

ORIGINAL REPORT

FUNCTIONAL OUTCOMES AND HEALTH-RELATED QUALITY OF LIFE IN FRACTURE VICTIMS 27 MONTHS AFTER THE SICHUAN EARTHQUAKE

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Objective: To evaluate functional outcomes, health-related quality of life and life satisfaction in fracture victims 27 months after the 2008 Sichuan earthquake.

Methods: A total of 390 earthquake survivors from 3 earthquake areas who sustained fractures were divided into early intervention, late intervention and control groups. Functional outcomes assessed included activities of daily living using the Modified Barthel Index and pain level with a visual analogue scale. Health-related quality of life was evaluated with the Medical Outcomes Study Short-Form 36 and life satisfaction using the Life Satisfaction Questionnaire.

Results: Activities of daily living and life satisfaction in the intervention groups were significantly improved compared with the control group. Health-related quality of life was higher in early intervention subjects compared with controls. Group differences in pain level were not significant. In addition, the early and late intervention groups did not differ significantly in any of the measured outcomes. Good performance of activities of daily living and widowed marital status predicted high health-related quality of life, while pain level was associated with worsened outcomes. Rehabilitation therapy, remunerative employment and female gender were predictors of improved life satisfaction.

Conclusion: Clinical effectiveness of physical rehabilitation intervention was demonstrated in fracture earthquake victims.

Key words: earthquake; rehabilitation; activities of daily living; life satisfaction; pain; fracture.

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INTRODUCTION

Following the Sichuan earthquake, the focus of medical care had shifted from rescue and stabilization to functional recovery

and health-related quality of life (HRQOL) by 27 months. Fractures were the most common earthquake-related injuries (1, 2). Among 2,287 earthquake victims in County MZ, 84.3% (1,920) were diagnosed with a fracture (2). Patients with fractures who underwent rehabilitative therapies had better functional outcomes and reduced complications, and thus decreased mortality rates and improved quality of life (QoL) (1–4).

The ultimate goal of the rehabilitation process following fractures is functional recovery and restoration or improvement of the person's QoL. Increased age, male gender, and worsened physical and mental condition have been identified as predictors of decreased HRQOL in earthquake victims (5–7).

However, studies evaluating functional recovery and HRQOL in fracture victims receiving rehabilitation therapy following a natural disaster have not yet been performed. Quasi-experimental studies, retrospective analyses of hospital cohorts, observational studies, and surveys are appropriate designs to investigate the clinical impact of physical rehabilitation on disaster-induced disability (8), as prospective, randomized controlled trials of rehabilitation interventions following disaster are not feasible.

Institutional-based rehabilitation was performed in counties MZ and AX, beginning at 4 and 16 months after the Sichuan earthquake, respectively, while only routine care was provided in county SF. Rehabilitation therapy was provided in counties MZ and AX by rehabilitation professionals and local health departments, and funded by international non-governmental organizations (NGOs).

This study evaluates functional outcomes, HRQOL, and life satisfaction in fracture victims 27 months after the Sichuan earthquake. Major determinants of HRQOL and life satisfaction are analysed.

METHODS

Design

This is a cross-sectional quasi-experimental design study performed with two intervention groups and a control group.

Participants

A total of 390 fracture victims from 3 heavily destroyed areas who sustained injuries in the 2008 Sichuan earthquake were identified and

Table I. Demographic characteristics by research subgroup

Demographic characteristics	Early intervention group (n=226)	Late intervention group (n=80)	Control group (n=84)
Age, years, mean (SD)	55.7 (16.6)	52.9 (16.7)	52.1 (18.0)
Male: female ratio	0.53:1	0.43:1	0.75:1
Education, %			
No school education	1.8	1.3	0
Primary school	38.9	36.3	27.4
Middle school	31.0	42.5	39.3
High school	23.0	17.5	31.0
University	5.3	2.5	2.4
Marital status, %			
Married	76.1	91.3	81
Single	8.4	0	10.7
Divorced	0.9	1.3	1.2
Widowed	14.6	7.5	7.1
Annual family income, %			
<Average level ^a	10.2	23.8	9.5
=Average level	8.4	10.0	10.7
>Average level	81.3	66.3	79.8
Remunerative employment, %	25.7	27.5	39.3

