

**Table S1** MIS vs. open surgery: demographic and clinicopathological characteristics before and after PSM

Characteristics	Unmatched cohort			Matched cohort		
	MIS (n=687)	Open (n=2,976)	P value	MIS (n=683)	Open (n=1,317)	P value
Age (years)	67.46±9.74	66.29±9.74	0.005	67.44±9.75	67.23±9.53	0.640
Sex			0.018			0.962
Male	333 (48.5)	1,593 (53.5)		333 (48.8)	645 (49.0)	
Female	354 (51.5)	1,383 (46.5)		350 (51.2)	672 (51.0)	
Race			0.815			0.899
White	603 (87.8)	2,622 (88.1)		602 (88.1)	1,169 (88.8)	
Black	65 (9.5)	263 (8.8)		62 (9.1)	115 (8.7)	
Others	19 (2.8)	91 (3.1)		19 (2.8)	33 (2.5)	
Insurance			0.031			0.548
No insurance	9 (1.3)	92 (3.1)		9 (1.3)	22 (1.7)	
Private	227 (33.0)	998 (33.5)		226 (33.1)	461 (35.0)	
Government	451 (65.6)	1,886 (63.4)		448 (65.6)	834 (63.3)	
Income			<0.001			0.809
<\$48,000	260 (37.8)	1,377 (46.3)		260 (38.1)	509 (38.6)	
≥\$48,000	427 (62.2)	1,599 (53.7)		423 (61.9)	808 (61.4)	
Education			0.001			0.701
<13%	275 (40.0)	1,397 (46.9)		409 (59.9)	776 (58.9)	
≥13%	412 (60.0)	1,579 (53.1)		274 (40.1)	541 (41.1)	
Charlson score			0.185			0.985
0	325 (47.3)	1,522 (51.1)		325 (47.6)	632 (48.0)	
1	274 (39.9)	1,050 (35.3)		270 (39.5)	517 (39.3)	
≥2	88 (12.8)	404 (13.6)		88 (12.9)	168 (12.8)	
Facility			<0.001			0.899
Community	25 (3.6)	178 (6.0)		25 (3.7)	52 (3.9)	
Comprehensive community	280 (40.8)	1,505 (50.6)		280 (41.0)	558 (42.4)	
Academic/research	300 (43.7)	1,041 (35.0)		297 (43.5)	560 (42.5)	
Integrated network	82 (11.9)	252 (8.5)		81 (11.9)	147 (11.2)	
Tumor size (mm)	39.87±25.38	49.00±51.02	<0.001	39.97±25.41	40.63±24.88	0.575
Clinical T stage			<0.001			0.524
T1	271 (39.4)	851 (28.6)		268 (39.2)	498 (37.8)	
T2	248 (36.1)	1,115 (37.5)		248 (36.3)	484 (36.8)	
T3	129 (18.8)	838 (28.2)		129 (18.9)	261 (19.8)	
T4	39 (5.7)	172 (5.8)		38 (5.6)	74 (5.6)	
Clinical N stage			0.144			0.731
N0	554 (80.6)	2,335 (78.5)		551 (80.7)	1054 (80.0)	
N1	84 (12.2)	349 (11.7)		83 (12.2)	165 (12.5)	
N2	49 (7.1)	292 (9.8)		49 (7.2)	98 (7.4)	
Neoadjuvant			<0.001			0.554
Yes	74 (10.8)	479 (16.1)		74 (10.8)	155 (11.8)	
No	613 (89.2)	2,497 (83.9)		609 (89.2)	1162 (88.2)	
Location			0.261			0.978
Carina or hilus	5 (0.7)	13 (0.4)		5 (0.7)	9 (0.7)	
Upper lobe	364 (53.0)	1675 (56.3)		361 (52.9)	717 (54.4)	
Middle lobe	63 (9.2)	222 (7.5)		63 (9.2)	127 (9.6)	
Lower lobe	178 (25.9)	755 (25.4)		178 (26.1)	325 (24.7)	
Overlapping	48 (7.0)	221 (7.4)		48 (7.0)	88 (6.7)	
NOS	29 (4.2)	90 (3.0)		28 (4.1)	51 (3.9)	
Histology			0.041			0.944
SCC	236 (34.4)	1,177 (39.5)		236 (34.6)	465 (35.3)	
ADC	344 (50.1)	1,371 (46.1)		341 (49.9)	651 (49.4)	
Others	107 (15.6)	428 (14.4)		106 (15.5)	201 (15.3)	
Surgery codes			<0.001			0.566
45 (NOS)	498 (72.5)	1,838 (61.8)		494 (72.3)	935 (71.0)	
46–48 (specified)	189 (27.5)	1,138 (38.2)		189 (27.7)	382 (29.0)	

Data are presented as n (%) or mean ± SD. MIS, minimally invasive surgery; PSM, propensity score matching; NOS, not otherwise specified; SCC, squamous cell carcinoma; ADC, adenocarcinoma; SD, standard deviation.

