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ORIGINAL REPORT

HEALTH-RELATED QUALITY OF LIFE OF FRACTURE VICTIMS FOUR YEARS AFTER THE 2008 SICHUAN EARTHQUAKE

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Objective: **To investigate health-related quality of life and its relationship with functional status and other related factors in victims with fractures 4 years after the 2008 Sichuan earthquake.**

Design: **A cross-sectional survey with a multi-stage random sampling method.**

Setting: **Five hospitals from the areas most severely affected by the 2008 Sichuan earthquake.**

Subjects: **Victims with fractures aged 14 years and older who were hospitalized in the rehabilitation departments of the 5 identified hospitals during the period 12 May 2008 to 12 May 2009.**

Methods: **Information on demographics, such as age, gender, marital status and educational level, functional status, working status, income, and health-related quality of life, were investigated. Manual muscle test, visual analogue scale, Modified Barthel Index and Medical Outcomes Short Form 36 (SF-36) were employed as the main outcome measures.**

Results: **A total of 243 victims with fractures were interviewed. Thirty-seven percent of the fracture victims had decreased muscle strength, 28.8% had limited range of motion, 51.8% still experienced pain, and 17.7% were dependent to different extents. With the exception of the domains vitality and mental health, the earthquake victims perceived significantly lower health-related quality of life than the local general population. Older age, being female, unmarried, low education, multiple fractures, muscle weakness, pain and being dependent were significant predictors of lower health-related quality of life. Most SF-36 subscales were negatively correlated with age, multiple fractures and pain, but positively correlated with independence in activities of daily living and income.**

Conclusion: **Four years after the major Sichuan earthquake, many victims with fractures still had reduced functional status and experienced pain, and their health-related quality of life was low compared with the general population.**

Key words: earthquake; rehabilitation; function; fracture; quality of life.

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INTRODUCTION

The earthquake that affected Sichuan, China on 12 May 2008 measured 8.0 on the Richter Scale, killed 69,227 people, injured 374,643, and left 17,824 unaccounted for (1). Thirty days after the earthquake, 89,994 persons had been hospitalized due to injuries, including bone fractures, traumatic brain injury, spinal cord injury, peripheral nerve injury and amputation (2). Of those patients, approximately 46.5% had bone fractures (3, 4). Rehabilitation services were provided to many of the earthquake victims soon after emergency treatment and lasted for months (5). In the first 9 months after the earthquake, 28,008 earthquake victims received treatment in rehabilitation departments or centres in Sichuan. Among these cases, there were 16,440 fracture victims, accounting for 58.7% (6).

The most common functional deficits in fracture victims are muscle weakness, reduced range of motion (ROM), pain, and limitations in activities of daily living (7). The mental health of earthquake victims may also be affected and they often face destruction of their living environment (8). These impairments and limitations may ultimately lead to restrictions in participation and reduced quality of life (9). Health-related quality of life (HRQOL) is a concept focusing on people's ability to lead a normal healthy lifestyle. HRQOL relates to people's satisfaction with health and health-related dimensions (10). "Approaches that enhance a person's HRQOL in partnership between person and provider" should be considered in rehabilitation programmes in addition to function and disability (11).

Previous studies have shown that older age, being female and economic problems are associated with reduced HRQOL

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of earthquake victims (12–14). One study investigated the relationship between functional outcomes measured with the Barthel Index and HRQOL of victims with fractures 27 months after the Sichuan earthquake, demonstrating a positive relationship (15). However, muscle weakness and limited ROM, which are the most common impairments in fracture patients, were not considered. Moreover, no information about HRQOL of fracture victims from the 2008 Sichuan earthquake after a longer period is available at present. The aim of this study was to investigate the relationship between functional status and HRQOL of fracture victims 4 years after the 2008 Sichuan earthquake. Other determinants of HRQOL were also identified.

METHODS

Design

This cross-sectional study was conducted from February to May 2012, employing multi-stage random sampling. In the first stage, 5 hospitals were randomly selected from the 10 areas most severely affected by the 2008 Sichuan earthquake according to the Chinese government (16). The hospitals were Wenchuan County Hospital, Pengzhou Municipal People's Hospital, Mianzu Municipal People's Hospital, Shifang Municipal People's Hospital and Dujiangyan Municipal People's Hospital. In the second stage, victims with fractures aged 14 years and older, who were hospitalized in the rehabilitation departments of the 5 identified hospitals during the period 12 May 2008 to 12 May 2009, were randomly selected from the hospitals' databases. Victims with amputation, spinal cord injury or brain injury were excluded. The sample size was estimated following a previous report (15). All victims were interviewed face-to-face and assessed by trained rehabilitation practitioners. This study was approved by the medical ethics committee of West China Hospital, Sichuan University, and written informed consent was obtained from all participants. For minors, written consent was obtained from their parents or guardians.