^aAverage level: Sichuan provincial average annual family income at the time of the study. SD: standard deviation.

enrolled. Eligibility criteria were: (i) 18 years and older; (ii) had received institutional-based rehabilitation therapy in MZ and AX counties (intervention groups) or had not received rehabilitation therapy in SF county (control group), and; (iii) agreed to participate in demographic and medical questionnaires, medical examinations, and clinical assessments.

Participants were divided into two research groups and a control group, as follows:

- early intervention group: 226 earthquake victims rehabilitated in county MZ in September 2008;
- late intervention group: 80 earthquake survivors rehabilitated in county AX 1 year later in September 2009;
- control group: 84 earthquake survivors who did not receive any institutional-based rehabilitation in county SF.

Table I provides subject demographics for each group.

This study was approved by the ethics committee of Nanjing Medical University and written informed consent was obtained from all participants.

Data measurement

The research group comprised 40 rehabilitation professionals, including physiatrists, therapists (physical and occupational) and rehabili-

tation nurses assessed victims with fractures and worked with local healthcare providers in support of community follow-up (9). All the team members were from well-developed rehabilitation areas in China, who had a degree in rehabilitation medicine and at least 2 years' clinical experience. Data were collected from September 2010 to February 2011 via a survey administered at a central community site, physical examinations, and home visits. ADL performance was assessed with the Modified Barthel Index (MBI) (10); pain level (in the past month) was evaluated with the visual analogue scale (VAS) (11); HRQOL was evaluated with the Medical Outcomes Study Short-Form-36 (SF-36) (12), and; life satisfaction was assessed with the Life Satisfaction Questionnaire (LiSat-9) (13).

Data processing and analysis

Data were entered by two trained coders into Epidata 3.1 and analysed with SPSS 17.0 and Stata 12. Inconsistencies between the independent coders led to re-checking of the raw data. Continuous variables were tested for normal distribution with the Kolmogorov-Smirnov test and by the Levene test for homogeneity of group variances. Linear Mixed Models (LMM) using MBI, VAS, SF-36 and LiSat-9 as outcomes and age, gender, marital status, education, income and employment status as predictors were fitted. Random intercepts were used for each study group to account for unobserved differences between cluster heterogeneity. Group differences were evaluated with a Wald test applying Bonferroni's correction for multiple testing. Adjusted means and standard deviations across research groups are reported as well as test *p*-values for group differences. Rehabilitation intervention, age, gender, education, marital status, income, employment status, MBI, and VAS were used to predict SF-36 and LiSat-9. LMM introducing random intercepts for the study groups was reapplied. Significant predictors only are reported.

RESULTS

ADL and life satisfaction were significantly improved in the intervention groups compared with the control group. SF-36 scores were higher in early intervention subjects than in controls. Pain level did not differ significantly across groups. Early and late intervention groups did not differ significantly in any of the measured outcomes (Table II).

Improved ADL (MBI) and widowed marital status were positive predictors of HRQOL (SF-36), while higher pain levels were associated with worsened functional outcomes. Those subjects who had received rehabilitation therapy, or were in paid employment, or female subjects showed higher life satisfaction (Table III).

