

## Health-related quality of life of 256 recipients after liver transplantation

Pei-Xian Chen, Lu-Nan Yan, Wen-Tao Wang

Pei-Xian Chen, Wen-Tao Wang, Department of Liver and Vascular Surgery, West China Hospital of Sichuan University, Chengdu 610041, Sichuan Province, China

Lu-Nan Yan, Department of Liver and Vascular Surgery, West China Hospital of Sichuan University, Chengdu 610041, Sichuan Province, China

**Author contributions:** Chen PX, Yan LN and Wang WT designed the study, performed the literature search and analyzed the data; Yan LN interpreted the results; and Chen PX wrote the paper.

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**Correspondence to:** Lu-Nan Yan, PhD, Department of Liver and Vascular Surgery, West China Hospital of Sichuan University, Chengdu 610041, Sichuan Province,

China. [yanlunan688@163.com](mailto:yanlunan688@163.com)

Telephone: +86-28-85422867 Fax: +86-28-85422469

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### Abstract

**AIM:** To investigate health-related quality of life (HRQoL) and psychological outcomes in 256 adults who had undergone liver transplantation (LT).

**METHODS:** A stratified random sampling method was used in this follow-up multicenter study to select a representative sample of recipients undergoing either living donor liver transplantation (LDLT) or deceased donor liver transplantation (DDLT). HRQoL was measured by using the Chinese version of Medical Outcome Study Short Form-36 (SF-36), and psychological outcomes by using the beck anxiety inventory (BAI) and the self-rating depression scale (SDS). Clinical and demographic data were collected from the records of the Chinese Liver Transplant Registry and *via* questionnaires.

**RESULTS:** A total of 256 patients were sampled, including 66 (25.8%) receiving LDLT and 190 (74.2%) undergoing DDLT; 15 (5.9%) recipients had anxiety and four (1.6%) developed severe depression after the operation. Compared with LDLT recipients, DDLT patients had higher scores in general health ( $60.33 \pm 16.97$  vs  $66.86 \pm 18.42$ ,  $P = 0.012$ ), role-physical ( $63.64 \pm 42.55$  vs  $74.47 \pm 36.46$ ,  $P = 0.048$ ), role-emotional ( $61.11 \pm 44.37$  vs  $78.95 \pm 34.31$ ,  $P = 0.001$ ), social functioning ( $78.60 \pm 22.76$  vs  $88.16 \pm 21.85$ ,  $P = 0.003$ ), vitality ( $70.30 \pm 15.76$  vs  $75.95 \pm 16.40$ ,  $P = 0.016$ ), mental health ( $65.88 \pm 12.94$  vs  $71.85 \pm 15.45$ ,  $P = 0.005$ ), physical component summary scale (PCS,  $60.07 \pm 7.36$  vs  $62.58 \pm 6.88$ ,  $P = 0.013$ ) and mental component summary scale (MCS,  $52.65 \pm 7.66$  vs  $55.95 \pm 10.14$ ,  $P = 0.016$ ). Recipients > 45 years old at the time of transplant scored higher in vitality ( $77.33 \pm 15.64$  vs  $72.52 \pm 16.66$ ,  $P = 0.020$ ), mental health ( $73.64 \pm 15.06$  vs  $68.00 \pm 14.65$ ,  $P = 0.003$ ) and MCS ( $56.61 \pm 10.00$  vs  $54.05 \pm 9.30$ ,  $P = 0.037$ ) than those aged  $\leq 45$  years. MCS was poorer in recipients with than in those without complications ( $52.92 \pm 12.21$  vs  $56.06 \pm 8.16$ ,  $P = 0.017$ ). Regarding MCS ( $55.10 \pm 9.66$  vs  $50.0 \pm 10.0$ ,  $P < 0.05$ ) and PCS ( $61.93 \pm 7.08$  vs  $50.0 \pm 10.0$ ,  $P < 0.05$ ), recipients scored better than the Sichuan general and had improved overall QoL compared to patients with chronic diseases. MCS and PCS significantly correlated with scores of the BAI ( $P < 0.001$ ) and the SDS ( $P < 0.001$ ).

