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The Effect of Recreational Activities on Upper Extremity Functional Recovery in Stroke Survivors: A Randomized Controlled Trial

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Abstract
Background: Persistent upper-extremity impairment limits independence, quality of life, and social participation after stroke. Conventional rehabilitation is effective but may be constrained by repetitive task formats and declining adherence. This pilot randomized controlled trial evaluated whether a structured recreational-activity programme could improve upper-limb recovery and broader rehabilitation outcomes. Methods: Thirty chronic stroke survivors aged 60 years or older were randomized equally to structured recreational activities plus standard rehabilitation (n=15) or conventional rehabilitation (n=15). The 12-week programme included adaptive sports, art-based tasks, music-related activities, and virtual-reality or game-based upper-limb practice delivered three to four times weekly. Outcomes were assessed at baseline, 6 weeks, and 12 weeks using the Fugl-Meyer Assessment for Upper Extremity (FMA-UE), Stroke Impact Scale (SIS), Hospital Anxiety and Depression Scale (HADS), and Frenchay Activities Index (FAI). A 2 × 3 mixed-design ANOVA, between-group comparisons, effect sizes, and intention-to-treat analyses were applied. Results: FMA-UE scores increased from 34.5 ± 8.7 to 52.8 ± 6.9 in the intervention group and from 34.0 ± 9.0 to 41.7 ± 7.8 in controls. The group × time interaction was significant ($F=7.56$, $p=0.002$, partial $\eta^2=0.213$). At 12 weeks, the adjusted between-group difference was 11.1 points (95% CI 5.3-16.9; $p<0.001$; Cohen's $d=1.42$). The intervention group also showed better SIS (mean difference 13.7; $p=0.002$), lower HADS (mean difference -3.9; $p=0.013$), higher FAI (mean difference 7.9; $p=0.004$), and greater attendance (90.6% vs 78.6%; $p=0.006$). Clinically meaningful FMA-UE improvement occurred in 93.3% versus 40.0% of participants. No significant adverse events were reported. Conclusion: Structured recreational activities produced large preliminary gains in upper-limb motor recovery, quality of life, psychological well-being, social participation, and adherence. Larger multicentre trials with longer follow-up are required.
Keywords: stroke rehabilitation; upper extremity; recreational therapy; FMA-UE; neuroplasticity; adherence; randomized controlled trial

1. Introduction

Stroke remains a leading cause of complex adult disability, and upper-extremity impairment is among its most persistent consequences [1-5]. Impaired reaching, grasping, object manipulation, and fine hand control restrict activities of daily living, increase dependence on caregivers, and reduce social participation and quality of life [5,6]. Recovery of arm and hand function is often slower and less complete than recovery of basic mobility because upper-limb tasks require precise multi-joint control, sensory integration, graded force, and dexterity.

Contemporary physical and occupational therapy use range-of-motion exercises, strengthening, task-specific training, neuromuscular re-education, and constraint-induced approaches [4,6]. These methods are evidence-based, yet the repetition and intensity needed for experience-dependent neuroplasticity can be difficult to sustain. Boredom, low motivation, limited therapy access, and inadequate practice volume may reduce adherence and dilute treatment effects [7,8].

Recreational activities provide an alternative format for delivering meaningful, repetitive, goal-directed upper-limb practice. Adaptive sports, painting, clay modelling, drumming, singing, and virtual-reality gaming combine motor, sensory, cognitive, emotional, and social demands. Their intrinsic reward may increase engagement and repetition, while enriched multimodal practice may support cortical reorganization and motor learning [9-11]. Recreational activities may additionally reduce isolation and psychological distress and encourage return to valued community roles [12-14].

However, evidence has been limited by small samples, heterogeneous programmes, inconsistent outcome measures, and few controlled comparisons with conventional rehabilitation. The present pilot randomized controlled trial therefore examined whether a 12-week structured recreational-activity programme improved upper-extremity motor recovery in chronic stroke survivors. Secondary aims were to evaluate quality of life, psychological well-being, social participation, adherence, clinically meaningful improvement, and safety.