Instruments

The assessment form included information on demographics, such as age, gender, marital status and educational level, functional status, working status and income, as well as HRQOL.

Physical function and pain

Around the fracture sites a manual muscle test was used to assess muscle strength (17). Patients classes as grade 5 were defined as "normal"; otherwise, they were defined as "decreased". The goniometric method was used to measure range of motion (ROM) (18). Patients were classified into "normal" (having full ROM of the joints around fracture parts) or "limited" (having limited ROM). The visual analogue scale (VAS), which presented a single horizontal line of 10 cm, was employed to assess pain. The VAS score (cm) for each patient was transferred into the relevant 0–10 scores. A score of 0 was defined as no pain, while scores of 1–4, 5–6 and 7–10 were classified into mild, moderate and severe pain, respectively (19).

Activities of daily living

The Modified Barthel Index (MBI) (20), with a score ranging from 0 to 100, was used to measure independence in activities of daily living (ADL). The instrument contains items to evaluate individuals' ability independently to take care of personal hygiene, bowel and bladder control, bathing, feeding, toileting, dressing, climbing stairs and ambulation. Dependency levels were classified as follows: total (0–24), severe (25–49), moderate (50–74), mild (75–89), minimal (90–99) and none (100) (21).

Health-related quality of life

The Mandarin version of the Medical Outcomes Short Form 36 (SF-36) was used to evaluate HRQOL (22). The SF-36 is a 36-item questionnaire that covers perceived health or health status in 8 domains: physical functioning (PF), role-physical (RP), bodily pain (BP), general health (GH), vitality (VT), social functioning (SF), role-emotional (RE) and mental health (MH). Subscales scores range from 0 to 100, with higher scores indicating better HRQOL (23). The first 4 subscales represent physical health-related dimensions and can be used for computing a physical component summary score (PCS); the other 4 subscales represent mental health-related dimensions and can be combined in a mental component summary score (MCS) (24). The mean value of 8 subscales was calculated as SF-36 score. The Mandarin version of the SF-36 showed good psychometric properties in the Chinese population (22, 25, 26).

Statistical analysis

Non-parametric statistics would be desirable for analysis of SF-36 scores. Unfortunately, most comparable papers, including those providing reference values from the general population, applied an interval scale approach and provided means and standard deviations (SD) (15, 26,–29). Thus, we presented PCS, MCS and SF-36 scores as means and SD in addition to medians and interquartile ranges (IQR). PCS, MCS and SF-36 scores were calculated and compared across groups with different demographic characteristics and functional status. Mann-Whitney *U* tests for independent samples were used to compare PCS, MCS and SF-36 scores between genders, fracture sites, normal vs decreased muscle strength, and range of motion. Comparison among 3 or more groups, such as in the case of age, marital status, education, pain, dependency level, work status and income, was performed by Kruskal–Wallis tests. If the overall test was significant, individual groups were compared by using Bonferroni-adjusted Mann-Whitney *U* tests. Furthermore, we compared SF-36 subscale scores of the earthquake victims in our sample with normative values from the Sichuan general population that had been established in a study by Li and colleagues (25). For this comparison we performed 8 1-sample *t*-tests, as only mean values and SDs were available from the general population sample. According to Bonferroni the significance level was adjusted in order to account for multiple testing (30). Multivariate analysis featured a stepwise multivariate linear regression combining forward entry with backward elimination (SPSS command: stepwise) was performed. Alpha error level was set to $p<0.05$. Data were analysed with SPSS 19.0.

RESULTS

A total of 243 out of the 300 selected subjects were interviewed with complete data collected. Among the 57 missing subjects 44 could not be contacted; 8 changed their addresses; and 5 had died.

Demographic data and SF-36 mean scores

Mean SF-36 subscale scores were 67.9 (95% confidence interval (CI) 65.3–70.6), PCS was 68.1 (95% CI 65.3–70.9), MCS was 67.7 (95% CI 65.0–70.5). Demographic information and bivariate group comparisons of SF-36 scores, PCS and MCS are provided in Table I. SF-36 scores, PCS and MCS of the 124 male interviewees were higher than those of the 119 female interviewees. The mean age of all interviewees was 48.3 years (SD 15.9, range 18–85 years). People aged younger than 40 years had the highest SF-36 scores, PCS and MCS, and people aged 60 years and older scored lowest. Most of the

interviewees (86.4%) were married, 20 were unmarried, and 13 were divorced or widowed. Divorced or widowed victims had significantly lower SF-36 scores, PCS and MCS compared with married and unmarried subjects. Approximately one-third of the interviewees had no or only primary education, more than half had 7–9 years of formal education, and approximately 10% had 10 or more years of formal education. People who had 7–9 years or above 10 years of education had higher PCS, MCS and SF-36 scores than those who had less than 6 years of education.