**CONCLUSION:** Age > 45 years at time of transplant, DDLT, full-time working, no complications, anxiety and depression were possible factors influencing postoperative HRQoL in liver recipients.

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**Key words:** Liver transplantation; Living donor liver transplantation; Deceased donor liver transplantation; Psychology; Health-related quality of life

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## INTRODUCTION

Liver transplantation (LT) has been an established therapy for various end-stage liver diseases for more than three decades. Aside from the role of ensuring the survival of individuals with liver disease, LT also offers patients the health they enjoyed prior to the disease, achieving a good balance between the functional efficacy of the graft and the patient's mental and physical integrity. Satisfactory overall long-term outcomes have been reported by many transplant centers around the world<sup>[1-3]</sup>. Saab *et al*<sup>[4]</sup> have reported that most patients were able to resume occupation early after liver transplantation. In addition, a Portuguese study showed that the majority of recipients could enjoy improved post-LT mental health<sup>[5]</sup>. However, Kousoulas *et al*<sup>[6]</sup> have published their results that patients who survived > 15 years after orthotopic LT demonstrated poor quality of life (QoL). It has also been suggested by de Kroon *et al*<sup>[7]</sup> that some patients exhibit physiological or psychological difficulties irrespective of favorable overall HRQoL.

Discordant conclusions with regard to post-LT overall QoL drawn from transplant centers have resulted in studies to identify potential influencing factors of health-related QoL (HRQoL). More than 10 years survival<sup>[8]</sup> and male sex<sup>[9]</sup> have been found to contribute to better post-LT QoL among recipients. Additionally, many studies have reported equivalent recipient results with living donor LT (LDLT) vs deceased donor LT (DDLT) in adult recipients. This was mainly indicated by similar short-term patient survival rates in both groups<sup>[10]</sup>. However, few studies have focused on the relationship of QoL, severity of depression, and incidence of anxiety. Thus, more careful analysis is warranted to ensure that a meaningful comparison is being made. The present study sought to evaluate carefully the HRQoL and psychological outcomes of adult recipients who underwent DDLT or LDLT between 2001 and December 2010 in Sichuan Province, China. We also aimed to establish the potential factors influencing QoL in our recipients after transplantation. In addition, comparisons of Short Form-36 (SF-36) scores were made between our sample and those of the Sichuan general population, patients with chronic illness, and 126 healthy controls.

## MATERIALS AND METHODS

### Follow-up model

To keep track of our recipients after transplantation and

help them enjoy good physical and psychosocial recovery, our center developed its own follow-up model. At discharge, patients and their family members were lectured about what to pay attention to in daily life. It was also suggested that patients visit their doctors monthly in the first 6 mo, every 2 mo in the second 6 mo, and quarterly beyond 12 mo. In addition, patients were welcome to contact our transplant panel or their regular physicians by mail, telephone or fax if they had any transplant-related difficulties or it was inconvenient to come back. Regular contact was made to maintain follow-up in recipients. As soon as abnormalities were identified, patients underwent further examination or intervention or even readmission if necessary. Besides, an annual reunion was held to update our patients with information pertinent to medication and daily care, as well as to facilitate professional consultation. Simultaneously, sharing of feelings about surgery and postoperative life, experience of daily care, and maintaining good QoL were encouraged at the annual reunion. Therefore, no patient was lost to follow-up.

### Study population and design

The study was designed as a follow-up multicenter study. A stratified random sampling technique was used to select a representative sample of recipients who underwent LT between 2001 and December 2010. Recipients aged  $\geq$  18 years, with the ability to understand Chinese, who had undergone LT > 6 mo previously and had no severe complications or limited ability for self-expression were eligible for inclusion. A total of 300 recipients were selected; among whom 14 died at the time of investigation, 10 were < 18 years old, eight had received LT < 6 mo previously, five spoke their own ethnic language, six had severe medical complications or rejection, and one was diagnosed with schizophrenia. The resulting study sample included 256 recipients with 66 receiving LDLT and 190 receiving DDLT.

