ORIGINAL RESEARCH

The Widowhood Effect on Mortality in Older Patients with Hip Fracture

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Objective: Widowed people have increased mortality than married people of the same age, a phenomenon known as the widowhood effect. This study aimed to investigate whether this effect exists in older patients with hip fracture.

Methods: Using our own hip fracture database, a total of 1101 hip fracture patients were consecutively included from January 2014 to December 2021. Marital status was stratified as married (n = 793) and widowed (n = 308). Patients survival status was obtained from medical records or telephone follow-ups, and the outcomes were all-cause mortality at 30 days, 1 year and at latest follow-up. Univariate and multivariate Cox proportional hazard models were used to assess the association between marital status and mortality, and subgroup analyses according to sex were also conducted.

Results: Compared with married patients, widowed patients were more likely to be older, female and intertrochanteric fracture, and were less likely to be urban area, smoking, drinking, and surgical treatment ($P < 0.05$). After a median follow-up of 37.1 months, the 30-day mortality was 4.3% (n = 47), 1-year mortality was 19.3% (n = 178), and total mortality was 34.2% (n = 376). Multivariate Cox analysis showed that widowed marital status remained an independent risk factor for 1-year mortality (HR = 1.437, 95% CI: 1.054–1.959, $P = 0.022$), and total mortality (HR = 1.296, 95% CI: 1.038–1.618, $P = 0.022$), whereas this association was not found in 30-day mortality (HR = 1.200, 95% CI: 0.607–2.376, $P = 0.599$). Moreover, subgroup analyses also found that the widowhood effect on mortality was present in both male and female.

Conclusion: Widowed marital status seems to be an independent risk factor for long-term mortality in older patients with hip fracture.

Keywords: widowhood, mortality, hip fracture, older adults

Introduction

With an increasingly ageing society, spousal loss or widowhood has become a common phenomenon.[1] In UK, more than 2 million older adults over 65 years were widowed, with an incidence of 23.4% in 2020.[2] In China, the number of the widowed older adults was estimated to be 47.7 million, which accounted for 26.9% of the older population.[3]

Widowhood is one of the most stressful life events that negatively influences the mental health of the older people, including loneliness,[4] anxiety,[5] depression[6] and cognition.[7] As a result, widowed people have poorer physical health and higher mortality than married people of the same age, a phenomenon known as the widowhood effect.[8–10] A meta-analysis of 15 prospective cohort studies involving more than 2.2 million people reported a 12.0% higher risk of mortality in widowed versus married persons.[11] To date, this effect has been confirmed in the general population,[8–10,12–14] as well as patients with cardiovascular disease,[15] stroke[16] and cancer.[17] Although China has a large number of widowed people, most of these prior studies were conducted in Western countries.[4] Given the differences in culture,

dietary habits and lifestyles between Western countries and China, it is still unclear whether the widowhood effect exists in Chinese population, although this effect has been confirmed in Asian populations.[18]

Hip fracture is a common injury among older adults, resulting in substantial excess short- and long-term mortality.[19] Most recently, two network meta-analyses including over 100 randomized controlled trails have showed that the 1-year mortality rates were as high as 23.5% and 20.2% in patients with intracapsular and extracapsular hip fracture, respectively.[20,21] This increased mortality risk persisted for more than two decades after hip fracture.[22] Due to the advanced age of hip fracture patients, the prevalence of widowhood is relatively high, such as 46.2% in Sweden,[23] 43.1% in USA,[24] 42.6% in Denmark,[25] and 39.2% in Norway.[26] For this reason, we hypothesized that widowed marital status might be associated with increased mortality of older patients with hip fracture. To date, only a few studies have examined the association between widowhood and mortality in hip fracture patients.[23,24,27,28] Despite this, half of them showed this relationship,[27,28] while the other half did not.[23,24] Therefore, using the data from our own hip fracture database,[29] we aimed to investigate the effect of widowhood on all-cause mortality in older patients with hip fracture.

