

Figure S1 Flowchart of the SEER cohort.

Table S1 Univariable and multivariable cox regression analyses of overall survival in the SEER cohort

Characteristics	Variable	All-cause death		Univariable analysis		Multivariable analysis	
		Female	Male	HR ^a (95% CI)	P	HR ^a (95% CI)	P
Tumor Size	≤1 cm	775 (16795)	397 (4062)	2.264 (2.006–2.556)	<0.001	1.759 (1.555–1.990)	<0.001
	>1 cm	1359 (24475)	1060 (9126)	2.211 (2.040–2.396)	<0.001	1.555 (1.434–1.688)	<0.001
Race	Black	206 (3033)	99 (661)	2.404 (1.891–3.055)	<0.001	1.635 (1.275–2.097)	<0.001
	White	1074 (32930)	1217 (11151)	2.282 (2.120–2.457)	<0.001	1.630 (1.512–1.757)	<0.001
	Other	254 (5307)	141 (1376)	2.353 (1.915–2.891)	<0.001	1.657 (1.346–2.040)	<0.001
Age, years	<55	535 (27290)	316 (6944)	2.380 (2.071–2.736)	<0.001	2.135 (1.852–2.463)	<0.001
	≥55	1599 (13980)	1141 (6244)	1.727 (1.601–1.864)	<0.001	1.500 (1.389–1.620)	<0.001
Median income	<\$55,000	394 (6429)	277 (1944)	2.472 (2.120–2.883)	<0.001	1.748 (1.493–2.047)	<0.001
	≥\$55,000	1740 (34841)	1180 (11244)	2.240 (2.080–2.412)	<0.001	1.617 (1.499–1.744)	<0.001
Surgery performed	No	98 (260)	86 (169)	1.479 (1.106–1.976)	0.008	1.225 (0.916–1.639)	0.171
	Yes	2036 (41010)	1371 (13019)	2.253 (2.104–2.413)	<0.001	1.650 (1.539–1.768)	<0.001
Histology recode/ pathological type	Medullary	69 (510)	26 (379)	1.772 (1.291–2.433)	<0.001	1.268 (0.914–1.759)	0.155
	HCC	102 (827)	78 (372)	1.823 (1.358–2.449)	<0.001	1.398 (1.032–1.893)	0.03
	Papillary	1253 (26990)	851 (8477)	2.304 (2.112–2.513)	<0.001	1.678 (1.536–1.833)	<0.001
	Pap with Fv	556 (10995)	329 (3129)	2.213 (1.931–2.536)	<0.001	1.682 (1.465–1.932)	<0.001
	follicular	154 (1948)	113 (831)	1.816 (1.425–2.315)	<0.001	1.257 (0.977–1.617)	0.075
T stage	Tx	4 (35)	7 (18)	3.839 (1.115–13.220)	0.033	6.306 (0.665–59.821)	0.109
	T0	10 (54)	16 (42)	2.394 (1.083–5.292)	0.031	3.594 (1.435–9.001)	0.006
	T1	1127 (26039)	572 (6474)	2.161 (1.954–2.390)	<0.001	1.719 (1.551–1.904)	<0.001
	T2	297 (7140)	236 (2547)	2.363 (1.992–2.804)	<0.001	1.772 (1.488–2.109)	<0.001
	T3	468 (7031)	424 (3549)	1.887 (1.655–2.152)	<0.001	1.517 (1.328–1.733)	<0.001
	T4	228 (971)	202 (558)	1.742 (1.441–2.106)	<0.001	1.425 (1.174–1.728)	<0.001
N stage	Nx	52 (1169)	38 (353)	2.667 (1.752–4.060)	<0.001	1.846 (1.198–2.845)	0.005
	N0	1648 (31438)	882 (8461)	2.079 (1,916–2.257)	<0.001	1.610 (1.481–1.749)	<0.001
	N1	434 (8663)	537 (4374)	2.578 (2.272–2.926)	<0.001	1.699 (1.493–1.933)	<0.001
M stage	Mx	27 (291)	18 (86)	2.388 (1.315–4.336)	0.004	2.249 (1.228–4.119)	0.009
	M0	1956 (40594)	1287 (12794)	2.212 (2.062–2.373)	<0.001	1.641 (1.527–1.762)	<0.001
	M1	151 (385)	152 (308)	1.410 (1.125–1.767)	0.003	1.269 (1.011–1.592)	0.04
Combined summary stage	Localized	1373 (29701)	748 (7898)	2.142 (1.960–2.342)	<0.001	1.654 (1.510–1.812)	<0.001
	Regional	515 (10773)	483 (4765)	2.235 (1.974–2.530)	<0.001	1.791 (1.578–2.033)	<0.001
	Distant	246 (796)	226 (525)	1.659 (1.384–1.989)	<0.001	1.332 (1.110–1.600)	0.002