Clinical and demographic data were collected from records of the Chinese Liver Transplant Registry. Self-reported questionnaires (completed by interview or mail) were used to evaluate QoL and psychological outcomes.

### Instruments

QoL was assessed using the validated Chinese version of the Medical Outcomes Study SF-36<sup>[11]</sup>. The SF-36 is a validated self-administered questionnaire used internationally to measure eight domains of health: physical functioning, role-physical, bodily pain, general health, vitality, social functioning, role-emotional, and mental health during the past 12 mo. The raw scores of each subscale were converted to scores that ranged from 0 to 100, with higher scores indicating higher levels of functioning or well-being. The level of HRQoL was assessed by comparing the mean value for the study sample with that for a representative sample of the general population of Sichuan Province<sup>[12]</sup>. The eight scale scores were aggregated into the norm-based physical and mental

component summary (PCS and MCS) scores that had a population mean of 50 and standard deviation of 10.

### Beck anxiety inventory

This is a self-report assessment<sup>[13]</sup> in which each subscale consists of 21 items that are rated along a four-point Likert scale (“never”, “sometimes”, “often” or “always”). The participants were required to rate each item in the scale that best represented their current mood, especially during the past 2 wk. The established cut-point of  $\geq 45$  corresponded to the likelihood of anxiety disorder.

### Self-rating depression scale

The Zung *et al.*<sup>[14]</sup> self-rating depression scale (SDS) was used in our study. It was a short self-administered survey to quantify the depressed status of a patient. There were 20 items on the scale that rated the four common characteristics of depression: the pervasive effect, the physiological equivalents, other disturbances, and psychomotor activities. There were 10 positively worded and 10 negatively worded questions. Each question was scored on a scale of 1-4 (based on these replies: “a little of the time”, “some of the time”, “good part of the time”, “most of the time”). The ratio of the raw scores on the test  $> 80$  was coined SDS indices, which are usually applied to assess the severity of the depressive symptoms of a patient. The SDS indices fell into four ranges: (1)  $< 0.50$  normal; (2) 0.50-0.59 minimal to mild depression; (3) 0.60-0.69 moderate depression; and (4)  $\geq 0.70$  severe depression.

### Ethical consideration

The study protocol conformed to the ethical guidelines of the 1975 Declaration of Helsinki and hence was approved by our Hospital Ethics Committee. All participants were asked to sign an informed consent form. There were no organs from prisoners and no subjects were prisoners.

### Statistical analysis

Statistical analysis was performed using SPSS statistical software, version 17.0. Scores from recipients were respectively compared with that from the Sichuan general population; from patients with other chronic medical conditions, including type 2 diabetes mellitus<sup>[15]</sup>, chronic hepatitis B<sup>[16,17]</sup>; and from 125 healthy persons<sup>[18]</sup>. Between-group differences in QoL were tested with independent-sample Student *t* test, analysis of variance, or nonparametric test as appropriate. Multiple comparisons for observed means were tested using the Student-Newman-Keuls procedure for which equal variances could be assumed and by the Games-Howell procedure when they could not be assumed. Pearson correlation analysis was used to analyze the relationships between the level of QoL and psychological outcomes. A probability value of  $P < 0.05$  was taken to represent a significant difference.