**Table S2** RATS vs. VATS: demographic characteristics before and after PSM

Characteristics	Unmatched cohort			Matched cohort		
	RATS (n=154)	VATS (n=533)	P value	RATS (n=149)	VATS (n=286)	P value
Age (years)	68.02±9.14	67.29±9.91	0.415	67.91±9.09	67.95±9.99	0.966
Sex			0.022			0.469
Male	62 (40.3)	271 (50.8)		62 (41.6)	108 (37.8)	
Female	92 (59.7)	262 (49.2)		87 (58.4)	178 (62.2)	
Race			0.575			0.769
White	132 (85.7)	471 (88.4)		129 (86.6)	253 (88.5)	
Black	18 (11.7)	47 (8.8)		16 (10.7)	28 (9.8)	
Others	4 (2.6)	15 (2.8)		4 (2.7)	5 (1.7)	
Insurance			0.852			0.829
No insurance	2 (1.3)	7 (1.3)		2 (1.3)	5 (1.7)	
Private	48 (31.2)	179 (33.6)		47 (31.5)	83 (29.0)	
Government	104 (67.5)	347 (65.1)		100 (67.1)	198 (69.2)	
Income			0.609			0.600
<\$48,000	61 (39.6)	199 (37.3)		57 (38.3)	101 (35.3)	
≥\$48,000	93 (60.4)	334 (62.7)		92 (61.7)	185 (64.7)	
Education			0.780			0.465
<13%	94 (61.0)	318 (59.7)		91 (61.1)	185 (64.7)	
≥13%	60 (39.0)	215 (40.3)		58 (38.9)	101 (35.3)	
Charlson score			0.697			0.780
0	77 (50.0)	248 (46.5)		73 (49.0)	143 (50.0)	
1	57 (37.0)	217 (40.7)		57 (38.3)	113 (39.5)	
≥2	20 (13.0)	68 (12.8)		19 (12.8)	30 (10.5)	
Facility			0.304			0.986
Community	3 (1.9)	22 (4.1)		3 (2.0)	5 (1.7)	
Comprehensive community	71 (46.1)	209 (39.2)		69 (46.3)	129 (45.1)	
Academic/research	63 (40.9)	237 (44.5)		61 (40.9)	122 (42.7)	
Integrated network	17 (11.0)	65 (12.2)		16 (10.7)	30 (10.5)	
Tumor size (mm)	36.66±25.65	40.79±25.25	0.075	36.38±26.02	37.43±21.73	0.655
Clinical T stage			0.102			0.924
T1	65 (42.2)	206 (38.6)		65 (43.6)	127 (44.4)	
T2	62 (40.3)	186 (34.9)		57 (38.3)	102 (35.7)	
T3	19 (12.3)	110 (20.6)		19 (12.8)	38 (13.3)	
T4	8 (5.2)	31 (5.8)		8 (5.4)	19 (6.6)	
Clinical N stage			0.120			0.488
N0	129 (83.8)	425 (79.7)		125 (83.9)	244 (85.3)	
N1	12 (7.8)	72 (13.5)		12 (8.1)	27 (9.4)	
N2	13 (8.4)	36 (6.8)		12 (8.1)	15 (5.2)	
Neoadjuvant			0.026			0.423
Yes	9 (5.8)	65 (12.2)		26 (8.5)	42 (6.9)	
No	145 (94.2)	468 (87.8)		279 (91.5)	563 (93.1)	
Location			0.966			0.710
Carina or hilus	2 (1.3)	3 (0.6)		0 (0.0)	3 (1.0)	
Upper lobe	82 (53.2)	282 (52.9)		81 (54.4)	150 (52.4)	
Middle lobe	13 (8.4)	50 (9.4)		13 (8.7)	23 (8.0)	
Lower lobe	40 (26.0)	138 (25.9)		39 (26.2)	74 (25.9)	
Overlapping	11 (7.1)	37 (6.9)		10 (6.7)	22 (7.7)	
NOS	6 (3.9)	23 (4.3)		6 (4.0)	14 (4.9)	
Histology			0.804			0.935
SCC	50 (32.5)	186 (34.9)		49 (32.9)	92 (32.2)	
ADC	78 (50.6)	266 (49.9)		76 (51.0)	144 (50.3)	
Others	26 (16.9)	81 (15.2)		24 (16.1)	50 (17.5)	
Surgery codes			0.152			0.726
45 (NOS)	119 (77.3)	379 (71.1)		114 (76.5)	213 (74.5)	
46–48 (specified)	35 (22.7)	154 (28.9)		35 (23.5)	73 (25.5)	

