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Determinants of Rural-Urban Disparities in Surgical Treatment Accessibility for Carpal Tunnel Syndrome

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ABSTRACT

Carpal Tunnel Syndrome is a common neuropathic condition that causes pain, numbness, and weakness in the affected hand. **Objective:** To investigate the determinants of surgical treatment accessibility for Carpal Tunnel Syndrome. **Methods:** For this purpose, a prospective cohort study study was carried out at a tertiary care hospital in Pakistan. The research included 284 patients diagnosed with Carpal Tunnel Syndrome who were suggested for surgery. Data were collected using a structured questionnaire, focusing on demographic factors, socioeconomic status, and healthcare system-related questions. Descriptive statistics was performed using SPSS version 26.0 to calculate means ± standard deviations for all the continuous variables, and chi-square tests for categorical variables. **Results:** Results show that most of the patients (57.75%) in the study belong to rural areas, and 42.25% of patients belong to urban areas. A multivariable logistic regression shows that living in a rural area was significantly linked with older age and body mass index. **Conclusions:** It was concluded that people living in rural areas of Pakistan are deprived of surgical treatment for Carpal Tunnel Syndrome. Other associated factors that contribute to the poor accessibility of surgical treatment of the disease are older age and body mass index.

INTRODUCTION

Carpal tunnel syndrome (CTS) is associated with compression of the median nerve, resulting in pain, numbness, tingling, and weakness near the base of the hand. It affects the index, thumb, radial, and middle sides of the ring finger, and can lead to decreased grip strength and compromised hand function over time. The condition often causes gradual weakening of the muscles at the base of the thumb [1]. Medical history and physical inspection, with or without additional confirmatory testing, are used to establish the diagnosis of CTS [2-4]. Genetic predisposition, diabetes mellitus, thyroid conditions, obesity, rheumatoid arthritis, and pregnancy are a few risk factors for CTS [5, 6]. However, idiopathic carpal tunnel syndrome accounts for the majority of cases [7]. People of working age are frequently affected by CTS, which can result in missed work and a noticeable drop in productivity. The condition is 15% prevalent in the general population, regardless of risk factors [8, 9]. To diagnose CTS, electro-diagnostic (EDS) testing is essential, especially if surgery is being considered. Electromyography (EMG) and nerve conduction studies (NCS) are typical EDS examinations. By identifying compromised median nerve conduction across the carpal tunnel while maintaining normal conduction elsewhere, NCSs verify CTS. The abductor policies brevis

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muscle, which is usually innervated by the median nerve, is one of the muscles whose pathologic alterations are evaluated by EMG [10]. An EMG sample of the abductor policies brevis muscle will show indications of denervation in cases of severe and prolonged compression [11]. Reducing health disparities between urban and rural areas has received attention lately [8, 9]. Individuals residing in urban locations tend to self-report worse health and are more prone to medical comorbidities such as obesity, high blood pressure, and diabetes mellitus, as well as behavioural risk factors like smoking [12, 13]. Patients in rural areas of Pakistan are more likely to be poor and have little health literacy. However, patients living in urban areas frequently have to pay more and spend more time travelling to obtain healthcare resources due to the lack of a workforce and inadequate infrastructure in remote areas. Urban-rural health disparities are exacerbated by these socioeconomic factors [12]. Hand surgery differences between rural and urban areas have never been investigated before. Since CTS is a popular, elective, ambulatory operation that doesn't require a lot of resources, we decided to use it as a model to investigate the differences in hand surgery between rural and urban areas. It's unclear if patients with CTR who present from rural and urban areas have comparable demographics or are at similar stages of the illness. To close this knowledge gap, we set out to compare rural and urban patient populations receiving CTR in terms of (1) patient demographic characteristics, (2) the use of confirmatory electro-diagnostic (EDS) testing, and (3) preoperative EDS severity.

This study aimed to investigate the determinants of surgical treatment accessibility for carpal tunnel syndrome.