Methods
Study Design and Patients

This was a single-center, observational study that was conducted using our own hip fracture database, which focused on the prognosis of hip fracture patients.[29] Briefly, a total of 1240 hip fracture patients aged ≥ 60 years have been consecutively entered into the database from January 2014 to December 2021. At admission, all patient were asked about their marital status, which was classified into four categories: married, unmarried, widowed, and divorced. In this study, patients who were unmarried, divorced, or lost to follow-up were excluded from the analyses. The patient selection flowchart is shown in Figure 1. This retrospective study was approved by the Institutional Ethics Committee of People's Hospital of Deyang City (Review No. 2022-04-040-K01), and was conducted according to the Declaration of Helsinki. Written informed consent was obtained from all participants at admission, and oral informed consent was completed during telephone follow-up.
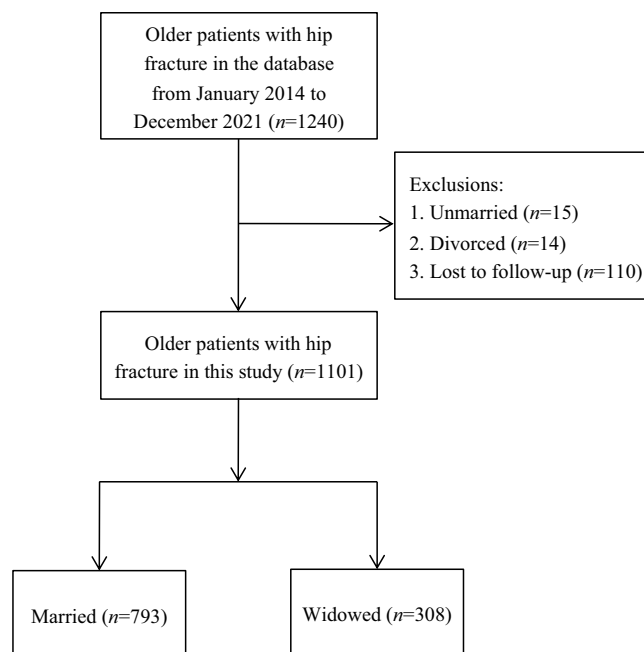

Figure 1 A flow diagram of the selection process.

Data Collection

As described previously,[29] data were extracted from the clinical database, including age, sex, residence address, smoking and drinking history, Charlson comorbidity index (CCI), hip fracture type, and surgery treatment. Specifically, age was categorized by 10-year age groups as 60–69, 70–79 and ≥ 80 years. Residence was classified as urban or rural areas according to the patients' addresses. On the basis of the smoking and drinking history, smoking and drinking status was defined as either current (yes) or not current (no). CCI is widely used for comorbidity assessment, and has been validated as a predictor of mortality in hip fracture patients.[30] Based on a prior study, CCI was categorized as none (CCI = 0), low (CCI = 1), or high (CCI ≥ 2).[26] Hip fracture type was confirmed by X-ray and/or computed tomography, and classified as femoral neck fracture or intertrochanteric fracture. Most of patients were surgically treated with percutaneous cannulated screw fixation, intramedullary nail fixation, or hip replacement (yes), and the remaining patients were classified as undergoing nonoperative management (no).

Follow-Up and Outcome

After discharge, all surviving patients were followed up annually by telephone interviews. The follow-up contents included survival status, cause of death and time of death. For patients who died in hospital, we obtained the death information from their hospital medical records. Survival time was defined as the time from hospital admission to death or last follow-up (January 31, 2022), whichever occurred first. The outcomes of interest were all-cause mortality at 30 days, 1 year and at latest follow-up. To ensure follow-up of at least 1 year, only patients between January 2014 and December 2020 were included in the 1-year mortality analysis.

