

Marital status does not affect the cancer-specific survival of patients with upper tract urothelial carcinoma treated with nephroureterectomy: a propensity score matching study

Weipu Mao*, Jianping Wu*, Keyi Wang*, Bin Xu and Ming Chen 

Abstract

Background: The purpose of this study was to investigate the relationship between marital status and the prognosis of patients with upper tract urothelial carcinoma (UTUC) treated with nephroureterectomy (NU).

Methods: Patients with UTUC who received NU treatment were identified from the Surveillance, Epidemiology, and End Results (SEER) database between 2004 and 2015. Kaplan–Meier curves and Cox regression were used to analyze the effect of marital status on cancer-specific survival (CSS), and 1:1 propensity score matching (PSM) was performed for married and unmarried patients to explore further the effect of marital status on patients with UTUC.

Results: Among 1565 eligible patients, 960 (61.3%) were married and 605 (38.7%) were unmarried, of which 146 (9.3%) were divorced/separated, 306 (19.6%) were widowed, and 153 (9.8%) were single. Multivariate Cox regression analysis showed that marital status was not an independent risk factor for patients with UTUC treated with NU. After stratification by grade and SEER stage, multivariate analysis showed that there was no significant difference in 5-year CSS between divorced/separated, widowed, and single patients compared with married patients in different grades and SEER stages. In addition, after PSM analysis, marital status was still not an independent risk factor for patients with UTUC treated with NU.

Conclusion: For patients with UTUC treated with NU, marital status has no prognostic effect on CSS.

Keywords: marital status, nephroureterectomy, Surveillance, Epidemiology, and End Results database, survival outcome, upper tract urothelial carcinoma

Received: 21 July 2020; revised manuscript accepted: 26 November 2020.

Background

Upper tract urothelial carcinoma (UTUC) refers to urothelial malignant tumors that occur in the renal pelvis, calyceal system, and the entire segment of the ureter, including renal pelvis cancer and ureteral carcinoma, which accounts for about 5–10% of urothelial cancer.^{1,2} Compared with bladder cancer, at the time of onset, more patients

with a combination of bladder cancer at the time of onset have a worse prognosis.³ UTUC has the characteristics of multicentric tumor growth and urinary dissemination tendency, and the tumor recurrence rate of residual renal pelvis or ureteral tissue after simple lesions and partial urethral resection was relatively high.⁴ The current gold standard for high-risk UTUC is

Ther Adv Urol

2020, Vol. 12: 1–15

DOI: 10.1177/
1756287220981510

© The Author(s), 2020.
Article reuse guidelines:
sagepub.com/journals-
permissions

Correspondence to:

Ming Chen
Department of Urology,
Affiliated Zhongda Hospital
of Southeast University,
No. 87 Dingjiaqiao, Hunan
Road, Gulou District,
Nanjing, 210009, China
mingchenseu@126.com

Bin Xu
Department of Urology,
Affiliated Zhongda Hospital
of Southeast University,
No. 87 Dingjiaqiao, Hunan
Road, Gulou District,
Nanjing, 210009, China
njxb1982@126.com

Weipu Mao
Department of Urology,
Affiliated Zhongda Hospital
of Southeast University,
Nanjing, China

Surgical Research Center,
Institute of Urology,
Southeast University
Medical School, Nanjing,
China

Department of Urology,
Nanjing Lishui District
People's Hospital,
Southeast University,
Nanjing, China

Jianping Wu
Department of Urology,
Affiliated Zhongda Hospital
of Southeast University,
Nanjing, China

Keyi Wang
Department of Urology,
Shanghai Tenth People's
Hospital, Tongji University,
Shanghai, China

*These authors
contributed equally.

radical nephroureterectomy (NU) plus bladder sleeve resection, but there are still 20–30% of patients with extra-urinary tract recurrence after operation.⁵

Marital status has always been closely related to cancer mortality. Many studies have confirmed that marital status may affect the prognosis of a variety of tumors, including bladder cancer,⁶ prostate cancer,⁷ penile cancer,⁸ as well as colorectal carcinoma,⁹ and married patients were considered to have a better survival prognosis. Previous studies have found that marital status was an independent risk factor for UTUC,¹⁰ but no study has reported the effect of marital status on the survival of patients with UTUC treated with NU. Therefore, the purpose of this study was to explore whether marital status has an impact on the survival of patients with UTUC treated with NU through the data extracted from the Surveillance, Epidemiology, and End Results (SEER) database.

Methods

Patient selection

The data presented in our study were retrieved from the SEER database, which is funded by the US National Cancer Institute. The SEER database covers approximately 28% of the US population and includes demographic information and cancer characteristics, such as age at diagnosis, year of diagnosis, race, marital status, insurance status, income status, primary tumor location, tumor grade and stage, histological type, tumor-node-metastasis stage, treatment modality, and survival time.¹¹ The National Cancer Institute's SEER × Stat software [version 8.3.5; SEER 18 Regs Custom Data (with additional treatment fields), November 2018 Sub (1975–2016 varying) database] was used in this study. Using the 'primary site-labeled' variable codes C65.9 – Renal pelvis and C66.9 – Ureter, we identified 15,119 patients between 1 January 2010 and 31 December 2015.

Exclusion criteria in our study were as follows: (a) marital status unknown or domestic partner ($n=723$); (b) patients under 18 years of age ($n=2$); (c) unknown survival time ($n=30$); (d) not one primary tumor only ($n=7185$); (e) surgery code not 50, 70, 80 ($n=5510$); (f) histology type not transitional cell carcinoma ($n=104$). Finally, we left 1565 eligible patients diagnosed with UTUC.

Study variables

Variable definition information about age at diagnosis, year of diagnosis, sex, race, marital status, histological type, tumor grade, SEER stage, radiotherapy, chemotherapy, median household income, and survival time can be found in the SEER database. The starting point for the follow up was the date of diagnosis of UTUC, and the endpoint was cancer-specific death or the last follow up in December 2015. When analyzing cancer-specific survival (CSS), mortality cases associated with other causes were excluded.

