

Survival Advantage of Non-hispanic White Patients with Pancreatic Head Carcinoma: A Population-based Study

Hongyu Yu¹, Chengzhuo Li^{2,3}, Qihui Wu¹, Jukun Su¹, Ankang Liu¹, Qiqi Ke¹, Qiaohong Yang^{1,*}

¹School of Nursing, Jinan University, Guangzhou, China

²School of Public Health, Xi'an Jiaotong University Health Science Center, Xi'an, China

³Department of Clinical Research, The First Affiliated Hospital of Jinan University, Guangzhou, China

Email address:

yqiaohong@163.com (Qiaohong Yang)

*Corresponding author

To cite this article:

Hongyu Yu, Chengzhuo Li, Qihui Wu, Jukun Su, Ankang Liu, Qiqi Ke, Qiaohong Yang. Survival Advantage of Non-hispanic White Patients with Pancreatic Head Carcinoma: A Population-based Study. *American Journal of Biomedical and Life Sciences*.

Vol. 9, No. 1, 2021, pp. 58-68. doi: 10.11648/j.ajbls.20210901.18

Received: January 10, 2021; Accepted: January 20, 2021; Published: February 2, 2021

Abstract: Numerous studies have shown that racial health disparities in gastroenterology and hepatology, but little is known about its effect on pancreatic head carcinoma (PHC). The aim of the present study was to determine whether racial disparities in the overall survival (OS) and cancer-specific survival (CSS) rates exist among US patients with PHC. The SEER database was searched for US residents who had been diagnosed with PHC from 2007 to 2015. The outcomes for 9724 Hispanic white (HW) patients and their non-Hispanic white (NHW) counterparts were compared using Kaplan-Meier survival and Cox regression analyses. We found that race affected both OS and CSS. The 5-year OS rate was worse for HW patients (45.9%) than for NHW patients (49.6%, $P < 0.001$), as was the 5-year CSS rate (39.8% versus 44.0%, $P = 0.002$). Race appeared to be an independent prognostic factor for PHC in the multivariate analysis, with NHW patients showing superior OS ($P = 0.007$) and CSS ($P = 0.037$) compared with HW patients. Subgroup analysis showed that race influenced survival among patients who received surgery, enjoyed Medicaid, and those at American Joint Committee on Cancer (AJCC) tumor-node-metastasis (TNM) stage II, but not of patients at AJCC TNM stage I, III, or IV and those who did not receive surgery or had no insurance. In short, the survival outcomes for PHC are better for NHW than HW patients. The survival advantage is more skewed towards NHW patients than HW patients with PHC, so culturally appropriate interventions, strengthened preventive services, and additional financial support should focus more on HWs.

Keywords: Pancreatic Head Carcinoma, Survival Advantage, SEER, OS, CSS

1. Introduction

Pancreatic cancer (PC) is poised to jump from fourth to second place among the factors influencing deaths in the US within the next decade [1]. Most cases of PC are accompanied by metastatic disease, and the efficacy of treatments remain unsatisfactory [2]. Pancreatic head carcinoma (PHC) accounts for 70–80% of PC patients. The resection rate of PHC was generally low, with about 60% of patients not being suitable for surgery due to distant metastasis already being present when the disease is first detected. Moreover, the median survival time of advanced-stage patients is only 6–9 months [3]. No major difference in outcome has been observed between pancreaticoduodenectomy and

more-extensive surgery [4]. The 5-year survival rate is just 5–7% in operative resection cases [5].

Latino Americans constitute the largest minority group in the US population and are expanding rapidly, now accounting for 16.3% of US residents [6]. A pattern of Mexican Americans and other Latino groups having survival advantages over non-Latino whites has been widely reported, which is referred to as the Latino, Hispanic, or epidemiological paradox [7]. The mortality rates are lower among Hispanic whites (HWs) than non-Hispanic whites (NHWs) for conditions such as cancer, heart disease, and chronic lower respiratory disease [8]. Studies are increasingly investigating racial health disparities in gastroenterology and hepatology [9], and race has been

demonstrated to play a role in survival among these cancer patients [10]. Nevertheless, the relationship between PHC prognosis and race remains to be clarified.

Given the above-mentioned situation, we obtained a large data sample of registered PHC patients in the US from the Surveillance, Epidemiology, and End Results (SEER) database [11]. We divided these patients into certain categories in order to determine whether racial differences exist in overall survival (OS) and cancer-specific survival (CSS) among PHC patients in the US, and particularly whether HWs have a survival advantage.

2. Material and Methods

2.1. Sample Source and Research Design

The SEER program initiated by National Cancer Institute of the US was used as the source of data in this population-based investigation. The SEER database contains information from 20 registries that account for approximately 28% of US residents [12]. Subscribers are supplied with detailed patient information regarding demographics, tumor situations, therapies, and outcomes [13].

We enrolled 9724 HWs with PHC who were diagnosed between 2007 and 2015. These people were sorted in accordance with the primary site labeled as ICD code C25.0 (head of pancreas). Patients were excluded if PHC was a secondary tumor, the marital and insurance statuses were unclear, or there was no information on pathological grade, surgical management, American Joint Committee on Cancer (AJCC) tumor-node-metastasis (TNM) stage, or vital status. This study focused on determining the OS and CSS defined as the duration from diagnosis to death due to PHC. Death due to PHC was deemed an event. Data were censored when the patient was living or had died of other causes at the last follow-up in 2015.

