



Association of geographic location of outpatient physical therapy clinics and population social vulnerability in Northeastern Pennsylvania, USA: a cross-sectional study

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ABSTRACT

Introduction

Access to healthcare for socially vulnerable populations is a global challenge. The geographic distribution and density of Outpatient Physical Therapy (OPT) clinics in the 10 County Health District of Northeastern Pennsylvania (NEPA) is unreported and is a potential important barrier in access to physical therapy services particularly for the most socially vulnerable of the population.

Methods

A cross-sectional study was conducted at the census tract level using OPT clinic data collected in the third quarter of 2022 and population data from the US Census (ACS 2019). The dependent variable was the number of OPT clinics. The independent variables were poverty, education, race and ethnicity, and the percentage of uninsured. We first explored the correlation coefficients between number of OPT clinics and a social vulnerability scale constructed based on the four variables. We then conducted a multiple linear regression and an ordered Logit regression of number of OPT clinics on the four independent variables. The sample size was 401, the 401 census tracts of the 10 counties of the Health District of NEPA with a population of 1 603 267.

Results

The number of OPT clinics per 10 000 population showed a strong negative association (Spearman -0.9) with overall social vulnerability at the census tract level. Linear regression indicates that a 1% increase in the number of uninsured residents in the population in a census tract is associated with a decrease of four OPT clinics, holding poverty, education, and race and ethnicity constant, significant at the 1% level. Ordered Logit regression results suggest that a 1% increase in the number of uninsured residents in the population is associated with a decrease of 0.114 in the log odds of having more OPT clinics. The log odds ratio of 0.892 indicates that as the number of uninsured residents increases by 1%, the odds of having more OPT clinics is less than the odds of having fewer OPT clinics. The average marginal effects of % uninsured on the number of OPT clinics from the ordered Logit regression suggest that as the percentage of uninsured residents goes up, it becomes more likely to have no OPT clinics, and less likely to have more OPT clinics. Separate from the regression analysis, we found that 20% of the population have Medicaid (government health insurance for low-income individuals) insurance, but only 26.4% of clinics accept all Medicaid plans for reimbursement.

Conclusion

These findings highlight inequity of access to OPT clinics and actionable policy suggestions are made.

Keywords: Social Vulnerability, Physical Therapy, Rehabilitation, Health Care Access, Equity

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INTRODUCTION

Access to rehabilitation is a global challenge. In 2017 the World Health Organization (WHO) launched the Rehabilitation 2030 initiative¹ in response to the recognition that rehabilitation is often under-resourced and not prioritized, as a result countless individuals do not have access to services and preventable complications and functional decline occur. Recently, there is a philosophical shift in the direction of the profession of physical therapy (PT) in the United States to not only meet the needs of the individual patients who come through the clinic doors but to also address the needs of society. The vision statement for the American Physical Therapy Association (APTA) is "Transforming society by optimizing movement to improve the human experience".² Guiding principles to achieve this vision further state that the PT profession must recognize and work to ameliorate health disparities and inequities and advocate for patients both as individuals and as a population.

Although it is true that the US is a high-income country, the official poverty rate in 2021 was 11.6% (37.9 million people) of the population.³ In Pennsylvania (PA) the poverty rate in 2021 was 12.1%. Rehabilitation services are mostly paid for by public or private insurance in the US. Private insurance is linked to employment (54.3% of the population had employer-based insurance in 2021⁴) therefore many people lacking equitable employment are living in poverty and are under or uninsured, especially with respect to providing reimbursement for PT services. In 2021, Medicaid, a government health coverage assistance program for low-income individuals, accounted for 18.9% of coverage in the US⁴ and 20.8% in PA.⁵ Also, almost 9% (or 27.2 million) in the US⁴ and 5.5% in PA⁶ did not have health insurance in any form. These numbers prompted us to ask the question if the more vulnerable members of society, who are more likely to have Medicaid insurance, have equity in access to OPT for their rehabilitation. Access to physical therapist services is an important component to provide the services needed to meet our guiding principles. Access to care is multidimensional and includes such elements as, cost, hours of operation of services, acceptability to the patient

and accessibility. It is this last element, that of geographic convenience that we focus on. Geographic location of out-patient physical therapy (OPT) clinics is a potential barrier to meeting the physical therapy and rehabilitation needs of the population. Previous work on access to primary care services suggests a greater supply of primary care locations is associated with better health outcomes.⁷ In addition, research in Australia reported that disproportionate number of people with disabilities have been found to concentrate in areas that are poor and under-served, particularly with respect to rehabilitation services.⁸ Currently, to our knowledge, there is minimal literature investigating geographic access for OPT. One study in the US constructed a social vulnerability measure to reflect an area's socioeconomic environment and reported disparities in geographic access to OPT service in a large metropolitan area.⁹ We further explore this topic by focusing on the association between social vulnerability and density and distribution of OPT clinics in a large mixed urban and rural location. The goal of this research is to investigate if there is disparity in the number and location of OPT clinics in a previously unreported geographic area of NEPA. This observational study was designed to address the following two questions, first, is the geographic distribution and density of OPT clinics associated with population social vulnerability? And second, what percentage of OPT clinics accept Medicaid insurance? We report a method of analysis that may be easily replicated in any geographic area of the US to identify disparities in OPT provision for the most socially vulnerable of the population.