Statistical Analysis

Continuous variable (age) was first assessed by the Shapiro–Wilk normality test, and reported as mean ± standard deviation (SD), and categorical variables were reported as numbers (percentages). Differences between groups were compared with Student's t-test or chi-square test, as appropriate. Survival analysis was performed using Kaplan-Meier survival curve and the Log rank test. Cox proportional hazard regression models were used to identify the factors associated with 30-day, 1-year and total mortality. Model 1 was unadjusted (crude model), model 2 was adjusted for significant variables ($P < 0.10$) in model 1, and model 3 was further adjusted for all variables (fully adjusted model). The hazard ratio (HR) and 95% confidence interval (CI) were calculated. The proportional hazard assumption was assessed with Schoenfeld residuals. Previous meta-analysis indicated that the widowhood effect on mortality was significant for men but not for women,[11] therefore, subgroup analyses according to sex were made. All analyses were conducted using JMP Pro software (version 16.0.0; SAS Institute Inc., Cary, NC, USA), and $P < 0.05$ was considered statistically significant.

Results

Patient Characteristics

Ultimately, 1101 patients were included in the final analysis, and patient characteristics are presented in Table 1. Among these patients, more than half were older than 80 years (53.7%), and almost two thirds were female (66.4%), and the majority lived in an urban area (60.9%). A total of 16.0% of patients were current smokers, 10.4% were drinkers, 21.3% had a high comorbidity level, 52.0% were intertrochanteric fracture, and 72.4% underwent surgical treatment. In terms of the marital status, 72.0% were married, and 28.0% were widowed. Compared with married patients, widowed patients were more likely to be older, female and intertrochanteric fracture, and were less likely to be urban area, smoking, drinking, and surgical treatment ($P < 0.05$).

All-Cause Mortality

After a median follow-up of 37.1 months, 376 patients died from any cause. Overall, the 30-day mortality was 4.3% (n = 47), 1-year mortality was 19.3% (n = 178), and total mortality was 34.2%. Compared with married patients, widowed patients suffered higher 1-year mortality (24.6% vs 17.2%, $P = 0.010$), and total mortality (41.2% vs 31.4%, $P = 0.002$),

Table 1 Patient Characteristics Stratified by Marital Status

Characteristics	Total (n = 1101)	Married (n = 793)	Widowed (n = 308)	P value
Age (years)	79.1 ± 8.6	77.5 ± 8.6	83.5 ± 7.0	<0.001
60–69, n (%)	178 (16.2)	166 (20.9)	12 (3.9)	<0.001
70–79, n (%)	332 (30.1)	264 (33.3)	68 (22.1)	
≥80, n (%)	591 (53.7)	363 (45.8)	228 (74.0)	
Sex, n (%)				<0.001
Male	370 (33.6)	319 (40.2)	51 (16.6)	
Female	731 (66.4)	474 (59.8)	257 (83.4)	
Residence, n (%)				0.043
Urban	671 (60.9)	498 (62.8)	173 (56.2)	
Rural	430 (39.1)	295 (37.2)	135 (43.8)	
Smoking, n (%)	176 (16.0)	145 (18.3)	31 (10.1)	0.001
Drinking, n (%)	114 (10.4)	92 (11.6)	22 (7.1)	0.029
CCI, n (%)				0.914
0	546 (49.6)	396 (49.9)	150 (48.7)	
1	320 (29.1)	230 (29.0)	90 (29.2)	
≥2	235 (21.3)	167 (21.1)	68 (22.1)	
Hip fracture type, n (%)				0.004
Femoral neck	528 (48.0)	402 (50.7)	126 (40.9)	
Intertrochanteric	573 (52.0)	391 (49.3)	182 (59.1)	
Surgery, n (%)				0.011
Yes	797 (72.4)	591 (74.5)	206 (66.9)	
No	304 (27.6)	202 (25.5)	102 (33.1)	

Abbreviations: SD, standard deviation; CCI, Charlson comorbidity index.

but the difference in mortality at 30 days did not reach statistical significance (4.2% vs 4.3%, $P = 0.961$). Kaplan-Meier survival curve also showed that widowed patients had significantly worse survival than married patients (log-rank $\chi^2 = 11.220$, $P < 0.001$, Figure 2).

