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# Quality of life as a predictor of cancer survival among Chinese liver and lung cancer patients

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ABSTRACT

The utility of quality of life (QoL) scores in predicting cancer survival remains inconclusive because of methodological and/or statistical heterogeneity. We examined whether QoL scores predicted survival among Chinese liver ($n = 176$) and lung cancer ($n = 358$) patients. Cox proportional hazards models examined if QoL and psychosocial variables predicted survival after fully adjusting for sociodemographic and clinical factors. The results showed that global QoL scores did not predict survival in either patient group. Less advanced cancer stage (HR = 2.574, $p < 0.05$) was associated with longer survival in liver cancer. Longer survival in lung cancer was predicted by younger age (HR = 1.016, $p < 0.05$), less advanced cancer stage (HR = 1.978, $p < 0.001$), having had treatment before baseline (HR = 0.671, $p < 0.05$), better physical well-being (HR = 0.941, $p < 0.001$) and better appetite (HR = 0.888, $p < 0.001$). Global QoL (FACT-G(Ch)) scores do not predict survival in Chinese liver and lung cancer patients. QoL physical well-being subscale predicted lung cancer survival.



## 1. Introduction

Some studies indicate that global quality of life (QoL) scores independently predict cancer survival,[1–8] but others have failed[9,10] to find a survival effect. Small sample sizes[2,3,11] or inadequate adjustment for clinical factors[1,5] are common drawbacks of studies reporting an independent prognostic effect. Among 474 cancer patients, after adjustment for diagnosis and metastatic disease, those with high global QoL scores lived longer.[6] However, only 74% of that sample was traced, the status of the remainder being unknown.[6] Among 735 patients from 10 countries, 89% of whom were followed up for five years, EORTC-QLQ-30 physical condition, overall QoL, and global and social functioning scores predicted prognosis. Proportional hazards analysis was stratified by diagnosis, but disease status was measured using a single global item, ECOG performance status.[5] Among 501 colorectal cancer patients, almost all baseline QoL domain scores on the disease-specific EORTC CRC-30 predicted a doubling of survival in those whose QoL score was above the median compared to those with scores below the median. Procedural and sampling details were poorly described and treatment

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effects may have significantly compounded QoL scores, with more advanced disease receiving more aggressive treatments and hence incurring greater QoL decrements.[7]

Among 125 mixed cancer patients, treatment intention was the only prognostic indicator that, after adjustment, independently predicted survival.[9] Among 206 advanced non-small cell lung carcinoma patients, weight loss, dyspnoea, non-adenocarcinoma and low serum albumen and several subscales and global QoL scores of the EORTC-30 univariately predicted survival. However, following adjustment for clinical factors, only the EORTC-30 pain subscale continued to predict survival.[10]

Thus, most studies identifying a survival effect suffered from either inadequate power or inadequate adjustment. Among the more methodologically sound studies, only one[10] failed to report an effect. Publication bias has probably excluded other negative findings. Three studies offer the strongest evidence for an independent effect.[5–7] Thus, QoL scores remain controversial as independent predictors of survival. The predictive power of QoL may also vary by disease type, with diseases that carry better prognoses showing more sensitivity to QoL and hence conferring greater predictive power to QoL scores. To our knowledge, this point has yet to be explored.

Full adjustment is needed for factors affecting outcome in order to demonstrate any independent predictive power of QoL. Individual clinical factors exert considerable variance on outcome. In effect, patient performance status determines outcome in most cases. Variation in type and stage of disease, age and nutritional status[3,10] affect both outcome and QoL assessment, generating collinearity problems. Treatment may influence short-term survival long enough to distort the outcome picture.[9] QoL itself must be comprehensively and robustly assessed.[12]

Several psychosocial variables also independently influence survival, including social support[1,13–15], mood and emotional function[2,6,16] and personality components such as primarily self-efficacy[17] and optimism,[18] while satisfaction with care[19–21] and distress[22] may confound QoL outcome studies.

We report a study that utilised a large sample size, a well-validated QoL measure, and which adjusted for disease type and stage, pain and other symptoms, treatment, demographics, depression, and other important psychosocial factors to clarify the impact of QoL on survival of Chinese lung and liver cancer patients.