Functional status and SF-36 scores

Data on functional status and bivariate comparison of SF-36 scores across groups is shown in Table II. On average, the victims with multiple fractures had lower SF-36 scores, PCS and MCS than victims with a single fracture site. For the 155 patients with single fracture, no significance was found among the different fracture sites of spine, pelvic, upper extremity, lower extremity and other sites (cranium, ribs, clavicle, patella and scapula). Victims with decreased muscle strength had lower PCS, MCS and SF-36 scores compared with victims with normal muscle strength. Victims with limited ROM had lower PCS, but not MCS and SF-36 scores. Approximately half of the victims who did not report any pain had higher SF-36 scores, PCS and MCS than those with mild, moderate or severe pain. Four-fifths of the victims were independent in ADL; they reported better HRQOL than patients who were dependent to different extents.

Work status, income and SF-36 scores

Approximately two-thirds of the victims had a full-time job. SF-36 scores, PCS and MCS did not differ significantly by occupational status. Victims with a monthly income of more than 2000 Renminbi (RMB) showed significantly higher SF-36 scores, PCS and MCS than those with a lower income (Table III).

SF-36 domains in fracture victims and Sichuan residents

Compared with the general population of Sichuan province (26), the studied earthquake victims had significantly decreased scores ($p < 0.006$) in all SF-36 subscales except VT and MH (Table IV).

Effect of demographic and functional data on SF-36 domains

Results from the stepwise linear regression of the 8 domains of SF-36 on potential determinants including demographic characteristics, functional status, work status and income are presented in Table V. All subscales, except BP, significantly decreased with older age. Women had decreased RP and PCS values, while unmarried victims were more affected in VT, SF and MCS. Victims with high education had higher BP and MH. Having multiple fractures was associated with lower scores across all SF-36 domains apart from GH.

Muscle weakness decreased GH and PCS scores. Limitations in ROM were associated with lower scores in PF and, unexpectedly, higher scores of RE. Pain had a negative effect

Table I. *Demographic characteristics and Medical Outcomes Short Form 36 (SF-36) scores*

Demographics	Patients *n* (%)	PCS Median (IQR)/mean (SD)	MCS Median (IQR)/mean (SD)	SF-36 Median (IQR)/mean (SD)
Age				
<40 years	75 (30.9)	86.8 (74–94.3)/80.6 (17.6), $p=0.000$	85 (63–94.5)/78.8 (17.3), $p=0.004$	84.6 (73.0–93.6)/ 79.7 (16.2), $p=0.001$
40~59 years	110 (45.3)	65.8 (49.9–90.8)/68.1 (22.0), $p=0.000$	65.5 (54.1–92)/68.1 (22.3), $p=0.000$	67.0 (52.9–91.0)/ 68.1 (21.2), $p=0.000$
≥60 years	58 (23.9)	48.8 (38.9–61.8)/51.9 (17.7), $p=0.000$	52.1 (40.2–61.5)/52.8 (16.2), $p=0.000$	51.4 (40.7–63.0)/ 52.4 (15.7), $p=0.000$
Gender				
Male	124 (51.0)	81.6 (52.9–93)/73.0 (22.1), $p=0.000$	72.5 (55.0–94.3)/71.4 (21.6), $p=0.004$	75.4 (55.4–92.4)/ 72.2 (21.0), $p=0.001$
Female	119 (49.0)	59 (47.3–82.8)/62.9 (21.4)	59.5 (50.3–84.5)/64.0 (21.3)	61.6 (50.2–80.9)/ 63.4 (20.1)
Marital status				
Unmarried	20 (8.2)	74.4 (49.8–91.4)/71.1 (21.0)	62.6 (56.1–80.6)/65.7 (16.7)	70.3 (54.6–80.8)/ 68.4 (17.3)
Married	210 (86.4)	74 (49.6–90.3)/69.2 (22.2), $p=0.000$	66.8 (54.2–92)/69.1 (21.8), $p=0.001$	69.7 (52.8–91.0)/ 69.2 (21.1), $p=0.000$
Divorced & widowed	13 (4.98)	49 (33.4–56.4)/45.7 (13.1), $p=0.002$	47.6 (32.6–57.1)/48.7 (17.6)	49.3 (33.1–57.9)/ 47.2 (13.4), $p=0.008$
Education level				
0~6 years	85 (35.0)	52.5 (39.6–61)/52.0 (17.1), $p=0.000$	54.8 (43.3–64.4)/53.7 (18.1), $p=0.000$	52.9 (41.3–63.0)/ 52.89 (15.9), $p=0.000$
7~9 years	135 (55. 6)	82.8 (57.8–93)/75.8 (20.2)	75.2 (58.5–94.5)/73.7 (19.9)	77.3 (59.3–93.6)/ 74.76 (19.1)
≥10 years	23 (9.5)	89 (76.4–95.5)/82.2 (17.1), $p=0.000$	91.5 (80.6–95.5)/84.4 (16.2), $p=0.000$	90.1 (75.3–94.1)/ 83.31 (16.0), $p=0.000$

