

Table S1. Number of LN examined by age and stage

Age, y	T1		T2		T3		T4	
	N	25 <sup>th</sup> , 50 <sup>th</sup> , 75 <sup>th</sup> percentile	N	25 <sup>th</sup> , 50 <sup>th</sup> , 75 <sup>th</sup> percentile	N	25 <sup>th</sup> , 50 <sup>th</sup> , 75 <sup>th</sup> percentile	N	25 <sup>th</sup> , 50 <sup>th</sup> , 75 <sup>th</sup> percentile
20-39	3,239	11, 17, 25	9,773	12, 17, 27	54,130	14, 21, 30	34,368	12, 18, 26
40-49	8,536	8, 13, 20	29,438	9, 15, 22	139,096	13, 18, 25	78,909	10, 15, 22
50-59	30,120	7, 13, 18	76,871	9, 14, 20	304,125	12, 16, 23	156,018	8, 14, 20
60-69	45,123	6, 11, 17	125,223	7, 13, 18	437,790	10, 15, 21	252,823	8, 12, 19
70-79	58,551	6, 11, 17	177,438	7, 12, 18	557,505	9, 14, 20	343,898	7, 12, 17
80+	37,655	6, 11, 16	148,295	7, 12, 17	522,701	9, 14, 20	287,902	7, 11, 17
Total	183,224	6, 12, 17	567,038	8, 13, 18	2,015,347	10, 15, 21	1,153,918	7, 12, 18

Trend was estimated using quantile regression model for each T stage; all P < .0001.  
Abbreviations: N = total number of lymph nodes.

Table S2: Patient and tumor characteristics

Characteristic	OR (95% CI)				
	All	T1	T2	T3	T4
Age at diagnosis, y					
20-39	1.83 (1.72-1.94)	3.06 (2.09-4.48)	2.46 (2.00-3.02)	1.77 (1.62-1.93)	1.68 (1.51-1.86)
40-49	1.67 (1.61-1.74)	1.97 (1.53-2.55)	2.06 (1.83-2.33)	1.75 (1.66-1.85)	1.47 (1.37-1.57)
50-59	1.49 (1.45-1.54)	1.67 (1.40-1.99)	1.72 (1.58-1.88)	1.61 (1.55-1.68)	1.46 (1.39-1.53)
60-69	1.27 (1.24-1.30)	1.38 (1.17-1.62)	1.51 (1.40-1.63)	1.35 (1.30-1.39)	1.27 (1.22-1.32)
70-79	1.09 (1.06-1.11)	1.09 (0.93-1.27)	1.21 (1.13-1.30)	1.16 (1.13-1.20)	1.09 (1.05-1.13)
80 <sup>+</sup>	1	1	1	1	1
Race					
White	1	1	1	1	1
Black	0.80 (0.78-0.83)	0.75 (0.62-0.90)	0.78 (0.71-0.86)	0.80 (0.77-0.84)	0.82 (0.78-0.86)
Others	0.95 (0.92-0.99)	0.98 (0.78-1.24)	1.01 (0.90-1.14)	0.93 (0.89-0.99)	0.93 (0.87-0.99)
Grade					
I	1	1	1	1	1
II	0.61 (0.58-0.65)	0.90 (0.68-1.20)	0.62 (0.51-0.74)	0.61 (0.56-0.67)	0.67 (0.61-0.74)
III	0.99 (0.94-1.04)	1.54 (1.20-1.97)	0.93 (0.79-1.10)	0.86 (0.79-0.93)	0.91 (0.84-0.99)