Statistical analysis

Age and household income (Figure S1) were categorically divided based on the optimal cut-off value generated by X-tile software (Version 3.6.1). Chi-square analysis was performed to evaluate clinical characteristics of patients with UTUC treated with NU. Kaplan–Meier curves were used to estimate the CSS of patients with UTUC treated with NU, and the differences between the curves were analyzed by log-rank test. Univariate and multivariate Cox regression models were performed to estimate the hazard ratios and 95% confidence intervals to analyze independent prognostic factors of patients with UTUC treated with NU.

Patients were divided into a married group and an unmarried group according to marital status. The 1:1 propensity score matching (PSM) reduced the selection bias of two groups of baseline variables, including year of diagnosis, age at diagnosis, sex, race, primary site, grade, SEER stage, radiotherapy, chemotherapy, and household income (Figure S2). After PSM, the impact of marital status on the entire cohort and different grades and SEER stages were re-evaluated. The Statistical Package for the Social Sciences software (version 24.0; SPSS, Chicago, IL, USA) and R software (version 3.5.1, <http://www.r-project.org/>) were used for all statistical analyses. p value < 0.05 (two-sided) was considered statistically significant.

Results

Demographic and clinicopathologic characteristics

According to the screening criteria in Figure 1, a total of 1565 eligible patients with UTUC treated with NU were included in our study cohort from 2004 to 2015, of which 960 (61.3%) were married, 146 (9.3%) were divorced/separated, 306 (19.6%) were widowed, and 153 (9.8%) were

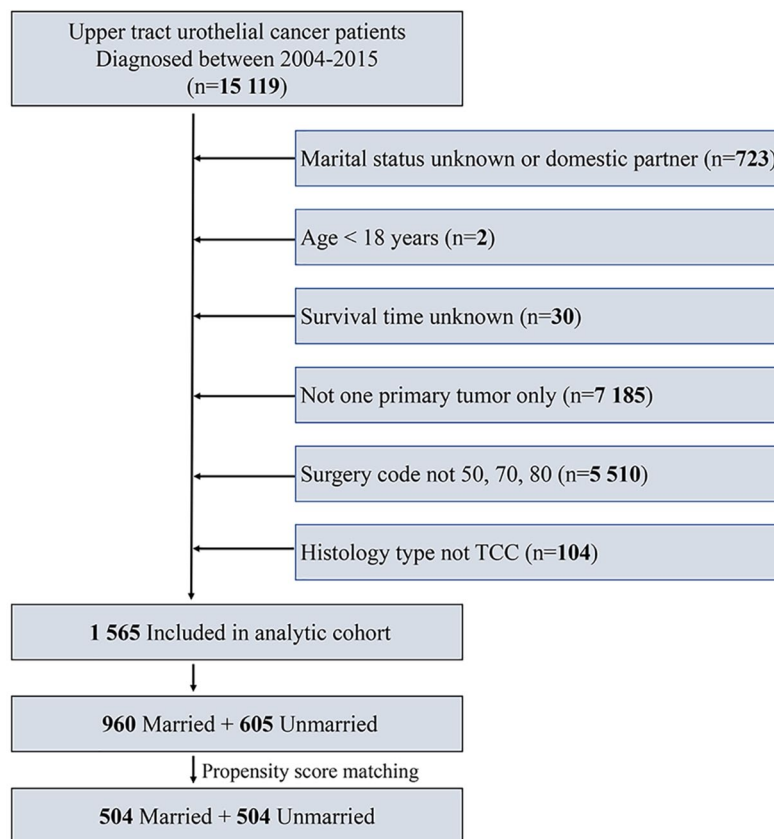


Figure 1. Schematic flow diagram of inclusion and exclusion criteria for the study cohort. TCC, transitional cell cancer.

single. Table 1 shows the demographic and clinical characteristics of patients with UTUC treated with NU. In the whole cohort, 1250 (79.9%) were patients with renal pelvis cancer and 315 (20.1%) with ureter cancer. The majority of patients were men (56.2%), ≤ 76 years (64.9%), grade IV (48.9%), regional (63.1%), and no radiotherapy (92.8%) or chemotherapy (72.8%). In addition, chi-square tests showed differences in sex, age, race, and chemotherapy between married and unmarried groups or between married, divorced/separated, widowed, and single groups. The proportion of women (77.1% *versus* 33.5%, 43.8%, 41.8%), > 76 years (65.7% *versus* 29.6%, 24.7%, 19.0%), did not receive chemotherapy (84.6% *versus* 69.1%, 75.3%, 69.9%) in the widowed group was higher than in other groups.

Identification of prognostic factors of CSS before PSM

Univariate and multivariate Cox regression were used to analyze the factors associated with CSS of patients with UTUC treated with NU (Table 2).

Univariate and multivariate Cox regression analyses showed that age, primary site, grade, SEER stage, radiotherapy, and chemotherapy were related factors (all $p < 0.05$) of CSS in patients with UTUC treated with NU, while marital status was not an independent risk factor for CSS (Figure 2).

Subsequently, after stratification by grade and SEER stages, univariate analysis showed that marital status was not related to CSS of the different grades and SEER stages (Figures 3 and S3). Multivariate analysis showed that there was no significant difference in 5-year CSS between married and unmarried or divorced/separated, widowed, and single patients; marital status was not an independent risk factor for CSS in patients in the different grades and SEER stages (Table 3).

Identification of prognostic factors of CSS after PSM

After year of diagnosis, age at diagnosis, sex, race, primary site, grade, SEER stage, radiotherapy,

Table 1. Baseline demographic and clinical characteristics of upper tract urothelial carcinoma patients in our study.