p-values were obtained from Mann-Whitney *U* tests in the case of 2 categories; in the case of 3 categories Kruskal–Wallis tests were used for determining overall significance and Mann-Whitney *U* tests for comparisons of individual groups, where applicable (Bonferroni-adjusted *p*-value is 0.017). *p*-values for comparisons between the first and the second rows in each group are given in the first row, for comparisons between the second and the third row in the second row, and for comparisons between the third and the first row in the third row.
PCS: physical component summary score; MCS: mental component summary score; IQR: interquartile range; SD: standard deviation.

Table II. *Functional status and Medical Outcomes Short Form 36 (SF-36) scores*

Functional status	Patients *n* (%)	PCS Median (IQR)/mean (SD)	MCS Median (IQR)/mean (SD)	SF-36 Median (IQR)/mean (SD)
Fracture sites				
Single	155 (63.8)	80.5 (55.3–93)/74.0 (21.2), $p=0.000$	75.4 (58.4–94.3)/73.9 (19.5), $p=0.000$	75.8 (58.8–93.1)/73.9 (19.3), $p=0.000$
Multiple	88 (36.2)	53.5 (40.6–77.4)/57.8 (20.5)	55.3 (42.3–69.6)/56.9 (21.3)	54.1 (42.8–71.6)/57.3 (19.7)
Single fracture ($n=155$)				
Spine	27 (17.4)	68.5 (54–91.8)/71.2 (20.0)	61.4 (54.5–95.5)/70.1 (20.4)	63.6 (55.7–91.6)/70.6 (19.4)
Pelvic	12 (7.7)	89.9 (78.4–93.9)/83.9 (15.6)	91.7 (59.8–95.3)/80.4 (17.4)	90.8 (69.1–94.7)/82.2 (15.8)
Upper extremity	17 (11.0)	82.5 (52.8–96.1)/73.4 (25.2)	71.3 (59.5–95.5)/74.9 (19.1)	72.5 (57.4–96.1)/74.2 (21.0)
Lower extremity	68 (43.9)	81.6 (53.1–91.8)/72.7 (22.8)	80.2 (58.3–94.3)/74.3 (19.5)	77.3 (59.0–92.3)/73.5 (20.8)
Other sites	31 (20.0)	75.5 (60.3–95.5)/75.7 (17.6)	74.5 (58.4–89)/73.3 (17.0)	75.6 (58.1–92.4)/74.5 (16.3)
Muscle strength				
Normal	154 (63.4)	82.5 (59–94.3)/76.2 (19.6), $p=0.000$	75.2 (58.1–94.8)/74.3 (20.6), $p=0.000$	78.4 (58.8–93.7)/75.2 (19.4), $p=0.000$
Decreased	89 (36.6)	49 (40–69.4)/54.1 (19.6)	55 (43.3–67.6)/56.4 (18.7)	52.3 (42.0–68.8)/55.3 (17.5)
Range of motion				
Normal	173 (71.2)	75.3 (52–91.8)/70.1 (21.6), $p=0.001$	64 (53.9–91.8)/68.0 (21.3)	69.8 (52.9–91.4)/69.5 (20.7)
Abnormal	70 (28.8)	58.8 (41.2–84.1)/60.9 (22.6)	67.6 (48.6–87.9)/67.2 (22.8)	63.0 (47.6–84.9)/64.1 (21.5)
Pain				
No pain	117 (48.2)	89.3 (78.8–95.5)/83.6 (15.6), $p=0.000$	89.1 (63.4–95.5)/79.8 (17.8), $p=0.000$	88.1 (71.8–94.9)/81.7 (16.0), $p=0.000$
Mild	93 (34.2)	52.8 (42.9–71)/55.6 (17.6)	56.3 (44.6–72.7)/57.0 (19.9)	54.8 (43.1–69.5)/56.3 (17.6)
Moderate & severe	33 (17.7)	49.8 (37.9–58.5)/48.5 (16.1), $p=0.000$	55.5 (44.5–65.1)/55.2 (15.6), $p=0.000$	52.5 (45.8–60.7)/51.9 (13.1), $p=0.000$
Dependency level in activities of daily living				
Independent	200 (82.3)	77.1 (53.5–91.8)/72.4 (20.9), $p=0.000$	67.8 (55.6–93.3)/70.5 (21.2), $p=0.000$	73.1 (55.5–91.7)/71.5 (20.2), $p=0.000$
Minimal	23 (9.5)	49.8 (34.8–66.5)/51.6 (20.9)	57 (42.3–80.6)/57.2 (22.6)	53.9 (33.3–72.5)/54.4 (20.1)
Mild, moderate, severe & total	20 (8.2)	41.3 (35.5–53.4)/44.1 (11.2), $p=0.000$	48.2 (41.2–58.6)/51.8 (14.8), $p=0.000$	47.6 (40.9–54.4)/47.9 (9.6), $p=0.000$

