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Pilot Trial of a Tele-Rehab Intervention to Improve Outcomes after Stroke in Ghana: A Feasibility and User Satisfaction Study

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Abstract

Background—Tele-rehabilitation after stroke holds promise for under-resourced settings, especially sub-Saharan Africa (SSA), with its immense stroke burden and severely limited physical therapy services.

Objective—To preliminarily assess the feasibility and outcomes of mobile technology-assisted physical therapy exercises for stroke survivors in Ghana.

Methods—We conducted a prospective, single arm, pre-post study involving 20 stroke survivors recruited from a tertiary medical center, who received a Smartphone with the 9zest Stroke App® to deliver individualized, goal-targeted 5-days-a-week exercise program that was remotely supervised by a tele-therapist for 12 weeks. Outcome measures included changes in stroke levity scale scores (SLS), Modified Rankin score (MRS), Montreal Cognitive Assessment (MOCA), and feasibility indicators.

Results—Among study participants, mean ± SD age was 54.6 ± 10.2 years, 11 (55%) were men, average time from stroke onset was 6 months. No participants dropped out. Compared with baseline status, mean ± SD scores on SLS improved from 7.5 ± 3.1 to 11.8 ± 2.2 at month 1 ($p<0.0001$) and 12.2 ± 2.4 at month 3 ($p<0.0001$), MOCA scores improved from 18.2 ± 4.3 to 20.4 ± 4.7 at month 1 ($p=0.14$), and 22.2 ± 7.6 at month 3 ($p=0.047$). Mean ± SD weekly sessions performed by participants per month was 5.7 ± 5.8 and duration of sessions was 25.5 ± 16.2 minutes. Erratic internet connectivity negatively affected full compliance with the intervention, although satisfaction ratings by study participants were excellent.

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Conflicts of interest: None declared by authors

Conclusion—It is feasible to administer an m-health delivered physical therapy intervention in SSA, with high user satisfaction. Randomized trials to assess the efficacy and cost-effectiveness of this intervention are warranted.

Keywords

tele-rehabilitation; feasibility; stroke survivors; resource-limited; Post-stroke rehabilitation; M-health; Disability; Ghana

INTRODUCTION

Rehabilitation after stroke in sub-Saharan Africa (SSA) is challenged by lack of trained rehabilitation personnel, with 2.5 physiotherapists 100,000 people served[1]. Stroke survivors often resort to alternative forms of treatment and refuse orthodox care due to highly prevalent stroke related stigma.[2] Furthermore, 70% of individuals in SSA reside in rural settings[3] with limited geographic access to rehabilitation services which coupled with the prohibitive costs make post-stroke rehabilitation a major challenge.

One promising avenue for effective mobilization and utilization of the scanty health professionals available to meeting the huge population demand in LMICs for neurology care is via the agency of telemedicine.[4,5] Tele-rehabilitation has been evaluated for feasibility and efficacy and data pooled from 7 studies provided limited, moderate evidence that tele-rehabilitation had equal effects with conventional rehabilitation in improving abilities of activities of daily living and motor function for stroke survivors.[6]

However, the feasibility of m-health administered rehabilitation for stroke survivors has not been tested in SSA. Hence the objective of the present study was to preliminarily assess the feasibility of and satisfaction with a comprehensive physical therapy tele-rehabilitation intervention for post-stroke rehabilitation among 20 recent Ghanaian stroke survivors.

METHODS

Study design and Site

This is a single site, single arm, observational prospective pilot study to assess the feasibility of a mobile phone administered physical therapy intervention administered remotely at home of Ghanaian stroke survivors. The study was conducted at the Neurology Clinic of the Komfo Anokye Teaching Hospital (KATH), a tertiary medical center in Kumasi, Ghana.[7]