Characteristic	All	Married	Unmarried				p value*	p value [§]
			Total	Divorced/ separated	Widowed	Single		
	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)		
Total	1565	960 (61.3)	605 (38.7)	146 (9.3)	306 (19.6)	153 (9.8)		
Year of diagnosis							0.411	0.294
2004–2007	509 (32.5)	313 (32.6)	196 (32.4)	42 (28.8)	109 (35.6)	45 (29.4)		
2008–2011	546 (34.9)	324 (33.8)	222 (36.7)	54 (37.0)	115 (37.6)	53 (34.6)		
2012–2015	510 (32.6)	323 (33.6)	187 (30.9)	50 (34.2)	82 (26.8)	55 (35.9)		
Sex							<0.001	<0.001
Male	879 (56.2)	638 (66.5)	241 (39.8)	82 (56.2)	70 (22.9)	89 (58.2)		
Female	686 (43.8)	322 (33.5)	364 (60.2)	64 (43.8)	236 (77.1)	64 (41.8)		
Age at diagnosis, years							<0.001	<0.001
≤76	1015 (64.9)	676 (70.4)	339 (56.0)	110 (75.3)	105 (34.3)	124 (81.0)		
>76	550 (35.1)	284 (29.6)	266 (44.0)	36 (24.7)	201 (65.7)	29 (19.0)		
Race							0.001	<0.001
White	1353 (86.5)	833 (86.8)	520 (86.0)	131 (89.7)	257 (84.0)	132 (86.3)		
Black	72 (4.6)	31 (3.2)	41 (6.8)	11 (7.5)	16 (5.2)	14 (9.2)		
Other	140 (8.9)	96 (10.0)	44 (7.3)	4 (2.7)	33 (10.8)	4 (4.6)		
Primary site							0.676	0.234
Renal pelvis	1250 (79.9)	770 (80.2)	480 (79.3)	114 (78.1)	236 (77.1)	130 (85.0)		
Ureter	315 (20.1)	190 (19.8)	125 (20.7)	32 (21.9)	70 (22.9)	23 (15.0)		
Grade							0.960	0.035
Grade I	38 (2.4)	22 (2.3)	16 (2.6)	6 (4.1)	8 (2.6)	2 (1.3)		
Grade II	158 (10.1)	95 (9.9)	63 (10.4)	19 (13.0)	27 (8.8)	17 (11.1)		
Grade III	480 (30.7)	298 (31.0)	182 (30.1)	28 (19.2)	105 (34.3)	49 (32.0)		
Grade IV	766 (48.9)	472 (49.2)	294 (48.6)	72 (49.3)	145 (47.4)	77 (50.3)		
Unknown	123 (7.9)	73 (7.6)	50 (8.3)	21 (14.4)	21 (6.9)	8 (5.2)		
SEER stage							0.579	0.814
Localized	263 (16.8)	152 (15.8)	111 (18.3)	29 (19.9)	59 (19.3)	23 (15.0)		
Regional	988 (63.1)	615 (64.1)	373 (61.7)	86 (58.9)	191 (62.4)	96 (62.7)		
Distant	303 (19.4)	187 (19.5)	116 (19.2)	29 (19.9)	54 (17.6)	33 (21.6)		

(Continued)

Table 1. (Continued)

Characteristic	All	Married	Unmarried				<i>p</i> value*	<i>p</i> value [§]
			Total	Divorced/ separated	Widowed	Single		
			No. (%)	No. (%)	No. (%)	No. (%)		
Unstaged	11 (0.7)	6 (0.6)	5 (0.8)	2 (1.4)	2 (0.7)	1 (0.7)		
Radiotherapy							0.038	0.148
No	1453 (92.8)	881 (91.8)	572 (94.5)	138 (94.5)	292 (95.4)	142 (92.8)		
Yes	112 (7.2)	79 (8.2)	33 (5.5)	8 (5.5)	14 (4.6)	11 (7.2)		
Chemotherapy							<0.001	<0.001
No	1139 (72.8)	663 (69.1)	476 (78.7)	110 (75.3)	259 (84.6)	107 (69.9)		
Yes	426 (27.2)	297 (30.9)	129 (21.3)	36 (24.7)	47 (15.4)	46 (30.1)		
Median household income							0.404	0.965
≤US\$43,930	807 (51.6)	487 (50.7)	320 (52.9)	77 (52.7)	163 (53.3)	80 (52.3)		
>US\$43,930	758 (48.4)	473 (49.3)	285 (47.1)	69 (47.3)	143 (46.7)	73 (47.7)		

Percentages may not total 100 because of rounding.
*Chi-square detected the difference between the married group and unmarried group.
[§]Chi-square detected the difference between the married group, divorced/separated group, widowed group, and single group.
Grade I, well differentiated; Grade II, moderately differentiated; Grade III, poorly differentiated; Grade IV, undifferentiated.
SEER, Surveillance, Epidemiology, and End Results.

Table 2. Univariate and multivariate analysis of CSS rates before propensity score matching.

Characteristic	CSS			
	Univariate analysis		Multivariate analysis*	
	HR (95% CI)	<i>p</i> value	HR (95% CI)	<i>p</i> value
Sex				
Male	Reference			
Female	0.99 (0.83–1.18)	0.915		
Age at diagnosis, years				
≤76	Reference		Reference	
>76	1.39 (1.16–1.66)	<0.001	1.37 (1.14–1.66)	0.001
Race				
White	Reference			
Black	1.22 (0.83–1.79)	0.324		
Other	1.31 (0.97–1.76)	0.077		

(Continued)

Table 2. (Continued)

Characteristic	CSS			
	Univariate analysis		Multivariate analysis*	
	HR (95% CI)	p value	HR (95% CI)	p value
Primary site				
Renal pelvis	Reference		Reference	
Ureter	0.62 (0.48–0.79)	<0.001	0.65 (0.50–0.84)	0.001
Marital status				
Married	Reference			
Unmarried	0.94 (0.78–1.13)	0.540		
Divorced/separated	0.81 (0.58–1.12)	0.210		
Widowed	0.96 (0.76–1.22)	0.737		
Single	1.05 (0.78–1.42)	0.732		
Grade				
Grade I	–		–	
Grade II	Reference		Reference	
Grade III	3.07 (2.04–4.62)	<0.001	1.95 (1.28–2.95)	0.002
Grade IV	2.60 (1.72–3.89)	<0.001	1.81 (1.20–2.72)	0.005
Unknown	1.98 (1.19–3.30)	0.009	1.31 (0.77–2.22)	0.313
SEER stage				
Localized	Reference		Reference	
Regional	4.57 (2.99–6.97)	<0.001	3.92 (2.55–6.02)	<0.001
Distant	16.26 (10.48–25.22)	<0.001	13.60 (8.57–21.57)	<0.001
Unstaged	5.41 (1.88–15.55)	0.002	5.46 (1.83–16.28)	0.008
Radiotherapy				
No	Reference		Reference	
Yes	2.72 (2.10–3.52)	<0.001	1.97 (1.52–2.55)	<0.001
Chemotherapy				
No	Reference		Reference	
Yes	1.43 (1.19–1.73)	<0.001	0.71 (0.58–0.86)	0.001
Median household income				
≤US\$43,930	Reference			
>US\$43,930	0.86 (0.72–1.03)	0.103		

*Model was adjusted by age, primary site, grade, SEER stage, and treatment pattern.