IV	2.03 (1.93-2.14)	3.56 (2.71-4.69)	1.68 (1.41-2.00)	1.53 (1.40-1.66)	1.71 (1.58-1.86)
Unknown	2.16 (1.99-2.35)	2.94 (1.66-5.21)	1.74 (1.28-2.36)	1.53 (1.33-1.73)	1.90 (1.65-2.19)
Histological type					
Adenocarcinoma	0.41 (0.38-0.45)	0.29 (0.19-0.45)	0.57 (0.41-0.78)	0.53 (0.47-0.60)	0.38 (0.33-0.43)
Mucinous adenocarcinoma	0.41 (0.38-0.44)	0.39 (0.24-0.62)	0.64 (0.46-0.89)	0.49 (0.43-0.55)	0.35 (0.31-0.40)
Signet ring cell carcinoma	1	1	1	1	1
Tumor location					
Right	1	1	1	1	1
Left	0.79 (0.74-0.84)	1.02 (0.53-1.98)	0.93 (0.70-1.24)	0.87 (0.79-0.95)	0.97 (0.88-1.08)
Transverse	0.92 (0.86-0.98)	1.68 (0.87-3.25)	1.35 (1.01-1.81)	1.04 (0.95-1.14)	0.96 (0.86-1.06)
NOS	0.72 (0.68-0.78)	1.05 (0.53-2.08)	0.86 (0.63-1.16)	0.76 (0.69-0.84)	0.82 (0.74-0.92)
Year of diagnosis					
1988 to 2003	1.07 (1.05-1.09)	0.94 (0.83-1.05)	1.04 (0.98-1.10)*	0.85 (0.82-0.87)	0.74 (0.71-0.76)
2004 to 2013	1	1	1	1	1
LN examined					
Log transformed	1.30 (1.28-1.33)	1.23 (1.11-1.37)	1.22 (1.16-1.30)	1.19 (1.15-1.22)	1.27 (1.23-1.31)
LN examined					
< 12	1.06 (1.03-1.09)	0.99 (0.84-1.17)	1.11 (1.02-1.20)	1.05 (1.01-1.10)	1.09 (1.04-1.14)
≥ 12	1	1	1	1	1

Score statistic Chi-square test for the variable in the multivariable model; all  $P < .0001$ , except \*:  $P = 0.132$ . Abbreviations: LN = lymph nodes; OR = odds ratio; CI = confidence interval.

Table S3. Association of age and number of positive LNs in node-positive patients

Age, y	T1		T2		T3		T4	
	Mean (SD)	Rate ratio* (95% CI)	Mean (SD)	Rate ratio* (95% CI)	Mean (SD)	Rate ratio* (95% CI)	Mean (SD)	Rate ratio* (95% CI)
20-39	4.14 ± 5.399	1.79 (1.50-2.13)	2.96 ± 3.06	1.70 (1.19-2.42)	4.70 ± 4.70	1.19 (1.15-1.22)	4.90 ± 5.16	1.00 (0.97-1.03)
40-49	2.03 ± 2.47	0.92 (0.78-1.09)	2.50 ± 2.21	1.17 (0.94-1.46)	3.99 ± 4.04	1.11 (1.08-1.13)	4.48 ± 4.48	1.02 (1.01-1.06)
50-59	2.05 ± 2.11	0.97 (0.86-1.09)	2.46 ± 2.35	1.24 (1.05-1.46)	3.85 ± 4.00	1.11 (1.09-1.13)	4.16 ± 4.19	1.02 (1.01-1.04)
60-69	1.96 ± 1.74	0.95 (0.85-1.06)	2.26 ± 1.99	1.04 (0.91-1.21)	3.59 ± 3.72	1.06 (1.05-1.08)	4.02 ± 4.16	1.02 (1.01-1.04)
70-79	2.11 ± 2.08	0.99 (0.90-1.10)	2.25 ± 2.03	1.07 (0.93-1.22)	3.45 ± 3.54	1.03 (1.02-1.05)	3.85 ± 3.89	1.00 (0.98-1.01)
80+	2.13 ± 2.23	1	2.19 ± 1.95	1	3.35 ± 3.51	1	3.86 ± 3.97	1

Abbreviations: CI = confidence interval; SD = standard deviation.