Table II. Functional outcomes in subgroups

Outcomes	Early intervention group Mean (SD)	Late intervention group Mean (SD)	Controls Mean (SD)	Between-group, <i>p</i>		
				Early intervention group vs Late intervention group	Early intervention group vs controls	Late intervention group vs controls
MBI	92.24 (9.46)	92.24 (9.56)	87.39 (9.45)	1.0000	0.0004	0.0071
VAS	3.82 (1.85)	4.02 (1.87)	4.19 (1.85)	1.0000	0.3903	1.0000
SF-36	477.12 (107.76)	474.90 (108.96)	433.40 (107.64)	1.0000	0.0080	0.0672
LiSat-9	49.41 (8.66)	49.34 (8.76)	44.74 (8.65)	1.0000	0.0002	0.0049

p-values are based on post-estimation Wald Tests with Bonferroni correction. All models are adjusted for age, gender, education, marital status, income, and employment status.

MBI: Modified Barthel Index; VAS: visual analogue scale; SF-36: Medical Outcomes Study Short-Form 36; LiSat-9: Life Satisfaction Questionnaire.

Table III. Significant determinants of Medical Outcomes Study Short-Form-36 (SF-36) and Life Satisfaction Questionnaire (LiSat-9)

Independent variables					
Dependent variables	Name	Coefficient	Standard error	Beta	p-value
SF-36	VAS	-15.04	2.68	-5.62	0.000
	MBI	3.99	0.52	7.62	0.000
	Widowed	34.47	16.10	2.14	0.032
LiSat-9	Rehabilitation intervention	4.40	1.15	3.81	0.000
	Male	-2.18	0.96	-2.27	0.023
	Remunerative employment	2.01	0.77	1.48	0.008

All models included the following predictors: rehabilitation intervention, age, gender, education, income, employment status, marital status, Modified Barthel Index (MBI) and visual analogue scale (VAS).

VAS: visual analogue scale; MBI: Modified Barthel Index.

DISCUSSION

Medical rehabilitation should begin immediately after emergency trauma stabilization and continue after the patient has been discharged to the community as necessary, in order to achieve maximum restoration of function (14, 15). Previous studies have demonstrated that early rehabilitation programming can effectively reduce fracture complications and improve functional outcomes of the injured limb (2–4). Rehabilitation was shown to be effective in improving ADL and life satisfaction in both the early and late intervention groups in this study of Sichuan earthquake fracture victims. HRQOL was significantly higher in the early intervention group than in the control group, but did not differ significantly between the groups. This finding confirms the results of other studies, which showed a positive benefit of rehabilitation on HRQOL (2, 8, 16). ADL performance was one of the strongest positive predictors of HRQOL, which is not surprising since achieving independence in ADL is of vital importance to disaster victims (17). Rehabilitative therapy thereby contributes to HRQOL as functional independence is a primary objective of rehabilitation.

Pain level also influences rehabilitation outcomes following complex orthopaedic trauma (18). At 27 months post-injury all subjects had chronic pain, which is one of the main complications of fractures (19, 20) and is correlated with HRQOL (21). Pain level was found to be the strongest negative predictor of HRQOL in this study, which is consistent with previous investigations that showed that chronic pain significantly affected physical, emotional, cognitive, communicative and social function of fracture patients (5, 21, 22). Variation of HRQOL among disaster survivors has also been found to be associated with changes in pain levels (23). Effective pain control is thus essential for improved long-term HRQOL of earthquake survivors.

In contrast with other studies (24, 25), widowed individuals reported better HRQOL (when adjusted for potential determinants) following the Sichuan earthquake. The high resilience of the rural population, which is accustomed to a difficult, challenging life could explain this finding. This explanation suggests a “response shift” coping mechanism whereby victims

quickly accepted and adjusted their life expectations following the earthquake (26).

Rehabilitation therapy was shown to be a significant predictor of improved life satisfaction, which correlates with another study of Sichuan SCI victims who reported that the most important goal of rehabilitation was “recovery of independence in everyday functioning” (17). ADL in rehabilitated patients in this study were significantly improved compared with those who did not receive therapy, perhaps contributing to the positive association between rehabilitation and life satisfaction.