Grade I, well differentiated; Grade II, moderately differentiated; Grade III, poorly differentiated; Grade IV, undifferentiated. CI, confidence interval; CSS, cancer-specific survival; HR, hazard ratio; SEER, Surveillance, Epidemiology, and End Results.

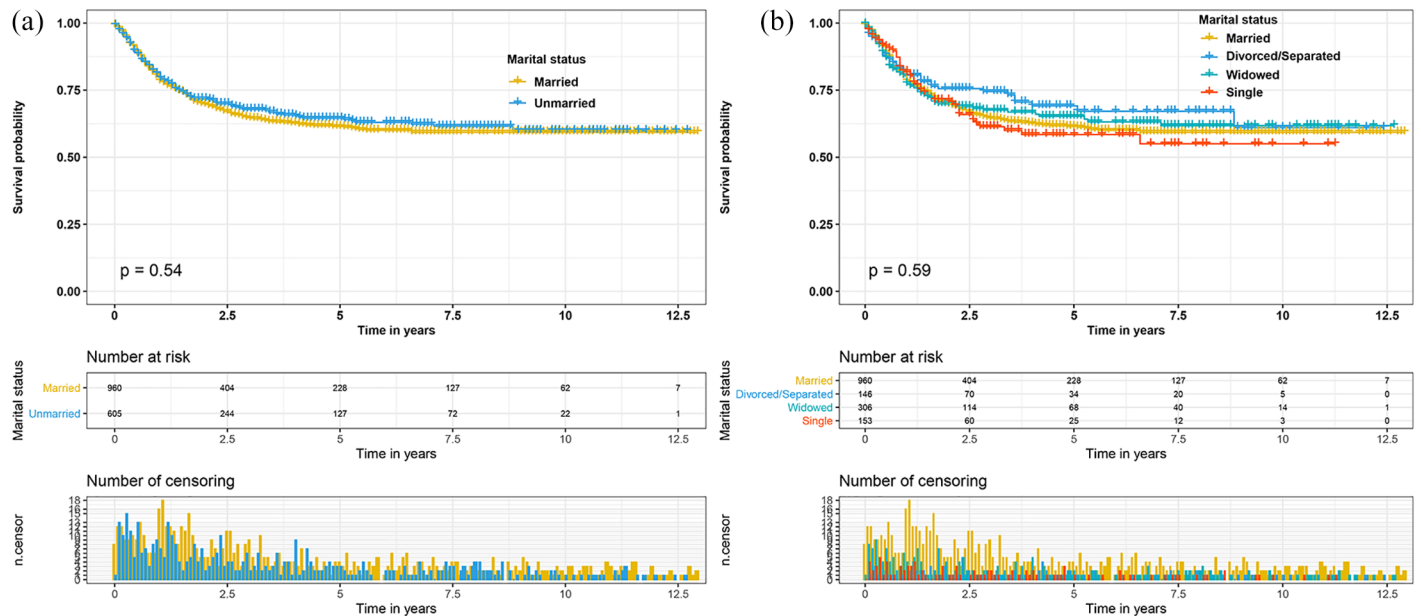


Figure 2. (a) and (b) Cancer-specific survival curves according to marital status in patients with upper tract urothelial carcinoma treated with nephroureterectomy before propensity score matching.

chemotherapy, and household income at 1:1 PSM, we screened 504 married patients and 504 unmarried patients. We performed univariate and multivariate Cox regression analyses on all patients, and found that age, primary site, grade, SEER stage, radiotherapy, chemotherapy, and household income were independent risk factors (Table 4), while marital status was not an independent risk factor for CSS in all patients (Figure 4). After stratification by grade and SEER stage, multivariate analysis showed that there was no significant difference in 5-year CSS between married and unmarried or divorced/separated, widowed, and single patients (Table 5); marital status was not an independent risk factor for the different grades and SEER stages in patient CSS (Figures 5 and S4).

Discussion

In this 12-year retrospective study, we conducted a multivariate Cox regression analysis of a large number of patients with UTUC who received NU treatment through the SEER database, and found that marital status was not an independent risk factor for CSS. After stratifying by grade and SEER stage, multivariate analysis showed that there was no significant difference in 5-year CSS between married and unmarried or divorced/separated, widowed, and single

patients. In addition, marital status was still not an independent risk factor for patients with UTUC treated with NU after PSM.

Marital status was widely regarded as an independent prognostic factor for many tumors.^{12–15} However, the impact of marital status on the outcome of surgical patients was still a controversial topic. Wu *et al.*¹⁶ investigated 13,408 patients with hepatocellular carcinoma (HCC) who underwent surgical resection and found that marital status was an independent risk factor, and widowed patients had the highest risk of death. Roubion *et al.*¹⁷ investigated the relationship between marital status and prognosis of 422 patients undergoing total knee arthroplasty, and found that the overall prognosis of married patients after total knee arthroplasty was better. Wang *et al.*¹⁸ collected data from 10,852 patients with UTUC from the SEER database between 1988 and 2015 and found that marital status was a predictor of overall survival and CSS in patients with UTUC, and widowed patients had the worst overall survival and CSS. These studies showed that married patients have higher survival rates than unmarried patients.