2. Materials and Methods

2.1 Study design and participants

A parallel-group pilot randomized controlled design was used. Thirty community-dwelling chronic stroke survivors were allocated equally to an intervention group or a control group. The protocol specified computer-generated random allocation, concealment through sequentially numbered opaque sealed envelopes, and blinded outcome assessment. Assessments were conducted at baseline, 6 weeks, and 12 weeks. The planned study period extended from 3 March 2025 to 2 March 2026.

Eligible participants were aged 60 years or older, had a clinically confirmed ischemic or hemorrhagic stroke at least 3 months previously, were medically stable, and had moderate-to-severe upper-extremity impairment with an FMA-UE score between 20 and 50. Exclusion criteria included severe cognitive or communication impairment, major psychiatric or behavioural conditions, upper-limb musculoskeletal disorders that restricted participation, uncontrolled medical disease, severe sensory impairment, inability to participate safely, recent structured recreational therapy, or inability to complete the 12-week programme.

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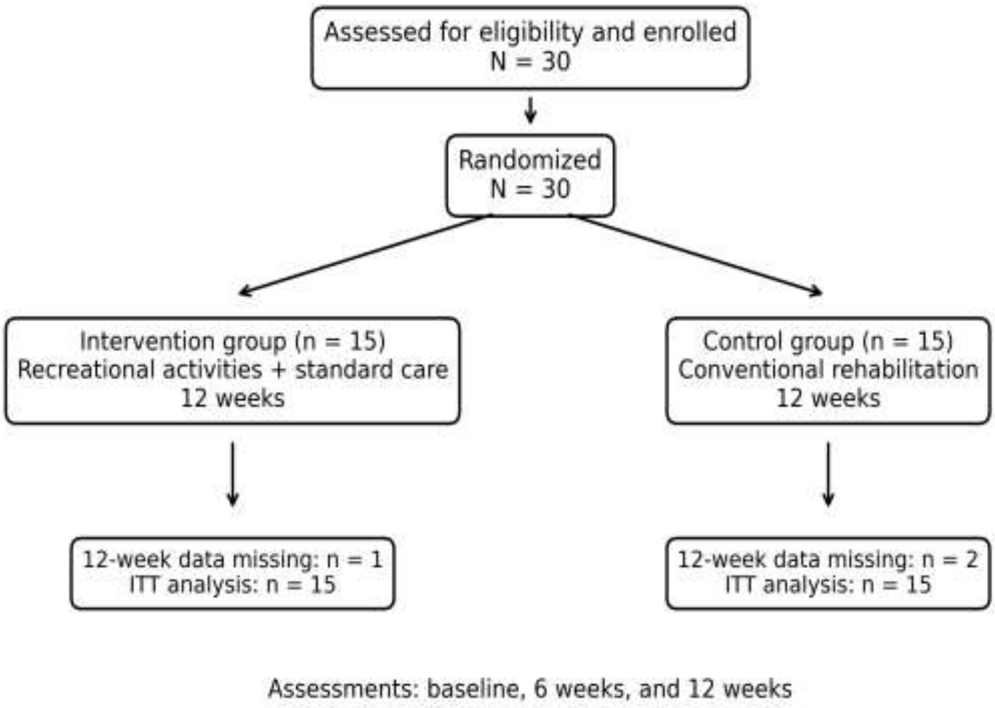

Figure 1. Participant allocation, assessment schedule, missing data, and intention-to-treat population

2.2 Interventions

The intervention group received structured recreational activities in addition to standard rehabilitation. Sessions were delivered three to four times per week for 12 weeks, lasted approximately 60 minutes, and were supervised by a trained physiotherapist or therapist. Activities included adaptive sports and ball games, reaching and grasp-release tasks, painting and drawing, clay modelling, drumming and other music-related activities, and virtual-reality or game-based upper-limb practice. Difficulty, assistance, rest periods, and task demands were individualized according to functional capacity.

The control group received conventional physiotherapy and occupational therapy focusing on range of motion, strengthening, coordination, task-specific practice, motor-skill training, and neuromuscular re-education. Both groups followed a comparable 12-week rehabilitation schedule. Attendance was documented using session registers and activity logs.