^a, males versus females. HCC, Hurthle cell carcinoma; Pap with Fv, papillary with follicular variant.

Table S2 Univariable and multivariable cox regression analyses of cancer-specific survival in the SEER cohort

Characteristics	Variable	Cancer-specific death		Univariable analysis		Multivariable analysis	
		Female	Male	HR ^a (95% CI)	P	HR ^a (95% CI)	P
Tumor size	≤1 cm	68 (16795)	45 (4062)	2.898 (1.989–4.224)	<0.001	1.883 (1.275–2.780)	0.001
	>1 cm	385 (24475)	333 (9126)	2.425 (2.094–2.808)	<0.001	1.375 (1.182–1.599)	<0.001
Race	Black	38 (3033)	19 (661)	2.456 (1.416–4.260)	0.001	1.087 (0.604–1.958)	0.78
	White	328 (32930)	323 (11151)	3.055 (2.619–3.562)	<0.001	1.567 (1.336–1.837)	<0.001
	Other	87 (5307)	36 (1376)	1.733 (1.175–2.557)	0.006	1.025 (0.689–1.525)	0.902
Age, years	<55	89 (27290)	91 (6944)	4.121 (3.077–5.520)	<0.001	2.630 (1.954–3.541)	<0.001
	≥55	364 (13980)	287 (6244)	1.875 (1.606–2.188)	<0.001	1.221 (1.042–1.432)	0.014
Median income	<\$55,000	74 (6429)	76 (1944)	3.574 (2.595–4.923)	<0.001	1.645 (1.179–2.295)	0.003
	≥\$55,000	379 (34841)	302 (11244)	2.600 (2.235–3.025)	<0.001	1.422 (1.219–1.660)	<0.001
Surgery performed	No	50 (260)	38 (169)	1.256 (0.823–1.917)	0.29	0.954 (0.607–1.497)	0.836
	Yes	403 (41010)	340 (13019)	2.797 (2.421–3.231)	<0.001	1.508 (1.300–1.750)	<0.001
Histology recode/ pathological type	Medullary	35 (510)	53 (379)	2.146 (1.400–3.289)	<0.001	1.128 (0.724–1.758)	0.593
	HCC	38 (827)	32 (372)	1.986 (1.241–3.180)	0.004	1.183 (0.713–1.961)	0.515
	Papillary	237 (26990)	211 (8477)	2.979 (2.474–3.586)	<0.001	1.646 (1.363–1.988)	<0.001
	Pap with Fv	88 (10995)	51 (3129)	2.146 (1.520–3.030)	<0.001	1.288 (0.906–1.830)	0.158
	Follicular	55 (1948)	31 (831)	1.392 (0.896–2.161)	0.141	0.890 (0.555–1.428)	0.63
T stage	Tx	2 (35)	5 (18)	5.168 (0.999–26.746)	0.05	16.956 (0.581–494.632)	0.1
	T0	5 (54)	4 (42)	1.141 (0.305–4.262)	0.845	3.234 (0.445–23.502)	0.246
	T1	96 (26039)	60 (6474)	2.640 (1.912–3.645)	<0.001	1.867 (1.342–2.596)	<0.001
	T2	52 (7140)	44 (2547)	2.500 (1.673–3.736)	<0.001	1.512 (1.000–2.286)	0.05
	T3	148 (7031)	137 (3549)	1.923 (1.524–2.426)	<0.001	1.245 (0.978–1.586)	0.075
	T4	150 (971)	128 (558)	1.637 (1.293–2.073)	<0.001	1.250 (0.981–1.593)	0.071
N stage	Nx	13 (1169)	8 (353)	2.231 (0.922–5.401)	0.075	1.165 (0.423–3.206)	0.768
	N0	240 (31438)	140 (8461)	2.251 (1.827–2.772)	<0.001	1.593 (1.289–1.968)	<0.001
	N1	200 (8663)	230 (4374)	2.385 (1.973–2.883)	<0.001	1.339 (1.103–1.627)	0.003
M stage	Mx	7 (291)	4 (86)	2.033 (0.595–6.946)	0.258	1.444 (0.344–6.062)	0.616
	M0	332 (40594)	259 (12749)	2.601 (2.211–3.060)	<0.001	1.513 (1.281–1.787)	<0.001
	M1	114 (385)	115 (308)	1.400 (1.080–1.815)	0.011	1.190 (0.912–1.552)	0.2
Combined summary stage	Localized	127 (29701)	77 (7898)	2.375 (1.790–3.153)	<0.001	1.569 (1.172–2.099)	0.002
	Regional	148 (10773)	143 (4765)	2.296 (1.824–2.889)	<0.001	1.635 (1.293–2.067)	<0.001
	Distant	178 (796)	158 (525)	1.565 (1.262–1.940)	<0.001	1.184 (0.950–1.475)	0.133