Table 1 Recipient characteristics

Factors	n (%)
Age, yr (mean $\pm$ SD, 44.57 $\pm$ 9.97)	
$\leq 45$	151 (59)
$> 45$	105 (41)
Sex	
Male	211 (82.4)
Female	45 (17.6)
Marital status	
Married	241 (94.1)
Unmarried	3 (1.2)
Divorced/widowed	12 (4.7)
Education attainment	
Elementary school	15 (5.9)
Middle school	108 (42.2)
University	133 (52)
Household income (RMB/mo)	
$\leq 1000$	35 (13.7)
$> 1000$ to $\leq 3000$	153 (59.8)
$> 3000$	68 (26.6)
Etiology disease	
Hepatic cirrhosis	142 (55.5)
HCC	71 (27.7)
Severe hepatitis	30 (11.7)
Others	13 (5.1)
HCC/non-HCC	71 (27.7)/185 (72.3)
Complications (yes/no)	78 (30.5)/178 (69.5)
LT types (DDLT/LDLT)	190 (74.2)/66 (25.8)
Time since transplant	
$\leq 1$ yr	38 (14.8)
$> 1$ yr, $\leq 3$ yr	54 (21.1)
$> 3$ yr, $\leq 5$ yr	66 (25.8)
$> 5$ yr	98 (38.3)
Employment after transplant	
Full-time	83 (32.4)
Part-time	75 (29.3)
None	98 (38.3)

HCC: Hepatocellular carcinoma; DDLT: Deceased donor liver transplantation; LDLT: Living donor liver transplantation.

## RESULTS

### Recipient characteristics

Informed consent for participation was obtained from all recipients and they all completed the validated questionnaires by interview or mail. The results from questionnaires completed by interview versus mail were not significantly different. The demographic and transplant-related characteristics of the study population are listed in Table 1. Most recipients were  $\leq 45$  years at the time of transplantation (59.0%), were male (82.4%), had attained a higher education level (52.0%), and suffered from hepatic cirrhosis (55.5%). Many recipients remained or got married after transplantation (94.1%) and earned a salary between 1000 and 3000 RMB/mo (59.8%). Among our participants, 30.5% reported that they experienced early or late post-transplant complications including biliary events, endocrine disorders, physical or psychiatric problems, and 38.3% had received a liver transplant  $> 5$  years ago, three of whom were  $> 10$ -year survivors. Roughly equal numbers of recipients

Table 2 Psychological outcomes after transplantation

BAI/SDS scores	Frequency	mean $\pm$ SD (%)
BAI		30.26 $\pm$ 7.44
< 45	241	94.1
$\geq$ 45	15	5.9
SDS		0.49 $\pm$ 0.11
< 0.5	114	44.5
$\geq$ 0.5, $\leq$ 0.59	104	40.6
$\geq$ 0.6, $\leq$ 0.69	34	13.3
$\geq$ 0.7	4	1.6

BAI: Beck anxiety inventory; SDS: Self-rating depression scale.

engaged in three post-transplant employment statuses (full-time, part-time and no employment). The majority of recipients (98.4%) insisted on regular follow-up with their regular physicians or community clinics. Approximately 74.2% of the recipients underwent DDLT and 25.8% received LDLT, all of whom were related to their donors.

### Post-transplant QoL and psychological outcomes

**Beck anxiety inventory (BAI):** A mean score of 30.26 was obtained among 256 recipients, 15 (5.9%) of whom scored  $\geq$  45 on the BAI, indicating the possibility of post-LT anxiety disorder (Table 2).

**SDS:** The SDS index reached an average level of 0.49 in our study sample. It was suggested that 142 out of 256 study participants exhibited depressive symptoms, with 104 mild, 34 moderate and four severe (Table 2).

**Medical outcome study SF-36:** In the general health ( $P = 0.012$ ), role-physical ( $P = 0.048$ ), role-emotional ( $P = 0.001$ ), social-functioning ( $P = 0.003$ ), vitality ( $P = 0.016$ ), mental health ( $P = 0.005$ ), PCS ( $P = 0.013$ ) and MCS ( $P = 0.016$ ) domains, recipients receiving DDLT scored higher than those undergoing LDLT. Patients aged  $\leq$  45 years at the time of transplant scored lower than those  $>$  45 years in vitality ( $P = 0.020$ ), mental health ( $P = 0.003$ ) and MCS ( $P = 0.037$ ). MCS scores were lower in recipients with than without complications ( $P = 0.017$ ). Recipients who resumed full-time employment scored higher in general health ( $P = 0.038$ ), physical-functioning ( $P = 0.003$ ), social-functioning ( $P = 0.018$ ), bodily pain ( $P = 0.005$ ), vitality ( $P = 0.038$ ) and PCS ( $P = 0.001$ ) than those who undertook part-time jobs or gave up working after transplantation (Table 3).