Study participants

Consecutive stroke survivors attending the Neurology service at KATH were approached for enrollment into the study after obtaining informed consent. Eligible subjects should have had a stroke within 6 months with a Modified Rankin score of 1 to 4. Subjects were excluded if they had serious medical co-morbidities such as (1) recent hospitalization for myocardial infarction, stage IV heart failure, unstable cardiac arrhythmias, (2) history of severe chronic obstructive pulmonary disease on Long term oxygen Therapy (LTOT), (3) pre-existing neurological disorders such as severe dementia, Parkinson’s disease, (4) severe

uncontrolled psychiatric illness such as schizophrenia or medication refractory depression, (5) uncontrolled hypertension with systolic blood pressure (BP) >220 and Diastolic BP >120mmHg refractory on optimal anti-hypertensive therapy, (6) history of sustained alcoholism or drug abuse in the last six months, (7) severe arthritis or orthopedic problems that limit passive ranges of motion, (8) unable to ambulate at least 50 meters prior to stroke, or intermittent claudication while walking <200m.

Intervention

Patients received a Smartphone with internet capabilities (on loan if they did not have one already – taken from inventory of a previously conducted mHealth study[8]) and equipped with (or downloaded on to their phone) the 9zest Stroke Rehab App® (https://9zest.com/stroke) to deliver individualized, goal-targeted 5-days-a-week exercise program that was progressively graduated by a tele-therapist for 12 weeks. A typical session lasted for 30–60 minutes. The mobile-phone system allowed for recording of daily exercise with video and weekly telephone-conference call with tele-therapist after data review. The stroke survivors received a standardized rehabilitation program comprising of 4 categories of physiotherapy components namely (I) mobility, upper and lower limb strengthening, (II) dexterity to improve fine motor movements, (III) seated and standing balance exercise and (IV) Walking endurance. Each category of physiotherapy has levels of increasing difficulty chosen based on level of disability and modifiable based on progress. Where indicated and for ethical reasons, patients in the intervention arm are allowed to supplement their tele-rehab sessions with hospital-based rehab if they wished and were allowed to contact a physiotherapist or a physician if there were any difficulties. Research assistants (RA) and physiotherapist serving as tele-therapists received training provided by the study coordinator before commencement of the study. The tele-therapist were trained in the use of the 9zest Stroke Rehab App® tele-rehabilitation system from the tele-therapist user interface, exercise progression protocols and documenting patients' progress. RAs were trained in assessing the eligibility of potential participants. The tele-therapist and RAs attained a competency level of >90% in their respective study related responsibilities at the end of training prior to initiation of study.

Baseline data collected

We first collected demographic information including age, gender, educational status, monthly income level as well as location of residence. Vascular risk factor profile, stroke type, stroke severity was assessed using National Institute of Health Stroke Scale (NIHSS), and functional status assessed using the Modified Rankin scale were collected by the two trained Research Assistants through review of medical charts and interview of stroke survivors and/or their proxy. Stroke type was defined radiologically into ischemic and hemorrhagic based on cranial CT scan done at onset of stroke symptoms.

Outcome measures

We measured the following outcome measures: (i) Stroke Levity Scale (SLS)[9], a concise, valid and reliable stroke impairment scale used to monitor outcomes of stroke patients by calculating the maximum power (0–5) in the dexterous hand, maximum power in the weaker lower limb (0–5), mobility score (0–4) and aphasia score (0–1), (ii) Modified Rankin score, (iii) Barthel's Index of Activities of Daily living, (iv) National Institute of Health Stroke

Scale, (v) Montreal Cognitive assessment, (vi) Fatigue severity scale[10] (vii) visual analogue scale for pain and (viii) feasibility outcomes such as fidelity checklist including internet connectivity issues and App functionality. Finally, patient satisfaction assessed at the end of the intervention via a telephone survey was performed using a telehealth satisfaction instrument designed for the study. The satisfaction measure consisted of 12 items corresponding to aspects of the telerehabilitation experience with 11 items using five-point Likert rating scales and one item used a “yes” or “no” response.

Statistical analysis

Descriptive statistics comprised of frequency counts with their respective percentages for discrete variables and means with standard deviation. Means and medians were compared using the Student’s t-test or the Mann-Whitney’s U-test for paired comparisons or Analysis of variance for month 0, 1 and 3 comparisons of study outcomes. Correlations between changes in outcome measures between baseline and 12 weeks versus average duration of telerehabilitation sessions were explored using the Spearman’s correlation. In all analysis, two-tailed p-values <0.05 were considered statistically significant with no adjustments for multiple comparisons. Statistical analysis was performed using GraphPad Prism version 7.

