Original Article

Community-based rehabilitation for physically impaired earthquake victims: An evidence-based practice protocol and its pre–post experimental study

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Abstract

Background: A natural disaster like earthquake is a sudden event that causes not only the loss of life but also mental, emotional, and physical disabilities. An earthquake of 7.8 magnitudes hit Nepal and injured more than 18,500 people in 2015. There was a critical need to develop rehabilitation protocols. Therefore, we aimed to structure community-based rehabilitation protocols for physically impaired earthquake victims and to investigate immediate effect of the intervention to address disability and reduce public health burden. **Materials and Methods:** Evidence-based rehabilitation protocols for various injuries were structured to address the victims' impairments and activity limitations. The protocols were administered to 13 victims of one of the most affected community sites, for 60 min/day, 12 days in 2 weeks at their own doors. Local resources were used to make the protocols sustainable. An immediate effect of the protocols was evaluated within the group. The World Health Organization Disability Assessment Schedule, numerical pain rating scale, and time up and go (TUG) test were used to measure disability level, pain, and mobility status, respectively. Wilcoxon's signed rank test was used to analyze pre–post data. **Results:** All participants completed the rehabilitation without adverse effects. The treatment demonstrated significant reduction in disability level ($P < 0.001$, effect size = 0.63) and pain level ($P = 0.007$). However, change with TUG was not significant. **Conclusion:** The evidence-based, structured community rehabilitation protocols demonstrated benefits in improving the victim's quality of life. Follow-ups will be continued to explore sustainability and long-term effects of the interventions.

Keywords: Community rehabilitation, disability, disaster, earthquake

Background

A natural disaster like earthquake is a sudden event that causes not only the loss of life but also results in mental, emotional, and physical disabilities.[1,2] The prevalence of disability after the earthquake is 3.4%–4.7%.[3] About 23,000 people were injured in a devastating earthquake in Iran,[4] about 11,000 people were injured with 2008 earthquake in China,[2] and about 300,000 people were injured in another devastating earthquake in Haiti[5] resulting in a large number of residual deficits. An earthquake of 7.8 magnitudes with the epicenter in Gorkha on 25th April 2015 and second earthquake of 6.5 magnitude with epicenter at Sindupalchwok on 12th May 2015 followed by more than 4000 after-shocks of larger than 4.0 magnitudes struck Nepal and killed more than 8,500 people and injured more than 18,500 individuals.[6-9]

In this earthquake, the majority of injuries were fractures (70%) followed by spinal cord injuries (6%), sustained traumatic brain injuries (2%), and multiple injuries.[1] The victims had multiple impairments, and therefore, there was an urgent need of immediate health care.[1,2] Acute care was provided at the moment.[1,7] The ratio of injured victims to the death people was very high[7,10] compared to the evidence in various

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countries,[7,11] which further explained the critical need of well-structured rehabilitation at the community level to make them self-dependent, return to routine work, and to prevent from life-long disabilities.

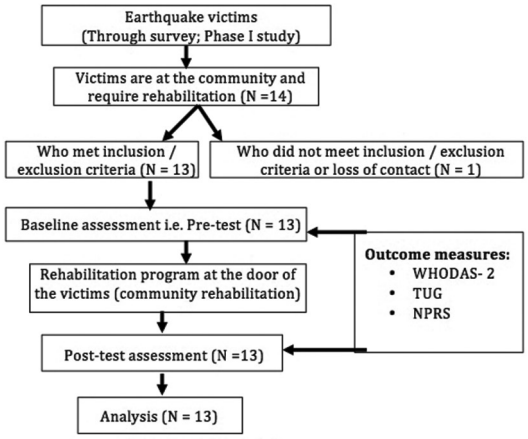
During previous earthquakes, most notably, Iran in 2003,[4] Pakistan in 2005,[11] China in 2008,[2] and Haiti in 2010,[3] the need and acceptance for the role of rehabilitation had been well-established[10] for both short term and long term.[3,4] However, the rehabilitation protocols administered to the earthquake victims has not been structured elsewhere. Therefore, the authors aimed to structure rehabilitation protocols for various injuries based on evidence and current practices that are feasible at the community and to investigate the effectiveness of the protocols.

