for assessing motor recovery in patients with upper extremity hemiplegia (Meng et al., 2022).

Level 1 involves reflexive movements only. At this stage, only reflexive movements are observed in the upper extremity, and the individual cannot perform voluntary movements. Basic reflexes such as the biceps reflex may be present.

Level 2 reflects basic movements. Muscle contractions and some basic movements appear, but they are uncoordinated. The individual can perform simple movements, although full control is lacking.

Level 3 represents voluntary movements. Movements become more coordinated and voluntary, and simple yet controlled movements can be performed, although overall movement may remain limited.

Level 4 indicates coordinated movements. Movements become smoother and more coordinated, and the individual can carry out more complex actions and tasks with improved control and coordination.

Level 5 corresponds to advanced movements. Movements are near-normal and well-coordinated, fine motor skills and detailed movements become achievable, and greater independence in activities of daily living is attained.

Level 6 reflects normal movements. Full recovery of normal upper extremity movements is achieved, and the individual can independently and completely perform all activities of daily living (Qin et al., 2022).

Range of Motion (ROM)

ROM refers to the degree of movement possible around a specific joint, encompassing both passive and active motion. Passive ROM denotes the movement achieved when an external force is applied to the joint, whereas active ROM is the movement generated by the individual's own muscular effort (Alizadeh et al., 2023). Measurements were conducted using a universal goniometer- the most commonly used instrument for ROM assessment. The goniometer objectively quantifies joint angle changes in degrees, offering reliable evaluation of joint mobility (Pérez-De La Cruz et al., 2021). The accuracy of these measurements depends significantly on the use of proper positioning and standardized techniques (Shamsi et al., 2019; Guvenc et al., 2024).

Manual Muscle Testing (MMT)

MMT is one of the most widely used clinical methods for evaluating the strength of individual muscles or muscle groups. The test is typically performed

by a physiotherapist or trained healthcare professional, who assesses muscle contraction under standardized resistance in a specific position (Bittmann et al., 2020). Muscle strength is graded using various scoring systems, with the Oxford Grading Scale being among the most commonly applied. This scale rates muscle strength on a scale from 0 to 5 (Saygin et al., 2021).

Statistical Analysis

All statistical analyses were performed using IBM SPSS Statistics for Windows, Version 25.0. Continuous variables were expressed as mean $\pm$ standard deviation ($M \pm SD$), and categorical variables as frequency (n) and percentage (%). The Kolmogorov-Smirnov and Shapiro-Wilk tests were used to assess the normality of data distribution. Since data in both groups did not demonstrate a normal distribution according to Shapiro-Wilk test results, parametric assumptions were not met, and the non-parametric Mann-Whitney U test was used to evaluate between-group differences. For non-normally distributed variables, descriptive statistics were presented using median, minimum, and maximum values. Correlations among continuous variables were assessed using Pearson correlation analysis for normally distributed data and Spearman's rank correlation for non-normally distributed data. Differences between categorical variables were analyzed using Pearson's chi-square

test; where expected cell frequencies were less than 5, Fisher's Exact Test was applied. A p -value $<.05$ was considered statistically significant for all analyses.

Ethical Considerations

Prior to data collection, ethical approval was obtained from the Ethics Committee for Human Research of a foundation university (decision number 06, dated November 5, 2024), along with formal institutional permission. The study included hemiplegic patients who received outpatient physiotherapy at the Physical Therapy and Rehabilitation Clinic of a private secondary-level healthcare hospital in Türkiye between January 2020 and September 2024.

RESULTS

The study included 97 participants (41 females and 56 males) who fulfilled the inclusion criteria. Participants were stratified into two groups based on age: Group 1 had a mean age of 55.31 ± 5.89 years (range: 45–64), and Group 2 had a mean age of 71.20 ± 5.11 years (range: 65–82). In Group 1, sex distribution was equal (24 females and 24 males; 50.0% each), while Group 2 included 17 females (34.7%) and 32 males (65.3%); this difference was not statistically significant ($p=.09$). Regarding stroke chronicity, Group 1 included 4 (8.3%) acute, 9 (18.8%) subacute, and 35 (72.9%) chronic cases, whereas Group 2 included 8 (16.3%) acute, 12 (24.5%) subacute, and 29 (59.2%) chronic cases. There was no significant difference in stroke chronicity

between the groups ($p=0.31$). In terms of stroke etiology, Group 1 comprised 36 (75.0%) ischemic and 12 (25.0%) hemorrhagic cases; Group 2 included 39 (79.6%) ischemic and 10 (20.4%) hemorrhagic cases. The intergroup difference in etiology distribution was not statistically significant ($p=0.38$). Regarding the affected side of hemiplegia, 30 (62.5%) participants in Group 1 had right-sided involvement, and 18 (37.5%) had left-sided involvement; in Group 2, 23 (46.9%) had right-sided and 26 (53.1%) had left-sided hemiplegia. This distribution also showed no significant difference between groups ($p=.09$). The

sociodemographic and clinical characteristics of the participants are summarized in Table 1.

