

Socioeconomic Status and Delays in Carpal Tunnel Syndrome Surgery: A Census Tract Level Analysis



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Introduction

Background and Significance

- Carpal Tunnel Syndrome (CTS) is the most common entrapment neuropathy, causing major disability and healthcare costs worldwide⁵
- Patients from socioeconomically disadvantaged areas often present with worse baseline function, greater pain, and higher rates of anxiety and depression¹²
- Prior research found mixed evidence regarding whether lower socioeconomic status (SES) causes longer delays to surgery^{2,3,7,12}
- Most previous studies used ZIP code-level SES data, which can misrepresent underlying disparities⁹
- This study uses **census tract-level** Area Deprivation Index (ADI) and Social Vulnerability Index (SVI) to assess whether neighborhood deprivation predicts delays from **symptom onset to specialist consultation and surgery**^{8,11}

Focus Question

Does lower census tract level socioeconomic status predict longer delays between symptom onset and carpal tunnel release surgery?

Methods

Design

Retrospective cohort study at a multi-hospital academic health system (IRB approved).

Population

276 adults (≥ 18 years) who underwent endoscopic CTR between November 2022 and March 2025.

Exclusions

Non-U.S. address, bilateral/revision CTR, concurrent procedures, or missing address data.

Predictors

Census tract-level ADI, SVI, and American Community Survey (ACS) variables (% poverty, % without high school diploma, unemployment, % households without vehicle).

Covariates

Age, sex, race/ethnicity, insurance type, travel distance to consult and surgery sites.

Outcomes

Time from symptom onset to (1) specialist consultation and (2) surgery.

Analysis

Univariable and multivariable linear regression with quintile analysis.

Significance set at $p < 0.05$ ^{7,11}

Results

• **Median time to consultation:** 730 days (IQR 182–1857).

• **Median time to surgery:** 927 days (IQR 401–2218).

• ADI and SVI **not associated** with delays to consultation or surgery ($p > 0.2$).

• Confidence intervals ruled out clinically meaningful differences (> 4 –6 months).¹⁰

• No consistent gradient across deprivation quintiles.

• Census tract unemployment rate showed a brief negative association (shorter delay) that became nonsignificant after outlier removal.

Different Levels of Granularity in Measuring Socioeconomic Disparities in Carpal Tunnel Syndrome Care