RESULTS

Demographic and clinical characteristics of study participants

Of the 24 stroke patients approached, 20 were eligible for this feasibility study. Of those excluded, 3 had fully recovered from stroke without demonstrable motor deficits and 1 declined enrollment into the study. The mean ± SD age of study subjects was 54.6 ± 10.2 years, 11 of whom were male participants and 15 (75%) resided in urban settings and other characteristics are shown in Table 1.

Outcomes

The mean score on the stroke levity scale at enrollment was 7.5 ± 3.1 which increased to 11.8 ± 2.2 at month 1 and to 12.2 ± 2.4 ($p<0.0001$) with higher score suggesting lower functional impairment on this scale. Modified Rankin score at month 0 was 2.2 ± 0.6 at enrollment, 2.2 ± 1.1 at month 1 and improved non-significantly to 1.8 ± 0.7 at month 3 ($p=0.06$, comparing baseline with month 3). The mean ± SD baseline Barthel’s index score was 94.4% ± 6.4 at month 0, 95.8% ± 6.3 at month 1 and 96.1% ± 6.4 at month 3. There was an improvement in the Montreal cognitive assessment scores from a baseline mean value of 18.2 ± 4.3 to 20.4 ± 4.7 at month 1 and 22.2 ± 7.6 ($p=0.047$, comparing month 3 with baseline), (Figure 1A–C). There were no significant changes in the NIHSS score, fatigue or pain scores during follow-up.

Adherence to intervention protocol

The mean ± SD number of weekly rehabilitation sessions performed by study participants per month was 5.7 ± 5.8 (maximum possible sessions 20/month). The mean ± SD duration of sessions was 25.5 ± 16.2 minutes. The average duration of sessions per subject was strongly and significantly correlated with change in scores on the MOCA between week 12 and baseline, Spearman $r=0.71$, $p=0.0006$.

Satisfaction with telerehabilitation intervention

All 20 subjects completed the survey on satisfaction with the telerehabilitation intervention and results are shown in table 2. Overall, 60% of participants reported “excellent” satisfaction with the telehealth system, 30% reported “very good”, 5% reported “good” and 5% reported a fair experience with the post-stroke rehabilitation intervention. All subjects (100%) reported they would use the telerehabilitation intervention in the future. Internet connectivity and stability of streaming of audiovisuals was a major challenge reported by 12 out 20 subjects. In view of this challenge, 10 out 12 subjects with internet connectivity issues performed exercises sometimes without using the mobile phone App.

DISCUSSION

We demonstrate for the first time the feasibility of and high user satisfaction involved with deploying a mobile phone delivered domiciliary rehabilitation intervention for stroke survivors in a challenging resource-limited setting in West Africa. Overall, the intervention was associated with improvements in baseline motor deficits over the 12 weeks of follow-up. This study builds upon our initial survey in this Ghanaian population where we found ≈ 60% of stroke survivors were functionally dependent after an average of 15 months after stroke onset and that only 30% of stroke survivors were accessing physiotherapy services on an inconsistent basis due to financial constraints and heavy case load on the few available physiotherapists.[11,12]

In the present study, we noted significant amelioration of existing deficits among study participants particularly in motor impairments as well as cognition function evidenced by improvements in Montreal Cognitive Assessment scores over follow-up as has been previously reported among Veterans who received physical therapy via an in-home video telerehabilitation program.[13]

In discussing the implications of our study findings, we acknowledge a limitation in not having a control population of stroke survivors without the intervention to compare their response rates with those on the intervention. Without this control group, it is difficult to assess how much of the recovery observed is attributable to natural recovery. Having recently demonstrated the feasibility of using m-health under nurse guidance for control of blood pressure among a sample of West Africans stroke survivors[14,15], our findings broadly support a growing notion that technology-centered interventions that can be innovative avenues for the implementation of task shifting interventions within resource limited settings.