Materials and Methods

This was a pre–post experimental design for testing the protocols that were structured during this study. Individuals with physical impairments who were medically and surgically stable but required rehabilitation (survey findings) were recruited in this study. Individuals having difficulty in communication and/or complications due to comorbidities and/or internal injuries were excluded. As per the survey finding (which is under review process), the number of victims in Bahunepati was highest among surveyed sites.[12] Therefore, this rehabilitation program was purposively focused on that site. The rehabilitation program was started 1 year after the earthquake, and thus we focused for sub-acute management.

Qualified physiotherapists were first trained for administration of the intervention. The guidelines for treatment were provided.[4,10] They administered the intervention at victim's own door. Other physiotherapists, who were not involved in treatment, assessed each individual before and after the rehabilitation.

Ethical approval was obtained from the institutional review committee of Kathmandu University School of Medical Sciences (approval number: 83/15). Informed written consent was taken from all participants before starting the study. The study procedure is illustrated in Figure 1.



In the figure: WHODAS 2.0 - World Health Organization Disability Assessment Schedule 2.0, TUG – Time Up and Go test, NPRS – Numerical Pain Rating Scale

Figure 1: Study Consort

Intervention

The rehabilitation needs were analyzed based on the survey result with respect to patients' impairment and functional level, and environmental condition. The rehabilitation protocol for each condition and progression parameters were derived as per evidence-based current practices, physiotherapists' experience gained during early post-earthquake rehabilitation with consideration of the contextual factors of international classification of functioning, disability, and health (ICF).The protocols derived were patient-centered, individually tailored (for exercise selection and parameters prescription), reproducible, feasible in the community, and progressive (either one or multiple parameters). The treatment was provided for 2 weeks.[13] The local resources such as sand bags, sticks, rubber tubes, water bottles and straw, utensils to train for functional activities, and ropes were used during the treatment. The local health workers were trained to treat and continue and/or progress the rehabilitation to make the program sustainable. The summarized protocol in general is as follows.

A) Rehabilitation protocol for upper limb injuries

Based on the available evidence,[14-19] the protocol derived for the rehabilitation of earthquake victims with upper limb injuries is as follows:

To manage impairments

- For restricted joints, range of motion (ROM) exercises (active and/or passive) (10 repetitions, two to three sets, twice a day) and mobilization 30 glides per restricted movement, every day
- Strengthening exercises of the weak muscles (active exercises, isometric and isotonic contractions, dynamic exercises, resisted and functional training using tire tubes and sand bags) (20 repetitions, two to three sets, twice a day)
- Stretching of shortened muscles or muscles that are prone to shorten (30 s hold, five repetitions, twice per set, three times a day)
- Overhead exercises with/without weight (including diagonal pattern) and functional training.

To improve activity level

- Gripping and dexterity training, coordination exercises (10 min, once a day)
- Encouragement for using affected hand during activities of daily living (ADLs) to maximum (e.g., carrying a mug from floor and keeping just above head/vice versa) (10 repetitions, two sets, three times a day)
- Transferring objects from one hand to another hand, one place to another using affected hand, opening and closing bottles, lifting objects from the ground.

B) Rehabilitation protocol for lower limb injuries

Based on the available evidence,[14-21] the protocol derived for the rehabilitation of earthquake victims with lower limb injuries is as follows:

To manage impairments

- For restricted joints: ROM exercises (active and/or passive as per need) (10 repetitions, two to three sets, twice a day) and mobilization 30 glides for each restricted movement, every day
- Strengthening exercises of the weak muscles (active exercises, isometric and isotonic contractions, dynamic exercises, resisted and functional training using tire tubes and sand bags) (20 repetitions, two to three sets, twice a day)
- Isometric contractions (10 s hold, 15 repetitions, three times a day) and concentric contraction through interval training
- Stretching of shortened muscles or muscles that are prone to shorten (20 s hold, five repetitions, twice per set, three times a day)
- Balance training – both static and dynamic (one-leg standing, tandem walking, wobble board training, walking on uneven surface) (10 min, three times per day)
- Circuit training (for strengthening, balance training and gait training)
- Coordination exercises (10 min, once a day) and proprioceptive training sideways walking × 10 steps × 3 repetitions, three times a day, squatting)
- Frankle's exercise (10 min, once a day), squats/mini squats (10 repetitions, two sets/day)
- Encouragement for ADL activities, regular work, and jogging.

To improve activity level

- Encouragement for ADL activities, for example, jogging, walking, continuation of regular work
- Walking to grocery shop to buy things, to the fields to bring objects, walking to school
- Counseling to the victim and/or care taker regarding need of physiotherapy, long-term need of rehabilitation, prognosis, and progression of the exercises.