p-values were obtained from Mann-Whitney *U* tests in the case of 2 categories; in the case of 3 categories Kruskal–Wallis tests were used for determining overall significance and Mann-Whitney *U* tests for comparisons of individual groups, where applicable (Bonferroni-adjusted *p*-value is 0.017). *p*-values for comparisons between the first and the second rows in each group are given in the first row, for comparisons between the second and the third row in the second row, and for comparisons between the third and the first row in the third row.
PCS: physical component summary score; MCS: mental component summary score; IQR: interquartile range; SD: standard deviation.

on all the subscales except RE. Dependent victims had lower PF, BP, SF and PCS. Employed victims were better in PF, GH, VT, MH and PCS, but worse in RE. Higher income had a positive effect on all SF-36 domains except PF, BP and RE. The models could explain a large amount of variance in SF-36 scores, with r-squared ranging from 0.38 to 0.68.

Table III. *Work status, income and Medical Outcomes Short Form 36 (SF-36) mean scores*

Variables	Patients *n* (%)	PCS Median (IQR)/mean (SD)	MCS Median (IQR)/mean (SD)	SF-36 Median (IQR)/mean (SD)
Working status				
Full-time job	164 (67.5)	73.8 (48.5–91.8)/69.4 (22.4)	64.5 (53.5–93.3)/68.0 (22.6)	68.8 (51.2–91.7)/68.7 (21.8)
Part-time job	22 (9.1)	81.5 (61.3–89.3)/74.1 (19.3)	65.2 (53.8–92.6)/69.6 (18.4)	73.7 (55.3–91.6)/71.9 (17.7)
Jobless	42 (17.3)	62.4 (51.8–79.2)/62.6 (21.9)	69.2 (50.0–83.8)/66.4 (20.1)	65.0 (52.9–81.2)/64.5 (19.5)
Full-time students	9 (3.7)	55.3 (41.5–86.6)/62.1 (22.3)	66.1 (52.0–77.5)/63.2 (17.5)	57.9 (44.2–80.3)/62.7 (18.1)
Retired	6 (2.5)	48.5 (33.1–90.2)/57.0 (27.6)	80.5 (35.7–92.9)/69.5 (28.0)	64.5 (33.1–91.5)/63.3 (26.7)
Household monthly income				
<RMB 1000	60 (24.7)	54.1 (39.9–67.6)/54.8 (18.3)	55 (45.1–62.8)/54.0 (18.2)	55.3 (43.1–67.1)/54.4 (16.2)
RMB 1000~2000	80 (32.9)	58.3 (46–78.5)/60.6 (19.6), $p=0.000$	58.4 (47.8–66.7)/58.4 (16.0), $p=0.000$	58.3 (46.5–73.4)/59.5 (16.7), $p=0.000$
>RMB 2001	103 (42.4)	90.25 (71.5–96.3)/81.7 (18.8), $p=0.000$	92.0 (75.2–95.5)/83.1 (17.6), $p=0.000$	91 (75.3–95.5)/82.4 (17.4), $p=0.000$

Kruskal–Wallis tests were used for determining overall significance and Mann-Whitney *U* tests for comparisons of individual groups where applicable (Bonferroni-adjusted *p*-value is 0.017). *p*-values for comparisons between the first and the second rows in each group are given in the first row, for comparisons between the second and the third row in the second row, and for comparisons between the third and the first row in the third row.
PCS: physical component summary score; MCS: mental component summary score; IQR: interquartile range; SD: standard deviation; RMB: Renminbi.