Figure 2. Illustrative clinical documentation from the thesis: (A) therapist-guided upper-extremity assessment and (B) a ball-based reaching task. Images are cropped to exclude identifiable facial features

2.3 Outcome measures

The primary outcome was upper-extremity motor function measured using the 33-item Fugl-Meyer Assessment for Upper Extremity (FMA-UE; score range 0-66), where higher scores indicate better motor performance. Secondary outcomes were the Stroke Impact Scale (SIS) for stroke-related quality of life, the Hospital Anxiety and Depression Scale (HADS) for psychological distress, and the Frenchay Activities Index (FAI) for participation in domestic, leisure, and community activities. Attendance rate, proportion achieving at least 80% attendance, adverse events, and the proportion achieving a 5.5-point minimal clinically important difference (MCID) on the FMA-UE were also evaluated.

2.4 Statistical analysis

Baseline data were summarized using means, standard deviations, frequencies, and percentages. A 2 × 3 mixed-design analysis of variance tested group, time, and group × time effects for FMA-UE scores. Between-group comparisons at each time point used independent-samples tests, with 95% confidence intervals and Cohen's d. Secondary outcomes were compared at 12 weeks. Attendance and clinically meaningful improvement were analysed using parametric or categorical tests as appropriate. The relationship between sessions attended and FMA-UE improvement was assessed using Pearson correlation. Intention-to-treat analysis with multiple imputation was used for missing observations. Statistical significance was set at $p<0.05$, and analyses were conducted using SPSS version 26 or above.

3. Results

3.1 Baseline characteristics

The randomized groups were comparable at baseline. Mean age was 68.6 ± 6.3 years in the intervention group and 68.1 ± 7.0 years in the control group. Ischemic stroke accounted for 80% of participants in each group, and the distribution of sex, side of hemiparesis, time since stroke, and baseline outcome scores did not differ significantly (all $p>0.05$).

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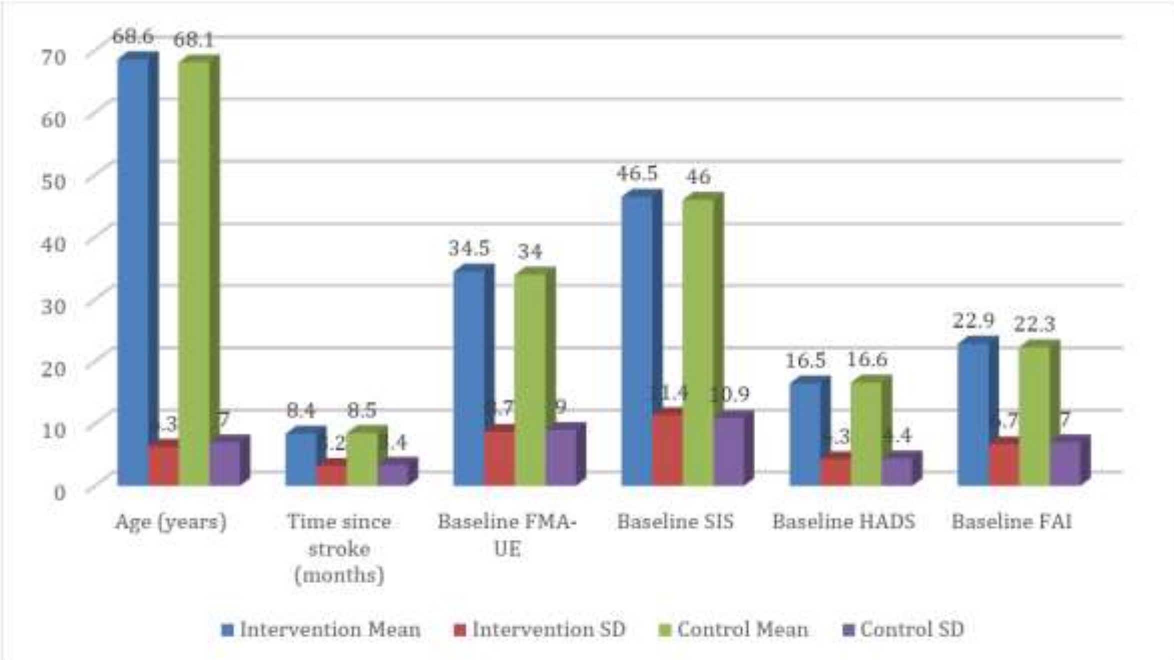
Table 1. Baseline demographic and clinical characteristics