## 2. Patients and methods

### 2.1. *Sampling frame*

A multi-centre cohort study of cancer-related QoL was initiated in Hong Kong (HKSAR), China, in 1995. Patients with primary liver (hepatocellular carcinoma) or lung (small and non-small cell lung and bronchogenic carcinoma) cancers were targeted. Both primary liver and lung cancers are highly prevalent and have the highest cancer-related mortality in HKSAR.[23]

To detect a 10% difference between groups at the end of the study, 125 survivors in each cancer category were required. HKSAR has about 2098 new cases annually of these two cancers.[23] Sample sizes were based on an assumed 40% and 30% survival rate, respectively, for liver and lung after two years. The sample frame comprised two-in-three of all newly referred patients in five regional centres, from which a one-in-two sample was drawn, ensuring that one-third of all new patients were recruited, giving a proportionally weighted total sample size of 747 (Fig. 1).

### 2.2. *Measurement*

The Functional Assessment of Cancer Treatment-General (FACT-G) is a 27 item QoL assessment for use with cancer patients receiving treatment.[24] Items are scored on 5-point scale ('0' = 'not at all', '4' = 'very much'). The Chinese version, the FACT-G (Ch) used here, has five subscales: physical (Phy), emotional (Emt), functional (Fnt) and social/family (Soc/Fam) well-being. The Doctor subscale was excluded due to low validity.[25] Summed subscale scores give a total QoL score. The FACT-G (Ch) has acceptable psychometrics and cultural equivalence.[25]

Additionally, seven single item visual analogue (VA) 10-cm lines marked '0' and '10' assessed eating ability, eating appetite, eating enjoyment, self-care ability and current perceived health. These items had the '0' end headed 'very bad'/'do not enjoy at all' and the '10' end 'very good'/'enjoy very much', with higher scores indicating better functioning. Depression was measured using a single statement headed 'I am depressed' with five categorical responses identical to those of the FACT-G (Ch). Higher scores indicate better mood. Pain was assessed using a white plastic rule graduated in 11 points labelled 0–10, along which respondents slide a red pointer corresponding to 'Your pain at its worst in the last month'. Scores were recorded by the interviewer in the form of an integer between 1 and 10.

Clinical data, disease type, stage, treatment before and after baseline, recurrence before and after baseline, and, for lung patients, histology (non-small cell/small cell), were extracted from patients' medical record using a standardised form by a medical researcher. Demographic data comprised age, gender, education, religion and marital status collected during baseline interviews.

### 2.3. *Procedure*

Following approval by the Medical Ethical Committee of the University of Hong Kong, all new referrals to the five clinical Oncology Departments, aged 18–85 years, native Cantonese speakers and communications-competent, who gave fully informed consent were eligible for recruitment. Depending on manpower and patient availability in each targeted clinical session, either consecutive or systematic sampling was employed. Telephone interviews at 24 and 52 weeks confirmed status.

Data were collected at baseline during the first outpatient visit and at follow-up (FU) after the patients' clinical consultations in the five hospitals by face-to-face interviews. The mean duration between baseline and FU was 1.53 months (range: 1–4 weeks) for the liver cancer sample and 3.17 months (range: 2–7 months) for the lung cancer sample. Between 1996 and 1997, 253 eligible liver cancer patients and 377 lung cancer patients were enrolled to the study.

