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Focus and Scope

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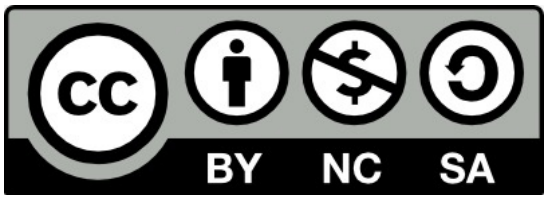

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Evaluating the Impact of Computer-Assisted Cognitive Remediation on Recovery Outcomes in Schizophrenia: A Quasi-Experimental Study from Northwest Nigeria

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ABSTRACT

Introduction: Cognitive deficits are a core feature of schizophrenia, profoundly impacting functional recovery. Computer-assisted cognitive remediation (CACR) has shown promise in improving cognitive and functional outcomes globally, but its effectiveness in low-resource settings like Nigeria remains under-investigated. This study aimed to evaluate the impact of CACR on recovery outcomes among patients with schizophrenia in Northwest Nigeria.

Materials and Methods: A quasi-experimental study was conducted with 500 participants attending the psychiatric clinic of Ahmadu Bello University Teaching Hospital, Shika-Zaria. Participants were allocated to either a 12-week CACR programme (n=250) using the *BrainHQ* platform or treatment as usual (TAU, n=250). Recovery was assessed using the Recovery Assessment Scale (RAS). Data were analysed using independent t-tests, Chi-square tests, and multivariate analysis of covariance (MANCOVA).

Results: Post-intervention, the CACR group showed a significant improvement in total RAS scores (mean=78.3, SD=9.1) compared to the TAU group (mean=62.4, SD=10.5) ($p<0.001$). All RAS subscale scores (Personal Confidence, Willingness to Ask for Help, Goal Orientation, Reliance on Others, No Domination by Symptoms) were also significantly higher in the intervention group (all $p<0.001$).

Conclusion: CACR very significantly led to improved recovery outcomes among patients with schizophrenia in this Nigerian setting. The findings support the integration of CACR into routine psychiatric rehabilitation in resource-limited contexts to enhance functional recovery.

Keywords: Cognitive Remediation, Computer-Assisted, Recovery, Schizophrenia

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INTRODUCTION

Schizophrenia is a severe and chronic mental disorder affecting approximately 20 million people worldwide, with a significant burden in sub-Saharan Africa.[1] Beyond the hallmark positive and negative symptoms, cognitive impairment; encompassing deficits in attention, memory, executive function, and social cognition, is now recognised as a core feature of the illness.[2] These cognitive deficits are stronger predictors of poor functional recovery, including impaired independent living, unemployment, and social isolation, than the symptomatic manifestations themselves.[3]

The concept of recovery in schizophrenia has

evolved from a purely clinical remission of symptoms to a more personal, multidimensional process of rebuilding a meaningful life and a positive sense of self.[4] Consequently, interventions that target the functional barriers to this process, particularly cognitive deficits, are paramount. Cognitive remediation therapy (CRT) is a behavioural training intervention designed to improve cognitive processes with the ultimate goal of enhancing psychosocial functioning.[5] Computer-assisted cognitive remediation (CACR) is a form of CRT delivered via standardised, adaptive software programmes that target core cognitive domains such as attention, memory, and executive function through repeated exercises and feedback. The advent of computer-assisted cognitive remediation (CACR) has standardised delivery, increased scalability, and allowed for more engaging, adaptive training protocols.[6]

Globally, meta-analyses have consistently demonstrated that CACR confers moderate to large improvements in both cognitive performance and functional outcomes.[7,8] However, the vast majority of this evidence originates from high-income countries (HICs). In low- and middle-income countries (LMICs), including those in Africa, the implementation and evaluation of such technologically driven interventions face unique challenges, including limited resources, infrastructure, and trained personnel, alongside different cultural perceptions of illness and recovery.[9] In Nigeria, Africa's most populous nation, mental health services are severely under-resourced, with a treatment gap for severe mental disorders exceeding 90%.[10] While pharmacological treatment remains the mainstay, psychosocial interventions are scarcely available.[11] Preliminary studies from other parts of Nigeria have hinted at the acceptability and potential efficacy of cognitive interventions,[12] but a large-scale, rigorous evaluation is lacking.