Characteristic	Recreational activities (n=15)	Control (n=15)	p-value
Age, years	68.6 ± 6.3	68.1 ± 7.0	0.834
Male, n (%)	9 (60.0)	8 (53.3)	0.715
Time since stroke, months	8.4 ± 3.2	8.5 ± 3.4	0.936
Ischemic stroke, n (%)	12 (80.0)	12 (80.0)	1.000
Right hemiparesis, n (%)	7 (46.7)	8 (53.3)	0.715
FMA-UE, 0-66	34.5 ± 8.7	34.0 ± 9.0	0.882
SIS, 0-100	46.5 ± 11.4	46.0 ± 10.9	0.904
HADS, 0-42	16.5 ± 4.3	16.6 ± 4.4	0.951
FAI, 0-45	22.9 ± 6.7	22.3 ± 7.0	0.812

Values are mean ± SD unless otherwise indicated. FAI, Frenchay Activities Index; FMA-UE, Fugl-Meyer Assessment for Upper Extremity; HADS, Hospital Anxiety and Depression Scale; SIS, Stroke Impact Scale.



Graph 1: Comparison of Baseline Clinical Scores Between Intervention and Control Groups

3.2 Primary outcome: FMA-UE

Both groups improved over time, but the improvement was substantially greater with recreational activities. Mean FMA-UE increased from 34.5 ± 8.7 at baseline to 46.0 ± 7.8 at 6 weeks and 52.8 ± 6.9 at 12 weeks in the intervention group. The control group increased from 34.0 ± 9.0 to 38.3 ± 8.2 and 41.7 ± 7.8, respectively. The 12-week mean improvement was 18.3 points with recreational activities and 7.7 points with conventional rehabilitation.

Mixed-design ANOVA showed a significant group effect ($F=7.82$, $p=0.009$, partial $\eta^2=0.218$), time effect ($F=58.4$, $p<0.001$, partial $\eta^2=0.676$), and group × time interaction ($F=7.56$, $p=0.002$, partial $\eta^2=0.213$). At 6 weeks, the between-group difference was 7.7 points (95% CI 1.9-13.5;

p=0.012; d=0.98). At 12 weeks, the difference increased to 11.1 points (95% CI 5.3-16.9; p<0.001; d=1.42).