In contrast, a few studies have shown that marital status does not affect the survival outcomes of surgical patients. Gatchel *et al.*¹⁹ found no

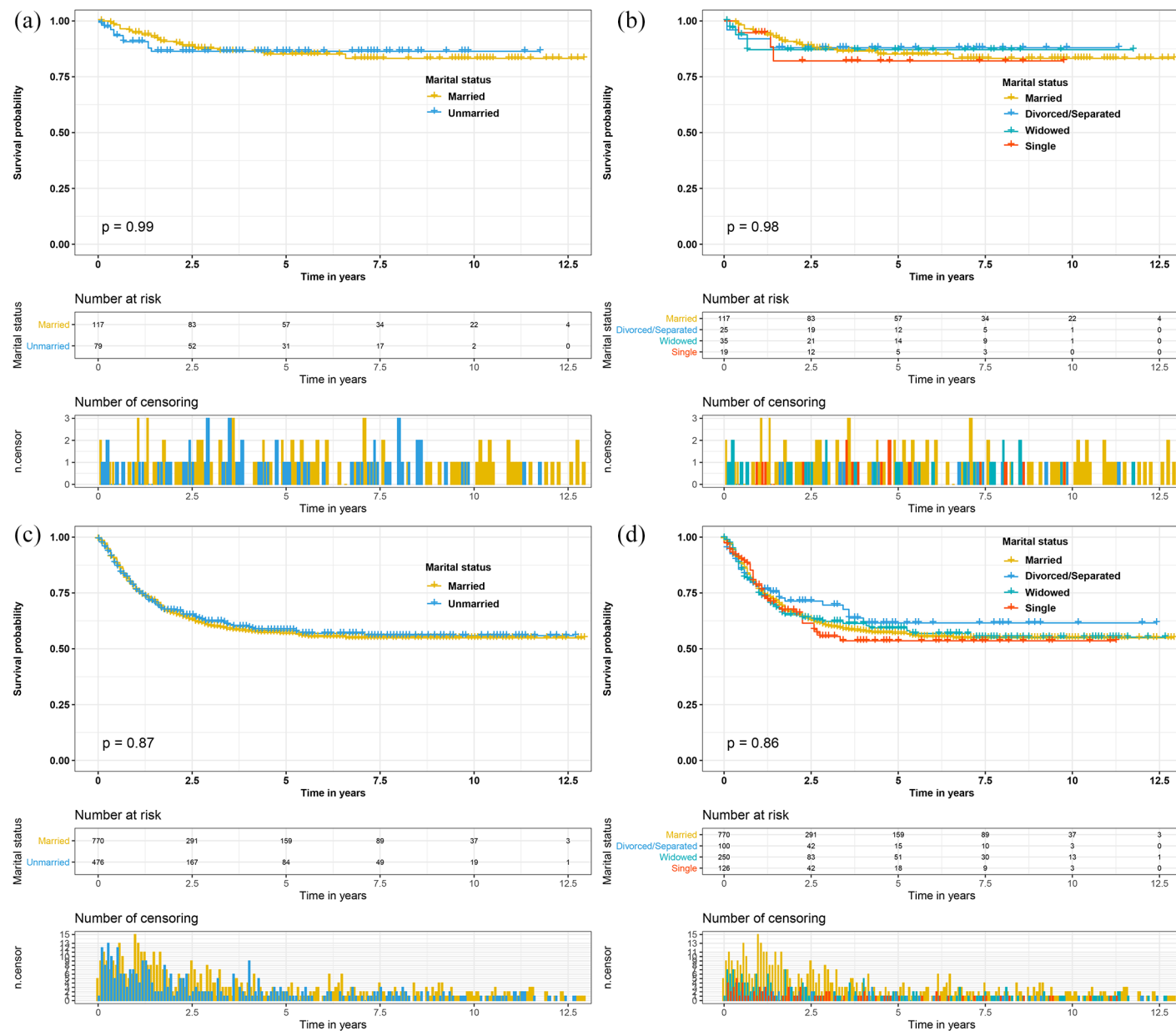


Figure 3. Cancer-specific survival curves of patients with upper tract urothelial carcinoma treated with nephroureterectomy according to marital status in different grades before propensity score matching. (a) and (b) Cancer-specific survival times in grade I/II patients. (c) and (d) Cancer-specific survival times in grade III/IV patients.

significant correlation between marital status and surgical outcome in a study of 1679 patients with consecutive chronically disabled work-related spinal disorders. Sorensen *et al.*²⁰ conducted a prospective study of 57 patients who underwent surgery for slipped lumbar disc and did not find that marital status could be used as an indicator of postoperative prognosis. Reyngold *et al.*²¹ found that there was no association between

marital status and overall survival or disease-free survival in patients with pancreatic cancer who received adjuvant postoperative chemotherapy followed by external radiotherapy and chemotherapy. In addition, Yan *et al.*²² found that marital status had no prognostic effect on survival based on the analysis of 1581 patients with less differentiated HCC who underwent surgery between 2004 and 2015. Similar to the above

Table 3. Multivariate analysis of CSS rates based on primary site before propensity score matching.

Characteristic	Total	5-year CSS	CSS*	
			HR (95% CI)	<i>p</i> value
Grade I/II				
Marital status				
Married	117	85%	Reference	
Unmarried	79	86%	1.00 (0.45–2.19)	0.990
Divorced/separated	25	88%	0.86 (0.25–2.94)	0.807
Widowed	35	87%	0.98 (0.33–2.92)	0.967
Single	19	82%	1.22 (0.36–4.20)	0.750
Grade III/IV				
Marital status				
Married	770	57%	Reference	
Unmarried	476	58%	0.98 (0.81–1.20)	0.868
Divorced/separated	100	62%	0.86 (0.60–1.25)	0.442
Widowed	250	59%	1.00 (0.78–1.28)	0.992
Single	126	54%	1.05 (0.76–1.45)	0.756
Localized				
Marital status				
Married	152	88%	Reference	
Unmarried	111	93%	0.59 (0.24–1.43)	0.243
Divorced/separated	29	89%	1.07 (0.31–3.67)	0.915
Widowed	59	96%	0.31 (0.07–1.34)	0.117
Single	23	91%	0.77 (0.18–3.34)	0.725
Regional				
Marital status				
Married	615	63%	Reference	
Unmarried	373	63%	1.07 (0.84–1.35)	0.586
Divorced/separated	86	78%	0.68 (0.45–0.99)	0.079
Widowed	191	60%	1.26 (0.94–1.69)	0.122
Single	96	56%	1.28 (0.89–1.86)	0.189
Distant				
Marital status				
Married	187	23%	Reference	
Unmarried	116	27%	0.98 (0.71–1.36)	0.921
Divorced/separated	29	15%	1.43 (0.89–2.31)	0.144
Widowed	54	29%	0.94 (0.61–1.46)	0.790
Single	33	34%	0.71 (0.40–1.26)	0.237

*Model was adjusted by age, primary site, grade, SEER stage, and treatment pattern.
CI, confidence interval; CSS, cancer-specific survival; HR, hazard ratio; SEER, SEER, Surveillance, Epidemiology, and End Results.