^a, males versus females. HCC, Hurthle cell carcinoma; Pap with Fv, papillary with follicular variant.

Table S3 Sex differences in nodal ratio

Sex	Regional nodes examined			Regional nodes positive			Nodal ratio
	Mean	Range	Median	Mean	Range	Median	Mean± SD
Female (n=21825)	8.584	1–90	3	2.045	0–67	0	0.192±0.312
Male (n=7256)	13.408	1–90	5	4.013	0–65	1	0.297±0.351

Table S4 Baseline characteristics of the post-PSM cohort

Characteristic	Variable	Female	Male	P
		(n=12779)	(n=12779)	
Age, years	<55	6781 (53.1)	6800 (53.2)	0.812
	≥55	5998 (46.9)	5979 (46.8)	
Race	White	10795 (84.5)	10808 (84.6)	0.76
	Black	653 (5.1)	628 (4.9)	
	Other	1331 (10.4)	1343 (10.5)	
Tumor size	≤1.0 cm	3963 (31.0)	3991 (31.2)	0.705
	>1.0 cm	8816 (69.0)	8788 (68.8)	
T stage	Tx	4 (<0.1)	14 (0.1)	0.313
	T0	28 (0.2)	26 (0.2)	
	T1	6339 (49.6)	6368 (49.8)	
	T2	2469 (19.3)	2451 (19.2)	
	T3	3416 (26.7)	3410 (26.7)	
	T4	523 (4.1)	510 (4.0)	
N stage	Nx	307 (2.4)	336 (2.6)	0.489
	N0	8257 (64.6)	8260 (64.6)	
	N1	4215 (33.0)	4183 (32.7)	
M stage	Mx	72 (0.6)	81 (0.6)	0.592
	M0	12487 (97.7)	12463 (97.5)	
	M1	220 (1.7)	235 (1.8)	
Combined summary stage	Localized	7666 (60.0)	7697 (60.2)	0.628
	Regional	4698 (36.8)	4645 (36.3)	
	Distant	415 (3.2)	437 (3.4)	
Surgery performed	No	92 (0.7)	92 (0.7)	1
	Yes	12687 (99.3)	12687 (99.3)	
Histology recode /pathological type	Medullary	223 (1.7)	223 (1.7)	1
	Hurthle cell carcinoma	351 (2.7)	351 (2.7)	
	Papillary	8367 (65.5)	8367 (65.5)	
	Papillary with follicular variant	3113 (24.4)	3113 (24.4)	
	Follicular	725 (5.7)	725 (5.7)	
Laterality	Bilateral	65 (0.5)	78 (0.6)	0.504
	Not paired Site	12714 (99.5)	12701 (99.4)	
Median income	< \$35,000	37 (0.3)	41 (0.3)	0.918
	\$35,000-\$54,999	1832 (14.3)	1828 (14.3)	
	\$55,000-\$74,999	5625 (44.0)	5665 (44.3)	
	≥\$75,000	5285 (41.4)	5245 (41.0)	
All-cause death	Alive	11897 (93.1)	11430 (89.4)	<0.001
	Dead	882 (6.9)	1349 (10.6)	
Cancer-specific death	Alive	12540 (98.1)	12456 (97.5)	<0.001
	Dead	239 (1.9)	323 (2.5)	
Survival months	Mean±SD	74.14±49.14	72.68±49.23	0.018