Data are presented as n (%) or mean ± SD. RATS, robot-assisted thoracoscopic surgery; VATS, video-assisted thoracoscopic surgery; PSM, propensity score matching; NOS, not otherwise specified; SCC, squamous cell carcinoma; ADC, adenocarcinoma; SD, standard deviation.

**Table S3** MIS vs. open surgery: univariable and multivariable analyses of risk factors for overall survival in whole group

Variables	Univariable analysis		Multivariable analysis	
	HR (95% CI)	P value	HR (95% CI)	P value
<b>Facility</b>				
Community (ref)				
Comprehensive community	1.643 (1.078–2.505)	0.021	1.809 (1.185–2.763)	0.006
Academic/research	1.375 (0.900–2.099)	0.141	1.386 (0.905–2.122)	0.133
Integrated network	1.468 (0.930–2.317)	0.099	1.434 (0.905–2.272)	0.125
<b>Sex</b>				
Male (ref)				
Female	0.678 (0.590–0.780)	<0.001	0.758 (0.656–0.876)	<0.001
<b>Age</b>				
≤65 years (ref)				
>65 years	1.573 (1.356–1.825)	<0.001	1.544 (1.326–1.798)	<0.001
<b>Race</b>				
White (ref)				
Black	0.857 (0.664–1.107)	0.239		
Others	0.865 (0.535–1.400)	0.555		
<b>Insurance</b>				
No insurance (ref)				
Private	0.770 (0.431–1.378)	0.379		
Government	1.259 (0.711–2.231)	0.430		
<b>Income</b>				
<\$48,000 (ref)				
≥\$48,000	0.995 (0.863–1.148)	0.945		
<b>Education</b>				
<13% (ref)				
≥13%	1.013 (0.879–1.168)	0.854		
<b>Charlson score</b>				
0 (ref)				
1	1.168 (1.005–1.359)	0.0043	1.141 (0.979–1.331)	0.092
≥2	1.503 (1.223–1.846)	<0.001	1.470 (1.190–1.816)	<0.001
<b>Location</b>				
Carina or hilus (ref)				
Upper lobe	6.228 (0.875–44.318)	0.068		
Middle lobe	6.139 (0.854–44.132)	0.071		
Lower lobe	7.328 (1.028–52.256)	0.047		
Overlapping	5.165 (0.713–37.436)	0.104		
NOS	4.904 (0.664–36.194)	0.119		
<b>Histology</b>				
SCC (ref)				
ADC	0.582 (0.499–0.679)	<0.001	0.704 (0.598–0.829)	<0.001
Others	0.971 (0.887–1.301)	0.463	1.186 (0.976–1.442)	0.086
<b>Clinical T stage</b>				
T1 (ref)				
T2	1.384 (1.172–1.635)	<0.001	1.181 (0.993–1.404)	0.060
T3	1.819 (1.509–2.194)	<0.001	1.499 (1.215–1.850)	<0.001
T4	1.427 (1.035–1.965)	0.030	1.347 (0.963–1.883)	0.081
<b>Clinical N stage</b>				
N0 (ref)				
N1	1.219 (0.995–1.494)	0.056	1.130 (0.919–1.389)	0.248
N2	1.588 (1.252–2.013)	<0.001	1.518 (1.172–1.966)	0.002
<b>Resection status</b>				
R0 (ref)				
R1 or R2	1.852 (1.534–2.236)	<0.001	1.657 (1.365–2.012)	<0.001
<b>Surgical approach</b>				
Open (ref)				
MIS	0.969 (0.835–1.125)	0.683	0.967 (0.832–1.123)	0.657
<b>Neoadjuvant</b>				
No (ref)				
Yes	1.336 (1.091–1.635)	0.005		

MIS, minimally invasive surgery; HR, hazard ratio; CI, confidence interval; ref, reference; NOS, not otherwise specified; SCC, squamous cell carcinoma; ADC, adenocarcinoma.