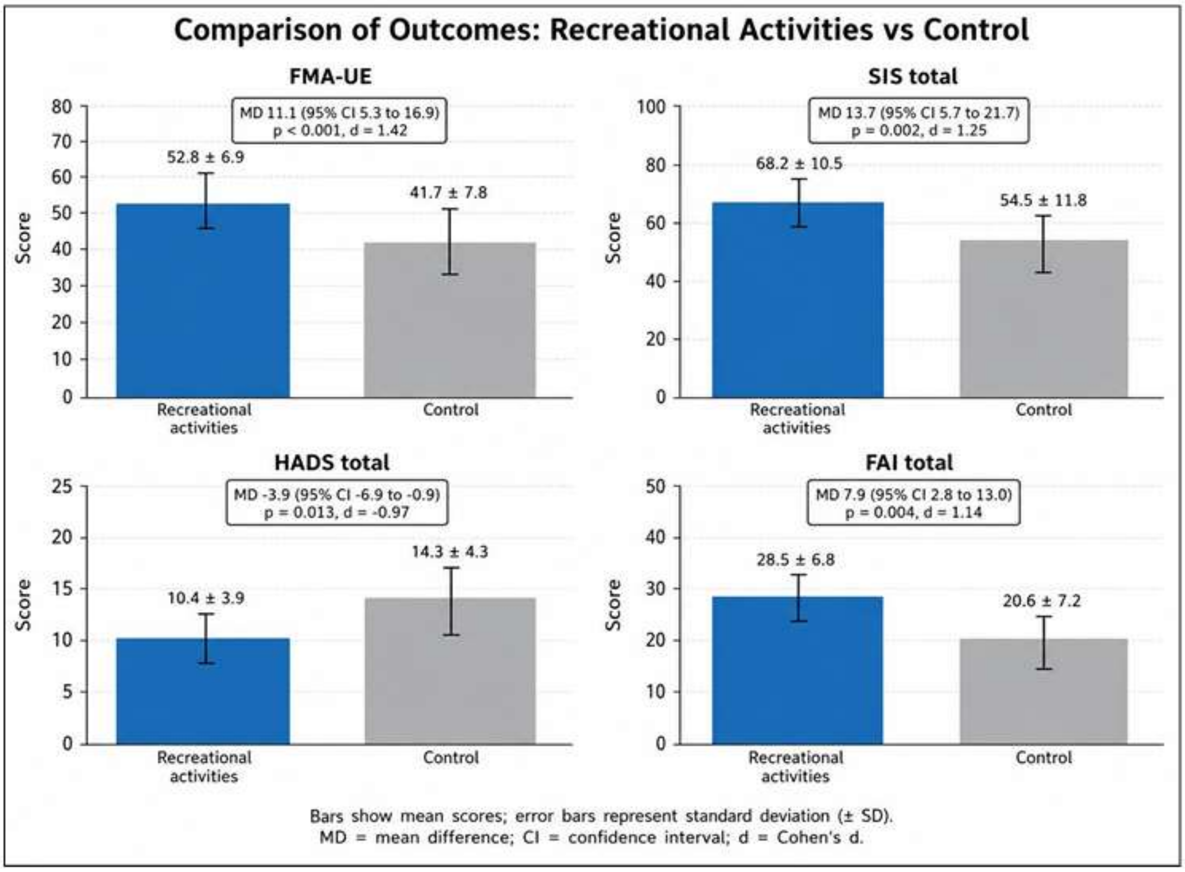
3.3 Secondary outcomes

At 12 weeks, the intervention group had a higher SIS score than the control group (68.2 ± 10.5 vs 54.5 ± 11.8; mean difference 13.7, 95% CI 5.7-21.7; p=0.002; d=1.25). Psychological distress was lower in the intervention group (HADS 10.4 ± 3.9 vs 14.3 ± 4.3; mean difference -3.9, 95% CI -6.9 to -0.9; p=0.013; d=-0.97). Social participation was also higher (FAI 28.5 ± 6.8 vs 20.6 ± 7.2; mean difference 7.9, 95% CI 2.8-13.0; p=0.004; d=1.14).

Table 2. Primary and secondary outcomes at 12 weeks

Outcome	Recreational activities	Control	Mean difference (95% CI)	p-value	Cohen's d
FMA-UE	52.8 ± 6.9	41.7 ± 7.8	11.1 (5.3 to 16.9)	<0.001	1.42
SIS total	68.2 ± 10.5	54.5 ± 11.8	13.7 (5.7 to 21.7)	0.002	1.25
HADS total	10.4 ± 3.9	14.3 ± 4.3	-3.9 (-6.9 to -0.9)	0.013	-0.97
FAI total	28.5 ± 6.8	20.6 ± 7.2	7.9 (2.8 to 13.0)	0.004	1.14

Negative HADS values favour the intervention because lower scores indicate less anxiety and depression.