Scores from recipients were lower in physical-functioning ( $P < 0.001$ ), role-physical ( $P = 0.001$ ) but higher in vitality ( $P = 0.003$ ), mental health ( $P = 0.001$ ), PCS ( $P < 0.001$ ) and MCS ( $P < 0.001$ ) compared with that from Sichuan general population. Recipients had higher scores in general health ( $P < 0.001$ ), social-functioning ( $P < 0.001$ ), bodily pain ( $P < 0.001$ ), vitality ( $P < 0.001$ ), PCS ( $P < 0.001$ ) and MCS ( $P < 0.001$ ) than patients with chronic hepatitis B. In general health ( $P < 0.001$ ), physical-functioning ( $P < 0.001$ ), role-physical ( $P < 0.001$ ),

social-functioning ( $P < 0.001$ ), bodily pain ( $P < 0.001$ ), mental health ( $P = 0.001$ ), patients after liver transplantation scored lower than the healthy controls. Compared with patients with type 2 diabetes mellitus, recipients had lower scores in physical-functioning ( $P = 0.001$ ) and mental health ( $P < 0.001$ ), as well as higher scores in role-physical ( $P < 0.001$ ), role-emotional ( $P < 0.001$ ), social-functioning ( $P < 0.001$ ), bodily pain ( $P = 0.023$ ) and vitality ( $P < 0.001$ ) (Table 4).

The correlation coefficients between PCS and MCS scores of the SF-36 and the scores of BAI or SDS respectively are presented in Table 5. Both PCS and MCS were significantly correlated with the scores of BAI ( $P < 0.001$ ) as well as the severity of depression based on the SDS ( $P < 0.001$ ).

## DISCUSSION

HRQoL is a multifaceted construct of physiological and psychosocial aspects of well-being. Integrity of this construct represents an important measure of the success of a medical intervention beyond simple high survival rates, because HRQoL involves every single detail of a person's daily activity and social functioning. As a result, HRQoL of recipients undergoing LT has been increasingly valued. Earlier studies<sup>[19-21]</sup> have shown that DDLT contributes greatly to improved QoL. Emerging as a life-saving alternative because of organ shortage worldwide, LDLT has also enabled patients to achieve better QoL after than before surgery<sup>[22]</sup>. The present study aimed to investigate HRQoL in recipients undergoing either DDLT or LDLT.

Established evidence shows that a high level of post-LT anxiety is harmful in the long term to the well-being of the recipients<sup>[23]</sup>, and depressive symptoms after LT are associated with an increased risk of long-term mortality<sup>[24]</sup>. Fortunately, the incidence of anxiety in our sample was low (5.9%) and those exhibiting severe depressive symptoms after surgery only accounted for a small proportion (4/256). Nevertheless, a high incidence of depressive symptoms (142/256) among recipients should not be underappreciated because of the low incidence of severe depression, because the frequency of depressive symptoms can impair QoL in liver recipients<sup>[25]</sup>. As a result, longitudinal studies and prolonged follow-up are required to disclose other possible factors that might undermine the psychological health of recipients.

In our study, patients receiving DDLT had significantly higher scores than those undergoing LDLT in the majority of domains on the SF-36. Smaller sample size in LDLT population could be one possible reason. Additionally, it was reported that total comprehensive cost<sup>[26]</sup>, incidence of complications<sup>[27-30]</sup>, rehospitalization rate<sup>[27]</sup>, and HCC recurrence<sup>[31,32]</sup> were higher in LDLT than DDLT recipients. Higher blood level of tacrolimus in LDLT recipients was also pointed out, which indicated higher incidence of adverse effects<sup>[33]</sup>. These factors might all contribute to the poorer QoL in LDLT