In conclusion, we have demonstrated feasibility and excellent user satisfaction involved with administering a mobile phone administered physical rehabilitation intervention for stroke survivors in a LMIC in West Africa.

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References

1. Health Systems Trust Health Systems Trust-Health Statistics. 2011. From http://www.hst.org.za/healthstats/index.php
2. Sarfo FS, Nichols M, Qanungo S, Teklehaimanot A, Singh A, Mensah N, et al. Stroke-related stigma among West Africans: Patterns and predictors. Journal of Neurological Sciences. 2017; 375:270–274.
3. Ademiluyi IA, Aluko-Arowolo SO. Infrastructural distribution of healthcare services in Nigeria: An overview. Journal of Geography and Regional Planning. 2009; 2(5):104–110.
4. Wechsler L, Tsao JW, Levine SR, Swain-Eng RJ, Adams RJ, Demaerschalk BM, et al. Teleneurology applications. Report of the telemedicine working gro up of the American Academy of Neurology. Neurology. 2013; 80:670–676. [PubMed: 23400317]
5. Sarfo FS, Adamu S, Awuah D, Ovbiagele B. Tele-neurology in sub-Saharan Africa: a systematic review of the literature. J Neurol Sci. 2017; 380:196–199. [PubMed: 28870567]
6. Chen J, Jin W, Zhang XX, Xu W, Liu XN, Ren CC. Telerehabilitation approaches for stroke patients: systematic review and meta-analysis of Randomized Controlled Trials. J Stroke Cerebrovasc Dis. 2015; 24(12):2660–8. [PubMed: 26483155]
7. Sarfo FS, Akassi J, Badu E, Okorozo A, Ovbiagele B, Akpalu A. Profile of neurological disorders in an adult neurology clinic in Kumasi, Ghana. eNeurologicalSci. 2016; 3:69–74. [PubMed: 27110596]
8. Sarfo FS, Treiber F, Jenkins C, Patel S, Gebregziabher M, Singh A, et al. Phone-based Intervention under Nurse Guidance After Stroke (PINGS): study protocol for an randomized controlled trial. Trials. 2016; 17(1):436. [PubMed: 27596244]
9. Owolabi MO, Platz T. Proposing the Stroke Levity Scale: a valid, reliable, simple and time-saving measure of stroke severity. Eur J Neurol. 2008; 15(6):627–33. [PubMed: 18474078]
10. Krupp LB, Larocca NG, Muir-Nash J, et al. The fatigue severity scale. Application to Patients with multiple sclerosis and systemic lupus erythematosus. Arch Neurol. 1989; 46:1121–3. [PubMed: 2803071]
11. Sarfo FS, Adamu S, Awuah D, Sarfo-Kantanka O, Ovbiagele B. Potential role of tele-rehabilitation to address barriers to implementation of physical therapy among West African stroke survivors: A cross-sectional survey. J Neurol Sci. 2017; 381:203–208. [PubMed: 28991682]
12. Sarfo FS, Ovbiagele B. Response by Sarfo and Ovbiagele to letter regarding “Potential role of tele-rehabilitation to address barriers to implementation of physical therapy among West African stroke survivors: A cross-sectional survey”. J Neurol Sci. 2017; 382:162–163. [PubMed: 28992944]
13. Levy CE, Silverman E, Jia H, Geiss M, Omura D. Effects of physical therapy delivered via home video telerehabilitation on functional and health-related quality of life outcomes. J Rehabil Res Dev. 2015; 52(3):361–70. [PubMed: 26230650]
14. Sarfo FS, Treiber F, Gebregziabher M, Adamu S, Patel S, Nichols M, et al. PINGS (Phone-based Intervention under Nurse Guidance After Stroke): Interim Results of a pilot Randomized Controlled Trial. Stroke. 2018; 49(1):236–239. [PubMed: 29222227]
15. Nichols M, Sarfo FS, Singh A, Qanungo S, Treiber F, Ovbiagele B, et al. Assessing mobile health capacity and task shifting strategies to improve hypertension among Ghanaian stroke survivors. Am J Med Sci. 2017; 354(6):573–580. [PubMed: 29208254]