Table IV. *Comparison of Medical Outcomes Short Form 36 (SF-36) domains between earthquake victims with fractures and normative values from Sichuan residents*

SF-36 domains	Fracture victims (n=243) Mean (SD)	Sichuan residents (n=2,249) Mean (SD)	Decrease %	p-value
PF	77.26 (24.02)	90.62 (15.40)	14.74	<0.0001
RP	55.56 (43.27)	79.51 (34.70)	30.12	<0.0001
BP	74.78 (18.01)	85.61 (18.37)	12.65	<0.0001
GH	64.76 (23.76)	69.55 (21.32)	6.89	0.001
VT	69.38 (19.09)	70.29 (17.07)	1.29	0.436
SF	75.62 (21.51)	86.85 (17.28)	12.93	<0.0001
RE	52.54 (45.63)	76.45 (38.47)	31.28	<0.0001
MH	73.43 (18.78)	72.65 (16.81)	–1.07	0.497

Bonferroni-corrected significance level is 0.006.
SD: standard deviation; PF: physical functioning; RP: role-physical; BP: bodily pain; GH: general health; VT: vitality; SF: social functioning; RE: role-emotional; MH: mental health.

DISCUSSION

Data for 243 victims with fractures from the major 2008 Sichuan earthquake, collected 4 years after the disaster, were analysed. Although victims had received institutional rehabilitation and were largely functionally independent, many still reported pain, decreased muscle strengths or limited ROM. Across almost all dimensions, victims' HRQOL was significantly lower than that of the Sichuan general population. Older age, having multiple fractures, pain levels, lower independence in ADL and lower income were associated with decreased HRQOL in many of the SF-36 domains.

The HRQOL of fracture victims found in this study was significantly higher than results from a comparable population of fracture victims for which SF-36 data had been collected 27 months after the Sichuan earthquake (SF-36 mean 59.64, 95% CI 57.73–61.25) (15). Although these are different populations and longitudinal data are currently lacking, this might suggest that HRQOL of fracture victims somewhat improved within the time-period in question. Further longitudinal research is warranted to better understand the development of HRQOL in earthquake victims over time.

While our result regarding higher age being associated with decreased HRQOL is consistent with previous studies on quality of life of earthquake survivors (13, 15), we did not find a consistent association with female gender when adjusting for other factors. As reported in the literature (31, 32), victims with multiple fractures require more intensive medical services, experience more severe functional limitations and, accordingly, need longer rehabilitation. In this study, we could additionally demonstrate that having suffered multiple fractures from an earthquake leads to decreased quality of life. Our results regarding pain and functional independence confirm findings from a study in fractures victims by Zhang et al. conducted 27 months after the Sichuan earthquake (15).

This is the first study comparing HRQOL of earthquake fracture victims with the general population of the affected region. Our result that the HRQOL of fracture victims is decreased compared with the general population is, however, in line with research from Li and colleagues demonstrating decreased HRQOL in earthquake victims with amputations (28). Lack of an association between work status and SF-36 scores was observed. Although unemployed victims had lower scores in PCS and total SF-36 than those with full-time or part-time work, the differences were not statistically significant. A strong association between family income and SF-36 scores was found. However, income was not a predictor of quality of life of fracture victims 27 months after the earthquake (15). This may imply that the victims' family income may become more important at a longer time after the earthquake when external social and financial support ebb away.

This study focused on the relationship between physical function and HRQOL, and did not include measures of anxiety, depression or post-traumatic stress disorder, which have been found to be related to the quality of life of earthquake survivors in previous research (8, 29). Also, we did not assess environmental factors or whether people had received community-based rehabilitation services (33), which could have affected their HRQOL. Furthermore, data on HRQOL collected at discharge from inpatient rehabilitation was not available, precluding lon-