2.2. Research Variables

The following variables were also derived from the SEER database and categorized as indicated within parentheses: diagnosis year (2007–2009, 2010–2012, or 2013–2015), age at diagnosis (<60, 60–74, or >74 years), race (HW or NHW), sex (male or female), tumor grade (I, well differentiated; II, moderately differentiated; III, poorly differentiated; or IV, undifferentiated), marital status (married or unmarried), AJCC TNM stage (I, II, III, or IV), surgery status (yes or no), insurance status (insured, Medicaid, or uninsured), survival time, and vital status.

2.3. Statistical Analysis

HWs and NHWs served as fundamental objects of the comparison, and then the patient characteristics in both groups were processed multiple times. First, the continuous variables—age at diagnosis (presented as mean±SD values) and diagnosis duration—conforming to a Gaussian distribution were compared using Pearson's χ^2 test, while qualitative data were compared using Fisher's exact test. Second, to calculate OS and CSS values, the Kaplan-Meier

method was used along with the log-rank test for distinguishing the Kaplan-Meier curves among subgroups. Cox proportional-hazards models were established to identify significant predictors.

All of the statistical analyses were carried out using SPSS (version 26.0, IBM Corporation), with a probability value below 0.05 considered to indicate a difference that was statistically significant.

3. Results

3.1. Baseline Characteristics

Table 1 stratifies the baseline characteristics of patients according to race. The patients comprised 1351 (13.89%) HWs and 8373 (86.11%) NHWs. There were more males than females among both HWs (51.15% versus 48.85%) and NHWs (53.57% versus 46.43%). The HW group comprised considerably fewer unmarried than married patients (39.90% versus 60.10%), as did the NHW group (36.31% versus 63.69%). More NHW than HW patients had received surgery (63.18% versus 56.18%) and were insured (90.29% versus 70.17%). There were significant intergroup differences in age ($P<0.001$), sex ($P=0.001$), marital status ($P=0.012$), AJCC TNM stage ($P<0.001$), surgery status ($P<0.001$), and insurance status ($P<0.001$).

3.2. Race Effects on OS

Survival varied with race ($P<0.001$), as indicated by the Kaplan-Meier curve for OS in Figure 1A. The OS duration was longer for NHWs than HWs, with median values of 60 months and 56 months, respectively. Similarly, the 5-year OS rate of NHWs was superior to that of HWs (49.6 versus 45.9%). Univariate analyses revealed that the significant predictive factors for OS were year of diagnosis ($P<0.001$), AJCC TNM stage IV ($P=0.002$), NHW ($P<0.001$), and uninsured ($P=0.008$). After subsequent adjustment in the multivariate analysis, all of these variables other than AJCC TNM stage IV ($P=0.372$) remained significant. Compared with HW patients, NHW patients had positive survival outcomes [hazard ratio (HR)=0.832, 95% confidence interval (CI)=0.728–0.951, $P=0.007$] (Table 2).

3.3. Race Effects on CSS

The Kaplan-Meier curves for CSS are presented in Figure 1B. The 5-year CSS rate was worse for HW than NHW patients (44.0% versus 39.8%, $P=0.001$ in log-rank test). Univariate analyses revealed that all variables were significant predictive factors for CSS, with the exception of male ($P=0.085$), tumor grades II, III, and IV ($P=0.915$, 0.613, and $P=0.625$ respectively), AJCC TNM stages II and III ($P=0.228$ and 0.292 respectively), and unmarried ($P=0.153$). After subsequent adjustment in the multivariate analysis, all of these variables other than AJCC TNM stage IV ($P=0.747$) remained significant. The survival outcomes were better for NHWs than their HW counterparts (HR=0.879, 95% CI=0.779–0.992, $P=0.037$; Table 3).

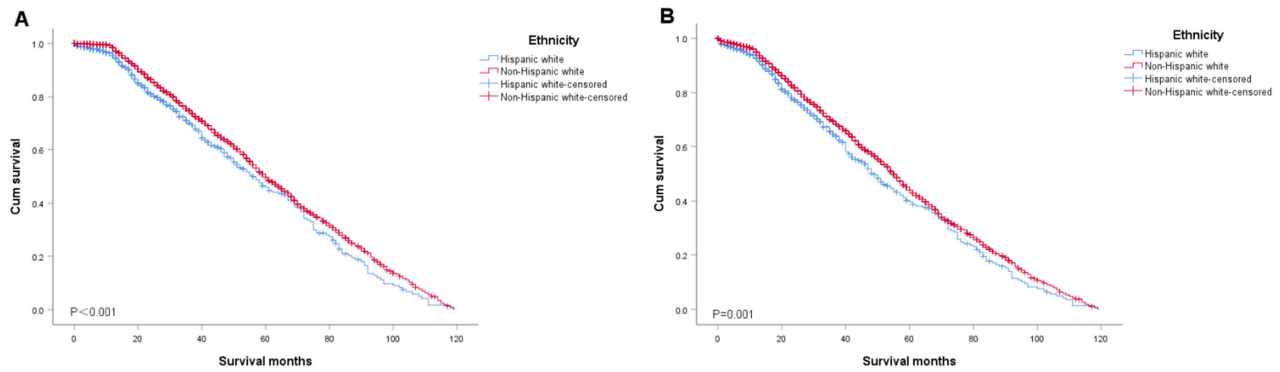


Figure 1. The survivorship curves of Hispanic and non-Hispanic whites with pancreatic head carcinoma were compared. (A) Overall survival. (B) Cause-specific survival. Cum, cumulative.

Table 1. Basic demographics and tumor features of sufferers from SEER database.