Risk Factors Associated with Mortality

As shown in Table 2, univariate Cox regression analysis revealed that marital status, age, sex, CCI score and surgery were associated with 1-year mortality (Model 1). After adjusting for these variables, widowed marital status remained an independent risk factor for 1-year mortality ($HR = 1.477$, 95% CI: 1.085–2.010, $P = 0.013$; Model 2). Further adjustment for all variables did not change the result ($HR = 1.437$, 95% CI: 1.054–1.959, $P = 0.022$; Model 3). Meanwhile, age, sex,
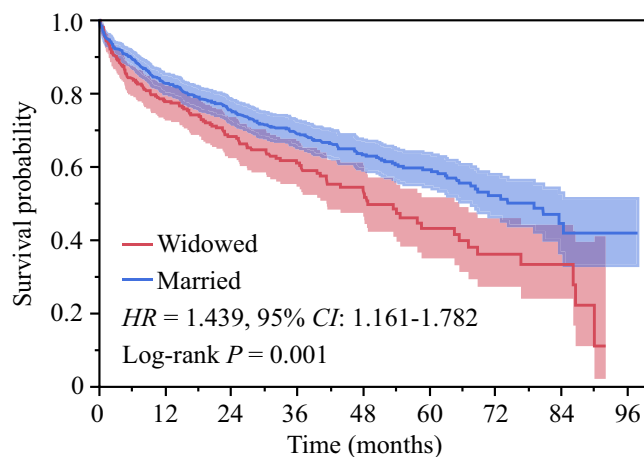

Figure 2 Kaplan-Meier survival curve for all-cause mortality stratified by marital status.

Table 2 Cox Regression Analysis for the Risk Factors Associated with 1-Year All-Cause Mortality

Variables	Model 1		Model 2		Model 3	
	HR (95% CI)	P value	HR (95% CI)	P value	HR (95% CI)	P value
Marital status (widowed vs married)	1.532 (1.125–2.086)	0.007	1.477 (1.085–2.010)	0.013	1.437 (1.054–1.959)	0.022
Age (years)						
69–69	1.0 (reference)	–	1.0 (reference)	–	1.0 (reference)	–
70–79	3.310 (1.564–7.004)	0.002	2.577 (1.213–5.472)	0.014	2.469 (1.155–5.280)	0.020
≥80	5.662 (2.777–11.548)	<0.001	3.578 (1.736–7.375)	0.001	3.441 (1.651–7.171)	0.001
Sex (male vs female)	1.563 (1.176–2.077)	0.002	1.445 (1.074–1.945)	0.015	1.571 (1.141–2.163)	0.006
Residence (rural vs urban)	1.027 (0.771–1.370)	0.854	–	–	1.035 (0.764–1.401)	0.826
Smoking	1.045 (0.715–1.527)	0.820	–	–	1.256 (0.784–2.012)	0.343
Drinking	0.864 (0.532–1.403)	0.554	–	–	1.086 (0.610–1.932)	0.779
CCI						
0	1.0 (reference)	–	1.0 (reference)	–	1.0 (reference)	–
1	1.767 (1.230–2.539)	0.002	1.658 (1.152–2.384)	0.006	1.673 (1.161–2.411)	0.006
≥2	3.657 (2.604–5.135)	<0.001	2.537 (1.797–3.580)	<0.001	2.541 (1.794–3.560)	<0.001
Hip fracture type (intertrochanteric vs neck)	1.248 (0.939–1.658)	0.127	–	–	1.032 (0.770–1.381)	0.834
Surgery (yes vs no)	0.098 (0.065–0.147)	<0.001	0.180 (0.132–0.244)	<0.001	0.179 (0.132–0.244)	<0.001

Abbreviations: HR, hazard ratio; CI, confidence interval; CCI, Charlson comorbidity index.

CCI score and surgery were significantly associated with 1-year mortality ($P < 0.05$). Consistent with this finding, subgroup analysis also showed that the widowhood effect on 1-year mortality was present in both male (*HR* = 1.328, 95% *CI*: 1.013–1.741, *P* = 0.040) and female (*HR* = 1.728, 95% *CI*: 1.179–2.532, *P* = 0.005).