Table 4. Univariate and multivariate analyses of CSS rates after the 1:1 propensity score matching sample.

Characteristic	CSS			
	Univariate analysis		Multivariate analysis*	
	HR (95% CI)	p value	HR (95% CI)	p value
Sex				
Male	Reference			
Female	0.98 (0.78–1.22)	0.825		
Age at diagnosis, years				
≤76	Reference		Reference	
>76	1.44 (1.15–1.80)	0.002	1.34 (1.06–1.69)	0.013
Race				
White	Reference			
Black	1.26 (0.78–2.02)	0.347		
Other	1.04 (0.67–1.61)	0.872		
Primary site				
Renal pelvis	Reference		Reference	
Ureter	0.64 (0.47–0.88)	0.007	0.70 (0.51–0.96)	0.028
Marital status				
Married	Reference			
Unmarried	0.92 (0.73–1.14)	0.441		
Divorced/separated	0.79 (0.56–1.13)	0.206		
Widowed	0.87 (0.65–1.17)	0.362		
Single	1.12 (0.81–1.54)	0.490		
Grade				
Grade I	–	–	–	
Grade II	Reference		Reference	
Grade III	3.13 (1.88–5.20)	<0.001	1.84 (1.09–3.10)	0.022
Grade IV	2.73 (1.66–4.49)	0.001	1.84 (1.10–3.05)	0.019
Unknown	2.00 (1.06–3.78)	0.034	1.37 (0.71–2.65)	0.350
SEER stage				
Localized	Reference		Reference	
Regional	4.84 (2.91–8.05)	<0.001	4.25 (2.54–7.12)	<0.001
Distant	17.46 (10.28–29.63)	<0.001	15.35 (8.79–26.81)	<0.001
Unstaged	7.40 (2.17–25.25)	0.002	7.44 (2.06–26.88)	0.002

(Continued)

Table 4. (Continued)

Characteristic	CSS			
	Univariate analysis		Multivariate analysis*	
	HR (95% CI)	p value	HR (95% CI)	p value
Radiotherapy				
No	Reference		Reference	
Yes	2.86 (2.01–4.06)	<0.001	1.95 (1.35–2.83)	<0.001
Chemotherapy				
No	Reference		Reference	
Yes	1.51 (1.18–1.94)	0.001	0.70 (0.53–0.93)	0.013
Median household income				
≤US\$43,930	Reference		Reference	
>US\$43,930	0.79 (0.63–0.99)	0.040	0.80 (0.63–1.00)	0.047

*Model was adjusted by age, primary site, grade, SEER stage, treatment pattern, and household income. Grade I, well differentiated; Grade II, moderately differentiated; Grade III, poorly differentiated; Grade IV, undifferentiated. CI, confidence interval; CSS, cancer-specific survival; HR, hazard ratio; SEER, Surveillance, Epidemiology, and End Results.

Table 5. Multivariate analysis of CSS rates based on primary site in the 1:1 propensity score matching sample.

Characteristic	Total	5-year CSS	CSS*	
			HR (95% CI)	p value
Grade I/II				
Marital status				
Married	66	81%	Reference	
Unmarried	68	90%	0.56 (0.21–1.52)	0.254
Divorced/separated	24	88%	0.74 (0.21–2.65)	0.643
Widowed	26	100%	–	0.960
Single	18	81%	1.07 (0.30–3.84)	0.916
Grade III/IV				
Marital status				
Married	399	58%	Reference	
Unmarried	394	58%	0.96 (0.76–1.22)	0.732
Divorced/separated	91	63%	0.84 (0.56–1.25)	0.386
Widowed	187	60%	0.94 (0.69–1.27)	0.674
Single	116	51%	1.11 (0.78–1.56)	0.570

(Continued)

Table 5. (Continued)

Characteristic	Total	5-year CSS	CSS*	
			HR (95% CI)	p value
Localized				
Marital status				
Married	97	88%	Reference	
Unmarried	94	93%	0.62 (0.23–1.72)	0.360
Divorced/separated	26	92%	0.80 (0.18–3.64)	0.769
Widowed	47	95%	0.41 (0.09–1.88)	0.252
Single	21	90%	0.89 (0.19–4.04)	0.875
Regional				
Marital status				
Married	308	64%	Reference	
Unmarried	308	63%	1.09 (0.82–1.46)	0.555
Divorced/separated	81	78%	0.62 (0.37–0.99)	0.054
Widowed	138	60%	1.27 (0.89–1.82)	0.184
Single	89	52%	1.43 (0.96–2.13)	0.082
Distant				
Marital status				
Married	97	19%	Reference	
Unmarried	98	30%	0.71 (0.48–1.04)	0.078
Divorced/separated	26	14%	1.22 (0.73–2.05)	0.443
Widowed	42	41%	0.61 (0.39–1.01)	0.063
Single	30	32%	0.68 (0.41–1.18)	0.074
*Model was adjusted by age, primary site, grade, SEER stage, treatment pattern, and household income. Grade I, well differentiated; Grade II, moderately differentiated; Grade III, poorly differentiated; Grade IV, undifferentiated. CI, confidence interval; CSS, cancer-specific survival; HR, hazard ratio; SEER, Surveillance, Epidemiology, and End Results.				

studies, we found that marital status had no significant effect on the prognosis of patients with UTUC treated with NU.

In addition, we also made an interesting discovery: nearly half (48.9%) of the patients included in this study were at grade IV stage. Unlike the study by Wang *et al.*,¹⁸ we found that marital status is not a prognostic factor for patients with UTUC treated with NU, which may be due to the fact

that most patients had a higher stage, poor prognosis, and short survival course.