Characteristic	Total	Hispanic White	Non-Hispanic White	P-value
Patient, n(%)	9724 (100.00)	1351 (13.89)	8373 (86.11)	
Age, mean±SD	66.49±11.22	64.39±12.20	66.82±11.02	<0.001
Year of diagnosis, n(%)				0.003
2007-2009	3208 (32.99)	404 (29.90)	2095 (25.02)	
2010-2012	3233 (33.25)	449 (33.24)	2804 (33.49)	
2013-2015	3283 (33.76)	498 (36.86)	3474 (41.49)	
Gender, n(%)				0.001
Female	4579 (47.09)	660 (48.85)	3888 (46.43)	
Male	5145 (52.91)	691 (51.15)	4485 (53.57)	
Marital status, n(%)				0.012
Married	6145 (63.19)	812 (60.10)	5333 (63.69)	
Unmarried	3579 (36.81)	539 (39.90)	3040 (36.31)	
Grade, n(%)				0.578
I	1256 (12.92)	179 (13.25)	1077 (12.86)	
II	4223 (43.43)	571 (42.26)	3652 (43.62)	
III	4015 (41.29)	562 (41.60)	3453 (41.24)	
IV	230 (2.36)	39 (2.89)	191 (2.28)	
AJCC TNM stage, n(%)				<0.001
I	788 (8.10)	113 (8.36)	675 (8.06)	
II	5985 (61.55)	762 (56.40)	5223 (62.38)	
III	789 (8.12)	111 (8.22)	678 (8.10)	
IV	2162 (22.23)	365 (27.02)	1797 (21.46)	
Surgery, n(%)				<0.001
Yes	6049 (62.21)	759 (56.18)	5290 (63.18)	
No	3675 (37.79)	592 (43.82)	3083 (36.82)	
Insurance status, n(%)				<0.001
Insured	8508 (87.49)	948 (70.17)	7560 (90.29)	
Medicaid	986 (10.14)	343 (25.39)	643 (7.68)	
Uninsured	230 (2.37)	60 (4.44)	170 (2.03)	

AJCC, American Joint Committee on Cancer; TNM, Tumor-Node-Metastasis.

Table 2. Univariate along with multivariate tabulated interpretation of OS amongst sufferers confirmed to pancreatic head carcinoma.

Characteristic	Univariate analysis				Multivariate analysis		
	5-year OS,%	HR	95%CI	P-value	HR	95%CI	P-value
Year of diagnosis							
2007-2009	97.6	Reference			Reference		
2010-2012	58.0	30.745	21.409-44.152	<0.001	30.417	21.169-43.705	<0.001
2013-2015	N/A	1254.822	808.107-1948.477	<0.001	1257.477	809.476-1953.424	<0.001
Age of diagnosis, years							
≤59	49.8	Reference			Reference		
60-74	48.0	1.087	0.978-1.209	0.12	1.012	0.909-1.126	0.833
>74	51.4	0.996	0.864-1.149	0.961	1.053	0.91-1.217	0.489
Gender							
Female	48.9	Reference			Reference		
Male	49.3	0.942	0.857-1.036	0.218	1.025	0.93-1.13	0.618
Grade							

Characteristic	5-year OS,%	Univariate analysis			Multivariate analysis		
		HR	95%CI	P-value	HR	95%CI	P-value
I	48.2	Reference			Reference		
II	49.5	0.994	0.883-1.119	0.925	1.031	0.913-1.165	0.622
III	50.6	0.985	0.862-1.124	0.818	1.014	0.885-1.163	0.838
IV	34.3	1.167	0.795-1.712	0.43	0.742	0.503-1.094	0.132
AJCC TNM							
I	49.0	Reference			Reference		
II	50.1	1.133	0.995-1.291	0.06	1.093	0.955-1.252	0.195
III	45.3	1.056	0.804-1.388	0.694	0.994	0.751-1.317	0.969
IV	45.0	1.392	1.13-1.715	0.002	1.112	0.881-1.404	0.372
Surgery							
Yes	49.6	Reference			Reference		
No	44.7	1.151	0.989-1.339	0.068	1.143	0.955-1.367	0.145
Race							
Hispanic White	45.9	Reference			Reference		
Non-Hispanic White	49.6	0.781	0.686-0.89	<0.001	0.832	0.728-0.951	0.007
Marital status							
Married	49.0	Reference			Reference		
Unmarried	49.4	0.962	0.869-1.064	0.45	0.975	0.877-1.083	0.634
Insurance status							
Insured	49.6	Reference			Reference		
Medicaid	46.0	1.157	0.969-1.381	0.106	1.201	1-1.442	0.051
Uninsured	43.1	1.46	1.104-1.93	0.008	1.482	1.115-1.968	0.007

OS, overall survival; HR, hazard ratio; CI, confidence interval; AJCC, American Joint Committee on Cancer; N/A, not available; TNM, Tumor-Node-Metastasis.

Table 3. Univariate along with multivariate tabulated interpretation of OS amongst sufferers confirmed to pancreatic head carcinoma.