In this study, clinical and physical parameters were evaluated to assess the functional status of individuals with hemiplegia in a multidimensional manner. Demographic data-including age, sex, height, weight, body mass index, education level, occupation, and smoking status-were recorded, along with clinical variables such as disease duration, etiology, affected side, and the presence of orthopedic, neurological, or systemic comorbidities. Functional independence was assessed using the Barthel Index,

Table 1. Sociodemographic characteristics of the participants

		Group 1			Group 2			p
		n (%)	M $\pm$ SD	Min-max	n (%)	M $\pm$ SD	Min-max	
Gender	Female	24 (50.0)			17 (34.7)			.09**
	Male	24 (50.0)			32 (65.3)			
	Total	48 (100)			49 (100)			
Age (years)		48	55.31 $\pm$ 5.89	45-64	49	71.20 $\pm$ 5.11	65-82	.00
Disease Duration	Acute	4 (8.3)			8 (16.3)			.31*
	Subacute	9 (18.8)			12 (24.5)			
	Chronic	35 (72.9)			29 (59.2)			
Etiology	Ischemic	36 (75.0)			39 (79.6)			.38**
	Hemorrhagic	12 (25.0)			10 (20.4)			
Affected Side	Right	30 (62.50)			23 (46.9)			.09**
	Left	18 (37.50)			26 (53.1)			

*:Fischer's Exact Test, **: Pearson Chi-Square. $p < .05$ indicates significance. n: number of cases, M: mean, SD: standard deviation, Min: minimum, Max: Maximum.

and motor recovery was evaluated separately for the upper extremity, lower extremity, and hand using the Brunnstrom Stages. Spasticity was measured with the MAS. Active and passive ROM and muscle strength were assessed for the shoulder, elbow, wrist, fingers, hip, knee, and ankle. All evaluations were performed bilaterally-on both affected and unaffected sides-at two time points: before and after the intervention. Despite the comprehensive nature of the data, only statistically significant findings are presented in the results section.

As presented in [Table 2](#), intergroup comparisons revealed that Group 1 demonstrated more pronounced and statistically significant improvements in both functional level and clinical outcomes compared to Group 2. Both groups improved in Barthel Index from pre- to post-treatment; however, Group 1 demonstrated a greater pre-post gain ($p = .002$). Furthermore, Group 1 exhibited significantly better outcomes in the following parameters: right hip flexion active range of motion ($p = .031$), initial strength of left hip adduction ($p = .049$), initial strength of left knee flexion ($p = .013$), and initial strength of left plantar flexion ($p = .037$).

In contrast, no statistically significant differences were found between the groups in Brunnstrom staging scores (upper extremity, hand, and lower extremity) or in the MAS (upper extremity, lower extremity) at either the baseline or post-treatment

assessments. However, clinical improvements were noted in both groups across these measures. Similarly, while no statistically significant intergroup differences were observed in other range of motion and muscle strength assessments of the upper and lower extremities, an overall positive trend in recovery was evident in both cohorts.

DISCUSSION

Hemiplegia is a neuromuscular dysfunction affecting one side of the body due to cerebral circulatory pathology. Initially thought to involve only unilateral motor loss, it is now known to also include balance, sensory, and cognitive impairments, necessitating a comprehensive clinical approach (Çoban et al., [2023](#)). Stroke, mainly affecting middle-aged and the older cohort individuals, remains a major global cause of mortality and chronic disability, while its incidence in young adults is relatively rare (Gulzar et al., [2025](#)).

Our study included hemiplegic patients aged 45 to 89, categorized into two groups: 45–64 and 65–89 years. Modern research has identified most stroke risk factors as modifiable, although age remains the most significant non-modifiable risk factor, with the risk doubling after age 55 (Gulzar et al., [2025](#)). Külcü et al. conducted a multicenter retrospective cohort study in 2022, examining 1,529 hospitalized stroke patients in Türkiye, with an average age of 61.7 ± 14.0 , and found 817 male and 712 female participants

(Geler Külcü et al., 2022).

In our sample, the mean age was 55.31 in Group 1 and 71.20 in Group 2, consistent with the existing literature. However, Memiş et al. previously reported that while age is a significant risk factor for stroke incidence, it may not significantly influence post-stroke functional outcomes.

It should be noted that baseline functional status differed between age groups, and therefore age-related differences observed after rehabilitation should be interpreted in the context of these initial

functional disparities as well as recovery potential during the rehabilitation process.