Despite these conflicting views about the effects of marital status on surgical outcomes, variables in each study should be considered. As most of these studies included heterogeneous cohort study, it is not possible to evaluate properly the usefulness of marital status for the prognosis. Therefore, further prospective studies are

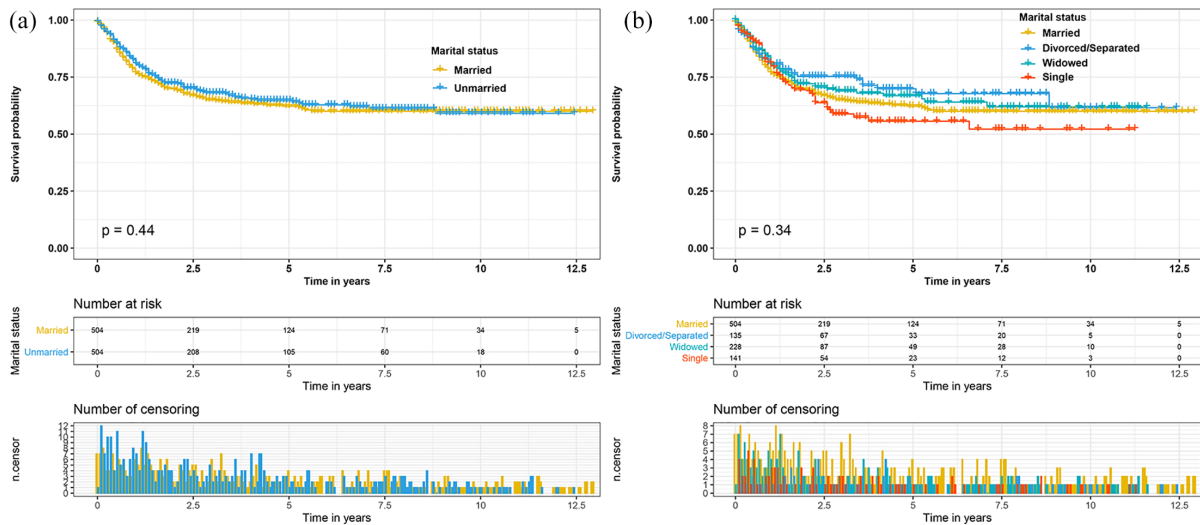


Figure 4. (a) and (b) Cancer-specific survival curves according to marital status in patients with upper tract urothelial carcinoma treated with nephroureterectomy after propensity score matching.

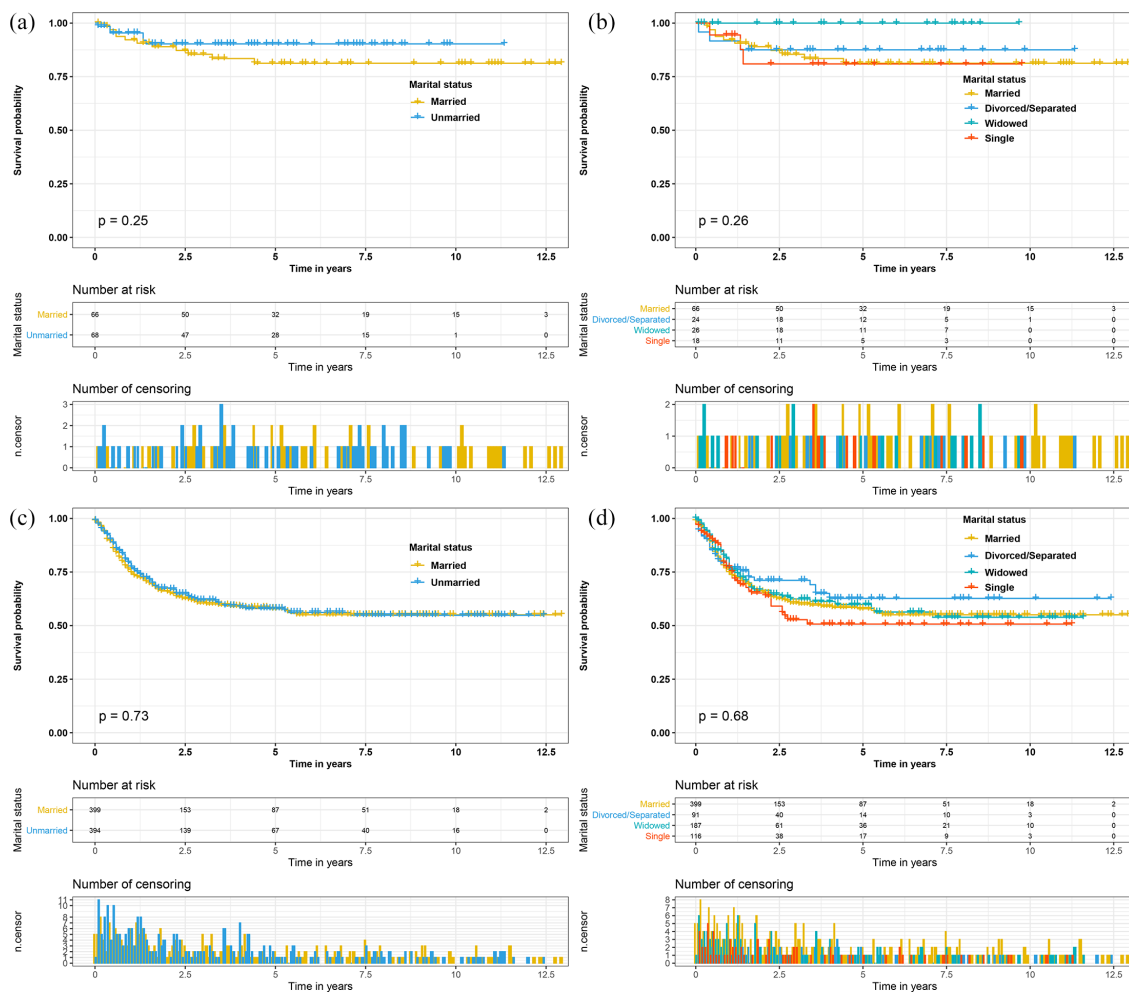


Figure 5. Cancer-specific survival curves of patients with upper tract urothelial carcinoma treated with nephroureterectomy according to marital status in different grades after propensity score matching. (a) and (b) Cancer-specific survival times in grade I/II patients. (c) and (d) Cancer-specific survival times in grade III/IV patients.

needed to investigate the effect of marital status on the prognosis of patients with UTUC treated with NU.

There are limitations to be recognized in this study. First, this study was a retrospective study with obvious limitations. Second, there are no data on parenthood in the SEER database, and having supportive children might be a stronger predictor for longevity. Moreover, the specific content of surgery and other adjuvant therapy (e.g. radiotherapy, chemotherapy, immunotherapy, etc.) was not included, which are also prognostic factors for patients with UTUC.