Characteristic	5-year CSS,%	Univariate analysis			Multivariate analysis		
		HR	95%CI	P-value	HR	95%CI	P-value
Year of diagnosis							
2007-2009	83.9	Reference			Reference		
2010-2012	52.5	3.954	3.352-4.663	<0.001	3.926	3.326-4.634	<0.001
2013-2015	N/A	29.288	24.28-35.33	<0.001	29.412	24.369-35.498	<0.001
Age of diagnosis, years							
≤59	46.5	Reference			Reference		
60-74	42.6	1.167	1.059-1.287	0.002	1.132	1.025-1.25	0.014
>74	40.7	1.3	1.151-1.467	<0.001	1.357	1.198-1.536	<0.001
Gender							
Female	43.9	Reference			Reference		
Male	43.0	1.077	0.99-1.172	0.085	1.078	0.988-1.176	0.092
Grade							
I	42.9	Reference			Reference		
II	44.0	0.994	0.892-1.108	0.915	1.009	0.903-1.128	0.869
III	44.1	1.031	0.916-1.161	0.613	1.038	0.919-1.173	0.547
IV	29.6	1.091	0.77-1.545	0.625	0.828	0.583-1.176	0.291
AJCC TNM							
I	42.8	Reference			Reference		
II	44.5	1.075	0.956-1.21	0.228	1.063	0.941-1.201	0.323
III	40.3	1.129	0.901-1.415	0.292	1.061	0.84-1.34	0.622
IV	39.5	1.269	1.058-1.522	0.01	1.034	0.844-1.267	0.747
Surgery							
Yes	44.2	Reference			Reference		
No	38.8	1.273	1.126-1.439	<0.001	1.263	1.09-1.463	0.002
Race							
Hispanic White	39.8	Reference			Reference		
Non-Hispanic White	44.0	0.826	0.734-0.93	0.002	0.879	0.779-0.992	0.037
Marital status							
Married	44.0	Reference			Reference		
Unmarried	42.5	1.067	0.976-1.166	0.153	1.067	0.972-1.171	0.171
Insurance status							
Insured	44.2	Reference			Reference		
Medicaid	36.4	1.348	1.165-1.559	<0.001	1.371	1.178-1.596	<0.001
Uninsured	39.1	1.383	1.072-1.785	0.013	1.489	1.15-1.928	0.003

CSS, cause-specific survival; HR, hazard ratio; CI, confidence interval; AJCC, American Joint Committee on Cancer; N/A, not available; TNM, Tumor-Node-Metastasis.

3.4. Discrepancies in Surgery Status by Race

The relevance of race to survival was also assessed based on whether or not the patients had received surgery. Figure 2 shows Kaplan-Meier survival curves for race and surgery. The 5-year OS rate among patients who received surgery was superior for NHWs than HWs (49.9% versus 47.5%, $P=0.017$), as was the 5-year CSS rate (44.5% versus 41.7%, $P=0.042$). The 5-year OS rate remained superior for NHWs (46.6%) over

HWs (30.0%, $P<0.001$) who had not received surgery, as did the CSS rate (41.1% versus 22.9%, $P=0.002$). Multivariate analysis indicated that OS was affected by race both among those who received surgery (HR=0.843, 95% CI=0.731–0.972, $P=0.018$) and did not receive surgery (HR=0.491, 95% CI=0.351–0.686, $P<0.001$), as was CSS (HR=0.874, 95% CI=0.767–0.997, $P=0.045$; and HR=0.653, 95% CI=0.495–0.861, $P=0.003$; respectively) (Table 4).