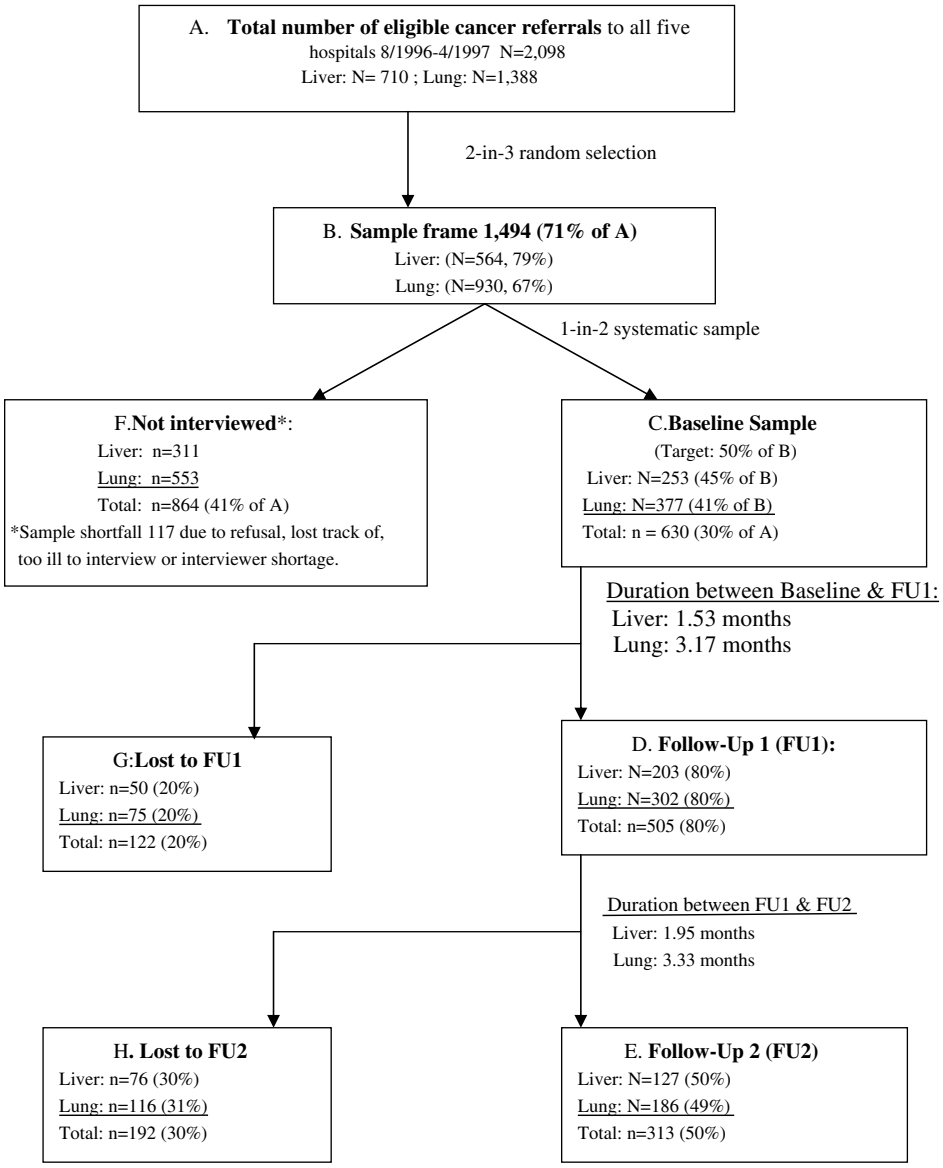


**Fig. 1 – Sampling structure and attrition pattern of the study.**

### 2.4. *Statistical analysis*

Standard descriptive analyses (mean, standard deviation [SD], chi-squared [$\chi^2$] and *t*-tests) were performed to assess sample characteristics. Disease stage was dichotomised as 'Early' or 'Advanced' to accommodate the different staging systems of liver and lung cancer, with 'Early' corresponding to Stages 1 and 2 (Liver), and Stages 0–IIB and 'early' for non-small cell and small-cell lung cancers, respectively. 'Advanced' included all other stages. Survival time was defined as the period between the date of baseline interview and the date of death. Survival was censored at the date of last follow-up for surviving patients (up to 25 months after baseline). Survival curves were estimated using the Kaplan–Meier method.[26] Differences between survival curves were assessed using the log-rank test.[27]

The Cox proportional-hazards regression model was used for univariate and multivariate analyses of survival.[28] The proportionality assumption was checked for each of the variables under study by testing the dependency of their hazard ratio [HR] over time.[29] Preselection for entry of psychosocial factors into multivariate models required a $p$ value of $\leqslant 0.10$ in the univariate analyses in either sample. All disease-related[c], sociodemographic and FACT-G(Ch) variables were forced-entered in all multivariate models. A backward multivariate selection procedure was then applied. Each FACT-G(Ch) and psychosocial variable ($x$) was entered into the Cox model as a continuous linear function ($\beta_1 x$). Internal model validation was based on a bias-corrected estimate of the area under the receiver operating characteristic curve (ROC AUC), which measures the predictive discrimination of the model (a value of 0.5 indicates no discrimination and a value of 1 indicates perfect discrimination).[30] The importance of a predictor was assessed