Conclusion

Our study found that marital status had no prognostic effect on CSS for patients with UTUC treated with NU. After stratification and PSM of the primary site, marital status was still not an independent prognosis factor.

Acknowledgements

We acknowledge the efforts of the SEER Program tumor registries in the creation of the SEER database.

Authors' contributions

WM, BX, and MC studied the concept and design. WM and JW collected the data. WM and KW analyzed and interpreted the data, and drafted the manuscript. BX, JW, and MC critically revised the manuscript for important intellectual content. WM and MC performed the statistical analysis.

Conflict of interest statement

The authors declare that there is no conflict of interest.

Funding

The authors disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This study was supported by the National Natural Science Foundation of China (No. 81572517), the Natural Science Foundation of Jiangsu Province (BK20161434), Jiangsu Provincial Medical Innovation Team (CXTDA2017025), national key research and development projects (SQ2017YFSF090096), and Jiangsu Provincial Medical Talent (ZDRCA2016080).


Ethical approval

Cancer is a reportable disease in every state of the USA. The data in the SEER database do not require informed patient consent. The present study complied with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. This study used previously collected de-identified data, which was deemed exempt from review by the Ethics Committee of the Affiliated Zhongda Hospital of Southeast University and does not require informed patient consent.

Data availability statement

The datasets are available in the SEER repository and can be obtained from <https://seer.cancer.gov>.

ORCID iD

Ming Chen  <https://orcid.org/0000-0002-3572-6886>

Supplemental material

Supplemental material for this article is available online.

References

1. Roupret M, Babjuk M, Comperat E, *et al.* European Association of Urology guidelines on upper urinary tract urothelial carcinoma: 2017 update. *Eur Urol* 2018; 73: 111–122.
2. Siegel RL, Miller KD and Jemal A. Cancer statistics, 2020. *CA Cancer J Clin* 2020; 70: 7–30.
3. Margulis V, Shariat SF, Matin SF, *et al.* Outcomes of radical nephroureterectomy: a series from the upper tract urothelial carcinoma collaboration. *Cancer* 2009; 115: 1224–1233.
4. Yakoubi R, Colin P, Seisen T, *et al.* Radical nephroureterectomy versus endoscopic procedures for the treatment of localised upper tract urothelial carcinoma: a meta-analysis and a systematic review of current evidence from comparative studies. *Eur J Surg Oncol* 2014; 40: 1629–1634.
5. Cummings KB. Nephroureterectomy: rationale in the management of transitional cell carcinoma of the upper urinary tract. *Urol Clin North Am* 1980; 7: 569–578.
6. Datta GD, Neville BA, Kawachi I, *et al.* Marital status and survival following bladder cancer. *J Epidemiol Community Health* 2009; 63: 807–813.
7. Tyson MD, Andrews PE, Etzioni DA, *et al.* Marital status and prostate cancer outcomes. *Can J Urol* 2013; 20: 6702–6706.

8. Mao W, Zhang Z, Huang X, *et al.* Marital status and survival in patients with penile cancer. *J Cancer* 2019; 10: 2661–2669.
9. Li QG, Gan L, Liang L, *et al.* The influence of marital status on stage at diagnosis and survival of patients with colorectal cancer. *Oncotarget* 2015; 6: 7339–7347.
10. Vemana G, Kim EH, Bhayani SB, *et al.* Survival comparison between endoscopic and surgical management for patients with upper tract urothelial cancer: a matched propensity score analysis using Surveillance, Epidemiology and End Results-Medicare data. *Urology* 2016; 95: 115–120.
11. Makkar N, Ostrom QT, Kruchko C, *et al.* A comparison of relative survival and cause-specific survival methods to measure net survival in cancer populations. *Cancer Med* 2018; 7: 4773–4780.
12. Sergesketter AR, Thomas SM, Lane WO, *et al.* The influence of marital status on contemporary patterns of postmastectomy breast reconstruction. *J Plast Reconstr Aesthet Surg* 2019; 72: 795–804.
13. Zhang SL, Wang WR, Liu ZJ, *et al.* Marital status and survival in patients with soft tissue sarcoma: a population-based, propensity-matched study. *Cancer Med* 2019; 8: 465–479.
14. Feng Y, Dai W, Li Y, *et al.* The effect of marital status by age on patients with colorectal cancer over the past decades: a SEER-based analysis. *Int J Colorectal Dis* 2018; 33: 1001–1010.
15. Niu Q, Lu Y, Wu Y, *et al.* The effect of marital status on the survival of patients with bladder urothelial carcinoma: a SEER database analysis. *Medicine (Baltimore)* 2018; 97: e11378.
16. Wu C, Chen P, Qian JJ, *et al.* Effect of marital status on the survival of patients with hepatocellular carcinoma treated with surgical resection: an analysis of 13,408 patients in the Surveillance, Epidemiology, and End Results (SEER) database. *Oncotarget* 2016; 7: 79442–79452.
17. Roubion RC, Fox RS, Townsend LA, *et al.* Does marital status impact outcomes after total knee arthroplasty? *J Arthroplasty* 2016; 31: 2504–2507.
18. Wang K, Mao W, Shi H, *et al.* Marital status impacts survival in patients with upper tract urothelial carcinoma: a population-based, propensity-matched study. *Transl Androl Urol* 2020; 9: 1611–1629.
19. Gatchel RJ, Mayer TG, Kidner CL, *et al.* Are gender, marital status or parenthood risk factors for outcome of treatment for chronic disabling spinal disorders? *J Occup Rehabil* 2005; 15: 191–201.
20. Sorensen LV, Mors O and Skovlund O. A prospective study of the importance of psychological and social factors for the outcome after surgery in patients with slipped lumbar disk operated upon for the first time. *Acta Neurochir (Wien)* 1987; 88: 119–125.
21. Reyngold M, Winter KA, Regine WF, *et al.* Marital status and overall survival in patients with resectable pancreatic cancer: results of an ancillary analysis of NRG oncology/RTOG 9704. *Oncologist* 2020; e477–e483.
22. Yan B, Bai DS, Qian JJ, *et al.* Does marital status impact postoperative survival in patients with less differentiated hepatocellular carcinoma? A population-based study. *Cancer Med* 2019; 8: 6272–6279.

Visit SAGE journals online
[journals.sagepub.com/
home/tau](https://journals.sagepub.com/home/tau)

 SAGE journals