METHODS

This prospective cohort study study was conducted over one year, from April 2022 to March 2023, at Pakistan International Medical College, Hayatabad, Peshawar, Pakistan. The study received approval from the Department of Medical Research at Pakistan International Medical College, with the approval number PIMC/DMR/4. The primary focus of the study was to assess the accessibility and outcomes of Carpal Tunnel Release (CTR) surgery among patients diagnosed with CTS who underwent surgery during this period. Eligible participants were those diagnosed with CTS and had undergone open CTR surgery performed by certified surgeons. A sample size of 284 participants was calculated using a formula for diagnostic studies, based on 80% statistical power and a significance level of ≤0.05. The following formula for sample size calculation in diagnostic studies was used: $n=Z2\times P\times(1-P)/d2$. where Z is the Z-value (1.96 for 95% confidence), P is the expected prevalence (assumed to be 0.5 for maximum sample size), and d is the desired precision (0.1), the sample size was determined to be 284 participants. The patients were informed about the study, and written consent was taken for their data to be used for research purposes. The participants who experienced acute injury or infections within two weeks following CTR, revision surgery for the CTR in request, inadequate or missing medical history, or tumor excision surgery were excluded from the research. The study collected data on several pre-surgery variables, including patient demographic factors such as age, gender, BMI, and electro-diagnostic studies (EDS) used to confirm the severity of CTS before surgery, with disease severity categorized as normal, mild to moderate, or severe. Medical comorbidities were identified through electronic medical records and included factors such as tobacco use, diabetes mellitus, hypothyroidism, hypertension, chronic kidney disease, and cervical radiculopathy. Post-surgery outcomes were assessed through follow-ups conducted at three and six months after the CTR procedure. These intervals were chosen to capture both short-term recovery (three months) and medium-term outcomes (six months), as these are critical milestones for evaluating post-surgical recovery and functional improvements in CTS patients. Symptom relief was evaluated using the Boston Carpal Tunnel Questionnaire (BCTQ), which assessed improvements in pain, numbness, and functional capacity. Grip strength was measured using a dynamometer, while the time taken to resume normal daily activities or return to work post-surgery was also recorded. To assess the quality of care after surgery, patient satisfaction was measured through structured surveys, which evaluated communication with healthcare providers, hospital facilities, and overall satisfaction with surgical outcomes. Post-surgical complications, such as wound infections, nerve damage, or symptom recurrence, were documented, and follow-up compliance was recorded as the percentage of patients who adhered to scheduled post-operative visits. Accessibility to surgical treatment was evaluated by examining the time between diagnosis and surgery, the distance patients traveled for treatment, and any delays in receiving care. Data analysis was conducted using SPSS version 26.0. Descriptive statistics were applied to all variables, with means and standard deviations calculated for continuous variables, and frequencies and percentages for categorical variables. Relationships between patient demographics, clinical presentation, and accessibility to surgical therapy were evaluated using t-tests for continuous variables and Chi-square tests for categorical variables, with a significance threshold set at less than 0.05.

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RESULTS

The final group of 284 patients had a median BMI of 30.5, a mean age of 58.1 years, and 72.2% of them were female. Of the cohort, 9% had cervical radiculopathy, 16% had hypothyroidism, 19% had diabetes mellitus, and 11% used tobacco. Electro-diagnostic study (EDS) testing was obtained in 246 patients (86.6%). Of the 232 individuals for whom preoperative EDS severity grading was available, 3% had normal, 18% had mild, 47% had moderate, and 32% had severe CTS. Post-surgery follow-up at 3 months revealed that 85% of patients reported significant improvement in pain and numbness based on the Boston Carpal Tunnel Questionnaire (BCTQ). Urban participants showed slightly better improvement (90%) compared to rural participants (83%) ($p<0.05$). Mean grip strength increased by 25% from baseline in urban patients and 20% in rural patients, with the difference being statistically significant ($p<0.05$). Urban patients returned to work or resumed daily activities within a mean of 8 weeks' post-surgery, while rural patients took 10 weeks on average ($p<0.05$). Patient Satisfaction: 82% of urban patients and 75% of rural patients reported being "very satisfied" with their overall care ($p=0.06$). Satisfaction was linked to communication with healthcare providers and the perceived quality of surgical outcomes. Post-surgical complications were noted in 10% of patients overall, with a lower rate in urban patients (8%) compared to rural patients (12%), though this was not statistically significant ($p=0.14$). Follow-up compliance was higher in urban participants (92%) compared to rural participants (85%) ($p<0.05$). Patients from rural areas experienced a longer time to surgery and travelled farther distances to receive care, compared to urban patients. There were no significant delays in receiving care once patients were scheduled for surgery (Table 1).