[c] 'Histology' (non-small cell versus small cell) was included in models for lung cancer sample only.

using Hazard Ratios (HR), their 95% Confidence Intervals [CI] for survival and the *p*-value of the Wald statistic. All significance tests were two-sided. Statistical analyses were performed using the SPSS-13/PC software package.[31]

## 3. Results

### 3.1. Patient characteristics

The sample is summarised in Table 1. Ninety-six patients, consisting of 77 liver cancer and 19 lung cancer patients, were excluded from analyses due to incomplete data on disease-related variables, including cancer stage, recurrence before baseline and treatment before baseline. Hence, a total of 176 liver cancer patients and 358 lung cancer patients remained in the baseline analyses. Median survival was 4 months for the liver cancer sample (range, 0.4–23 months) and 7 months (range, 0.2–25 months) for the lung cancer patients. Fig. 2 presents Kaplan–Meier survival curves for the two samples. A total of 43 (25.3%) and 77 (21.9%) cases were censored in the liver and lung cancer samples, respectively, after 25 months. The result of log-rank test evidenced no statistically significant difference in survival time between the two samples ($\chi^2 = 1.148$, df = 1, NS). Patients in the lung cancer sample

**Table 1 – Baseline univariate Cox regression analyses of disease-related and sociodemographic factors**

| | Liver cancer[a] (*n* = 176) | | | | Lung cancer[b] (*n* = 358) | | | |
|---|---|---|---|---|---|---|---|---|
| | No. of patients (%) | HR[c] | 95% CI | *p*-Value | No. of patients (%) | HR[c] | 95% CI | *p*-Value |
| *Age*[d] | | | | | | | | |
| ⩽ 40 | 21 (11.9) | | | | 11 (3.1) | | | |
| 41–50 | 30 (17.0) | 0.983 | 0.506, 1.907 | 0.959 | 33 (9.2) | 0.896 | 0.399, 2.012 | 0.790 |
| 51–60 | 42 (23.9) | 0.876 | 0.463, 1.657 | 0.683 | 56 (15.6) | 1.155 | 0.539, 2.477 | 0.711 |
| 61–70 | 56 (31.8) | 1.109 | 1.109, 1.999 | 0.731 | 143 (39.9) | 1.475 | 0.720, 3.021 | 0.288 |
| ⩾71 | 27 (15.3) | 1.394 | 1.394, 2.693 | 0.323 | 115 (32.1) | 1.379 | 0.669, 2.843 | 0.384 |
| *Sex*[e] | | | | | | | | |
| Male | 150 (85.2) | | | | 271 (75.7) | | | |
| Female | 26 (14.8) | 0.856 | 0.525, 1.394 | 0.532 | 87 (24.3) | 0.978 | 0.743, 1.286 | 0.872 |
| *Marital status* | | | | | | | | |
| Single | 10 (5.7) | | | | 21 (5.9) | | | |
| Married/cohabited | 139 (79.4) | 0.579 | 0.292, 1.149 | 0.118 | 275 (77.0) | 0.829 | 0.498, 1.379 | 0.470 |
| Divorced/separated | 5 (2.9) | 0.479 | 0.129,1.776 | 0.271 | 8 (2.2) | 0.477 | 0.174, 1.302 | 0.149 |
| Widowed | 21 (12.0) | 0.665 | 0.296,1.493 | 0.323 | 53 (14.8) | 0.931 | 0.524, 1.653 | 0.806 |
| *Cancer stage at diagnosis*[f] | | | | | | | | |
| Zero | | | | | 1 (0.3) | | | |
| I | | | | | 43 (12.0) | 0.900 | 0.122, 6.630 | 0.918 |
| II | | | | | 36 (10.1) | 0.781 | 0.105, 5.815 | 0.810 |
| III | | | | | 174 (48.6) | 1.566 | 0.219, 11.217 | 0.655 |
| IV | | | | | 92 (25.7) | 2.328 | 0.323, 16.766 | 0.402 |
| X[g] | | | | | 12 (3.4) | 1.094 | 0.137, 8.755 | 0.933 |
| *Cancer stage*[e,h] | | | | | | | | |
| Less advanced | 19 (10.8) | | | | 92 (25.7) | | | |
| More advanced | 157 (89.2) | 3.226 | 1.501, 6.932 | 0.003 | 266 (74.3) | 2.032 | 1.513, 2.730 | <0.001 |
| *Histology*[f] | | | | | | | | |
| Non-small cell | | | | | 288 (88.1) | | | |
| Small cell | | | | | 39 (11.9) | 1.133 | 0.773, 1.660 | 0.523 |
| *Recurrence before baseline*[e] | | | | | | | | |
| No | 169 (96.0) | | | | 306 (85.5) | | | |
| Yes | 7 (4.0) | 0.590 | 0.218, 1.600 | 0.300 | 52 (14.5) | 1.299 | 0.938, 1.800 | 0.116 |
| *Treatment before baseline*[e] | | | | | | | | |
| No | 157 (89.2) | | | | 298 (83.2) | | | |
| Yes | 19 (10.8) | 0.489 | 0.256, 0.933 | 0.030 | 60 (16.8) | 0.601 | 0.427, 0.848 | 0.004 |