**Table S4** Conversion vs. open: demographic characteristics before and after PSM

Characteristics	Unmatched cohort			Matched cohort		
	Conversion (n=271)	Open (n=2,976)	P value	Conversion (n=271)	Open (n=542)	P value
Age (years)	67.70±9.81	66.29±9.74	0.023	67.70±9.81	67.13±9.82	0.431
Sex			0.751			0.710
Male	142 (52.4)	1,593 (53.5)		142 (52.4)	276 (50.9)	
Female	129 (47.6)	1,383 (46.5)		129 (47.6)	266 (49.1)	
Race			0.597			0.549
White	244 (90.9)	2,622 (88.1)		244 (90.9)	486 (89.7)	
Black	21 (7.7)	263 (8.8)		21 (7.7)	37 (6.8)	
Others	6 (2.2)	91 (3.1)		6 (2.2)	19 (3.5)	
Insurance			0.113			0.666
No insurance	7 (2.6)	92 (3.1)		7 (2.6)	12 (2.2)	
Private	75 (27.7)	998 (33.5)		75 (27.7)	166 (30.6)	
Government	189 (69.7)	1,886 (63.4)		189 (69.7)	364 (67.2)	
Income			0.203			0.821
<\$48,000	114 (42.1)	1,377 (46.3)		114 (42.1)	223 (41.1)	
≥\$48,000	157 (57.9)	1,599 (53.7)		157 (57.9)	319 (58.9)	
Education			0.252			0.598
<13%	154 (56.8)	1,397 (46.9)		154 (56.8)	319 (58.9)	
≥13%	117 (43.2)	1,579 (53.1)		117 (43.2)	223 (41.1)	
Charlson score			0.867			0.541
0	134 (49.4)	1,522 (51.1)		134 (49.4)	257 (47.4)	
1	99 (36.5)	1,050 (35.3)		99 (36.5)	202 (37.3)	
≥2	38 (14.0)	404 (13.6)		38 (14.0)	83 (15.3)	
Facility			0.019			0.727
Community	16 (5.9)	178 (6.0)		16 (5.9)	27 (5.0)	
Comprehensive community	111 (41.0)	1,505 (50.6)		111 (41.0)	234 (43.2)	
Academic/research	115 (42.4)	1,041 (35.0)		115 (42.4)	214 (39.5)	
Integrated network	29 (10.7)	252 (8.5)		29 (10.7)	67 (12.4)	
Tumor size (mm)	43.07±24.80	49.00±51.02	0.058	43.07±24.80	42.94±23.64	0.943
Clinical T stage			0.447			0.900
T1	81 (29.9)	851 (28.6)		81 (29.9)	166 (30.6)	
T2	111 (41.0)	1,115 (37.5)		111 (41.0)	217 (40.0)	
T3	66 (24.4)	838 (28.2)		66 (24.4)	135 (24.9)	
T4	13 (4.8)	172 (5.8)		13 (4.8)	24 (4.4)	
Clinical N stage			0.057			0.992
N0	203 (74.9)	2,335 (78.5)		203 (74.9)	404 (74.5)	
N1	45 (16.6)	349 (11.7)		45 (16.6)	100 (18.5)	
N2	23 (8.5)	292 (9.8)		23 (8.5)	38 (7.0)	
Neoadjuvant			0.001			0.583
Yes	24 (8.9)	479 (16.1)		24 (8.9)	41 (7.6)	
No	247 (91.1)	1,378 (93.6)		247 (91.1)	501 (92.4)	
Location			0.223			0.842
Carina or hilus	1 (0.4)	13 (0.4)		1 (0.4)	5 (0.9)	
Upper lobe	136 (50.2)	1,675 (56.3)		136 (50.2)	282 (52.0)	
Middle lobe	20 (7.4)	222 (7.5)		20 (7.4)	35 (6.5)	
Lower lobe	84 (31.0)	755 (25.4)		84 (31.0)	154 (28.4)	
Overlapping	25 (9.2)	221 (7.4)		25 (9.2)	58 (10.7)	
NOS	5 (1.8)	90 (3.0)		5 (1.8)	8 (1.5)	
Histology			0.503			0.922
SCC	117 (43.2)	1,177 (39.5)		117 (43.2)	226 (41.7)	
ADC	118 (43.5)	1,371 (46.1)		118 (43.5)	242 (44.6)	
Others	36 (13.3)	428 (14.4)		36 (13.3)	74 (13.7)	
Surgery codes			0.515			0.706
45 (NOS)	162 (59.8)	1,838 (61.8)		162 (59.8)	315 (58.1)	
46–48 (specified)	109 (40.2)	1,138 (38.2)		109 (40.2)	227 (41.9)	

Data are presented as n (%) or mean ± SD. PSM, propensity score matching; NOS, not otherwise specified; SCC, squamous cell carcinoma; ADC, adenocarcinoma; SD, standard deviation.