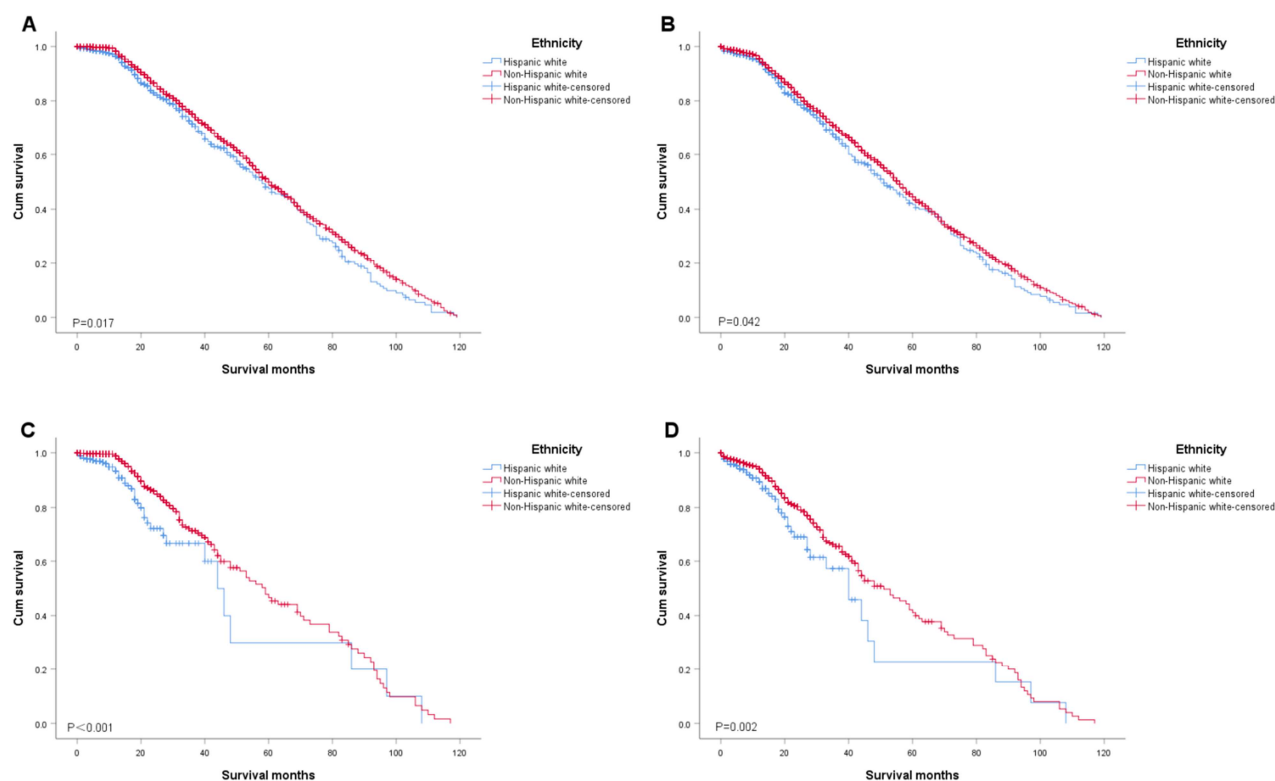


Figure 2. Survivorship curves of pancreatic head carcinoma sufferers of different races in two different surgical branches. (A) Surgical patient OS. (B) Surgical patient CSS (C) No surgical patient OS. (D) No surgical patient CSS. OS, overall survival; CSS, cause-specific survival; Cum, cumulative.

Table 4. Tabulated interpretation of univariate and multifactorial survivorship for pancreatic head carcinoma sufferers drawn on surgery.

A, OS							
Characteristic	5-year survival,%	Median survival time, months	Univariate analysis		Multivariate analysis		
			Log rank χ^2	P-value	HR	95%CI	P-value
Surgery (Yes)			5.721	0.017			
Hispanic White	47.5	58			Reference		
Non-Hispanic White	49.9	60			0.843	0.731-0.972	0.018
Surgery (No)			18.342	<0.001			
Hispanic White	30.0	44			Reference		
Non-Hispanic White	46.6	49			0.491	0.351-0.686	<0.001
B, CSS							
Characteristic	5-year survival,%	Median survival time, months	Univariate analysis		Multivariate analysis		
			Log rank χ^2	P-value	HR	95%CI	P-value
Surgery (Yes)			4.136	0.042			
Hispanic White	41.7	51			Reference		
Non-Hispanic White	44.5	56			0.874	0.767-0.997	0.045
Surgery (No)			9.373	0.002			
Hispanic White	22.9	40			Reference		
Non-Hispanic White	41.1	51			0.653	0.495-0.861	0.003

OS, overall survival; CSS, cause-specific survival; HR, hazard ratio; CI, confidence interval.

3.5. Discrepancies in Insurance Status by Race

The Kaplan-Meier survival curves for the effects of insurance status are shown in Figure 3. The 5-year OS rate did not differ significantly between insured HWs and insured NHW (51.9% versus 49.3%, $P=0.293$), and likewise for the 5-year CSS rate (45.9% versus 44.0%, $P=0.792$). However, the 5-year OS rate among Medicaid recipients was better in the NHW group (50.3%) than the HW group (50.3% versus 38.6%, $P=0.001$), as was the 5-year CSS rate (40.3% versus 29.9%, $P=0.005$). Consistently, the 5-year

OS rate among uninsured NHWs was far better than that among HWs (64.0% versus 6.0%, $P<0.001$), as was the 5-year CSS rate (57.0% versus 5.9%, $P<0.001$). Multivariate analysis showed that OS was influenced by race not only among Medicaid recipients ($HR=0.574$, 95% $CI=0.407-0.81$, $P=0.002$) but also among uninsured patients ($HR=0.289$, 95% $CI=0.083-0.289$, $P<0.001$), and similarly for CSS ($HR=0.669$, 95% $CI=0.505-0.887$, $P=0.005$; and $HR=0.233$, 95% $CI=0.134-0.404$, $P<0.001$; respectively) (Table 5).