*Note:* HR, hazard ratio.

a Number of deaths = 133, number of censored = 43.

b Number of deaths = 281, number of censored = 77.

c First value in each comparison is the reference value. HRs greater than 1.00 reflected an increased risk of death or poorer survival.

d *T*-test comparing mean age between the liver and the lung cancer samples significant at $p < 0.001$.

e $\chi^2$ tests comparing the liver and the lung cancer sample significant at $p < 0.05$.

f Applicable to the lung cancer sample only.

g Tumour stage unknown, but not Stage IV.

h Stages III and IV were classified as 'more advanced'; other stage categories were classified as 'less advanced'. For the liver cancer sample, 'less advanced' and 'more advanced' are equivalent to the classification of 'operable' and 'inoperable', respectively.

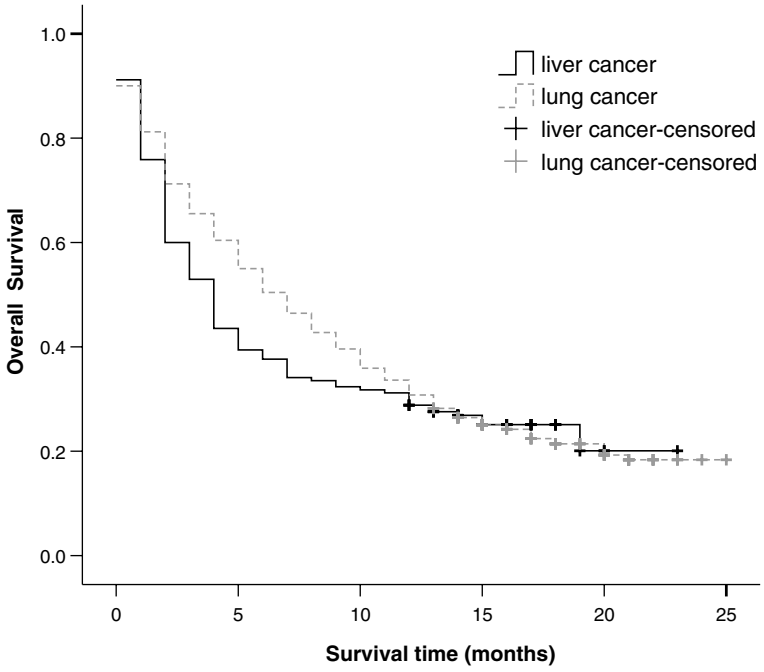


**Fig. 2 – Overall survival (months) for the liver ($n$ = 176) and lung cancer ($n$ = 358) sample.**

(mean = 64.81, SD = 10.28) were significantly older than patients in the liver cancer sample (mean = 57.34, SD = 12.76) ($t = -7.28$, $p < 0.001$). More liver cancer patients were male ($\chi^2 = 5.69$, df = 1, $p < 0.05$), whereas more lung cancer patients had less advanced disease ($\chi^2 = 15.60$, df = 1, $p < 0.001$). More lung cancer patients experienced disease recurrence before baseline (14.5%) ($\chi^2 = 13.48$, df = 1, $p < 0.001$) and most of these (88.1%) had non-small cell cancer. Univariate Cox regression indicated that cancer stage (liver: HR = 3.226, 95% CI: 1.501, 6.932, $p < 0.005$; lung: HR = 2.032, 95% CI: 1.513, 2.730, $p < 0.001$) and treatment before baseline (liver: HR = 0.489, 95% CI: 0.256, 0.966, $p < 0.05$; lung: HR = 0.601, 95% CI: 0.427, 0.848, $p < 0.005$) predicted poorer survival in both samples (Table 1). No sociodemographic variables predicted overall survival.

### 3.2. *Univariate Cox regression models*

As shown in Table 2, predictors of survival for the liver cancer patients were Phy, Fnt, Tot, eating ability, eating appetite, eating enjoyment and self-care ability ($p$s < 0.05). All QoL, except Emt, and psychosocial scores predicted overall survival for the lung cancer sample ($p$s < 0.05). Excepting pain in the case of the lung cancer sample (HR = 1.076, 95% CI: 1.032, 1.121, $p < 0.005$), all significant predictors had associated HRs of less than 1.0.