The association between widowed marital status and mortality was slightly attenuated with the duration of follow-up, but remained independently associated with total mortality in Model 2 (*HR* = 1.256, 95% *CI*: 1.012–1.558, *P* = 0.039) and Model 3 (*HR* = 1.296, 95% *CI*: 1.038–1.618, *P* = 0.022; Table 3). Moreover, age, CCI score and surgery were significantly associated with total mortality ($P < 0.05$). Also, the widowhood effect on total mortality for male (*HR* = 1.282 95% *CI*: 1.004–1.636, *P* = 0.046) and female (*HR* = 1.409, 95% *CI*: 1.086–1.829, *P* = 0.010) was observed in a subgroup analysis.

Table 3 Cox Regression Analysis for the Risk Factors Associated with Total All-Cause Mortality

Variables	Model 1		Model 2		Model 3	
	HR (95% CI)	P value	HR (95% CI)	P value	HR (95% CI)	P value
Marital status (widowed vs married)	1.439 (1.161–1.782)	0.001	1.256 (1.012–1.558)	0.039	1.296 (1.038–1.618)	0.022
Age (years)						
69–69	1.0 (reference)	–	1.0 (reference)	–	1.0 (reference)	–
70–79	2.776 (1.694–4.549)	<0.001	2.234 (1.356–3.679)	0.002	2.212 (1.342–3.646)	0.002
≥80	5.252 (3.296–8.368)	<0.001	3.659 (2.268–5.904)	<0.001	3.620 (2.238–5.858)	<0.001
Sex (male vs female)	1.165 (0.943–1.440)	0.157	–	–	1.149 (0.904–1.461)	0.256
Residence (rural vs urban)	1.035 (0.839–1.277)	0.750	–	–	1.002 (0.806–1.247)	0.982
Smoking	1.033 (0.782–1.364)	0.819	–	–	1.049 (0.733–1.502)	0.793
Drinking	0.861 (0.602–1.231)	0.413	–	–	1.174 (0.761–1.812)	0.467
CCI						
0	1.0 (reference)	–	1.0 (reference)	–	1.0 (reference)	–
1	1.783 (1.397–2.277)	<0.001	1.730 (1.354–2.210)	<0.001	1.725 (1.349–2.206)	<0.001
≥2	3.148 (2.454–4.038)	<0.001	2.505 (1.948–3.223)	<0.001	2.461 (1.909–3.172)	<0.001
Hip fracture type (intertrochanteric vs neck)	1.431 (1.163–1.761)	0.001	1.184 (0.960–1.460)	0.114	1.184 (0.957–1.464)	0.120
Surgery (yes vs no)	0.244 (0.199–0.299)	<0.001	0.300 (0.244–0.369)	<0.001	0.301 (0.245–0.371)	<0.001

Abbreviations: HR, hazard ratio; CI, confidence interval; CCI, Charlson comorbidity index.

However, univariate and multivariate Cox regression analysis revealed that there was no association between widowed marital status and 30-day mortality ($P = 0.949$ in Model 1, $P = 0.685$ in Model 2, $P = 0.599$ in Model 3; Supplementary Table 1).

Discussion

Widowhood is a common phenomenon in older adults, and has been identified as a risk factor for fall.[31] Many of these falls lead to fractures, a recent analysis of up to 1.7 million individuals found that widows and widowers had a 1.34-fold and 1.32-fold higher risk of hip fracture than married persons.[32] Other studies also showed an increased risk of hip fracture after spousal loss.[25,33] In turn, hip fracture patients tend to be older, thereby, the incidence of widowhood is expected to be high. In this study, the prevalence of widowhood was 28.0%. Although this was much higher than a survey conducted in China (6.6%),[27] it was still lower than that in Western countries.[23–26]