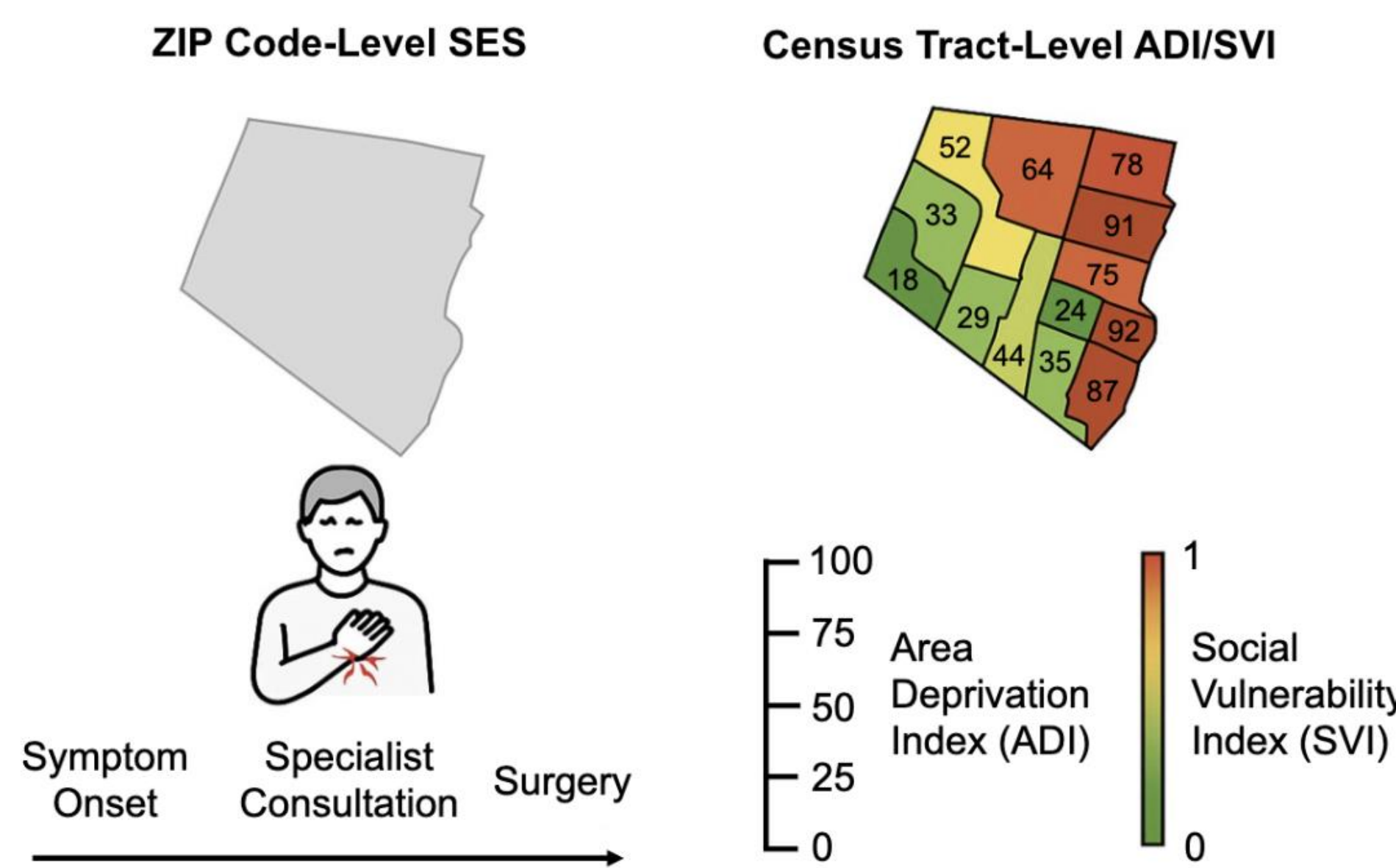


Figure 1. Geographic granularity in assessing socioeconomic disparities in timely access to specialist care for carpal tunnel syndrome. ZIP code-level analysis provides broader estimates, while census tract-level analysis provides higher resolution.

Results + Discussion

Discussion

- Findings **do not support** the hypothesis that neighborhood deprivation predicts longer delays to CTS consultation or surgery
- Results align with prior studies showing **no relationship between ADI and CTS severity or treatment timing**^{1,7,12}
- Confirms that delays in CTS care likely occur **before specialty consultation**, not within surgical scheduling
- By analyzing earlier intervals (symptom onset → consultation → surgery), this study clarifies mixed evidence in previous ZIP-level analyses^{2,6,9}

		Univariable			Multivariable		
Covariate	Level	B	95%CI	P-value	B	95%CI	P-value
Sex	Female	0.78	(-603.57, 605.12)	0.998	-8.35	(-646.83, 630.14)	0.979
	Male	-	-	-	-	-	-
race	Black	-289.06	(-963.16, 385.03)	0.399	-149.55	(-901.78, 602.67)	0.696
	Other	-476.66	(-1404.94, 451.62)	0.313	-398.48	(-1366.96, 570.01)	0.419
	White	-	-	-	-	-	-
Insurance	Medicaid	-181.49	(-1211.02, 848.03)	0.729	-12.56	(-1103.98, 1078.85)	0.982
	Medicare	71.77	(-556.14, 699.67)	0.822	140.49	(-765.15, 1046.12)	0.760
	Unknown	407.48	(-1806.42, 2621.37)	0.717	408.94	(-1851.37, 2669.26)	0.722
	Private	-	-	-	-	-	-
ADI		-6.55	(-17.30, 4.20)	0.231	-3.45	(-16.9, 9.99)	0.614
SVI		-5.78	(-14.51, 2.93)	0.193	-376.91	(-1427.64, 673.82)	0.481

Table 1. Associations with Duration of Symptoms Before Initial Consultation (Days)

Conclusion

• Neighborhood deprivation, as measured by census tract-level ADI and SVI, **was not associated with clinically meaningful additional delays** from CTS symptom onset to consultation or surgery.