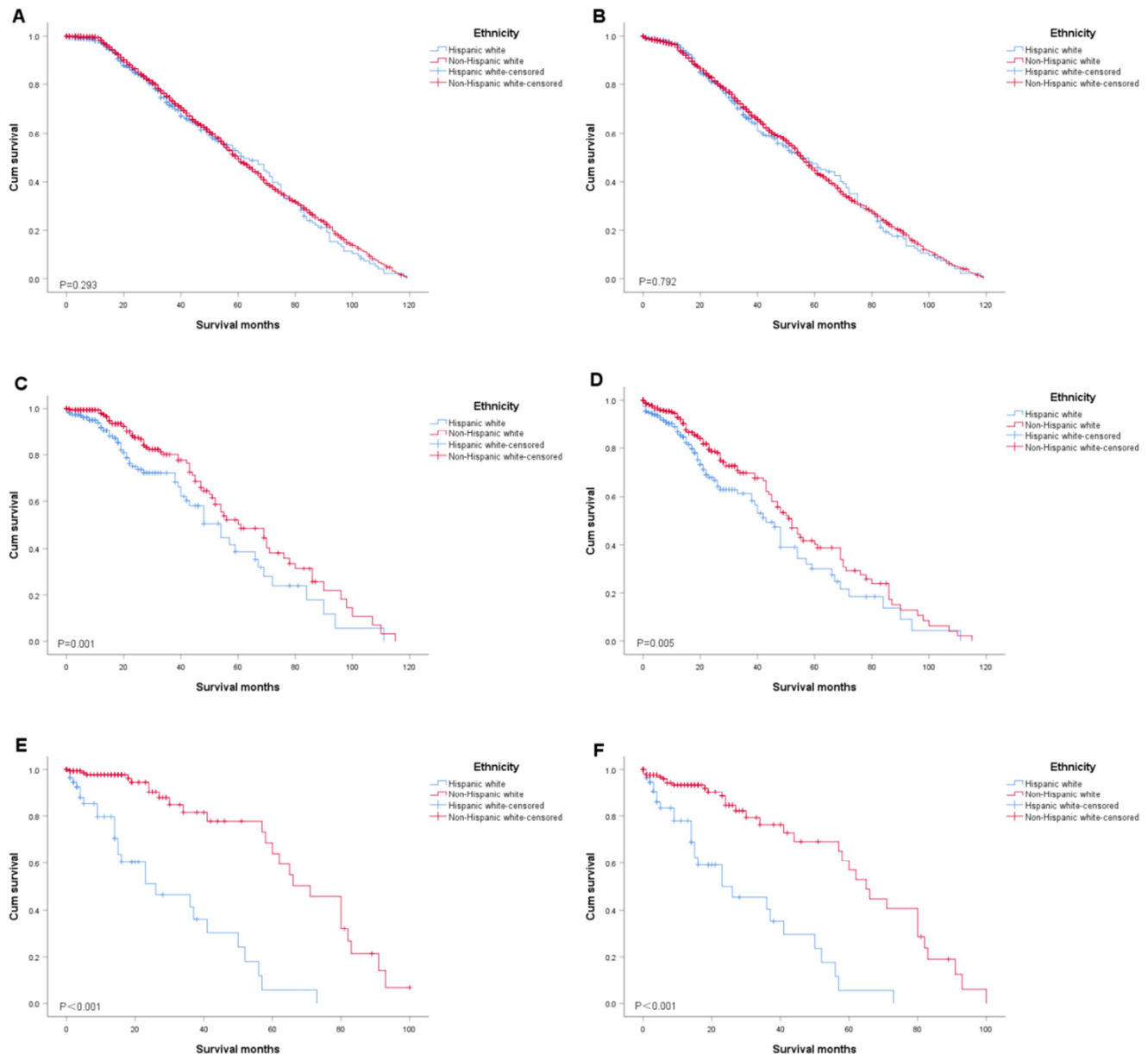


Figure 3. Survivorship curves in three Insurance status branchings sufferers with pancreatic head carcinoma in accordance with ethnicity. (A) Insured OS. (B) Insured CSS. (C) Any Medicaid OS. (D) Any Medicaid CSS. (E) Uninsured OS. (F) Uninsured CSS. OS, overall survival; CSS, cause-specific survival; Cum, cumulative.

Table 5. Tabulated interpretation of univariate and multifactorial survival for pancreatic head carcinoma sufferers drawn on insurance status.

A, OS							
Characteristic	5-year survival,%	Median survival time, months	Univariate analysis		Multivariate analysis		
			Log rank χ^2	P-value	HR	95%CI	P-value
Insured			1.106	0.293	Reference		
Hispanic White	51.9	62			Reference		
Non-Hispanic White	49.3	60			0.921	0.789-1.076	0.3
Medicaid			10.415	0.001	Reference		
Hispanic White	38.6	54			Reference		
Non-Hispanic White	50.3	61			0.574	0.407-0.81	0.002
Uninsured			44.871	<0.001	Reference		
Hispanic White	6.0	26			Reference		
Non-Hispanic White	64.0	71			0.289	0.083-0.289	<0.001
B, CSS							
Characteristic	5-year survival,%	Median survival time, months	Univariate analysis		Multivariate analysis		
			Log rank χ^2	P-value	HR	95%CI	P-value
Insured			0.07	0.792	Reference		
Hispanic White	45.9	55			Reference		
Non-Hispanic White	44.0	55			0.981	0.851-1.132	0.794
Medicaid			8.064	0.005	Reference		
Hispanic White	29.9	43			Reference		
Non-Hispanic White	40.3	52			0.669	0.505-0.887	0.005
Uninsured			31.729	<0.001	Reference		
Hispanic White	5.9	26			Reference		
Non-Hispanic White	57.0	65			0.233	0.134-0.404	<0.001

OS, overall survival; CSS, cause-specific survival; HR, hazard ratio; CI, confidence interval.

3.6. Discrepancies in AJCC TNM Stage by Race

Figure 4 shows Kaplan-Meier survival curves for the relationships between race and AJCC TNM stages I, II, III, and IV (n=788, 5985, 789, and 2162 respectively). Among those at AJCC TNM stage II, both the 5-year OS ($P=0.003$) and CSS ($P=0.001$) rates were higher in the NHW group (50.5% and 45.2% respectively) than the HW group (46.8 and 39.1% respectively), whereas the survival rates did not

differ significantly with race for AJCC TNM stage I, III, or IV. Multivariate analysis showed that race was an independent prognostic factor for OS (HR=0.787, 95% CI=0.671–0.925, $P=0.004$) and CSS (HR=0.789, 95% CI=0.683–0.911, $P=0.001$) among patients at AJCC TNM stage II, but not among those at AJCC TNM stage I, III, or IV (Table 6).

Table 6. Tabulated interpretation of univariate and multifactorial survivorship for pancreatic head carcinoma sufferers drawn on the AJCC TNM stage.