Highlights

- Rehabilitation services are severely limited in sub Saharan Africa
- Tele-rehabilitation holds promise for under-resource settings
- We assessed feasibility of a mobile technology-assisted physical therapy program for stroke survivors in Ghana
- The intervention was associated with improvements in motor deficits
- Tele-rehabilitation is feasible in resource-limited settings

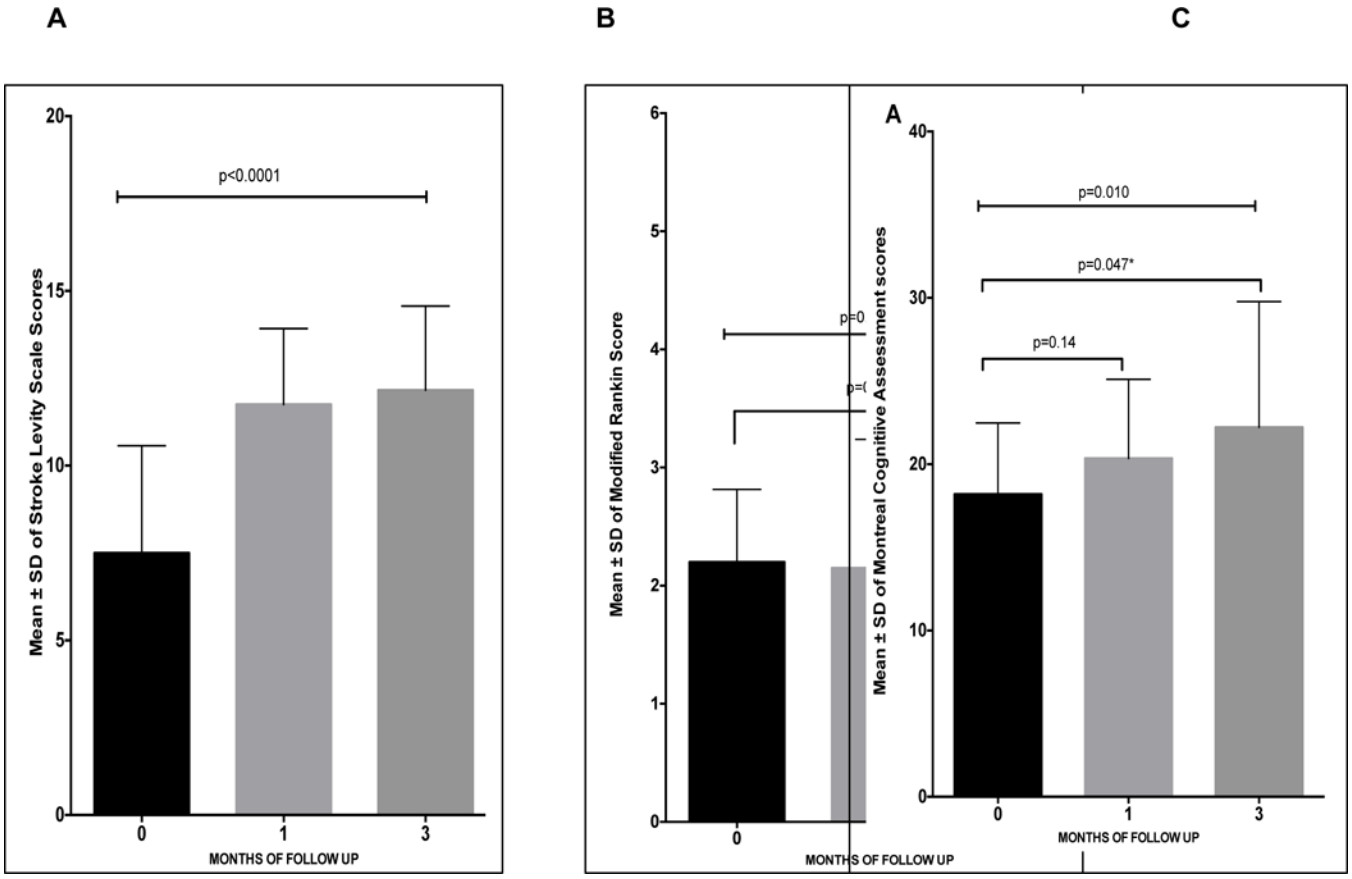

Figure 1.