\*: Estimates from Poisson regression models adjusting for covariates. Score statistic Chi-square test for the age variable in the multivariable model after adjusting for other covariates, all  $P < .0001$

Table S4a: Rate ratio estimates from a single multivariable Poisson models for number of positive LN for stage T1 and T2

Characteristic	Estimates from Poisson regression models			
	T1		T2	
	Rate ratio* (95% CI)	P	Rate ratio* (95% CI)	P
Age at diagnosis		<0.0001		0.013
20-39	1.79 (1.50-2.13)		1.70 (1.19-2.42)	
40-49	0.92 (0.78-1.09)		1.17 (0.94-1.46)	
50-59	0.97 (0.86-1.09)		1.24 (1.05-1.46)	
60-69	0.95 (0.85-1.06)		1.04 (0.91-1.21)	
70-79	0.99 (0.90-1.10)		1.07 (0.93-1.22)	
80 <sup>+</sup>	1		1	
Number of LN examined		0.470		0.167
< 12	0.96 (0.86-1.07)		1.12 (0.96-1.30)	
≥ 12	1		1	
Race		0.170		0.101
White	1		1	
Black	1.00 (0.90-1.11)		1.13 (0.97-1.31)	
Others	0.98 (0.86-1.07)		1.16 (0.98-1.37)	
Grade		< 0.0001		< 0.0001
I	1		1	
II	1.19 (1.05-1.34)		1.24 (0.88-1.76)	
III	1.45 (1.27-1.66)		1.13 (0.93-1.36)	
IV	1.57 (1.15-2.14)		1.83 (1.47-2.27)	
Unknown	1.49 (1.25-1.79)		1.19 (0.73-1.93)	
Histological type		0.615		0.688
Adenocarcinoma	1.06 (0.85-1.34)		0.80 (0.47-1.37)	
Mucinous adenocarcinoma	1.01 (0.78-1.30)		0.82 (0.47-1.43)	
Signet ring cell carcinoma	1		1	
Tumor location		0.576		0.031
Right	1		1	
Left	0.98 (0.91-1.07)		1.14 (1.02-1.27)	
Transverse	0.91 (0.80-1.04)		0.90 (0.75-1.09)	

NOS	1.02 (0.66-1.57)		1.19 (0.70-2.03)	
Year of diagnosis		0.605		< 0.0001
1988 to 2003	1.02 (0.94-1.10)		1.21 (1.09-1.34)	
2004 to 2013	1		1	
LN examined		< 0.0001		< 0.0001
Log transformed	1.25 (1.16-1.35)		1.91 (1.70-2.14)	

Table S4b: Rate ratio estimates from a single multivariable Poisson models for number of positive LN for stage T3 and T4 (Age-Site groups)

Characteristic	Estimates from Poisson regression models			
	T3		T4	
	Rate ratio* (95% CI)	P	Rate ratio* (95% CI)	P
Age-Site groups		< 0.0001		< 0.0001
Right				
20-39	1.10 (1.05-1.15)		0.92 (0.88-0.96)	
40-49	1.02 (0.98-1.05)		1.01 (0.98-1.05)	
50-59	1.10 (1.08-1.13)		1.04 (1.02-1.07)	
60-69	1.07 (1.05-1.09)		1.03 (1.01-1.05)	
70-79	1.02 (1.00-1.04)		0.99 (0.97-1.01)	
80+	1		1	
Left				
20-39	1.29 (1.25-1.34)		1.13 (1.08-1.18)	
40-49	1.20 (1.17-1.23)		1.06 (1.03-1.09)	
50-59	1.13 (1.11-1.16)		1.01 (0.99-1.03)	
60-69	1.08 (1.06-1.11)		1.02 (1.00-1.04)	
70-79	1.06 (1.04-1.08)		1.00 (0.98-1.02)	
80+	1.01 (0.98-1.03)		1.02 (0.99-1.04)	
Transverse				
20-39	0.98 (0.88-1.08)		0.82 (0.75-0.90)	
40-49	0.97 (0.91-1.03)		0.96 (0.90-1.03)	
50-59	1.02 (0.98-1.07)		0.94 (0.89-0.98)	
60-69	0.90 (0.87-0.94)		0.94 (0.90-0.97)	