A, OS							
Characteristic	5-year survival,%	Median survival time, months	Univariate analysis		Multivariate analysis		
			Log rank χ^2	P-value	HR	95%CI	P-value
Stage I			1.143	0.285	Reference		
Hispanic White	47.6	58			Reference		
Non-Hispanic White	49.3	60			0.852	0.632-1.149	0.293
Stage II			8.774	0.003	Reference		
Hispanic White	46.8	54			Reference		
Non-Hispanic White	50.5	61			0.787	0.671-0.925	0.004
Stage III			3.711	0.054	Reference		
Hispanic White	49.8	45			Reference		
Non-Hispanic White	45.4	59			0.519	0.262-1.027	0.06
Stage IV			3.084	0.079	Reference		
Hispanic White	43.6	60			Reference		
Non-Hispanic White	45.4	55			0.697	0.463-1.05	0.084
B, CSS							
Characteristic	5-year survival,%	Median survival time, months	Univariate analysis		Multivariate analysis		
			Log rank χ^2	P-value	HR	95%CI	P-value
Stage I			0.07	0.791	Reference		
Hispanic White	44.6	57			Reference		
Non-Hispanic White	42.4	55			0.963	0.726-1.277	0.794
Stage II			10.775	0.001	Reference		
Hispanic White	39.1	47			Reference		
Non-Hispanic White	45.2	56			0.789	0.683-0.911	0.001
Stage III			1.139	0.286	Reference		
Hispanic White	48.2	45			Reference		
Non-Hispanic White	40.0	52			0.728	0.404-1.311	0.29

A, OS			Univariate analysis		Multivariate analysis		
Characteristic	5-year survival,%	Median survival time, months	Log rank χ^2	P-value	HR	95%CI	P-value
Stage IV			0.519	0.471			
Hispanic White	37.3	48			Reference		
Non-Hispanic White	40.0	49			0.874	0.604-1.265	0.476

OS, overall survival; CSS, cause-specific survival; HR, hazard ratio; CI, confidence interval.

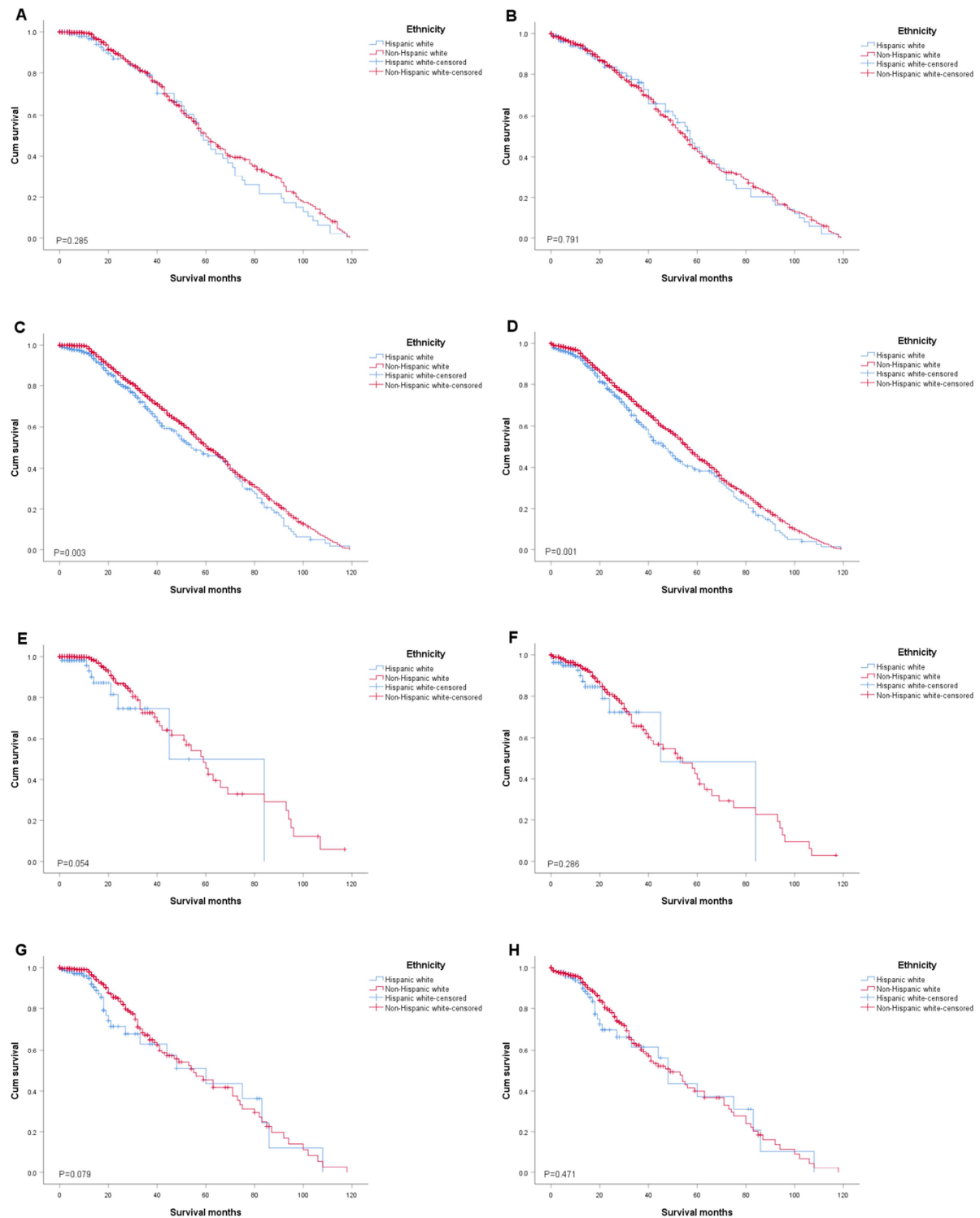


Figure 4. Survivorship curves of pancreatic head carcinoma sufferers at distinguished Tumor-Node-Metastasis stages in accordance with ethnicity. (A) Stage-I sufferers' OS. (B) Stage-I sufferers' CSS. (C) Stage-II sufferers' OS. (D) Stage-II sufferers' CSS. (E) Stage-III sufferers' OS. (F) Stage-III sufferers' CSS. (G) Stage-IV sufferers' OS. (H) Stage-IV sufferers' CSS. OS, overall survival; CSS, cause-specific survival; Cum, cumulative.