C) Rehabilitation protocol for spine and/or spinal cord injuries

Based on the available evidence,[22-24] the protocol derived for the rehabilitation of earthquake victims with spine and/or spinal cord injuries is as follows:

To manage impairments

- Sensory-motor reeducation program (for incomplete spinal cord injury): modified constraint-induced movement therapy: 30 min, every day
- Core stabilizing techniques: three times a day for about 10–20 min/session
- Strengthening exercises for weak back, neck, and lower extremity muscles (isometric, concentric, and resistance exercises): 10 repetitions per each exercise, twice a day.

To improve activity level

- Encouragement for walking to perform ADL, routine work
- Balance training – both static and dynamic (one-leg standing, tandem walking, wobble board training, walking on uneven surface) (10 min, three times per day)
- Coordination exercises (10 min, once a day) and proprioceptive training sideways walking, 10 steps, three repetitions, three times a day), Frankle's exercise (10 min, once a day).

D) Rehabilitation protocol for chest injuries

Based on the available evidence,[18,25,26] the protocol derived for the rehabilitation of earthquake victims with chest injuries is as follows:

To manage impairments

- Stabilizing techniques (during conservative management of chest trauma): maintaining stability using braces and/or local recourses to brace the injured site
- Increasing air entry: deep breathing and thoracic expansion exercises (five repetitions, 2 hourly)
- Thoracic mobility exercises and prevention of secretion collection (five repetitions, two times/day)
- Blow bottle exercise (8 s, five repetitions, 2 hourly).

To improve activity level

- Cardiorespiratory endurance training, involving in routine work and activities that required varied postures or positions with integration of respiratory facilitatory techniques.

E) Rehabilitation protocol (in addition to what has been mentioned above in A and B) for traumatic brain injury and extremity injuries when associated with stroke

Based on the available evidence,[18,27-33] the protocol derived for the rehabilitation of earthquake victims with traumatic brain injuries is as follows:

- Sensory-motor reeducation program for lower limb (LL): modified constraint-induced movement therapy, task-oriented training, bilateral training: 30 min/day, sensory training for orientation, motion and directionality using objects of varied textures (twice a day)
- Management of spasticity: stretching twice a day (self stretching with 20 s hold)
- Functional training: on task of participant's interest and of routine work. Aimed to achieve skills, to mitigate impairments. Motivational strategies were incorporated
- Circumductory gait management (addressing the weak part and integrating it into function)
- Cognitive therapy (management for memory, calculation, attention, comprehension based on participants impairment level): twice/day by therapist, caretakers were advised to do regularly
- Counseling to the victim and/or family members (regarding the disease, prognosis, consequences, physiotherapy interventions).

Encouragement for participation (in general)

Based on the available evidence,[33,34] the strategies applied to encourage participants were:

- Counseling to the victim and/or family members

- Encouragement to participate in daily and social activities.

Consideration of contextual factors (in general)

Based on the available evidence,[34] the contextual factors considered were:

- Training based on the house type and environmental access
- Exercise protocol based on participant's preferences (considering their education level, occupation, personal factors, and available local resources).

Outcome measures

The World Health Organization Disability Assessment Schedule (WHODAS 2.0) was used as a primary outcome measure. Measuring disability level before and after the rehabilitation program was our primary goal. WHODAS 2.0 is an appropriate tool for measuring the clinical effectiveness and productivity gains from interventions with respect to disability level. It has specific guidelines and is easy to administer.[35] Its use in clinical, community, and general population through either self-administration or interview has been already established.[36] This tool is in general, short, easy, and feasible, mostly to use in the community setting. The psychometric properties of WHODAS (reliability ranges from 0.93 to 0.98), internal consistency between 0.59 and 0.94, Cronbach's alpha which measures a single, unidimensional construct ranges from 0.94 to 0.98, good face validity as defined by ICF, good concurrent validity against functional independent measures, and good correlations with the World Health Organization Quality of Life tools.[35,37]

The time up and go (TUG) test, which is feasible to use in the community, has been used to assess mobility, balance, walking ability, and fall risk.[38] This has excellent test–retest reliability [intraclass correlation (ICC) =0.97), good inter-rater reliability (ICC = 0.99),[39,40] excellent correlation with Berg Balance ($r = -0.81$), and Barthel Index of ADL ($r = -0.78$).[40] The literature also suggests that the TUG is a sensitive (sensitivity = 87%) and specific (specificity = 87%) measure in community-dwelling population.[38] We also used Numerical Pain Rating Scale (NPRS) to assess pain intensity which also has good sensitivity,[41] test–retest reliability ($r = 0.63$–0.92), and inter-rater reliability (100% agreement).[42,43] An excellent concurrent validity of NPRS with visual analogue scale ($r = 0.86$)[43] has been established.