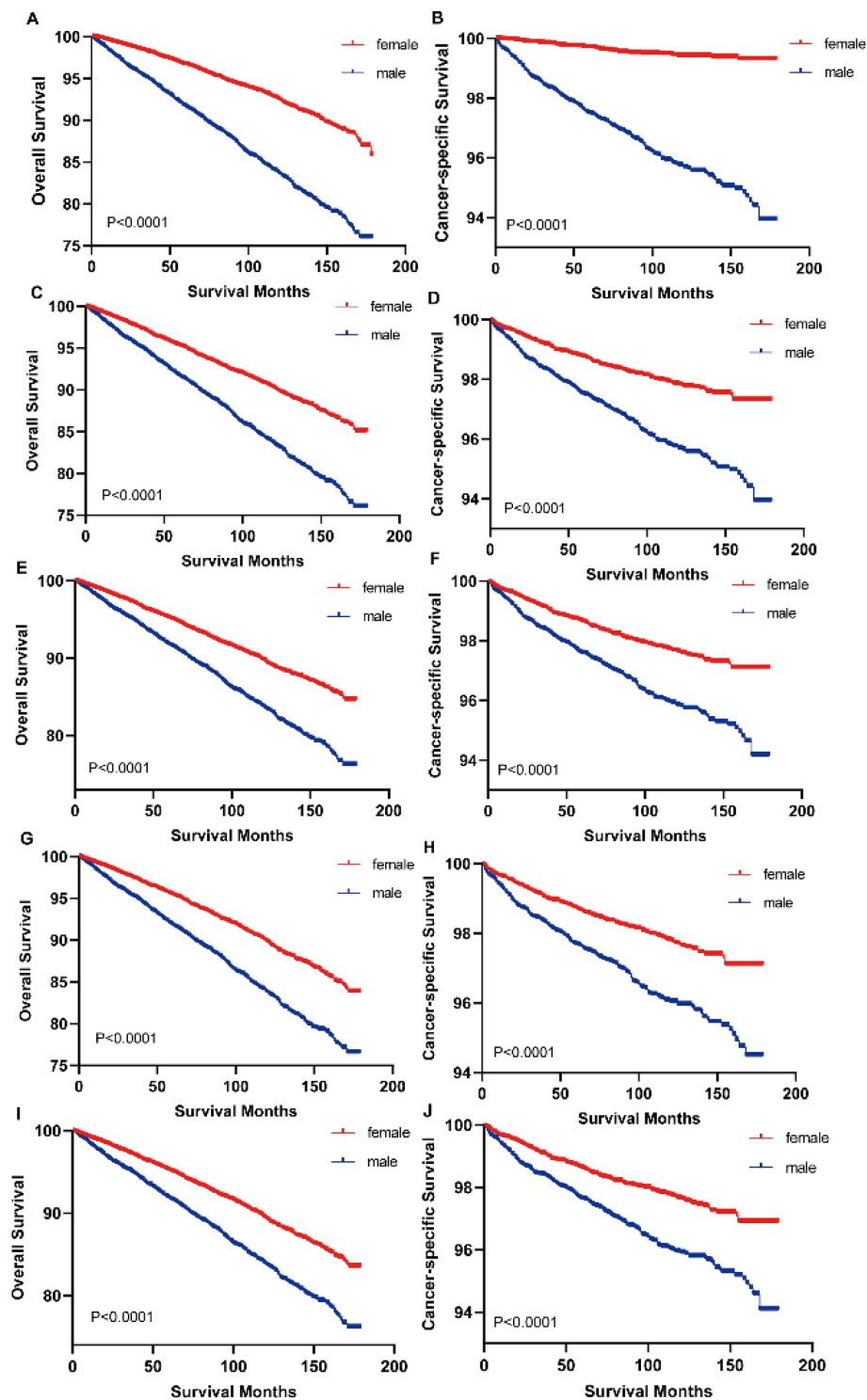


Figure S2 Overall and cancer-specific survival curves after propensity score matching including different factors, one-to-one match. (A,B) Only race and age of diagnosis were included in matching. (C,D) Race, age of diagnosis and combined summary stage included. (E,F) Race, age of diagnosis, combined summary stage and histology re-code included. (G,H) Race, age of diagnosis, combined summary stage, histology re-code and tumor size included. (I,J) Race, age of diagnosis, combined summary stage, histology re-code, tumor size, and surgery performed or not included. K-M curves were compared using log-rank test, $P < 0.001$, respectively.

Table S5 Univariable and multivariable cox regression analyses of overall survival in female thyroid cancer

Characteristics	Variable	Univariable analysis		Multivariable analysis	
		HR (95% CI)	P	HR (95% CI)	P
Tumor size	≤1 cm	1	–	1	–
	>1 cm	1.238 (1.133–1.352)	<0.001	1.030 (0.934–1.137)	0.55
Race	Black	1	–	1	–
	White	0.703 (0.608–0.813)	<0.001	0.736 (0.636–0.852)	<0.001
	Other	0.729 (0.598–0.864)	<0.001	0.682 (0.565–0.822)	<0.001
Age, years	<55	1	–	1	–
	≥55	6.622 (6.004–7.304)	<0.001	6.195 (5.612–6.838)	<0.001
Median income	<\$55,000	1	–	1	–