Relatively decreased life satisfaction in male victims may be related to differential gender roles. Chinese men may have been more negatively affected by loss of financial assets, employment, and earning ability compared with women, who are traditionally defined by their role as a non-earning caretaker within the home (27). Consequently, more women returned to their pre-injury, familial roles compared with men, who were more disenfranchised from their familiar roles.

Related, paid employment strongly predicted improved life satisfaction in this investigation. This finding is indirectly supported by a recent study following the Parnitha earthquake in Greece, which showed that loss of employment of a family member or financial problems contributed significantly to decreased life satisfaction (28).

The major limitation of the present study was that it did not focus on the detailed classification of fracture, i.e. the type and severity of fractures, and type of intervention (surgical or conservative). However, some studies also showed that HRQOL was not associated with the category of fractures or with the severity of injury (2, 29).

In conclusion, this study is the first to demonstrate the effectiveness of rehabilitation intervention on functional outcomes, HRQOL, and life satisfaction in earthquake fracture victims. Major determinants of QoL and life satisfaction were analysed. Longer-term follow-up is planned to further assess these findings, which remain to be confirmed in future earthquakes.

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REFERENCES

- Zhang X, Bian R, Li J. [Rehabilitation needs for the earthquake victims in Sichuan-Jiangyou.] Chin J Rehabil Med 2009; 24: 5–8 (in Chinese).
- Xiao MY, Li J, Zhang X, Zhao Z. Factors affecting functional outcome of Sichuan-earthquake survivors with tibial shaft fractures: a follow-up study. J Rehabil Med 2011; 43: 515–520.