Statistical analysis

Demographic characteristics and clinical data were analyzed using descriptive statistics. The distribution of the data was checked using Shapiro–Wilk test due to relatively small sample size. The continuous data showed non-normal distribution. Therefore, both continuous and ordinal data were analyzed using Wilcoxon's signed rank test while comparing pre- and post-tests. *P* values <0.05 were considered significant. The analysis was carried out using SPSS version 19.0 (version 19.0; Armonk, NY: IBM).

The effect size has been calculated using the formula: effect size = $z/\sqrt{}$ (number of observations).[44]

Results

A total of 13 participants [Table 1] were involved in the study (1 year after the earthquake) and all completed the rehabilitation program without any adverse effects. Both male and female victims of age from 9 to 80 (mean ± standard deviation: 50.85 ± 21.72) years received the rehabilitation program. The highest number of victims had upper extremity injury followed by lower extremity, chest, or spinal injuries.

As shown in Table 2, a maximum number of victims used to do agricultural works followed by household work. They were either illiterate or had just primary or below primary level of education. A total of 61.54% were living in a joint family whereas the remaining in nuclear family. Although the government of Nepal was supposed to provide disability

Table 1: Demographic and clinical characteristics of the participants

ID	Age (years)	Gender	Diagnosis
1	22	Male	Supracondylar fracture
2	46	Female	Cut injury over dorsum of hand
3	67	Female	Right humerus fracture
4	80	Female	Cut injury over wrist (with previous stroke)
5	60	Male	Radius fracture (with previous stroke)
6	32	Male	Patella fracture
7	70	Female	Bilateral knee injury
8	65	Female	Femur fracture
9	70	Male	Chest trauma
10	35	Male	Ribs fracture
11	9	Male	Traumatic brain injury
12	65	Male	Fourth lumbar vertebra burst fracture (with spinal cord injury)
13	40	Female	Soft tissue erosion over the cervical spine
	Mean: 50.85 SD: 21.72	Male: 7 Female: 6	Upper limb injury: 5, lower limb injury: 3, chest injury: 2, brain injury: 1, spine/spinal cord injury: 2

SD: Standard deviation

Table 2: Factors influencing rehabilitation training

Influencing factors to treatment	Categories	Number (%)
Occupation	Agriculture	6 (46.15)
	Household work (housewife)	4 (30.77)
	Labor	2 (15.38)
	Student	1 (7.69)
Living with	Family	5 (38.46)
	Independently	8 (61.54)
Education level	Illiterate or no schooling	9 (69.23)
	Below primary or primary school	4 (30.76)
	Secondary or above	Nil
Disability card (to get facilities from the government)	Received	0 (0)
	Not received	13 (100)
Barrier free facilities for living	Yes	4 (30.76)
	No	9 (69.23)

Table 3: Pre-post comparison

Variables	*n*	Pre-test			Post-test			*Z*	*P*
		25th	50th	75th	25th	50th	75th		
WHO-DAS	13	6.5	17	24	3.5	12	18	-3.196	<0.001*
NPRS	10	2.75	3.5	4.75	1.5	2	2	-2.72	0.007*
TUG	6	8.75	10.5	13	8.75	10	11.75	-1.41	0.16

The *P* value was from Wilcoxon signed rank test. pre: pre-test, post: post-test, *significant at $P<0.05$, WHO-DAS: World Health Organization Disability Assessment Schedule; NPRS: Numerical pain rating scale; TUG: Time up and go test; *n*: sample size

card to access for disability benefits, none of the victims had got such cards until the date. The majority (69.23%) of the victims were still living in the houses having many physical barriers for ADL.

As shown in Table 3, Wilcoxon's signed-rank test demonstrated that 2 weeks post earthquake rehabilitation elicited a statistically significant reduction of disability level ($Z = -3.196$, $P < 0.001$) with the decrease in median WHO-DAS score from 17 to 12. A medium effect size (0.63) was found.

Wilcoxon's signed-rank test also revealed a significant reduction in pain level ($Z = -2.72$, $P = 0.007$). The decrease in pain level from 3.5 to 2 demonstrated statistically significant improvement in pain with rehabilitation. Even though a decrease in time during TUG test from pre to post was seen, it was not significantly different.