**Table S5** Demographic characteristics before and after PSM in community/comprehensive community cancer program cohort

Characteristics	Unmatched cohort			Matched cohort		
	MIS (n=305)	Open (n=1,683)	P value	MIS (n=305)	Open (n=605)	P value
Age (years)	68.45±9.64	67.41±9.65	0.085	68.45±9.64	68.10±9.54	0.601
Sex			0.021			0.620
Male	138 (45.2)	884 (52.5)		138 (45.2)	262 (43.3)	
Female	167 (54.8)	799 (47.5)		167 (54.8)	343 (56.7)	
Race			0.862			0.529
White	274 (89.8)	1,511 (89.8)		274 (89.8)	541 (89.4)	
Black	25 (8.2)	131 (7.8)		25 (8.2)	57 (9.4)	
Others	6 (2.0)	41 (2.4)		6 (2.0)	7 (1.2)	
Insurance			0.091			0.820
No insurance	2 (0.7)	46 (2.7)		2 (0.7)	6 (1.0)	
Private	94 (30.8)	497 (29.5)		94 (30.8)	193 (31.9)	
Government	209 (68.5)	1,140 (67.7)		209 (68.5)	406 (67.1)	
Income			<0.001			0.829
<\$48,000	117 (38.4)	850 (50.5)		117 (38.4)	238 (39.3)	
≥\$48,000	188 (61.6)	833 (49.5)		188 (61.6)	367 (60.7)	
Education			<0.001			0.885
<13%	189 (62.0)	839 (49.9)		189 (62.0)	371 (61.3)	
≥13%	116 (38.0)	844 (50.1)		116 (38.0)	234 (38.7)	
Charlson score			0.130			0.768
0	146 (47.9)	815 (48.4)		146 (47.9)	282 (46.6)	
1	127 (41.6)	627 (37.3)		127 (41.6)	260 (43.0)	
≥2	32 (10.5)	241 (14.3)		32 (10.5)	63 (10.4)	
Tumor size (mm)	39.33±24.51	45.34±41.62	0.015	39.33±24.51	39.90±23.16	0.735
Clinical T stage			0.007			0.381
T1	122 (40.0)	534 (31.7)		122 (40.0)	231 (38.2)	
T2	111 (36.4)	665 (39.5)		111 (36.4)	214 (35.4)	
T3	57 (18.7)	403 (23.9)		57 (18.7)	120 (19.8)	
T4	15 (4.9)	81 (4.8)		15 (4.9)	40 (6.6)	
Clinical N stage			0.980			0.519
N0	249 (81.6)	1,375 (81.7)		249 (81.6)	483 (79.8)	
N1	34 (11.1)	187 (11.1)		34 (11.1)	74 (12.2)	
N2	22 (7.2)	121 (7.2)		22 (7.2)	48 (7.9)	
Neoadjuvant			0.198			0.423
Yes	26 (8.5)	185 (11.0)		26 (8.5)	42 (6.9)	
No	279 (91.5)	1,498 (89.0)		279 (91.5)	563 (93.1)	
Location			0.948			0.969
Carina or hilus	2 (0.7)	8 (0.5)		2 (0.7)	4 (0.7)	
Upper lobe	175 (57.4)	963 (57.2)		175 (57.4)	328 (54.2)	
Middle lobe	24 (7.9)	116 (6.9)		24 (7.9)	54 (8.9)	
Lower lobe	79 (25.9)	435 (25.8)		79 (25.9)	165 (27.3)	
Overlapping	18 (5.9)	110 (6.5)		18 (5.9)	38 (6.3)	
NOS	7 (2.3)	51 (3.0)		7 (2.3)	16 (2.6)	
Histology			0.518			0.967
SCC	110 (36.1)	654 (38.9)		110 (36.1)	213 (35.2)	
ADC	154 (50.5)	790 (46.9)		154 (50.5)	309 (51.1)	
Others	41 (13.4)	239 (14.2)		41 (13.4)	83 (13.7)	
Surgery codes			0.002			0.807
45 (NOS)	232 (76.1)	1,128 (67.0)		232 (76.1)	454 (75.0)	
46–48 (specified)	73 (23.9)	555 (33.0)		73 (23.9)	151 (25.0)	

Data are presented as n (%) or mean ± SD. PSM, propensity score matching; MIS, minimally invasive surgery; NOS, not otherwise specified; SCC, squamous cell carcinoma; ADC, adenocarcinoma; SD, standard deviation.