4. Discussion

PC is an aggressive disease whose mortality rate has been increasingly improved [14]. Interventions implemented over the past 2 decades have failed to improve the 5-year OS for PC, which is known to be the deadliest solid tumor [15]. Moreover, PHC represents the predominant form of PC and has the worst prognosis [16]. With the aim of clarifying the correlation between race and survival outcomes of PHC patients, the present study obtained information from the SEER database. Both OS and CSS rates were better among NHW than HW patients in univariate and multivariate analyses. Race was found to be an independent prognostic factor for survival among PHC patients, revealing that the epidemiological paradoxes are not entirely credible, which contrasts the results obtained by Ashktorab *et al.* [17].

In general, more PHC patients had received surgery, which is an important intervention in this population [18]. In the current study, a larger proportion of NHW than HW patients had received surgery. Multiple factors affect whether patients receive surgery, with the decision of a patient to reject surgical treatment remaining unclear [19]. The present analyses of the interactions between race and the surgery status in PHC patients found that both OS (surgery received: HR=0.843, 95% CI=0.731–0.972, $P=0.018$; surgery not received: HR=0.491, 95% CI=0.351–0.686, $P<0.001$) and CSS (surgery received: HR=0.874, 95% CI=0.767–0.997, $P=0.045$; surgery not received: HR=0.653, 95% CI=0.495–0.861, $P=0.003$) were better in NHW patients than HW patients. These results are similar to the finding of Nipp *et al.* [20].

Other studies have found discrepancies between cancer diagnosis and treatment, and that the OS can be improved if access to health care is improved [21]. Our study found that both the 5-year OS and CSS were better for insured patients than for those with Medicaid and without insurance. Abraham *et al.* found that the insurance status of PC patients did not vary among blacks, whites, and other races [22], whereas when we divided the patients into HWs and NHWs, the latter showed a survival advantage regardless of whether they had Medicaid or were uninsured.

Non-Hispanics are reportedly more likely to have stage IIB disease than Hispanics [23]. Also, our subgroup analysis of AJCC TNM stage revealed that for both the OS (HR=0.787, 95% CI=0.671–0.925, $P=0.004$) and CSS (HR=0.789, 95% CI=0.683–0.911, $P=0.001$), NHW race is an independent prognostic factor among patients at AJCC TNM stage II, but not among those at AJCC TNM stage I, III, or IV. Therefore, race may be a notable protective factor for patients in the early stage.

The survival advantage in NHW patients mentioned above provides reference information for the prophylaxis and cure of PHC. Strategies to reduce the likelihood of cancer in the Hispanic population include targeted, culturally appropriate interventions that increase access to preventive services and reduce the prevalence of cancer risk factors, as well as extra

financial support [24]. Since most patients die from distant metastasis, it is not sufficient to restrict treatment to the primary site when attempting to improve the survival rate of these patients; instead, effective treatment that addresses systemic metastasis is crucial [25]. It is necessary to determine how to encourage patients who need surgery to participate in making informed, shared decisions [26]. Consideration of the cultural and psychological environments is particularly important. Our study has indicated that interventions should be somewhat more focused on improving treatment compliance in HW patients. Prevention, early diagnosis, improved treatment, and drugs also form important parts of the broad strategy to reduce the incidence of this cancer and improve its prognosis [27].

A distinct increased risk of innate PC can be seen in close relatives of patients confirmed as having inherited PC, hereditary cancer syndrome, or genetic pancreatitis. Knowledge of risk, benefit, and outcome data allow patients to make personalized decisions about screening and monitoring strategies [27], and the interconnectedness of racial groups should also not be overlooked. Moreover, economic factors such as the type of insurance and the income level are related to whether patients receive adjuvant chemotherapy. Therefore, when a patient receives adjuvant chemotherapy, the decision to use multiple drugs or a single drug is more likely to be influenced by patient or provider bias than by cost issues. Moreover, receiving multidrug chemotherapy seems to be associated with demographic variables such as race [28]. This means that racial disparities can be narrowed by targeting certain populations, expanding insurance coverage, and increasing Medicaid subsidies.

The limitations of this study were as follows: (i) there have been very few studies specifically on PHC, and so most of the cited literature was related to PC in the hope that this would include data on PHC; (ii) the small amount of information on comorbidities and relapses in the SEER database makes it difficult to compare the findings of effectiveness analyses [29]; and (iii) if the data registrars had not been aware of changes in the socioeconomic status of cases or even missed or incorrectly recorded this information, the study might have been influenced by the sources of these errors and biases [30].

5. Conclusion

In summary, race appears to be an independent prognostic factor for the OS and CSS of PHC patients. The survival rate of NHW patients was superior to that of HW patients, with this racial advantage evident in patients in the early stage of disease, who had received surgery, and who had insurance or Medicaid.

Acknowledgements

We would like to express our sincere gratitude to Professor

Lv Jun and his big data research team on account of helping us to cultivate data thinking and master data mining methods.

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