### 3.3. *Multivariate Cox regression models*

After adjustment for sociodemographic and clinical factors, no FACT-G(Ch) variables were retained in Model 1 (Table 3). Only eating appetite was retained (HR = 0.852, 95% CI: 0.790, 0.920, $p < 0.001$), suggesting that liver cancer patients with a better appetite at baseline had a significantly lowered risk of death. The bias-corrected ROC AUC for this final model was 0.76 (95% CI: 0.674, 0.847, $p < 0.001$). Two significant predictors of survival were retained in final model for the lung cancer sample (Model 2); these included Phy (HR = 0.941, 95% CI: 0.919, 0.964, $p < 0.001$) and eating appetite (HR = 0.888, 95% CI: 0.837, 0.942, $p < 0.001$). Lung cancer patients with better baseline physical status and appetite had a significantly lowered risk of death. Functional well-being was retained in the final model for the lung cancer sample, though it did not achieve statistical significance (HR = 1.023, 95% CI: 0.997, 1.050, NS). The bias-corrected ROC AUC for this model was 0.75 (95% CI: 0.696, 0.804, $p < 0.001$). We also explored the impact of QoL scores on survival by excluding depression from Model 2. The *post hoc* analyses yielded the same results in that physical well-being remained the only QoL score predictive of lung cancer survival.

To ensure that this result was not due solely to low power, particularly among the liver cancer group, the two multivariate models were re-run this time including all subjects with missing data on recurrence before baseline and treatment before baseline (liver: $n$ = 252; lung: $n$ = 365). This enables a comparison between the liver group, for whom a large number of additional subjects were included, and the lung group, for whom only very few additional subjects were included. Model 1 was replicated using a bigger dataset. Less advanced cancer stage (HR = 2.159, 95% CI: 1.244, 3.749, $p < 0.01$) and better appetite (HR = 0.891, 95% CI: 0.823, 0.965, $p < 0.005$) were significantly associated with longer survival in the liver cancer sample (ROC AUC: 0.189; 95% CI: 0.127, 0.250,$p < 0.001$). After controlling for sociodemographics and disease stage, physical (HR = 0.944, 95% CI: 0.922, 0.960, $p < 0.001$) and functional well-being (HR = 1.029, 95% CI: 1.002, 1.057, $p < 0.05$) were significant predictors of lung cancer survival. Eating appetite (HR = 0.852, 95% CI: 0.790, 0.920, $p < 0.001$), eating enjoyment