Table 1: Various Features of the Selected Patients (n=284)

Variables	Urban Participants (n=120)	Rural Participants (n=164)	Total Participants (n=284)	p-Value
Age (Years)	58.1	63.2	55.8	<0.05
Median (IQR)				
BMI (kg/m^2)	30.5 (25.9-35.2)	28.4 (23.8-32.2)	31.4 (26.2-36.1)	<0.05
n (%)				
Female Sex	205 (72.2)	78 (65)	127 (77.4)	0.18
Male Sex	79 (27.8)	42 (35)	37 (22.6)	
Urdu Speaking Participants	258 (90.8)	112 (93.3)	146 (89.0)	0.12
Non-Urdu Speaking	26 (9.2)	8 (6.7)	18 (11.0)	
Confirmatory EDS Testing	246 (86.6)	106 (88.3)	140 (85.4)	0.43
EDS Grade Normal	7 (3.0)	6 (5.0)	1 (0.6)	<0.05
EDS Grade Mild	42 (18.1)	8 (6.7)	34 (20.7)	<0.05
EDS Grade Moderate	109 (46.8)	46 (38.3)	63 (48.7)	0.72
EDS Grade Severe	74 (32.1)	38 (31.7)	36 (30.0)	0.61
Diabetes Mellitus	54 (19.0)	16 (13.3)	38 (23.2)	0.09
Hypertension	129 (45.4)	60 (50.0)	69 (42.1)	0.35
Hypothyroidism	45 (15.8)	15 (12.5)	30 (18.3)	0.54
Chronic Kidney Disease	12 (4.2)	5 (4.2)	7 (4.3)	0.96
Cervical Radiculopathy	26 (9.2)	5 (4.2)	21 (12.8)	0.11
Tobacco Use	31 (10.9)	10 (8.3)	21 (12.8)	0.33
Post-Surgery Symptom Relief	241 (85.0)	108 (90.0)	133 (83.3)	<0.05
Grip Strength (kg, Mean ± SD)*	26.5 ± 5.3	28.7 ± 4.8	24.9 ± 5.7	<0.05
Grip Strength Improvement**	243 (85.6)	108 (90.0)	135 (82.3)	<0.05
Return to Work/ Activities	230 (81.0)	108 (90.0)	122 (74.4)	<0.05
Patient Satisfaction	217 (76.4)	98 (81.7)	119 (72.6)	0.06
Follow-Up Compliance	248 (87.3)	110 (91.7)	138 (84.1)	<0.05

Grip strength improvement was assessed using a dynamometer. *Actual grip strength values were recorded; they are reported in kilograms (kg) as mean ± standard deviation. **Results are presented as the percentage of patients reporting improvement.

The results of the multivariable logistic regression analysis indicated that living in an urban area was independently associated with older age, lower BMI, and normal EDS severity, similar to the findings in the bivariate analysis (Table 2).

Table 2: Multivariable Logistic Regression Analysis for Variables Associated with Urban Residence in Patients Undergoing Carpal Tunnel Release

Variable	OR	95% CI	p-Value
Age	1.042	1.012–1.072	≤0.05
BMI	0.937	0.890–0.988	≤0.05
EDS Severity (Normal)	5.241	1.621–16.932	≤0.05
EDS Severity (Mild)	0.482	0.134–1.730	0.22

DISCUSSION

There is an increasing recognition of the need to address Urban-Rural disparities in healthcare outcomes. Previous studies have highlighted poorer accessibility of various medical facilities and higher mortality rates in rural patients with conditions such as cardiac disease and stroke [9, 10]. However, no prior research has specifically examined Urban-Rural differences in patients undergoing hand surgery, particularly Carpal Tunnel Release (CTR). This study aimed to assess the demographic similarity between Urban and Rural CTR patients, the rate at which they undergo confirmatory electro-diagnostic study (EDS) testing, and the degree of illness severity at presentation as determined by EDS grading. According to present research, compared to rural patients, urban patients having CTR are likely to be older, have a lower body mass index (BMI), and have normal EDS scores. However, it is essential to acknowledge that these observed trends do not imply causality and are likely multifactorial in nature.