**Table 3 Recipient health-related quality of life**

Factors SF-36 domains	Groups (mean ± SD)	Groups (mean ± SD)	Groups (mean ± SD)	t/F value	P value
LT types	DDLT	LDLT			
GH	66.86 ± 18.42	60.33 ± 16.97		t = 2.530	0.012
RP	74.47 ± 36.46	63.64 ± 42.55		t = 1.990	0.048
RE	78.95 ± 34.31	61.11 ± 44.37		t = 3.361	< 0.001
SF	88.16 ± 21.85	78.60 ± 22.76		t = 3.029	0.003
VT	75.95 ± 16.40	70.30 ± 15.76		t = 2.433	0.016
MH	71.85 ± 15.45	65.88 ± 12.94		t = 2.816	0.005
PCS	62.58 ± 6.88	60.07 ± 7.36		t = 2.507	0.013
MCS	55.95 ± 10.14	52.65 ± 7.66		t = 2.415	0.016
Age	≤ 45 yr	> 45 yr			
VT	72.52 ± 16.66	77.33 ± 15.64		t = -2.332	0.020
MH	68.00 ± 14.65	73.64 ± 15.06		t = -2.995	0.003
MCS	54.05 ± 9.30	56.61 ± 10.00		t = -2.097	0.037
Complications	Yes	No			
MCS	52.92 ± 12.21	56.06 ± 8.16		t = 2.412	0.017
Employment after transplant	Full-time	Part-time	None		
GH	69.31 ± 18.23	63.88 ± 18.51	62.67 ± 17.63 <sup>a</sup>	F = 3.301	0.038
PF	88.67 ± 10.91	81.33 ± 17.66 <sup>a</sup>	83.32 ± 13.64 <sup>a</sup>	F = 5.809	0.003
SF	90.81 ± 20.01	85.67 ± 22.95	81.38 ± 23.28 <sup>a</sup>	F = 4.069	0.018
BP	86.02 ± 13.38	78.91 ± 19.76 <sup>a</sup>	78.76 ± 16.19 <sup>a</sup>	F = 5.331	0.005
VT	78.25 ± 15.86	72.93 ± 17.63	72.50 ± 15.45 <sup>a</sup>	F = 3.305	0.038
PCS	64.28 ± 6.20	60.87 ± 7.51 <sup>a</sup>	61.93 ± 7.08 <sup>a</sup>	F = 7.100	< 0.001

Only statistically significant data are displayed. <sup>a</sup>P = 0.05 vs group "Full-time". SF-36: Short Form-36; GH: General health; RP: Role-physical; RE: Role-emotional; SF: Social-functioning; VT: Vitality; MH: Mental health; PF: Physical functioning; BP: Bodily pain; LT: Liver transplantation; PCS: Physical component summary; MCS: Mental component summary.

**Table 4 Health-related quality of life in liver recipients**

SF-36 domain	LT (n = 256)	Sichuan general (n = 2249)	CHB (n = 150)	Healthy control (n = 126)	DM2 (n = 108)
General health	65.18 ± 18.25	67.30 ± 21.97	50.2 ± 24.0 <sup>a</sup>	91.23 ± 11.02 <sup>a</sup>	62.95 ± 23.87
Physical-functioning	84.47 ± 14.44	90.80 ± 15.07 <sup>a</sup>	84.5 ± 15.6	76.36 ± 26.09 <sup>a</sup>	87.38 ± 17.10 <sup>a</sup>
Role-physical	71.68 ± 38.33	79.51 ± 34.70 <sup>a</sup>	73.4 ± 27.4	82.79 ± 20.01 <sup>a</sup>	62.73 ± 39.64 <sup>a</sup>
Role-emotional	74.35 ± 37.89	76.45 ± 38.47	77.6 ± 23.8	69.46 ± 16.89	58.33 ± 43.74 <sup>a</sup>
Social-functioning	85.69 ± 22.43	85.29 ± 18.06	78.6 ± 25.8 <sup>a</sup>	74.44 ± 17.32 <sup>a</sup>	77.78 ± 25.60 <sup>a</sup>
Bodily pain	81.35 ± 16.17	82.41 ± 21.25	71.3 ± 26.0 <sup>a</sup>	85.55 ± 18.02 <sup>a</sup>	78.75 ± 25.48 <sup>a</sup>
Vitality	74.39 ± 16.41	71.44 ± 15.81 <sup>a</sup>	60.8 ± 23.6 <sup>a</sup>	75.57 ± 25.71	66.16 ± 21.66 <sup>a</sup>
Mental health	70.36 ± 15.05	73.52 ± 15.68 <sup>a</sup>	72.0 ± 20.3	73.35 ± 21.26 <sup>a</sup>	73.74 ± 21.08 <sup>a</sup>
PCS	61.93 ± 7.08	50.00 ± 10.00 <sup>a</sup>	42.8 ± 11.6 <sup>a</sup>	-	-
MCS	55.10 ± 9.66	50.00 ± 10.00 <sup>a</sup>	48.9 ± 12.3 <sup>a</sup>	-	-