Changes in (A) Stroke Levity Scale scores, (B) Modified Rankin Scale scores and (C) Montreal cognitive assessment scores among study participants at months 0, 1 and 3 on mobile phone delivered physical therapy intervention.

Table 1

Baseline & clinical characteristics of Participants of the Study

Characteristic	Frequency (%) or Average statistic
Age, mean ± SD	54.6 ± 10.2
Male gender, n (%)	11 (55.0)
Location of domicile	
Urban	15 (75.0)
Semi-urban	2 (10.0)
rural	3 (15.0)
Educational level	
Primary	10 (50.0)
Secondary	5 (25.0)
Tertiary	5 (25.0)
Average monthly income	
0–100$	7 (35.0)
101–250$	9 (45.0)
251–500$	2 (10.0)
>500$	2 (10.0)
Stroke type	
Ischemic	10 (50.0)
Hemorrhagic	4 (20.0)
Untyped	6 (30.0)
Vascular risk factors	
Hypertension	20 (100.0)
Dyslipidemia	13 (65.0)
Diabetes mellitus	1 (5.0)
Alcohol use	
Current use	1 (5.0)
Former use	6 (30.0)
Never use	13 (65.0)
Cigarette smoking	
Previous smoker	1 (5.0)
Never smoked	19 (95.0)
BMI categories	
<24.9 kg/m^2	10 (50.0)
25.0–29.9 kg/m^2	5 (25.0)
>30kg/m^2	5 (25.0)
Cardiac diseases	0 (0.0)
Systolic blood pressure, mean ± SD	143 ± 27.5

Characteristic	Frequency (%) or Average statistic
Diastolic blood pressure, mean ± SD	84.7 ± 12.5

Table 2

Patient satisfaction with Telehealth for post-stroke rehabilitation.

Satisfaction Item and Response Category	Level of satisfaction, n (%)				
	1	2	3	4	5
1. Length of time to get 1st Telehealth appointment	0 (0)	4 (20)	7 (35)	8 (40)	1 (5)
2. Waiting minutes to see Telehealth provider*	0 (0)	0 (0)	3 (15)	16 (80)	1 (5)
3. Time spent with your specialist	0 (0)	0 (0)	3 (15)	15 (75)	2 (10)
4. Thoroughness, carefulness and skillfulness of the specialist you saw	0 (0)	0 (0)	0 (0)	15 (75)	5 (25)
5. Courtesy, respect, sensitivity and friendliness of the specialist you saw	0 (0)	0 (0)	0 (0)	11 (55)	9 (45)
6. Respect for your privacy by staff	0 (0)	1 (5)	0 (0)	14 (70)	5 (25)
7. How well staff answered questions about equipment	0 (0)	0 (0)	1 (5)	11 (55)	8 (40)
8. Satisfaction with the voice quality of the equipment	0 (0)	0 (0)	0 (0)	15 (75)	5 (25)
9. Satisfaction with the visual quality of the equipment	0 (0)	0 (0)	0 (0)	10 (50)	10 (50)
10. Your personal comfort in using the Telehealth system	2 (10)	2 (10)	0 (0)	14 (70)	2 (10)
11. Your overall treatment experience with telehealth system	0 (0)	1 (5)	1 (5)	6 (30)	12 (60)
12. Future use of telehealth for post-stroke rehabilitation§	0 (0)	0 (0)	0 (0)	0 (0)	20 (100)

1=poor, 2=fair, 3=good, 4=very good, 5=excellent

*1= > 45 (minutes), 2 = 31–45, 3 = 16–30, 4 = 6–15, 5 = 1–5.

§Yes or no response