• Once patients seek specialty care, access to consultation and surgery appears **relatively equitable across socioeconomic strata**.

• These findings clarify prior conflicting evidence and support targeting upstream barriers in the referral and diagnostic stages to improve equity in CTS care.

References

- Aloi NF, Rahman H, Fowler JR. Area Deprivation Index Is Not Associated With the Severity of Carpal Tunnel Syndrome. *Hand (N Y)*. 2024;19:1062–1068.
- Boddu SP, Lin E, Gill VS, Hinckley NB, Lai CH, Renfree KJ. Low-Income, Poor Physical Health, Poor Mental Health, and Other Social Risk Factors Are Associated With Decreased Access to Care in Patients With Carpal Tunnel Syndrome. *J Prim Care Community Health*. 2024;15:21501319241240348.
- Brodeur PG, Patel DD, Licht AH, Lotus DH, Cruz AI, Jr., Gil JA. Demographic Disparities amongst Patients Receiving Carpal Tunnel Release: A Retrospective Review of 92,921 Patients. *Plast Reconstr Surg Glob Open*. 2021;9:e3959.
- Buhler M, Altmire C, Perry M, Crengle S, Norris P, Baxter GD. Patient experiences and perspectives of health service access for carpal tunnel syndrome in Aotearoa New Zealand: a normalisation process theory-informed qualitative study. *BMC Health Serv Res*. 2024;24:465.
- Dahlin LB, Zimmerman M, Calcagni M, Hundepool CA, van Alfen N, Chung KG. Carpal tunnel syndrome. *Nat Rev Dis Primers*. 2024;10:37.
- Day CS, Makhi EC, Mejia E, Lage DE, Rozental TD. Carpal and cubital tunnel syndrome: who gets surgery? *Clin Orthop Relat Res*. 2010;468:1796–1803.
- Dondapati A, Zaronias C, Tran JN, Fowler CC, Carroll TJ, Mahmood B. Timing of Carpal Tunnel Syndrome Treatment Based on Social Deprivation. *Cureus*. 2024;16:e75894.
- Goetschius LG, Henderson M, Han F, Mahmoudi D, Perman C, Haft H, Stockwell I. Assessing performance of ZCTA-level and Census Tract-level social and environmental risk factors in a model predicting hospital events. *Soc Sci Med*. 2023;326:115943.
- Krieger N, Waterman P, Chen JT, Soobader MJ, Subramanian SV, Carson R. Zip code caveat: bias due to spatiotemporal mismatches between zip codes and US census-defined geographic areas—the Public Health Disparities Geocoding Project. *Am J Public Health*. 2002;92:1100–1102.
- Masud M, Rashid M, Malik SA, Ibrahim Khan M, Sarwar SU. Does the Duration and Severity of Symptoms Have an Impact on Relief of Symptoms after Carpal Tunnel Release? *J Brachial Plex Peripher Nerve Inj*. 2019;14:e1–e8.
- Stephens CQ, Yap A, Vu L, Saito JM, Barry D, Shui AM, Cockrell H, Cairo S, Wakeman D, Berman L, Greenberg S, Linden AF, Kohler J, Tsao K, Wilson NA. Comparative Analysis of Indices for Social Determinants of Health in Pediatric Surgical Populations. *JAMA Netw Open*. 2024;7:e2449672.
- Wright MA, Beleckas CM, Calfee RP. Mental and Physical Health Disparities in Patients With Carpal Tunnel Syndrome Living With High Levels of Social Deprivation. *J Hand Surg Am*. 2019;44:335 e1–335 e9.
- Zimmerman M, Hall E, Carlsson KS, Nyman E, Dahlin LB. Socioeconomic factors predicting outcome in surgically treated carpal tunnel syndrome: a national registry-based study. *Sci Rep*. 2021;11:2581.