	≥\$55,000	0.717 (0.642–0.800)	<0.001	0.841 (0.753–0.940)	<0.001
Surgery performed	No	1	–	1	–
	Yes	0.075 (0.061–0.092)	<0.001	0.134 (0.108–0.167)	<0.001
Histology Recode /pathological type	Medullary	1	–	1	–
	HCC	0.773 (0.570–1.050)	0.099	0.949 (0.695–1.296)	0.743
	Follicular	0.526 (0.396–0.699)	<0.001	0.750 (0.564–0.998)	0.048
	Pap with Fv	0.344 (0.268–0.442)	<0.001	0.626 (0.484–0.810)	<0.001
	Papillary	0.328 (0.257–0.418)	<0.001	0.618 (0.481–0.793)	<0.001
T stage	Tx	0.607 (0.226–1.632)	0.323	0.206 (0.075–0.562)	0.002
	T0	0.894 (0.475–1.685)	0.729	0.307 (0.160–0.591)	<0.001
	T1	0.186 (0.161–0.214)	<0.001	0.354 (0.288–0.436)	<0.001
	T2	0.178 (0.149–0.211)	<0.001	0.347 (0.279–0.431)	<0.001
	T3	0.296 (0.253–0.347)	<0.001	0.470 (0.395–0.560)	<0.001
	T4	1	–	1	–
N stage	Nx	1.479 (1.109–1.973)	0.008	1.144 (0.848–1.542)	0.379
	N0	0.915 (0.823–1.017)	0.099	1.004 (0.872–1.157)	0.954
	N1	1	–	1	–
M stage	Mx	0.107 (0.071–0.161)	<0.001	0.207 (0.135–0.319)	<0.001
	M0	0.086 (0.072–0.101)	<0.001	0.266 (0.211–0.335)	<0.001
	M1	1	–	1	–
Combined summary stage	Localized	1	–	1	–
	Regional	1.118 (1.010–1.237)	0.031	0.994 (0.879–1.124)	0.92
	Distant	7.644 (6.673–8.755)	<0.001	2.133 (1.671–2.723)	<0.001

HCC, Hurthle cell carcinoma; Pap with Fv, papillary with follicular variant.