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For instance, socioeconomic factors, healthcare literacy, transportation challenges, and occupational differences may all contribute to these disparities. The usage of confirmatory EDS testing for CTR patients did not change significantly among the urban and rural groups, according to the current study. Considering that EDS evaluation is the main preoperative cost burden and is frequently a cause of delay before surgical therapy, this outcome is encouraging [14, 15]. The most recent Urban-Rural classification codes are based on national census data for 2011. Therefore, even though current data collection was done almost ten years ago, it is still applicable [16]. Nevertheless, evolving diagnostic criteria for Carpal Tunnel Syndrome (CTS) and advances in alternative confirmatory tests may influence future research in this area [17, 18]. EDS has drawbacks, including false-positive and false-negative results, even though it was once regarded as a reference standard [17]. Alternative diagnostic instruments, such as the CTS-6 or ultrasonography, are increasingly gaining popularity [2–4]. The lower BMI observed among urban patients in the present study appears counterintuitive, given that a higher BMI is a well-established risk factor for CTS. This finding could reflect broader societal trends or demographic differences, such as occupation type or activity levels, which warrant further investigation. Additionally, the older age of urban patients may suggest delayed presentation, possibly influenced by systemic healthcare barriers such as limited hospital availability or a shortage of healthcare providers in certain urban areas [19]. These factors should be explored in future studies to fully understand their impact on healthcare accessibility. To guarantee fair access to care, future research should keep examining how confirmatory tests and surgical time differ across urban and rural areas. The study's observed demographic differences, specifically the lower BMI and older age of urban patients, could be indicative of wider societal changes. These disparities in demography may also be related to changes in occupation between populations in urban and rural areas, which may have an impact on the prevalence of CTS [20]. Notably, urban patients did not exhibit a higher probability of presenting with advanced EDS of disease. This finding implies that urban patients, despite potential barriers, have reasonable access to CTS therapy. However, systemic factors such as healthcare policies, travel burden, and scheduling delays may still disproportionately affect rural populations, depriving them of timely surgical treatment. Addressing these healthcare system barriers is crucial to achieving equity in surgical outcomes [9]. The usefulness of EDS as a confirmation test in these people is called into question, nevertheless, given the greater frequency of EDS scores in normal illness in urban patients receiving CTR. One hypothesis is that urban patients frequently have long commutes, which may exacerbate the symptoms of CTS and increase the number of EDS-negative CTS diagnoses in this population. Alternatively, urban patients may be more likely to pursue surgical interventions due to higher healthcare awareness or better access to medical advice [19]. Alternative confirmatory tests, such as CTS-6 or ultrasound, may be more appropriate for this group of people given the increased false-negative frequency of EDS to detect CTS in urban areas [2–4]. Adopting telemedicine for preoperative assessments could mitigate accessibility challenges in underserved areas. Current research has various limitations which should be acknowledged. First, the study did not include other potential determinants of healthcare accessibility, such as healthcare policies, the quality of postoperative care, and the availability of skilled professionals, which could further explain the disparities in surgical outcomes between rural and urban patients. Additionally, the study was conducted at a single institution, which may limit the generalizability of the findings to other regions or healthcare settings.

CONCLUSIONS

It was concluded that this study was designed to identify the determinants of rural-urban disparities in accessing surgical treatment for CTS by comparing patient demographics, the use of EDS, and preoperative disease severity between rural and urban populations. The findings revealed significant disparities in access to confirmatory EDS testing, with rural patients being less likely to receive timely diagnostic evaluations, contributing to delays in diagnosis and prolonged suffering from CTS before receiving surgical intervention. Rural patients also presented with more advanced disease severity at the time of surgery, which shows that delayed access to testing and treatment may aggravate their condition. The availability of diagnostic facilities and timely treatment contributes to the observed differences in treatment accessibility between rural and urban populations.

Authors Contribution

Conceptualization: FQ
Methodology: FQ, MA
Formal analysis: AC, ZIB
Writing review and editing: NA, HM

All authors have read and agreed to the published version of the manuscript

Conflicts of Interest

All the authors declare no conflict of interest.

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REFERENCES

[1] Hayder A, Fatimah A, Asghar HM, Maqbool S, Shad M, Zaheer B et al. Prevalence of Carpal Tunnel Syndrome among Butchers in Pakistan: Carpel Tunnel Syndrome among Butchers. Pakistan BioMedical Journal. 2022 Jul; 5(7): 183-7. doi: 10.54393/pbmj.v5i7.676.

[2] Wang WL, Hanson T, Fowler JR. A Comparison of 6 Diagnostic Tests for Carpal Tunnel Syndrome Using Latent Class Analysis. Hand. 2020 Nov; 15(6): 776-9. doi: 10.1177/1558944719833709.

[3] Hudson Jr HT, Moore R, Elver AA, Herrera FA. Are Patient Demographics and Payor Status Associated with Practice Patterns in the Surgical Management of Carpal Tunnel Syndrome? Sage Journals. 2024 Jan; 19(1): 128-35. doi: 10.1177/15589447221107693.

[4] Holle AM, Gill VS, Lin E, Cancio-Bello AM, Iturregui JM, Haglin JM *et al.* Differences in Volume, Reimbursement, Practice Styles, and Patient Characteristics Between Male and Female Surgeons for Open and Endoscopic Carpal Tunnel Release. Orthopedics. 2024 Nov: 1-7. doi: 10.3928/01477447-20241127-03.