70-79	0.94 (0.91-0.97)		0.93 (0.90-0.96)
80+	0.87 (0.84-0.90)		0.92 (0.89-0.95)
NOS			
20-39	1.14 (0.93-1.40)		0.79 (0.64-0.98)
40-49	1.20 (1.07-1.35)		1.30 (1.17-1.44)
50-59	1.13 (1.03-1.24)		1.18 (1.09-1.28)
60-69	1.10 (1.02-1.20)		1.09 (1.02-1.16)
70-79	1.06 (0.99-1.14)		1.13 (1.06-1.20)
80+	1.08 (1.01-1.16)		0.97 (0.90-1.04)
Race		< 0.0001	< 0.0001
White	1		1
Black	0.95 (0.94-0.97)		0.96 (0.94-0.98)
Others	1.05 (1.04-1.07)		1.04 (1.02-1.06)
Grade		< 0.0001	< 0.0001
I	1		1
II	1.11 (1.08-1.13)		1.11 (1.08-1.15)
III	1.53 (1.49-1.57)		1.55 (1.51-1.59)
IV	1.55 (1.50-1.61)		1.64 (1.57-1.70)
Unknown	1.26 (1.21-1.31)		1.39 (1.34-1.45)
Histological type		< 0.0001	< 0.0001
Adenocarcinoma	0.68 (0.66-0.70)		0.66 (0.64-0.67)
Mucinous adenocarcinoma	0.74 (0.72-0.77)		0.74 (0.72-0.76)
Signet ring cell carcinoma	1		1
Year of diagnosis		0.150	< 0.0001
1988 to 2003	0.99 (0.98-1.00)		0.94 (0.93-0.95)
2004 to 2013	1		1
LN examined		0.033	0.003
< 12	0.98 (0.97-1.00)		0.98 (0.96-0.99)
≥ 12	1		1
LN examined		< 0.0001	< 0.0001
Log transformed	1.47 (1.45-1.49)		1.56 (1.54-1.58)

Table S4c. Rate ratio estimates from a single multivariable Poisson models for number of positive LN for stage T4 (Age-LNE groups)

Characteristic	Estimates from Poisson regression models	
	T4	
	Rate ratio* (95% CI)	P
Age-LNE groups		< 0.0001
LN examined < 12		
20-39	1.01 (0.93-1.08)	
40-49	1.07 (1.03-1.12)	
50-59	1.04 (1.01-1.07)	
60-69	1.03 (1.00-1.06)	
70-79	1.00 (0.97-1.02)	
80 <sup>+</sup>	1	
LNE ≥ 12		
20-39	1.03 (0.99-1.07)	
40-49	1.07 (1.03-1.10)	
50-59	1.05 (1.03-1.08)	
60-69	1.05 (1.03-1.08)	
70-79	1.03 (1.01-1.06)	
80 <sup>+</sup>	1.04 (1.01-1.06)	
Race		< 0.0001
White	1	
Black	0.96 (0.94-0.98)	
Others	1.04 (1.02-1.06)	
Grade		< 0.0001
I	1	
II	1.11 (1.08-1.15)	
III	1.55 (1.51-1.59)	
IV	1.64 (1.57-1.70)	
Unknown	1.39 (1.34-1.44)	
Histological type		< 0.0001
Adenocarcinoma	0.66 (0.64-0.67)	

Mucinous adenocarcinoma	0.74 (0.72-0.76)	
Signet ring cell carcinoma	1	
Primary site		< 0.0001
Right colon	1	
Left colon	1.01 (1.00-1.02)	
Transverse colon	0.92 (0.90-0.94)	
NOS	1.08 (1.05-1.12)	
Year of diagnosis		< 0.0001
1988 to 2003	0.94 (0.93-0.95)	
2004 to 2013	1	
LN examined		< 0.0001
Log transformed	1.56 (1.54-1.58)	

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Score statistic Chi-square test for the variable in the multivariable model.

\*: Estimates from Poisson regression models adjusting for covariates.

Abbreviations: LN = lymph nodes; CI = confidence interval.