3. Noyes FR, Mayfield W, Barber-Westin SD, Albright JC, Heckmann TP. Opening wedge high tibial: an operative technique and rehabilitation program to decrease complications and promote early union and function. *Am J Sports Med* 2006; 34: 1262–1273.
4. Castillo RC, Mackenzie EJ, Archer KR, Bosse MJ, Webb LX, LEAP Study Group. Evidence of beneficial effect of physical therapy after lower-extremity trauma. *Arch Phys Rehabil* 2008; 89: 1873–1879.
5. Tsai KY, Chou P, Chou FH, Su TT, Lin SC, Lu MK, et al. Three-year follow-up study of the relationship between posttraumatic stress symptoms and HRQOL among earthquake survivors in Yu-Chi, Taiwan. *J Psychiatr Res* 2007; 41: 90–96.
6. Chou FH, Chou P, Lin C, Su TT, Ou-Yang WC, Chien IC, et al. The relationship between HRQOL and psychiatric impairment for a Taiwanese community post earthquake. *Qual Life Res* 2004; 13: 1089–1097.
7. Wu HC, Chou P, Chou FH, Su CY, Tsai KY, Ou-Yang WC, et al. Survey of HRQOL and related risk factors for a Taiwanese village population 3 years post-earthquake. *Aust N Z J Psychiatry* 2006; 40: 355–361.
8. Reinhardt JD, Li J, Gosney J, Rethore FA, Haig AJ, Marx M, et al. Disability and health-related rehabilitation in international disaster relief. *Glob Health Action* 2011; doi: 10.3402/gha.v4i0.7191.
9. Gosney J, Reinhardt JD, Haig AJ, Li J. Developing Post-Disaster Physical Rehabilitation: Role of the World Health Organization Liaison Sub-Committee on Rehabilitation Disaster Relief of the International Society of Physical and Rehabilitation Medicine. *J Rehabil Med* 2011; 43: 965–968.
10. Leung SO, Chan CC, Shah S. Development of a Chinese version of the Modified Barthel Index – validity and reliability. *Clin Rehabil* 2007; 21: 912–922.
11. Aun C, Lam YM, Collett B. Evaluation of the use of visual analogue scale in Chinese patients. *Pain* 1986; 25: 215–221.
12. Ware JE Jr, Snow KK, Kosinski M, Gandek B. SF-36 Health Survey: manual and interpretation guide. Boston, MA: Nimrod Press; 1993.
13. Fugl-Meyer AR, Bränholm IB, Fugl-Meyer KS. Happiness and domain-specific life satisfaction in adult northern Swedes. *Clin Rehabil* 1991; 5: 25–35.
14. World Health Organization Disasters, disability and rehabilitation. Geneva: World Health Organization; 2005 [cited 2011 Nov 12]. Available from: URL: http://www.who.int/violence_injury_prevention/other_injury/disaster_disability2.pdf.
15. Redmond AD, Li J. The UK medical response to the Sichuan earthquake. *Emerg Med J* 2011; 28: 516–520.
16. Binder EF, Brown M, Sinacore DR, Steger-May K, Yarasheski KE, Schechtman KB. Effects of extended outpatient rehabilita-
- tion after hip fracture: a randomized controlled trial. *JAMA* 2004; 292: 837–846.
17. Tasiemski T, Nielsen S, Wilski M. Quality of life in people with spinal cord injury-earthquake survivors from Sichuan province in China. *Asia Pacific Disabil Rehabil J* 2010; 2: 28–36.
18. Blumer D, Heilbronn M. Chronic pain as a variant of depressive disease, the pain-prone disorder. *J Nerv Ment Dis* 1982; 170: 381–406.
19. Meyhoff CS, Thomsen CH, Rasmussen LS, Nielsen PR. High incidence of chronic pain following surgery for pelvic fracture. *Clin J Pain* 2006; 22: 167–172.
20. Gerbershagen HJ, Dagtekin O, Isenberg J, Martens N, Ozgür E, Krep H, et al. Chronic pain and disability after pelvic and acetabular fractures – assessment with the Mainz Pain Staging System. *J Trauma* 2010; 69: 128–136.
21. Li YX, Zhang X, Yi WC, Hu XR, Xiao MY, Jin H, et al. [Chronic pain related factors and HRQOL in victims with fracture 27 months post Sichuan earthquake.] *Chin J Phys Med Rehabil* 2011; 33: 673–677 (in Chinese).
22. Fugl-Meyer AR, Melin R, Fugl-Meyer KS. Life satisfaction in 18- to 64-year-old Swedes: in relation to gender, age, partner and immigrant status. *J Rehabil Med* 2002; 34: 239–246.
23. van den Berg B, van der Velden PG, Joris Yzermans C, Stellato RK, Grievink L. Health-related quality of life and mental health problems after a disaster: are chronically ill survivors more vulnerable to health problems? *Qual Life Res* 2006; 15: 1571–1576.
24. Lim JY, Park J, Kang MG, Ryu SY. Quality of life and its associated factors among some elderly residents using a hall for the aged in a community. *J Prev Med Public Health* 2007; 40: 337–344.
25. Chou FH, Chou P, Su TT, Ou-Yang WC, Chien IC, Lu MK, et al. Quality of life and related risk factors in a Taiwanese Village population 21 months after an earthquake. *Aust N Z J Psychiatry* 2004; 38: 358–364.
26. Howard JS, Mattacola CG, Howell DM, Lattermann C. Response shift theory: an application for health-related quality of life in rehabilitation research and practice. *J Allied Health* 2011; 40: 31–38.
27. Hampton NZ, Marshall A. Culture, gender, self-efficacy, and life satisfaction: A comparison between American and Chinese people with spinal cord injuries. *J Rehabil* 2000; 66: 21–28.
28. Goenjian AK, Roussos A, Steinberg AM, Sotiropoulou C, Walling D, Kakaki, M, et al. Longitudinal study of PTSD, depression, and HRQOL among adolescents after the Parnitha earthquake. *J Affect Disord* 2011; 133: 509–515.
29. Ponsford J, Hill B, Karamitsos M, Bahar-Fuchs A. Factors influencing outcome after orthopedic trauma. *Trauma* 2008; 64: 1001–1009.