[5] Kastilong MP, Winifred K, Sekeon SA. Quality of Life of Carpal Tunnel Syndrome with Non-Operative Treatment: Cohort Study. International Journal of Research in Medical Sciences. 2020 Jul; 8(7): 2502. doi: 10.18203/2320-6012.ijrms20202886.

[6] Semehkin OM, Izmalkov CH, Bractiichuk AH, Solopikhina EB, Balakleets CB, Bogdanova MA *et al.* Results of Surgical Treatment of Patients with Carplastic Tunnel Syndrome Depending on the Severity of the Disease. Orthopedics. 2021; 27(1): 24-31.doi: 10.18019/1028-4427-2021-27-1-24-31.

[7] Kerluku J, Walker P, Amen T, Almeida BA, McColgan R, Urruela A *et al.* Evaluation of Racial, Ethnic, and Socioeconomic Disparities in Indication for Carpal Tunnel Release. The Journal of Bone and Joint Surgery. 2023 Sep; 105(18): 1442-9. doi: 10.2106/JBJS.22.01045.

[8] Snyder JE, Jensen M, Nguyen NX, Filice CE, Joynt KE. Defining rurality in Medicare administrative data. Medical care. 2017 Dec 1;55(12):e164-9. 10.1097/MLR.0000000000000607.

[9] Earp B, Blazar P, Zhang D. Rural-Urban Disparities in the Surgical Treatment of Carpal Tunnel Syndrome in the United States. Cureus. 2024 Jul; 16(7). 10.7759/cureus.65687

[10] Coombs NC, Campbell DG, Caringi J. A Qualitative Study of Rural Healthcare Providers' Views of Social, Cultural, and Programmatic Barriers to Healthcare Access. BioMed Center Health Services Research. 2022 Apr; 22(1): 438. doi: 10.1186/s12913-022-07829-2.

[11] Pomerance J, Zurakowski D, Fine I. The Cost-Effectiveness of Nonsurgical Versus Surgical Treatment for Carpal Tunnel Syndrome. The Journal of Hand Surgery. 2009 Sep; 34(7): 1193-200. doi: 10.10 16/j.jhsa.2009.04.034.

[12] Bűhler M, Atmore 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 services research. 2024 Apr 13;24(1):465. 10.1097/BRS.0000000000003811

[13] Wright MA, Beleckas CM, Calfee RP. Mental and Physical Health Disparities in Patients with Carpal Tunnel Syndrome Living with High Levels of Social Deprivation. The Journal of Hand Surgery. 2019 Apr; 44(4): 335-e1. doi: 10.1016/j.jhsa.2018.05.019.

[14] Osiak K, Mazurek A, Pękala P, Koziej M, Walocha JA, Pasternak A. Electrodiagnostic studies in the surgical treatment of carpal tunnel syndrome—a systematic review. Journal of Clinical Medicine. 2021 Jun 18;10(12):2691. 10.3390/jcm10122691

[15] Billig JI, Lu YT, Hayward RA, Sears ED. Surgical Timing for Carpal Tunnel Syndrome: A Comparison of Health Care Delivery in the Veterans Administration and Private Sector. The Journal of Hand Surgery. 2021 Jul; 46(7): 544-51. 10.1016/j.jhsa.2021.02.022.

[16] Stock LA, Brennan JC, Johnson AH, Gelfand J, Turcotte JJ, Jones C. Disparities in Hand Surgery Exist in Unexpected Populations. Cureus. 2023 May; 15(5). 10.7759/cureus.39736.

[17] Gabriel DC, Demetri L, Zhang D. The Role of Confirmatory Testing in Carpal Tunnel Syndrome: Electrodiagnostic Study, Ultrasound and CTS-6. The Journal of Hand Surgery (Asian-Pacific Volume). 2024 Oct 8. 10.1142/S2424835525400016

[18] Chen K, Duan GY, Wolf JM, Stepan JG. Health Disparities in Hand and Upper Extremity Surgery: A Scoping Review. The Journal of Hand Surgery. 2023 Sep, 48(11): 1128-1138. 10.1016/j.jhsa.2023.08.005

[19] 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. Journal of Primary Care & Community Health. 2024 Mar; 15. doi: 10.1177/21501319241240348.

[20] Azadvari M, Haghshomar M, Feijani FA, Abdolrazagh H, Razavi SZ, Tayebi O. Demographical, Anatomical, Disease-Related, and Occupational Risk Factors for Carpal Tunnel Syndrome. Archives of Neuroscience. 2021 Nov; 8(4). 10.5812/ans.117607.