Table V. *Results from stepwise linear regression analysis*

Item	SF-36 domain and unstandardized coefficients (n=243) PF	RP	BP	GH	VT	SF	RE	MH	PCS	MCS
Constant	101.65	71.16	81.37	85.08	85.04	87.77	61.21	84.48	86.12	79.17
Age (year)	–0.31	–0.44	—	–0.41	–0.38	–0.30	–0.35	–0.17	–0.30	–0.32
Gender (M=1, F=0)	—	10.42	—	—	—	—	—	—	4.17	—
Marital status (Yes=1, No=0)	—	—	—	—	5.93	9.27	—	—	—	7.03
Education (≥7years=1, 0~6 years=0)	—	—	7.44	—	—	—	—	4.29	—	—
Multiple fractures (Yes=1, No=0)	–7.89	–13.96	–5.79	—	–6.46	–4.34	–23.91	–6.04	–6.85	–9.73
Muscle weakness (Yes=1, No=0)	—	—	—	–5.15	—	—	—	—	–4.83	—
ROM limitation (Yes=1, No=0)	–9.14	—	—	—	—	—	10.81	—	—	—
Pain (Yes=1, No=0)	–16.03	–20.06	–16.20	–17.20	–11.76	–14.36	—	–15.17	–16.79	–11.52
Dependency (Yes=1, No=0)	–15.12	—	–5.21	—	—	–6.88	—	—	–5.95	—
Employed (Yes=1, No=0)	9.35	—	—	7.54	4.61	—	–10.98	5.75	4.76	—
Income (>RMB 2001=1, <RMB 2,000=0)	—	37.33	—	10.59	6.02	10.44	52.27	—	11.46	17.71
R-squared	0.56	0.50	0.44	0.52	0.45	0.49	0.51	0.38	0.68	0.59

SF-36: Medical Outcomes Short Form 36; PF: physical functioning; RP: role-physical; BP: bodily pain; GH: general health; VT: vitality; SF: social functioning; RE: role-emotional; RMB: Renminbi; MH: mental health; PCS: physical component summary score; MCS: mental component summary score; IQR: interquartile range; M: male; F: female.

gitudinal analysis. Thus, we do not know whether earthquake victims' HRQOL improved or decreased from discharge to follow-up. It is suggested that an assessment of earthquake victims' HRQOL shortly after discharge from inpatient rehabilitation should be a standard procedure for monitoring the long-term effects of earthquake rehabilitation on HRQOL.

Apart from these limitations, this is the first study to investigate HRQOL and its determinants in fracture victims 4 years after the Sichuan earthquake. Furthermore, the study featured a multi-stage random sample to enhance the representativeness of the data regarding fracture victims 4 years after the 2008 Sichuan earthquake. Moreover, we applied conservative corrections for multiple testing in data analysis, further enhancing the credibility of our results.

In conclusion, 4 years after the major Sichuan earthquake many victims with fractures still had reduced functional status and experienced pain, while their HRQOL was low compared with the general population. Given that functional status and income showed close relationships with victims' HRQOL, further rehabilitative and social interventions are recommendable from the clinical point of view.