This study, therefore, sought to evaluate the impact of a structured CACR programme on recovery outcomes among a large cohort of patients with schizophrenia in Northwest Nigeria. It aims to contribute critical evidence on the translatability and effectiveness of evidence-based digital therapeutic tools in a low-resource, African setting, where such innovations could potentially transform rehabilitation services.

MATERIAL AND METHODS

Study Design

A quasi-experimental study design with a non-equivalent control group was employed. The control group was considered non-equivalent because participants were not randomly assigned to intervention or control conditions; instead, allocation was based on clinic attendance days in order to minimise contamination between groups. As a result, baseline equivalence could not be fully guaranteed, necessitating statistical adjustment for baseline differences during analysis using MANCOVA.

Study Setting

The study was conducted at the psychiatric outpatient clinic of the Ahmadu Bello University Teaching Hospital (ABUTH), Shika-Zaria, a major tertiary referral centre serving Northwest Nigeria.

Study Participants

The study participants were adult schizophrenia patients attending the psychiatric outpatient clinic of Ahmadu Bello University Teaching Hospital (ABUTH), Shika-Zaria, Northwest Nigeria. A total of 500 participants diagnosed with schizophrenia were enrolled.

Sample Size Determination

The sample size was calculated using the formula for comparing two means;[13] $n = [2\times (Z\alpha/2 + Z\beta)^2 \times \sigma^2] / d^2$), where $Z\alpha/2 = 1.96$ (for $\alpha=0.05$), $Z\beta =$

1.28 (for 90% power), σ = estimated pooled standard deviation, and d = effect size.[13] With an effect size (d) of 0.4 (moderate, based on prior meta-analyses),[7] a power of 90%, and an alpha level of 0.05, yielding a minimum of 199 per group. Anticipating a 20% attrition rate, the sample was inflated to 250 per group (500 total).

Sampling Technique

Consecutive sampling was used to recruit participants until the required sample size was achieved. Participants were allocated to the intervention (CACR) or control (Treatment As Usual - TAU) group based on their clinic attendance days to minimise contamination.

Inclusion Criteria

The inclusion criteria were; (i) Diagnosis of schizophrenia (F20) confirmed using the Mini-International Neuropsychiatric Interview (MINI) version 7.0.2;[14] (ii) Aged ≥18 years; (iii) Clinical stability (no hospitalisation or major medication change in preceding 8 weeks); (iv) On stable antipsychotic medication for ≥4 weeks; (v) Provided written informed consent.

Exclusion Criteria

The exclusion criteria were; (i) Co-morbid major neurological disorder or intellectual disability; (ii) Severe sensory impairment precluding computer use; (iii) Active substance dependence (excluding caffeine and tobacco); (iv) Participation in another structured psychosocial intervention.

Study Instruments and Measures

Socio-demographic and Clinical Proforma: Collected information on age, gender, education, occupation, duration of illness, and medication type.

Mini-International Neuropsychiatric Interview (MINI) 7.0.2: Used for diagnostic confirmation. It has been validated in Nigeria and shows good concordance with clinical diagnoses.[15]

Recovery Assessment Scale (RAS): The primary outcome measure. This 24-item self-report scale assesses personal recovery across five subscales: Personal Confidence and Hope, Willingness to Ask for Help, Goal and Success Orientation, Reliance on Others, and Not Being Dominated by Symptoms. Items are rated on a 5-point Likert scale (1=Strongly Disagree to 5=Strongly Agree). The total score ranges from 24 to 120, with higher scores indicating greater recovery. The RAS has demonstrated good psychometric properties and has been used and validated in Nigerian populations with mental illness, showing high internal consistency (Cronbach's alpha >0.85).[16,17]

Study Procedure

Ethical approval was obtained from the ABUTH Health Research Ethics Committee. After screening and consent, baseline assessments were conducted. The intervention group received the CACR programme in addition to TAU, while the control group received only TAU (regular psychiatric consultations and pharmacotherapy). The CACR intervention was administered over 12 weeks, with three 45-minute sessions per week, supervised by a trained research assistant. The programme used the *BrainHQ* online platform (Posit Science), which features adaptive exercises targeting speed of processing, attention, memory, and executive function. Post-intervention assessments were conducted within one week of programme completion for both groups.