Health-related quality of life (HRQoL) in liver recipients respectively compared with Sichuan general population and patients with chronic hepatitis B (CHB) or type 2 diabetes mellitus (DM2) as well as 126 healthy controls. <sup>a</sup>P < 0.05 vs group "Liver transplantation (LT)". SF-36: Short Form-36; PCS: Physical component summary; MCS: Mental component summary.

**Table 5 Correlation analysis between health-related quality of life and psychological outcomes**

BAI/SDS scores	PCS (SF-36)		MCS (SF-36)	
	r	P value	r	P value
BAI	-0.397	0.001	-0.401	< 0.001
SDS	-0.271	0.001	-0.239	< 0.001

BAI: Beck anxiety inventory; SDS: Self-rating depression scale; SF-36: Short Form-36; PCS: Physical component summary; MCS: Mental component summary.

than DDLT recipients. However, these factors were not considered in the preliminary study design and hence further studies are warranted.

Employment is one measure of the ability to resume normal physical and socializing well-being. It has been shown that lack of disability income coverage prior to transplantation and high physical functioning<sup>[4]</sup>, age and approaching retirement<sup>[12]</sup> are correlated with post-transplantation occupation. Among our 256 transplant recipients, age and worry about doing harm to the graft were the main reasons for part-time work status and unemployment instead of full-time work. Interestingly, recipients undertaking full-time work enjoyed better physical health than the other two according to the SF-36, regardless of higher scores for bodily pain. Early involvement in social activities and full-time work facilitate recipients normal physical and psychosocial well-being.

Other factors, including age and complications may

affect some QoL subscales. Age > 45 years at the time of transplant and no complications indicated better mental health in recipients. Duffy *et al*<sup>[1]</sup> have shown that age < 18 years at the time of transplantation was associated with improved long-term survival, and Jin *et al*<sup>[12]</sup> have concluded that post-transplant medical complications did not affect QoL or psychological outcomes.

In our study, sex, etiology of disease, time since transplant, marital status after transplant surprisingly turned out not to be associated with HRQoL in recipients after transplantation. Our results were in contrast with previous studies<sup>[1,12,34]</sup>.

Regarding the SF-36, our sample had comparable scores in most domains to the Sichuan general population and scored significantly higher in both PCS and MCS. Our results were consistent with earlier studies<sup>[2,35,36]</sup>. A systematic review demonstrated that liver transplantation recipients experienced improved QoL with reference to the general population and compromised well-being when compared with healthy persons<sup>[36]</sup>. However, this is inconsistent with our findings. In our study, the LT recipients scored lower in general health, role-physical, bodily pain, mental health and higher in physical-functioning and social-functioning, as well as similarly in other domains when compared with 126 healthy controls.