As is well known, hip fracture is associated with substantial excess mortality.[19] We found that the 30-day, 1-year and total all-cause mortality rates were 4.3%, 19.3% and 34.2%, respectively. Due to the high mortality, we were able to explore the association between widowed marital status and mortality based on a relatively small sample size. The results showed that widowed patients suffered higher 1-year mortality and total mortality. Further adjustment for all variables, widowed marital status remained an independent risk factor for 1-year mortality ($HR = 1.437$, 95% CI: 1.054–1.959), and total mortality ($HR = 1.296$, 95% CI: 1.038–1.618). Furthermore, subgroup analyses also found that the widowhood effect on mortality was present in both male and female. In line with our findings, Zeng et al[27] analyzed 210,450 patients from a large national database, and reported that hip fracture patients who were widowed exhibited higher mortality than married patients after hip arthroplasty ($HR = 1.3$, 95% CI: 1.0–1.7). Zhou et al[28] also reported that the 1-year mortality rate was significantly higher in unmarried hip fracture patients than in married patients (30.8% vs 13.9%). When compared with married hip fracture patients, another study found that widowed patients were more likely to undergo a preoperative transthoracic echocardiogram, and had a longer time to surgery. For this reason, the authors suggested that the use of preoperative noninvasive cardiac testing may lead to delays in surgery, thereby contributing to worse outcomes in hip fracture patients.[24] On the other hand, widowed hip fracture patients had a lower persistence on antiosteoporosis drugs.[34] This might be another reason for the high mortality in widowed patients. However, there was also study that found no obvious differences between widowed and married hip fracture patients with regard to medical complications, hip complications and mortality, but the associations were close to statistical significance.[23]

Moreover, age, sex, CCI score and surgery were found to be significantly associated with mortality in hip fracture patients, which have been previously reported.[35] However, most of these factors were inherent or unmodifiable. After spousal loss, widows and widowers often disengage from or restrict their social networks, leading to social isolation. Widowed elderly individuals who have children were found to be more likely to show higher level of satisfaction with life.[3] A result from a nationwide cohort study showed that having children was associated with a longer survival after hip fracture. The authors suggested that adult children may support their ageing parents with hip fracture, thereby potentially increasing survival chances.[36] In China, older patients with hip fracture are mainly cared for by their adult children in the acute phase after injury. This may be an explanation for no association between widowed marital status and 30-day mortality. In another study, hip fracture patients who lived alone had a higher mortality than those living with a partner.[37] These results implied that continuous support by their families may be an important strategy for reducing mortality for the widowed hip fracture patients. Indeed, family caregivers have been confirmed to be an essential component of recovery after hip fracture by providing emotional and physical support.[38]

However, several limitations should be acknowledged. First, like many other studies in this field,[15] marital status was assessed at the time of inclusion, thus change in marital status, such as the duration of widowhood and remarriage during the follow-up was not accounted for. Yet, the prevalence of remarriage was extremely low (1.9%) among Chinese old population.[4] Second, some important socioeconomic variables that could not be obtained from our database which may have influenced the results, such as education, income and occupation. As mentioned by Blanner et al,[8] it was not possible to meaningfully adjust for educational level or latest employment status due to the age range of the study population. Also, a recent study showed that income and education did not have a significant effect on medical complications, hip complications and mortality after hip fracture surgery.[23] Third, the small sample size in this study might limit the statistical power of the analysis. Four, 110 patients (8.9%) were lost to follow-up, although no difference was observed between follow-up and lost to follow-up patients in patient

characteristics (Supplementary Table 2). Finally, all patients were retrospectively identified from our institutional database, hence selection bias inevitably existed. To overcome these limitations, more prospective studies with large sample sizes are needed to confirm our findings.

Conclusions

Widowed marital status seems to be an independent risk factor for long-term mortality in older patients with hip fracture. Given the high prevalence of widowhood, it is necessary to pay more attention to its negative impacts on older patients with hip fracture, including high risks of subsequent hip fracture,[25,32,33] complications,[23] and mortality.[27,28] This also implies that social and familiar support, especially their adult children, may be important to improve prognosis.[3,36]

Data Sharing Statement

The data used during the current study are available from the corresponding author on reasonable request.

Ethics Approval and Consent to Participate

This retrospective study was approved by the Institutional Ethics Committee of People's Hospital of Deyang City (Review No. 2022-04-040-K01), and was conducted according to the Declaration of Helsinki. Written informed consent was obtained from all participants at admission, and oral informed consent was completed during telephone follow-up.

Disclosure

The authors declare that they have no competing interests in this work.

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