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REFERENCES

1. The Central People's Government of the People's Republic of China. It has been confirmed that 69227 people were killed in Wenchuan earthquake in Sichuan since September 22. [Cited 2008 Sept 22]. Available at: http://www.gov.cn/jrzg/2008-09/22/content_1102192.htm.
2. Jiang J, Li Y, Deng S, Zheng S, Wang M, Mo C, et al. Comparative research of Yushu earthquake and Wenchuan earthquake in medical rescue (3 months after Yushu earthquake). Chin J Evid-based Med 2010; 10: 784–790.
3. Lu-Ping Z, Rodriguez-Llanes JM, Qi W, van den Oever B, Westman L, Albela M, et al. Multiple injuries after earthquakes: a retrospective analysis on 1,871 injured patients from the 2008 Wenchuan earthquake. Crit Care 2012; 16: R87.
4. Dai ZY, Li Y, Lu MP, Chen L, Jiang DM. Clinical profile of musculoskeletal injuries associated with the 2008 Wenchuan earthquake in China. Ulus Travma Acil Cerrahi Derg 2010; 16: 503–507.
5. Li S, He C. Early rehabilitation prevents disability after earthquake: a letter to international rehabilitation colleagues. J Rehabil Med 2013; 45: 603.
6. Li Y, Pan F, Li Y. Analysis of rehabilitation needs, measures taken, and their effectiveness for the wounded following the Wenchuan earthquake. Chin J Evid-based Med 2009; 9: 1258–1262.
7. Gao Q, Leung A, Liang Q, Yang X, Li C, Yang L, et al. Functional status of fracture victims four years after the 2008 Wenchuan earthquake. J Rehabil Med 2014; 46: 289–293.
8. Ni J, Reinhardt JD, Zhang X, Xiao M, Li L, Jin H, et al. Dysfunction and post-traumatic stress disorder in fracture victims 50 months after the sichuan earthquake. PLoS One 2013; 8: e77535.
9. Meyer T, Gutenbrunner C, Bickenbach J, Cieza A, Melvin J, Stucki G. Towards a conceptual description of rehabilitation as a health strategy. J Rehabil Med 2011; 43: 765–769.
10. Guyatt GH, Feeny DH, Patrick DL. Measuring health-related quality of life. Ann Intern Med 1993; 118: 622–629.
11. Aprile I, Piazzini DB, Bertolini C, Caliandro P, Pazzaglia C, Tonali P, et al. Predictive variables on disability and quality of life in stroke outpatients undergoing rehabilitation. Neurol Sci 2006; 27: 40–46.
12. Ceyhan E, Ceyhan AA. Earthquake survivors' quality of life and academic achievement six years after the earthquakes in Marmara, Turkey. Disasters 2007; 31: 516–529.
13. Chou FHC, Chou P, Su TTP, 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 Nz J Psychiat 2004; 38: 358–364.
14. Wu HC, Chou P, Chou FHC, Su CY, Tsai KY, Ou-Yang WC, et al. Survey of quality of life and related risk factors for a Taiwanese village population 3 years post-earthquake. Aust Nz J Psychiat 2006; 40: 355–361.
15. Zhang X, Hu XR, Reinhardt JD, Zhu HJ, Gosney JE, Liu SG, et al. Functional outcomes and health-related quality of life in fracture victims 27 months after the Sichuan earthquake. J Rehabil Med 2012; 44: 206–209.
16. China News. Chinese government confirmed 10 hardest hit area and 41 harder hit area of Wenchuan earthquake. [Cited 2008 Jul 12]. Available at: http://www.chinanews.com/gn/news/2008/07-12/1310643.shtml.
17. Cuthbert SC, Goodheart GJ, Jr. On the reliability and validity of manual muscle testing: a literature review. Chiropr Osteopat 2007; 15: 4.
18. Gajdosik RL, Bohannon RW. Clinical measurement of range of motion. Review of goniometry emphasizing reliability and validity. Phys Ther 1987; 67: 1867–1872.
19. Serlin RC, Mendoza TR, Nakamura Y, Edwards KR, Cleeland CS. When is cancer pain mild, moderate or severe – grading pain severity by its interference with function. Pain 1995; 61: 277–284.
20. Shah S, Vanclay F, Cooper B. Improving the sensitivity of the Barthel Index for stroke rehabilitation. J Clin Epidemiol 1989; 42: 703–709.
21. Mandic M, Rancic N. The recovery of motor function in post stroke patients. Med Arh 2011; 65: 106–108.
22. Wang R, Wu C, Zhao Y, Yan X, Ma X, Wu M, et al. Health related quality of life measured by SF-36: a population-based study in Shanghai, China. BMC Public Health 2008; 8: 292.
23. Ware JE, Jr. SF-36 health survey update. Spine 2000; 25: 3130–3139.
24. Ware JE, Kosinski M. Interpreting SF-36 summary health measures: a response. Qual Life Res 2001; 10: 405–413; discussion 415–420.
25. Li L, Wang H, Shen Y. Development and psychometric tests of a Chinese version of the SF-36 Health Survey Scales. Chin J Prevent Med 2002; 36: 109–113.
26. Lam CL, Tse EY, Gandek B, Fong DY. The SF-36 summary scales were valid, reliable, and equivalent in a Chinese population. J Clin Epidemiol 2005; 58: 815–822.
27. Li N, Liu C, Li J, Ren X. The norms of SF-36 scale scores in urban and rural residents of Sichuan province. Hua Xi Yi Ke Da Xue Xue Bao 2001; 32: 43–47.
28. Li L, Reinhardt J, Zhang X, Pennycott A, Zhao Z, Zeng X, et al.Physical function, pain, quality of life and life satisfaction of amputees from the 2008 Sichuan earthquake: A prospective cohort study. J Rehabil Med 2015; 47: 466–471.
29. Wen J, Shi YK, Li YP, Yuan P, Wang F. Quality of life, physical diseases, and psychological impairment among survivors 3 years after Wenchuan earthquake: a population based survey. PLoS One 2012; 7: e43081.
30. Bland JM, Altman DG. Multiple significance tests: the Bonferroni method. BMJ 1995; 310: 170.
31. Clement ND, Aitken S, Duckworth AD, McQueen MM, Court-Brown CM. Multiple fractures in the elderly. J Bone Joint Surg Br 2012; 94: 231–236.
32. Weatherall M. Rehabilitation of elderly patients with multiple fractures secondary to falls. Disabil Rehabil 1993; 15: 38–40.
33. Zhang X, Reinhardt JD, Gosney JE, Li J. The NHV rehabilitation services program improves long-term physical functioning in survivors of the 2008 Sichuan earthquake: a longitudinal quasi experiment. PLoS One 2013; 8: e53995.