Ethical Considerations

The study procedures were reviewed and approved by the Health Research Ethics Committee of Ahmadu Bello University Teaching Hospital, Shika-Zaria (Ref: ABUTH/HREC/B63/2025). Informed consent was obtained from all participants prior to their

inclusion in the study. Confidentiality and anonymity of participants was maintained throughout the research process.

Statistical Analysis

Data were analysed using IBM SPSS Statistics version 26. Descriptive statistics (mean, standard deviation, frequencies, and percentages) were used to summarise data. Baseline group differences were assessed using independent samples t-tests for continuous variables and Chi-square tests for categorical variables. The primary analysis used Multivariate Analysis of Covariance (MANCOVA) to compare post-intervention RAS total and subscale scores between the CACR and TAU groups, controlling for any significant baseline differences and baseline RAS scores. Effect sizes were reported as partial eta squared (ηp^2). Statistical significance was set at $p<0.05$.

RESULTS

A total of 500 participants with schizophrenia were enrolled, with 250 allocated to the Computer-Assisted Cognitive Remediation (CACR) group and 250 to the Treatment As Usual (TAU) group. The baseline socio-demographic and clinical characteristics of both groups are presented in Table 1. The mean age of participants was approximately 35 years (CACR: 34.8 ± 8.7; TAU: 35.2 ± 9.1). The majority of participants were male, comprising 137 (54.8%) in the CACR group and 132 (52.8%) in the TAU group. The mean duration of illness was around 9 years for both groups. There were no statistically significant differences between the groups in terms of age, gender, years of education, duration of illness, or the proportion prescribed atypical antipsychotics (all $p > 0.05$). However, a statistically significant difference was observed in the baseline Recovery Assessment Scale (RAS) total score, with the TAU group scoring slightly higher (mean=63.5, SD=10.8) than the CACR group (mean=61.8, SD=11.2) ($p=0.049$).

The primary analysis, a Multivariate Analysis of Covariance (MANCOVA) controlling for the baseline RAS total score, revealed a statistically significant overall effect of the intervention group on the combined post-intervention RAS scores (Pillai's Trace = 0.342, $F(5, 493) = 51.28$, $p < 0.001$).

The detailed post-intervention outcomes are shown in Table 2. Following the 12-week intervention, the adjusted mean RAS total score for the CACR group was 78.3 (SE=0.6), which was significantly higher than the adjusted mean of 62.4 (SE=0.6) for the TAU group ($F(1, 497)=202.74$, $p < 0.001$).

Analysis of the individual RAS subscales showed a consistent pattern of superior performance in the CACR group. For the *Personal Confidence and Hope* subscale, the CACR group's adjusted mean was 19.8 (SE=0.2) compared to 15.2 (SE=0.2) for the TAU group ($p < 0.001$). On the *Willingness to Ask for Help* subscale, the CACR group scored an adjusted mean of 15.5 (SE=0.2) versus 12.1 (SE=0.2) for the control group ($p < 0.001$). Similarly, for *Goal and Success Orientation*, the adjusted mean was 16.9 (SE=0.2) in the CACR group and 13.4 (SE=0.2) in the TAU group ($p < 0.001$).

The scores for the *Reliance on Others* subscale were 14.2 (SE=0.2) for the intervention group and 11.6 (SE=0.2) for the control group ($p < 0.001$). Finally, on the *Not Dominated by Symptoms* subscale, the CACR group achieved an adjusted mean of 11.9 (SE=0.1), which was higher than the TAU group's mean of 10.1 (SE=0.1) ($p < 0.001$). All comparisons were statistically significant at the $p < 0.001$ level.