Graph 2: Primary and secondary outcomes at 12 weeks

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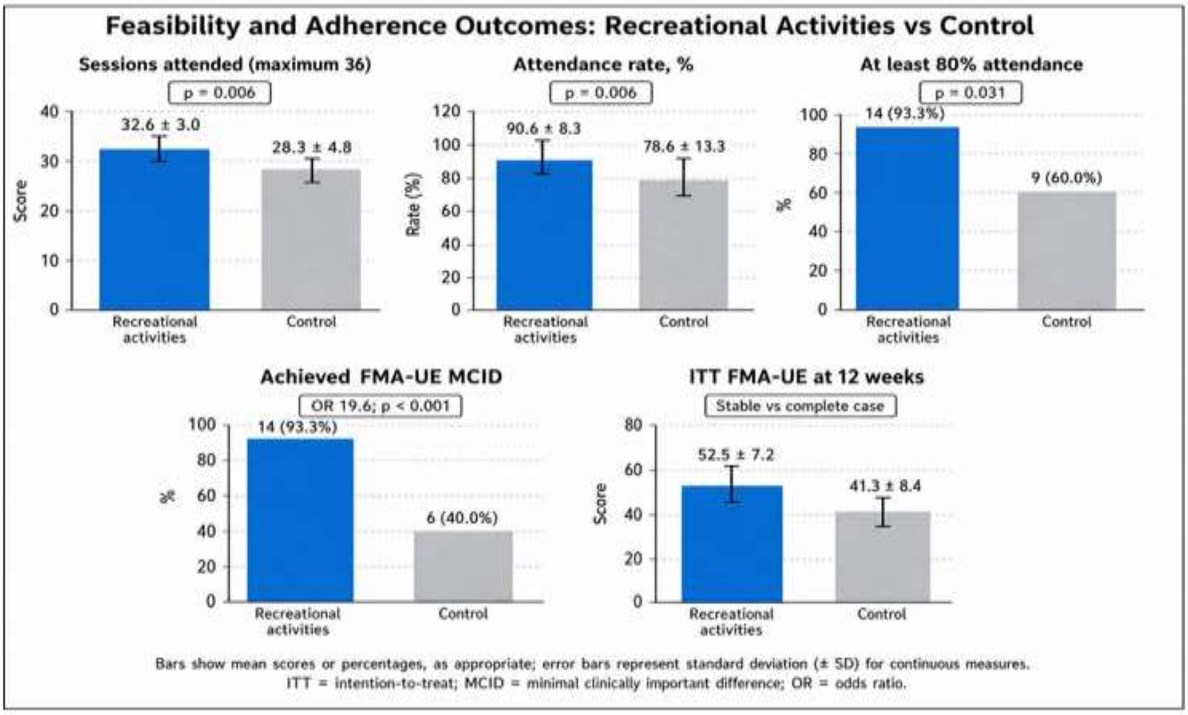
3.4 Adherence, clinical significance, missing data, and safety

Participants in the recreational-activity group attended 32.6 ± 3.0 of 36 sessions compared with 28.3 ± 4.8 sessions in the control group. Mean attendance was 90.6 ± 8.3% versus 78.6 ± 13.3% (p=0.006), and 93.3% versus 60.0% achieved at least 80% attendance (p=0.031). Attendance correlated positively with FMA-UE improvement (r=0.65, p<0.001), accounting for approximately 42% of observed variation in motor improvement.

Fourteen of 15 intervention participants (93.3%) achieved the 5.5-point FMA-UE MCID compared with 6 of 15 controls (40.0%; χ^2=11.4, p<0.001; odds ratio 19.6, 95% CI 2.1-182.5). At 12 weeks, one intervention participant and two control participants had missing outcome data. Multiple-imputation intention-to-treat estimates (52.5 ± 7.2 vs 41.3 ± 8.4) closely matched complete-case estimates (52.8 ± 6.9 vs 41.7 ± 7.8). No significant adverse events were reported, and minor transient discomfort did not prevent participation.

Table 3. Adherence, clinically meaningful improvement, and intention-to-treat findings

Parameter	Recreational activities	Control	Statistical result
Sessions attended (maximum 36)	32.6 ± 3.0	28.3 ± 4.8	p=0.006
Attendance rate, %	90.6 ± 8.3	78.6 ± 13.3	p=0.006
At least 80% attendance, n (%)	14 (93.3)	9 (60.0)	p=0.031
Achieved FMA-UE MCID, n (%)	14 (93.3)	6 (40.0)	OR 19.6; p<0.001
ITT FMA-UE at 12 weeks	52.5 ± 7.2	41.3 ± 8.4	Stable vs complete case



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4. Discussion

This pilot randomized controlled trial found that structured recreational activities produced a substantially greater trajectory of upper-extremity recovery than conventional rehabilitation alone. The intervention group gained 18.3 FMA-UE points over 12 weeks, compared with 7.7 points in controls, and the final between-group difference was 11.1 points with a very large standardized effect. The consistency of the group × time interaction, between-group comparison, MCID analysis, and intention-to-treat analysis strengthens the preliminary conclusion that the intervention was clinically as well as statistically meaningful.