Table S6 Univariable and multivariable cox regression analyses of overall survival in male thyroid cancer

Characteristics	Variable	Univariable analysis		Multivariable analysis	
		HR (95% CI)	P	HR (95% CI)	P
Tumor size	≤1 cm	1	–	1	–
	>1 cm	1.213 (1.081–1.361)	0.001	0.984 (0.864–1.120)	0.802
Race	Black	1	–	1	–
	White	0.675 (0.550–0.828)	<0.001	0.776 (0.630–0.955)	0.016
	Other	0.705 (0.545–0.912)	0.008	0.742 (0.572–0.963)	0.025
Age, years	<55	1	–	1	–
	≥55	4.727 (4.172–5.355)	<0.001	4.499 (3.967–5.102)	<0.001
Median income	<\$55,000	1	–	1	–
	≥\$55,000	0.662 (0.581–0.755)	<0.001	0.785 (0.687–0.897)	<0.001
Surgery performed	No	1	–	1	–
	Yes	0.103 (0.083–0.128)	<0.001	0.192 (0.152–0.242)	<0.001
Histology recode /pathological type	Medullary	1	–	1	–
	HCC	0.794 (0.585–1.079)	0.141	1.017 (0.737–1.403)	0.918
	Follicular	0.541 (0.409–0.717)	<0.001	0.814 (0.606–1.094)	0.173
	Pap with Fv	0.423 (0.333–0.536)	<0.001	0.719 (0.558–0.928)	0.011
	Papillary	0.422 (0.338–0.527)	<0.001	0.750 (0.592–0.951)	0.028
T stage	Tx	1.851 (0.871–3.933)	0.11	0.677 (0.314–1.463)	0.321
	T0	1.264 (0.760–2.103)	0.367	0.783 (0.462–1.326)	0.363
	T1	0.219 (0.187–0.257)	<0.001	0.391 (0.316–0.484)	<0.001
	T2	0.229 (0.189–0.276)	<0.001	0.441 (0.351–0.554)	<0.001
	T3	0.303 (0.257–0.359)	<0.001	0.498 (0.413–0.601)	<0.001
	T4	1	–	1	–
N stage	Nx	1.444 (1.039–2.008)	0.029	1.214 (0.864–1.707)	0.263
	N0	0.741 (0.665–0.825)	<0.001	0.965 (0.822–1.133)	0.664
	N1	1	–	1	–
M stage	Mx	0.186 (0.114–0.304)	<0.001	0.432 (0.260–0.718)	0.001
	M0	0.132 (0.111–0.156)	<0.001	0.364 (0.291–0.457)	<0.001
	M1	1	–	1	–
Combined summary stage	Localized	1	–	1	–
	Regional	1.163 (1.037–1.304)	0.01	1.135 (0.998–1.291)	0.054
	Distant	6.217 (5.356–7.217)	<0.001	2.153 (1.639–2.829)	<0.001

HCC, Hurthle cell carcinoma; Pap with Fv, papillary with follicular variant.

Table S7 Univariable and multivariable cox regression analyses of cancer-specific survival in female thyroid cancer

Characteristics	Variable	Univariable analysis		Multivariable analysis	
		HR (95% CI)	P	HR (95% CI)	P
Tumor size	≤1 cm	1	–	1	–
	>1 cm	4.004 (3.094–5.181)	<0.001	1.578 (1.199–2.077)	<0.001
Race	Black	1	–	1	–
	White	0.760 (0.543–1.063)	0.109	0.761 (0.541–1.070)	0.116
	Other	1.339 (0.915–1.960)	0.133	0.770 (0.520–1.140)	0.192
Age, years	<55	1	–	1	–
	≥55	8.766 (6.952–11.055)	<0.001	7.054 (5.562–8.946)	<0.001
Median income	<\$55,000	1	–	1	–
	≥\$55,000	0.875 (0.682–1.123)	0.293	0.949 (0.736–1.224)	0.686
Surgery performed	No	1	–	1	–
	Yes	0.031 (0.023–0.042)	<0.001	0.153 (0.109–0.217)	<0.001
Histology recode / pathological type	Medullary	1	–	1	–
	HCC	0.589 (0.372–0.933)	0.024	1.468 (0.902–2.390)	0.123
	Follicular	0.379 (0.248–0.579)	<0.001	0.968 (0.613–1.529)	0.889
	Pap with Fv	0.108 (0.073–0.160)	<0.001	0.500 (0.327–0.764)	0.001
	Papillary	0.123 (0.086–0.175)	<0.001	0.426 (0.291–0.624)	<0.001
T stage	Tx	0.456 (0.113–1.839)	0.27	0.136 (0.033–0.560)	0.006
	T0	0.633 (0.260–1.544)	0.315	0.326 (0.125–0.850)	0.022
	T1	0.023 (0.018–0.030)	<0.001	0.178 (0.122–0.260)	<0.001
	T2	0.046 (0.034–0.063)	<0.001	0.251 (0.170–0.368)	<0.001
	T3	0.136 (0.109–0.171)	<0.001	0.428 (0.329–0.557)	<0.001
	T4	1	–	1	–
	N stage	Nx	0.757 (0.431–1.328)	0.332	0.753 (0.424–1.337)
M stage	N0	0.297 (0.246–0.358)	<0.001	0.700 (0.565–0.868)	0.001
	N1	1	–	1	–
	Mx	0.042 (0.020–0.091)	<0.001	0.210 (0.096–0.460)	<0.001
Combined summary stage	M0	0.020 (0.016–0.025)	<0.001	0.243 (0.178–0.333)	<0.001
	M1	1	–	1	–
	Localized	1	–	1	–
	Regional	3.413 (2.679–4.326)	<0.001	1.594 (1.180–2.152)	<0.001
	Distant	59.119 (47.079–74.238)	<0.001	4.986 (3.247–7.658)	<0.001