Contrarily, our findings partly challenge this notion, as significantly greater improvements in Barthel Index scores were observed in the younger cohort (45–64 years) compared to the older group (65–89 years). This suggests that age may not only affect stroke risk but also influence recovery trajectories. Therefore, our study contributes to the literature by highlighting age as a potentially important prognostic factor in rehabilitation.

Table 2. Comparison of functional level and clinical outcomes between group 1 and group 2

Outcome Measure	Group 1 (n=48)		Group 2 (n=49)		p (z)
	M ± SD	Min–Max	M ± SD	Min–Max	
Barthel (Pre)	74.89 ± 16.16	30.00–105.00	63.67 ± 23.24	0.00–95.00	.019* (–2.351)
Barthel (Post)	88.33 ± 12.56	45.00–105.00	75.40 ± 23.33	15.00–100.00	.002* (–3.044)
Brunnstrom Upper Limb (Pre)	3.43 ± 1.18	1.00–6.00	3.40 ± 1.47	1.00–6.00	.891 (–0.137)
Brunnstrom Upper Limb (Post)	3.79 ± 1.41	1.00–6.00	3.81 ± 1.43	1.00–6.00	.823 (–0.224)
Brunnstrom Hand (Pre)	3.18 ± 1.48	1.00–6.00	3.24 ± 1.53	1.00–6.00	.765 (–0.299)
Brunnstrom Hand (Post)	3.56 ± 1.60	1.00–6.00	3.63 ± 1.64	1.00–6.00	.694 (–0.394)
Brunnstrom Lower Limb (Pre)	3.70 ± 1.23	1.00–6.00	3.46 ± 1.29	1.00–6.00	.411 (–0.822)
Brunnstrom Lower Limb (Post)	4.27 ± 1.14	1.00–6.00	3.91 ± 1.16	1.00–6.00	.157 (–1.416)
MAS Upper Limb (Pre)	1.62 ± 0.86	1.00–4.00	1.48 ± 0.81	1.00–4.00	.365 (–0.907)
MAS Upper Limb (Post)	1.64 ± 0.86	1.00–4.00	1.46 ± 0.79	1.00–4.00	.246 (–1.160)
MAS Lower Limb (Pre)	1.39 ± 0.53	1.00–4.00	1.46 ± 0.64	1.00–4.00	.688 (–0.402)
MAS Lower Limb (Post)	1.43 ± 0.54	1.00–4.00	1.46 ± 0.64	1.00–4.00	.997 (–0.004)
Right Hip Flexion (Active ROM – Post)	113.90 ± 21.68	42.00–125.00	99.65 ± 29.22	25.00–125.00	.031* (–2.155)
Left Hip Adduction (Strength – Pre)	3.14 ± 0.47	2.33–4.00	2.76 ± 0.71	1.00–3.66	.049* (–1.967)
Left Knee Flexion (Strength – Pre)	3.08 ± 0.58	1.50–3.66	2.74 ± 0.71	1.00–3.66	.013* (–2.475)
Left Plantar Flexion (Strength – Pre)	3.02 ± 0.57	1.50–3.66	2.69 ± 0.71	1.00–3.66	.037* (–2.088)

Notes: * Values are Mean ± SD. p values are from Mann–Whitney U test. p < .05 indicates significance. M: Mean, SD: Standard Deviation, Min–Max: Minimum and Maximum, values z: Mann–Whitney U test statistic, MAS: Modified Ashworth Scale, ROM: Range of Motion

Similarly, Nakipoglu Yuzer et al. found statistically significant improvements in Barthel Index scores between admission and discharge in a cohort of 46 geriatric hemiplegic patients undergoing physiotherapy (Nakipoglu-Yuzer et al., 2010). Our results parallel these findings, demonstrating significant functional gains in both age groups.

The predominance of ischemic stroke in the present sample, accounting for approximately three-quarters of all cases, is consistent with existing epidemiological literature reporting ischemic stroke as the most prevalent stroke subtype (Memiş et al., 2016).

Globally, stroke ranks as the second leading cause of death, with incidence increasing significantly with age. Among the geriatric population, prevalence ranges from 46 to 71 per 1,000 individuals, and 75–89% of all strokes occur in those aged 65 and above (Ergin Beton et al., 2023). As our single-center, cross-sectional study included only hemiplegic patients meeting specific criteria, generalizations regarding age-related stroke incidence in the broader older adults population are limited. In Türkiye, the prevalence of ischemic stroke has risen by 115% over the past three decades, particularly in individuals over 70, underscoring the importance of early risk factor identification and intervention (Ergin Beton et al., 2023).