**Table 2 – Univariate Cox regression analyses[a] of FACT-G(Ch) and psychosocial predictors**

| Predictors | Liver cancer[b] ($n$ = 176) | | | | Lung cancer[c] ($n$ = 358) | | | |
|---|---|---|---|---|---|---|---|---|
| | Mean (SD) | HR[d] | 95% CI | $p$-Value | Mean (SD) | HR[d] | 95% CI | $p$-Value |
| *FACT-G(Ch) Subscales*[e] | | | | | | | | |
| Physical well-being | 20.95 (6.16) | 0.953 | 0.927, 0.980 | 0.001 | 20.59 (5.74) | 0.937 | 0.919, 0.956 | <0.001 |
| Social/family well-being | 17.74 (4.42) | 0.992 | 0.956, 1.031 | 0.693 | 18.54 (4.32) | 0.970 | 0.944, 0.997 | 0.028 |
| Emotional well-being | 13.80 (3.83) | 0.981 | 0.938, 1.026 | 0.395 | 13.88 (3.95) | 0.979 | 0.950, 1.010 | 0.178 |
| Functional well-being | 12.90 (5.97) | 0.961 | 0.933, 0.990 | 0.009 | 12.04 (5.21) | 0.977 | 0.955, 1.000 | 0.049 |
| Total | 71.62 (13.45) | 0.985 | 0.973, 0.997 | 0.014 | 70.27 (12.92) | 0.979 | 0.971, 0.989 | <0.001 |
| *Psychosocial variables*[f] | | | | | | | | |
| Eating ability | 7.51 (2.44) | 0.881 | 0.824, 0.942 | <0.001 | 7.21 (2.10) | 0.853 | 0.807, 0.901 | <0.001 |
| Eating appetite | 6.78 (2.39) | 0.837 | 0.778, 0.901 | <0.001 | 6.59 (2.21) | 0.845 | 0.801, 0.890 | <0.001 |
| Eating enjoyment | 6.74 (2.83) | 0.928 | 0.876, 0.982 | 0.010 | 6.49 (2.45) | 0.910 | 0.869, 0.952 | <0.001 |
| Pain[g] | 2.07 (2.76) | 1.053 | 0.989, 1.120 | 0.106 | 2.53 (2.85) | 1.076 | 1.032, 1.121 | 0.001 |
| Self-care ability | 8.87 (2.53) | 0.927 | 0.862, 0.997 | 0.041 | 8.16 (2.97) | 0.932 | 0.896, 0.970 | <0.001 |
| Current perceived health | 2.46 (0.87) | 0.825 | 0.671, 1.014 | 0.067 | 2.40 (0.84) | 0.806 | 0.697, 0.933 | 0.004 |
| Depression | 2.99 (1.32) | 0.948 | 0.831, 1.081 | 0.426 | 3.03 (1.23) | 0.904 | 0.821, 0.995 | 0.040 |

*Note:* HR, hazard ratio; 95% CI: 95% confidence interval; FACT-G(Ch), the Chinese version of the Functional Assessment of Cancer Therapy-General.
a Survival time was defined as the period between the date of baseline interview and the date of death.
b Number of deaths = 133, number of censored = 43.
c Number of deaths = 246, number of censored = 72.
d HRs greater than 1.00 reflected an increased risk of death or poorer survival.
e Higher scores reflected better health-related quality of life.
f Except 'Pain', higher scores on all psychosocial variables reflected better psychosocial status. All psychosocial variables were entered into the Cox models as continuous linear functions.
g Higher scores indicated higher intensity of pain.

**Table 3 – Final multivariate Cox regression models[a]**

| Predictors | Liver cancer[b] ($n$ = 176) | | | Lung cancer[c] ($n$ = 358) | | |
|---|---|---|---|---|---|---|
| | Model 1 | | | Model 2 | | |
| | HR[d] | 95% CI | $p$-Value | HR[d] | 95% CI | $p$-Value |
| Age | | | | 1.016 | 1.003, 1.029 | 0.013 |
| *Disease-related variables* | | | | | | |
| Cancer stage | 2.574 | 1.183, 5.601 | 0.017 | 1.978 | 1.455, 2.690 | <0.001 |
| Treatment before baseline | | | | 0.671 | 0.473, 0.953 | 0.026 |
| *FACT-G(Ch) Subscales*[e] | | | | | | |
| Physical well-being | | | | 0.941 | 0.919, 0.964 | <0.001 |
| Functional well-being | | | | 1.023 | 0.997, 1.050 | 0.079 |
| *Psychosocial variable*[f] | | | | | | |
| Eating appetite | 0.852 | 0.790, 0.920 | <0.001 | 0.888 | 0.837, 0.942 | <0.001 |