HCC, Hurthle cell carcinoma; Pap with Fv, papillary with follicular variant.

Table S8 Univariable and multivariable cox regression analyses of cancer-specific survival in male thyroid cancer

Characteristics	Variable	Univariable analysis		Multivariable analysis	
		HR (95% CI)	P	HR (95% CI)	P
Tumor size	≤1 cm	1	–	1	–
	>1 cm	3.354 (2.457–4.579)	<0.001	1.705 (1.380–2.106)	<0.001
Race	Black	1	–	1	–
	White	0.947 (0.596–1.505)	0.819	0.916 (0.697–1.205)	0.531
	Other	0.933 (0.535–1.626)	0.807	0.814 (0.591–1.122)	0.209
Age, years	<55	1	–	1	–
	≥55	4.003 (3.161–5.070)	<0.001	3.392 (2.661–4.325)	<0.001
Median income	<\$55,000	1	–	1	–
	≥\$55,000	0.635 (0.493–0.816)	<0.001	0.739 (0.574–0.953)	0.02
Surgery performed	No	1	–	1	–
	Yes	0.063 (0.045–0.088)	<0.001	0.272 (0.188–0.395)	<0.001
Histology recode /pathological type	Medullary	1	–	1	–
	HCCv	0.539 (0.348–0.836)	0.006	1.263 (0.901–1.770)	0.175
	Follicular	0.247 (0.159–0.385)	<0.001	0.831 (0.601–1.150)	0.264
	Pap with Fv	0.107 (0.073–0.157)	<0.001	0.437 (0.325–0.588)	<0.001
	Papillary	0.171 (0.126–0.231)	<0.001	0.459 (0.355–0.593)	<0.001
T stage	Tx	1.912 (0.782–4.677)	0.156	0.315 (0.146–0.680)	0.003
	T0	0.479 (0.177–1.296)	0.147	0.475 (0.232–0.973)	0.042
	T1	0.036 (0.027–0.050)	<0.001	0.188 (0.141–0.251)	<0.001
	T2	0.068 (0.048–0.095)	<0.001	0.274 (0.207–0.363)	<0.001
	T3	0.154 (0.121–0.196)	<0.001	0.439 (0.363–0.531)	<0.001
	T4	1	–	1	–
N stage	Nx	0.642 (0.414–0.996)	0.048	0.721 (0.458–1.134)	0.157
	N0	0.258 (0.225–0.296)	<0.001	0.753 (0.638–0.889)	0.001
	N1	1	–	1	–
M stage	Mx	0.044 (0.024–0.081)	<0.001	0.240 (0.129–0.446)	<0.001
	M0	0.024 (0.020–0.028)	<0.001	0.256 (0.204–0.320)	<0.001
	M1	1	–	1	–
Combined summary stage	Localized	1	–	1	–
	Regional	3.688 (3.084–4.411)	<0.001	1.826 (1.456–2.291)	<0.001
	Distant	56.280 (47.287–66.984)	<0.001	5.129 (3.700–7.110)	<0.001

HCC, Hurthle cell carcinoma; Pap with Fv, papillary with follicular variant.