Petrea et al. investigated sex differences in stroke

incidence and outcomes. They found that women experienced their first stroke at an older age than men and had a higher incidence over age 85. Although there were no significant sex-based differences in stroke subtype, severity, or mortality, women were more functionally impaired during both the pre-stroke and acute phases, especially in dressing, grooming, and transferring. Greater disability was also reported among women at 3- to 6-month follow-ups (Petrea et al., 2009). Sex is recognized as a factor influencing both stroke incidence and outcomes (Delen & Cicek, 2022). Although men generally have a higher stroke incidence across most of their lifespan, the longer life expectancy of women leads to a higher overall prevalence in females. In our study, sex distribution was equal in Group 1 (50% male, 50% female), while Group 2 had a male predominance (65.3%). However, sex-based analysis of functional outcomes or stroke-related risk factors was not conducted; hence, sex-related results are descriptive rather than inferential. Additionally, our cross-sectional design, which included only hemiplegic patients, precludes generalizations about stroke incidence and prevalence by age or sex in the general population. Making this self-critique is important; however, it may also be useful to incorporate findings specifically related not only to stroke in general but to post-stroke hemiplegia in particular. This is because, within the context of this study, it is important to address

whether the incidence and prevalence of post-stroke hemiplegia differ by age and gender.

Yildiz et al. found that sex, age, and etiology did not independently affect functional recovery in 82 stroke patients, though early rehabilitation yielded better outcomes (Yildiz et al., 2009). In contrast, our analysis suggests age may influence recovery, as the younger cohort showed greater improvements in Barthel Index scores and lower limb strength and ROM. While upper extremity ROM and strength improved post-intervention, changes were not statistically significant; however, they contributed to functional gains. Similarly, Alsubiheen et al. reported significant improvements in upper extremity function and quality of life following eight weeks of task-oriented ADL training in chronic stroke patients, supporting the notion that structured rehabilitation interventions can lead to functional gains across different patient characteristics, including age (Alsubiheen et al., 2022).

Additionally, a recent RCT on virtual reality-supported mirror therapy (VR-MT) found significant improvements in wrist motor function and gross manual skills in chronic stroke patients. The group receiving VR-MT showed marked improvements in Box and Block Test and FM-UE wrist sub-scores, indicating that combining technological interventions with task-oriented approaches can enhance rehabilitation outcomes (Hsu et al., 2022).

In this context, our findings and current literature suggest that, beyond conventional rehabilitation, task-specific, functional, and patient-centered interventions may yield more meaningful and sustainable effects on upper extremity strength and functional independence. Integrating such approaches into classical therapy protocols may be essential for optimizing rehabilitation efficacy.

In our study, both groups showed clinical improvements in Brunnstrom and MAS scores, but these changes were not statistically significant. The high proportion of patients in the chronic phase may have limited gains due to reduced neuromuscular plasticity. Literature indicates that VR-supported therapy can enhance motor performance and balance in chronic cases, although it does not significantly affect MAS scores (Peláez-Vélez et al., 2023). This highlights the growing need to integrate innovative methods into conventional rehabilitation.

Limitations

There are certain limitations to this study. Primarily, the sample consisted solely of outpatients receiving physiotherapy, which may limit the applicability of the results to broader populations. Including inpatients, particularly those with more severe clinical presentations, could have broadened the results. Second, the single-center, retrospective design limited access to certain clinical and functional data. The relatively small sample size and specific

patient characteristics may have contributed not only to the lack of significant findings in some variables but also to a reduced strength and generalizability of the significant results obtained. Moreover, the cross-sectional nature of the study precludes causal inference. Despite these limitations, the study offers valuable clinical insights and lays groundwork for future multicenter, prospective studies with larger samples. This study aims to compare rehabilitation outcomes across different age groups. However, certain external factors that may be associated with age, vary with aging, and potentially influence outcomes (e.g., stroke phase, baseline functional status, clinical complexity) were not statistically controlled within the scope of the study. Therefore, the interpretation of age as an independent prognostic factor remains limited. Moreover, the retrospective design of the study precludes the establishment of causal relationships. These limitations underscore the need for caution in interpreting the findings. Future research should involve prospective designs with larger sample sizes and control for potential confounding variables that may introduce bias in outcome evaluation.

CONCLUSION

In conclusion, conventional physiotherapy interventions applied to hemiplegic individuals across various stages of recovery were associated

with meaningful improvements in functional independence, even though statistically significant changes were not observed in upper and lower extremity ROM and upper extremity strength. The more substantial functional gains observed in the younger group suggest that age may influence rehabilitation outcomes. Our findings underscore the importance of tailoring post-stroke rehabilitation programs to the patient's age and clinical stage.

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Ethical Statement

Ethics committee approval was obtained: Date: 05.11.2024 Approval no: 2024/11/05/06.

Conflict of Interest

The authors declare no conflicts of interest.

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