Discussion

This study has added two important evidences in the field of rehabilitation for earthquake victims. (1) A structured evidence-based treatment protocol applicable and feasible in the community setting has been derived for the treatment of physically impaired earthquake victims. (2) A significant reduction in disability level has been found with 2 weeks of community rehabilitation protocol.

Consistent with the world disability report and existing literatures,[13,45] the first phase of our study (manuscript is under review)[12] demonstrated varied type of disability, with different levels of severity, and activity or functional limitation at various locations.

Treatment protocol for earthquake victims at the community level

Developing protocols to address victims of a disaster is a complex process. The interventions to be effective should be evidence-based, feasible, and appropriate to cultural context and background. A large number of victims with varied levels and types of injuries have to be addressed right at their doors after earthquake.[1] The healthcare system of Nepal focused more at urban areas and the majority of damage during earthquake occurred in the rural areas.[1] Keeping this truth in mind, we derived condition-specific rehabilitation protocols appropriate for recovery phase (at sub-acute stage) based on our experience and global evidence, to address physical impairments of the victims. In our understanding, this study could be the first study to structure condition-specific rehabilitation protocol appropriate at the community with integration of evidence-based practices. The protocol outlined above consists of intervention along with their parameters for each specific condition, which can be applied in a context similar to this study.

Different studies have mentioned about the need and administration of rehabilitation program after earthquake.[2,7,10,13] However, the detail condition-specific and domain-specific (as per ICF) interventions with parameters described in this study provided additional evidence. This type of community rehabilitation protocols could be effective not only in Nepal but also in other earthquake-prone countries having similar geographical and socioeconomical scenarios.

Effectiveness of the intervention

Two-week community rehabilitation program administered in this study significantly reduced disability level. This short duration intervention resulted in moderate level of effect as per Cohen's criteria,[46] which indicated a meaningful intervention effect. The role of rehabilitation for physically impaired earthquake victims during recovery phase is vital. It not only improves quality of life (QOL) of the victims but also reduces public health burden.[2,7,10]

Since there were continuous after-shocks (significant number up to one year)[1] during the study period, rehabilitation program helped not only improvement of victim's functional level but also reduction in further traumatic injuries during after-shocks. Similar to other studies,[1,2,5] this study further indicated the need of long-term rehabilitation.

The decreased pain might have encouraged for active participation at individual level in daily functions. This in turn might have further reduced pain. Therefore, there could be a continuous improvement in physical impairments and disability level in the form of a vicious cycle. One of the major objectives was to return the victims to the functional level. With the reduction of the pain and disability level, our community rehabilitation helped them

to be independently functional in their ADLs. This is consistent with existing evidence.[1,5]

The rehabilitation programs making sustainable using local resources was an ultimate need.[1] The community health workers were trained to continue and gradually progress the interventions. This sustainable plan of this study at the community level was one of the strengths. Although 2 weeks intervention yielded better effect, we could not continue rehabilitation for long duration due to financial crisis and limited access, which was a limitation of this study. However, we had built a link with Dhulikhel hospital (tertiary center), for victims' easy access during follow-up and progressive rehabilitation.

The majority of the victims were of low socioeconomical status and were illiterate. According to them, they had not received any disability-related benefits from the government until the date. These factors further explained the need of the rehabilitation at their own doors. The modification of the interventions to suit their cultural context and background by maximizing the use of local resources was must. This study was able to address the need of those illiterate, poor victims living in remote areas.

We found that individuals who had disability before the earthquake got more injured during the earthquake which is consistent with the view of Sheppard *et al*.[1] Since Nepal is a disaster-prone country, individuals with any type of disability are to be rehabilitated on time to optimum level to minimize future disaster-related disability and public health burden. Since our aim was to reintegrate victims to their community, the rehabilitation that we provided at their own doors became significant important.

It could be further effective if the rehabilitation program was for longer duration (at least for a month). Since the program was made sustainable, the authors would continue to evaluate long-term outcome.

Conclusion and clinical implication

An evidence-based rehabilitation protocol for physically disabled earthquake victims at the community level has been structured. Two weeks interventions elicited significantly better effect and improved functional level of the earthquake victims. Therefore, this protocol can be useful in rehabilitation of earthquake victims to improve their QOL and reduce public health burden.

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Conflicts of interest

There are no conflicts of interest.

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