*Note:* HR, hazard ratio; 95% CI, 95% confidence interval; Cancer stage, less advanced/more advanced; FACT-G(Ch), the Chinese version of the Functional Assessment of Cancer Therapy-General.
a Survival time is defined as the period between the date of baseline interview and the date of death.
b Number of deaths = 133, number of censored = 43.
c Number of deaths = 281, number of censored = 77.
d Hazard ratios greater than 1.0 reflected an increased risk of death or poorer survival where 95% CI does not include 1.0 and reduced risk when less than 1.0 when 95%CI excludes 1.0.
e Higher scores reflected better health-related quality of life. All FACT-G(Ch) variables were entered into the Cox models as continuous linear functions.
f Higher scores reflected better psychosocial status. All psychosocial variables were entered into the Cox models as continuous linear functions.

(HR = 0.837, 95% CI: 0.772, 0.906, $p < 0.001$) and self-care ability (HR = 0.954, 95% CI: 0.912, 0.997, $p < 0.05$) also emerged as significant predictors among this inclusive lung cancer sample (ROC AUC: 0.244; 95% CI: 0.190, 0.297, $p < 0.001$).

## 4. Discussion

This study has some limitations. Single items measures of well-being may limit conclusiveness. Despite offering sim-

plicity and enhancing response rates among sick patients, they lack robustness and can have lower validity. However, elsewhere, a single-item measure of depression ('Do you often feel sad or depressed?') accurately classified more than 80% of elderly patients[32] or patients with stroke,[33] and both sets of findings were confirmed using standardised depression scales. For logistical reasons, we were unable to use standardised scales to tap psychological distress, which is assumed to be multidimensional. To overcome this shortcoming, future studies should employ standardised measures in order to more readily determine the relationship of psychosocial well-being, QoL and survival.

All fully adjusted multivariate Cox analyses showed that, in contrast to previous reports,[6–8] the FACT-G(Ch) total score, a global measure of QoL, did not predict survival in liver or lung cancer patients. No baseline QoL scores predicted survival in liver patients. Substantially increasing the sample size of liver patients did not increase predictive power for QoL. This is therefore likely to be a robust effect and not artifact. Among lung cancer patients, physical well-being was the only significant QoL score predicting survival (Model 2), agreeing with previous studies that physical well-being or status consistently accounts for the majority predictive power of QoL on survival time.[1,5,10,14] This was found to be the case irrespective of inclusion of treatment or not. Functional QoL became marginally significant when treatment was excluded. As such, these QoL indicators probably reflect physical deterioration from the disease and hence are probably not causal.

The predictive ability of QoL sub-scores on survival differed markedly between the liver and lung patients. After full adjustment, baseline QoL scores did not predict survival for liver cancer patients, even after exclusion of treatment influences and corresponding increase in power. The results of the ROC AUC for the liver cancer models (Model 1) suggested that with the two factors, cancer stage and eating appetite, retained in the model, it is possible to predict which of the two liver patients will live longer in 76% of cases. The non-significant findings of QoL scores in multivariate survival models for the liver cancer sample indicate that QoL measures are not useful in predicting overall survival in patients with primary hepatocellular carcinoma. These findings contribute to the scarcity of data on the QoL-survival association for liver cancer, whereas the association has been widely investigated in other tumour types such as breast and lung.

Disease stage was the strongest survival predictor for both samples. It was also the only significant disease-related predictor for liver patients. Age and treatment were significant predictors of lung cancer survival. Despite studying a reasonably heterogeneous group of cancer patients, there were no significant differences in overall survival time and QoL scores between the liver and lung samples.

Pain did not emerge as a significant predictor of survival in both multivariate models, contrary to prior reports.[10,34–36] Consistent with previous reports,[36,37] eating appetite consistently predicted survival in both multivariate models. While eating dysfunction, especially loss of appetite, is a common somatic symptom of depression, the possibility that the association between eating function and survival in the present study was confounded by depression could be ruled out since we controlled for depression in all multivariate models. These data highlight the potentially important role of eating function, particularly appetite, in cancer patients and as a prognostic marker. Although the mechanism by which eating function influences cancer survival remains unclear, and may reflect cachexic-linked processes, these associations deserve closer investigation. Our conclusions, as with all studies, should be treated as tentative until replicated.

## Conflict of interest statement

None declared.

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