Table 1: Baseline Socio-demographic and Clinical Characteristics of Participants

Characteristic	CACR Group (n = 250)	TAU Group (n = 250)	p-value
Age, Mean (SD)	34.8 (8.7)	35.2 (9.1)	0.621
Gender, Male, n (%)	137 (54.8)	132 (52.8)	0.658
Education (Years), Mean (SD)	11.4 (3.8)	11.1 (4.0)	0.387
Duration of Illness (Years), Mean (SD)	9.2 (5.6)	8.9 (5.8)	0.556
On Atypical Antipsychotic, n (%)	198 (79.2)	201 (80.4)	0.744
Baseline RAS Total, Mean (SD)	61.8 (11.2)	63.5 (10.8)	0.049

Table 2: Post-Intervention Recovery Assessment Scale (RAS) Scores: Comparison Between Groups (Adjusted Means from MANCOVA)

RAS Scale	CACR Group Mean (SE)	Adjusted TAU Group Adjusted Mean (SE)	F-value (1, 497)	p-value	Partial η^2
Total Score	78.3 (0.6)	62.4 (0.6)	202.74	< 0.001	0.289
Personal Confidence	19.8 (0.2)	15.2 (0.2)	165.33	< 0.001	0.249
Willingness to Ask for Help	15.5 (0.2)	12.1 (0.2)	142.19	< 0.001	0.222
Goal Orientation	16.9 (0.2)	13.4 (0.2)	151.67	< 0.001	0.234
Reliance on Others	14.2 (0.2)	11.6 (0.2)	98.45	< 0.001	0.165
Not Dominated by Symptoms	11.9 (0.1)	10.1 (0.1)	112.58	< 0.001	0.185

Note: SE = Standard Error

DISCUSSION

This quasi-experimental study of 500 patients with schizophrenia in Northwest Nigeria provides robust evidence that a 12-week Computer-Assisted Cognitive Remediation programme very significantly improves self-reported recovery outcomes. The intervention group demonstrated large, statistically superior gains on the overall RAS and across all its constituent domains; personal confidence, help-seeking, goal orientation, social reliance, and symptom management, compared to those receiving treatment as usual.

Our findings align with the global evidence base. International meta-analyses consistently report that cognitive remediation leads to significant improvements in functional outcomes, with effect sizes comparable to the large one (ηp^2=0.289) found in this study.[7,8] The results suggest that the core principles of neuroplasticity and skills training underpinning CACR are effective across diverse cultural and economic contexts. The use of the *BrainHQ* platform, with its adaptive difficulty and engaging interface, likely contributed to the high adherence and observed benefits, echoing successful implementations in HICs.[6]

Within the African context, this study significantly advances the field. While previous Nigerian research has focused on cognitive assessments or brief, non-computerised training,[12,19] this is one of the largest and most methodologically rigorous trials of a standardised CACR protocol in the region. A smaller pilot study from South Africa also found positive cognitive effects from computerised training,[20] but our study explicitly links the intervention to the holistic construct of personal recovery, which is increasingly prioritised in mental health service frameworks.[4] The significant improvement in *Willingness to Ask for Help* and *Reliance on Others* is particularly noteworthy, as it suggests CACR may foster the social connectivity crucial for recovery in communalistic African societies, potentially countering the stigma and isolation often experienced by this patient group.[21]

The findings must be interpreted considering the study's limitations. The quasi-experimental design, while pragmatic in a busy clinical setting, carries a risk of selection bias, though baseline characteristics were largely similar. The reliance on a self-reported primary outcome (RAS) is a strength for capturing the subjective experience of recovery but could be complemented by objective functional measures (e.g., vocational status) and performance-based cognitive tests in future research. Furthermore, the long-term sustainability of gains beyond the 12-week period remains to be investigated.

Notwithstanding these limitations, the implications are substantial. In a resource-constrained setting like Nigeria, where specialist therapists are scarce, CACR offers a scalable, cost-effective adjunct to pharmacotherapy. It can be administered by trained non-specialist personnel under supervision, a task-shifting model endorsed by the World Health Organization for LMICs.[22] The significant improvements in recovery-oriented outcomes advocate for the integration of CACR into the standard rehabilitation package at tertiary psychiatric centres in Nigeria and similar settings.

CONCLUSION

This study demonstrates that computer-assisted cognitive remediation is a highly effective intervention for enhancing personal recovery among patients with schizophrenia in Northwest Nigeria. It bridges a critical evidence gap, showing that a technologically mediated intervention proven in high-income countries can be successfully implemented and yield substantial benefits in a low-resource African context. We recommend that mental health service planners in Nigeria and similar regions consider the structured integration of CACR programmes to improve functional outcomes and quality of life for individuals living with schizophrenia.

AVAILABILITY OF RESEARCH DATA

Data are available upon reasonable request from the corresponding author.

FUNDING

No funding was received for this research.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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