LT patients are at high risk for cardiovascular events, impaired renal function and diabetes due to life-long immunosuppressive therapy<sup>[37]</sup>. Thus, there is a necessity to probe the QoL of LT recipients compared with matched controls. Overall HRQoL was significantly better in our LT recipients than patients with chronic hepatitis B or type 2 diabetes mellitus. The result was in accordance with the study of Duffy *et al*<sup>[1]</sup> about HRQoL of 20-year survivors after LT. Paradoxically, Elliott *et al*<sup>[36]</sup> have found that symptoms or functional abilities are not different between LT recipients and matched chronic liver disease controls. However, our findings were based on generic QoL instruments, which were not disease-targeted. Therefore, further studies with specific instruments are needed to explore factors contributing to the differences. With respect to the relationship between QoL and psychological outcomes, MCS and PCS scores significantly correlated with the scores of both BAI and SDS. This observation indicated that post-transplant anxiety and depression were potential factors influencing QoL, and our findings were inconsistent with earlier studies<sup>[12,38]</sup>. Attention should be paid to recipients who had difficulties in psychosocial adjustment after LT.

Generally, in our study recipients undergoing DDLT, age > 45 years, taking full-time work after transplantation, and absence of complications resulted in a favorable QoL. This result could be partly attributable to our follow-up model, which enabled early problem identification and prompt individual intervention as well as HRQoL maintenance and improvement of LT recipients. Telles-Correia *et al*<sup>[39]</sup> have pointed out that it is useful to design

special modes of follow-up to improve patients' medical outcomes. van Ginneken *et al*<sup>[40]</sup> and Gross *et al*<sup>[41]</sup> have shared their successful experience of improving QoL of LT recipients by a rehabilitation program and a trial called Mindfulness-Based Stress Reduction.

Our study had several limitations. The findings were based on cross-sectional data, which are less informative than those of a longitudinal study. Nevertheless, our sample was relatively large. The sample size of LDLT patients was small, which could have led to biased results in group comparison. Recipients' anxiety for donors' health should be investigated in future studies because that might affect recipients' post-transplant mental health. Studies with specific instruments are also needed. Moreover, prospective studies are required to explore tailored intervention to help patients through physical and psychological discomfort as well as social disadvantages.

In conclusion, age > 45 years at the time of transplantation, DDLT, full-time working status and no complications after transplantation indicated better QoL in our recipients. Post-transplant anxiety and depression significantly correlated with MCS and PCS. A well-designed follow-up model plays an important role in improving post-LT survival and HRQoL of recipients.

## COMMENTS

### Background

Living donor liver transplantation (LDLT) is effective treatment for patients with end-stage liver disease, especially in Asian countries where the cadaveric graft supply is markedly limited. The graft and recipient survival rates are excellent and similar to those after deceased donor liver transplantation (DDLT). However, recipients suffer a wide range of physical, mental and psychological difficulties other than the risks inherent to the surgical process. Therefore, the health-related quality of life (HRQoL) of recipients after transplantation should be given priority.

### Research frontiers

Currently, discordant conclusions as to HRQoL and psychological health of recipients after LT have been drawn based on varied instruments. Therefore, the study evaluated the HRQoL and psychological outcomes on DDLT or LDLT recipients and identified some underlying factors influencing their HRQoL, as well as delivering the perspectives.

### Innovations and breakthroughs

This study is one of the few that have compared HRQoL in liver recipients and those suffering chronic diseases. Furthermore, the authors compared DDLT and LDLT. Additionally, the study was well constructed and was a comprehensive assessment of HRQoL and psychological well-being in recipients after LT.

### Applications

The present study provides crucial preliminary findings on research into the recipients' QoL and psychological outcomes. The findings will play an important role in future clinical decision making.

### Terminology

LDLT is a procedure in which a living healthy person voluntarily donates part of his/her liver to another without any commercial purposes. DDLT is a procedure in which the donated liver is procured from a cadaver. HRQoL is a multifaceted construct of physiological and psychosocial aspects of well-being.

### Peer review

The study is well planned with HRQoL being compared between DDLT and LDLT and also patients with other chronic illnesses, healthy controls, as well as the general population. This was an interesting study in which the authors evaluated HRQoL and mental well being (anxiety and depression) in liver transplant recipients from Sichuan Province, China.

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