Several mechanisms may explain the magnitude of improvement. First, recreational tasks provided repeated, task-specific use of the affected limb in meaningful contexts. Reaching for a ball, manipulating art materials, modelling clay, drumming, or interacting with a game requires graded force, hand-eye coordination, sequencing, and sensory feedback. These characteristics align with established principles of experience-dependent neuroplasticity, including repetition, salience, specificity, and progressive challenge [8-10]. Second, enjoyable and self-relevant activities may reduce perceived effort and boredom. The higher attendance observed in the intervention group and the positive correlation between attendance and FMA-UE improvement support a dose-response interpretation: increased participation generated a larger volume of motor practice.

The results also suggest that recreational rehabilitation affects more than isolated motor performance. Large improvements in SIS and FAI indicate benefits for quality of life and participation, while lower HADS scores indicate reduced psychological distress. Post-stroke depression and social isolation can interfere with rehabilitation and community reintegration [12-14]. Group-based recreational activities provide peer contact, mastery experiences, and opportunities to resume meaningful roles. These findings are consistent with the International Classification of Functioning, Disability and Health, which emphasizes body function, activity, participation, and contextual factors rather than impairment alone [18].

The intervention may also address learned non-use. When a paretic arm is repeatedly avoided, compensatory reliance on the less-affected limb can reinforce inactivity and limit functional recovery [19]. Recreational tasks encourage spontaneous and purposeful use of the affected upper extremity, potentially increasing confidence and reducing avoidance. The large proportion of intervention participants who achieved the FMA-UE MCID suggests that this behavioural engagement translated into tangible motor gains.

The effect size compares favourably with many established upper-limb interventions, although direct comparisons should be interpreted cautiously because protocols, stroke chronicity, baseline severity, and outcome timing differ across studies. Constraint-induced and high-intensity task-specific approaches can improve arm function but may be demanding and resource-intensive [16,17]. Recreational activities require relatively inexpensive materials and can be adapted for clinic, community, or home settings. Their clinical value may therefore lie not only in efficacy but also in acceptability, scalability, and sustained participation.

4.1 Strengths and limitations

Strengths include randomized allocation, a parallel control group, blinded outcome assessment as specified in the protocol, validated multidimensional measures, repeated assessments, adherence monitoring, effect-size estimation, and intention-to-treat sensitivity analysis. Findings were coherent across motor, psychological, participation, and quality-of-life domains, and no significant safety concerns emerged.

The principal limitation is the small pilot sample, which produces wide confidence intervals and limits generalizability. The programme combined multiple recreational modalities, so the independent contribution of adaptive sports, art, music, and virtual-reality tasks could not be separated. The study did not include long-term follow-up, objective neurophysiological measures, formal cost-effectiveness analysis, or sufficiently powered subgroup analysis by stroke type, severity, or preferred activity. Some secondary outcomes were self-reported and may be influenced by expectancy or social desirability. The setting and institutional details were not fully reported in the thesis document and must be clarified before publication.

4.2 Clinical implications and future research

The findings support using structured recreational activities as an adjunct rather than a replacement for conventional rehabilitation. Clinicians may select activities according to each participant's interests, cultural context, motor capacity, and safety profile while preserving key therapeutic ingredients: frequent affected-limb use, progressive difficulty, task specificity, feedback, and measurable goals. Community centres, outpatient departments, old-age homes, and supervised home programmes may offer feasible delivery settings.

A confirmatory multicentre trial should recruit at least 100-150 participants, use concealed allocation and blinded assessment, pre-register the protocol, and include follow-up at 6 and 12 months. Future work should compare individual recreational modalities, examine dose and preference matching, evaluate caregiver-supported and tele-rehabilitation delivery, and incorporate economic and neurophysiological outcomes. Reporting should follow CONSORT guidance and should include an intervention manual to support replication.

5. Conclusion

A 12-week programme of structured recreational activities combined with standard rehabilitation produced substantially greater upper-extremity motor recovery than conventional rehabilitation in this pilot sample of chronic stroke survivors. Benefits extended to quality of life, mood, social participation, adherence, and clinically meaningful improvement, with no significant adverse events. The intervention appears feasible, engaging, and potentially scalable; however, the small sample and short follow-up mean that the findings should be considered preliminary until confirmed in larger, rigorously reported trials.

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