METHODS

Data and Methods

The geographic area of study is the 10 counties of the Health District of northeast Pennsylvania. We identified each census tract in the 10 counties in terms of its social vulnerability and the number of OPT clinics located in the tract. Census tracts are small, relatively stable permanent statistical subdivisions of a county; generally, the population is between 1200 and 8000.

We used the most recently publicly available American Community Survey (ACS 2019) from the US Census to create a social vulnerability scale for each census tract in the area of study.⁶ Following the methodology from Rovzar et al. (2019), we constructed a social vulnerability scale and assigned a social vulnerability score to each census tract based on educational attainment, poverty, race, and health insurance coverage.⁹ Specifically, we used the percentage of population living in poverty, percentage of population with less than or equal to high school diploma, percentage of population that are non-whites, and percentage of population who are uninsured. For each of the four variables, if the census tract has a percentage value greater than the weighted average percentage based on the size of the population across all census tracts, we added one point to its vulnerability score. We then summed up the scores on the four variables for each census tract and rescaled the sum from the 0-4 range to 1-5 to avoid using 0 which may be misinterpreted as no vulnerability. A score of 1 indicates the lowest social vulnerability and a score of 5 indicates the highest social vulnerability.

An OPT clinic is defined as a clinic providing physical therapy services by a licensed physical therapist on an outpatient basis in a facility (including hospital based) or office setting. Due to a lack of an established data set we identified and confirmed a list of OPT clinics. Two investigators searched google and google maps using the terms, 'physical therapy' and 'physical therapy outpatient clinic'. Investigators also searched all large medical network provider websites and followed up on suggestions from phone call conversations when enquiring about Medicaid coverage for PT. The US Census geocoder and Census Reporter tool were used to locate clinics within a census tract^{10,11} Alternative OPT delivery modes such as home health were not included.

To address our first research question, we first considered the correlation between the density of OPT clinics and the social vulnerability scale using Spearman rho correlation. We then investigated which socioeconomic variables comprising the social vulnerability scale have the most significant impacts on the number of OPT clinics located in each census tract. To answer this question, we examined the correlations between the number of OPT clinics and each of the four socioeconomic variables at the census tract level and conducted a multiple linear regression and an ordered Logit regression of the number of OPT clinics on the four variables. Lastly, the average marginal effects of percentage of uninsured population on number of OPT clinics was calculated.

In addition, each OPT clinic was contacted to clarify if they accepted Medicaid insurance for OPT services. One investigator placed a call with a verbal script stating a friend had a prescription for PT and asked if the practice accepted Medicaid insurance for OPT. If a clinic was part of a larger provider network, it was assumed, after spot checks, that the policy for accepting Medicaid insurance was Network-wide. If an OPT clinic was in the same provider network but located in a different county, the clinic in the second county was called to ensure accuracy of Medicaid acceptance. The response for each clinic was recorded as all Medicaid plans accepted, some Medicaid plans accepted, or Medicaid not accepted for OPT services.

RESULTS

Demographics

The 10 counties investigated in the NEPA Health District included a total population of 1 603 267 with 401 census tracts across an area of 5655 square miles with 220 OPT clinics.

Social vulnerability of each census tract

Table 1 presents the population-weighted averages (based on population size of the census tract) and ranges of the four socioeconomic

variables comprising the social vulnerability scale of the 401 census tracts.

Table 1: Characteristics of Census Tracts Located in Northeast Pennsylvania

Variable	Population-Weighted Average Percentage across Census Tracts (Range)
Educational Attainment - % with less than or equal to high school diploma	46.8% (13.8% – 78.9%)
Poverty - % living in poverty	12.3% (0.6% – 61.6%)
Race - % non-whites composition	14.5% (0% – 52%)
Health Insurance Coverage - % uninsured	5.6% (0% – 17.8%)

Social vulnerability and OPT clinic density

Table 2 shows the number of census tracts in each of the social vulnerability levels along with the average number of OPT clinics per 10 000

population. Results indicate as the social vulnerability scale increases, the density of OPT clinics has a tendency to decrease.

Table 2: Density and number of OPT clinics by Vulnerability Scale

Vulnerability	Average # of OPT Clinics per 10000 Population	# of Census Tracts	Total # of OPT Clinics	Total Population
1	1.64	94 (23.4%)	65	383,675
2	1.51	113 (28.2%)	70	499,721
3	1.33	74 (18.4%)	35	269,371
4	1.39	60 (15%)	34	220,713
5	0.70	60 (15%)	16	229,787

The Spearman correlation coefficient between the social vulnerability scale and density of OPT clinics per 10,000 population is -0.9 ($p=0.08$),

indicating a very strong negative relationship as depicted in Figure 1. The Pearson correlation coefficient was also calculated at -0.88 ($p=0.05$).

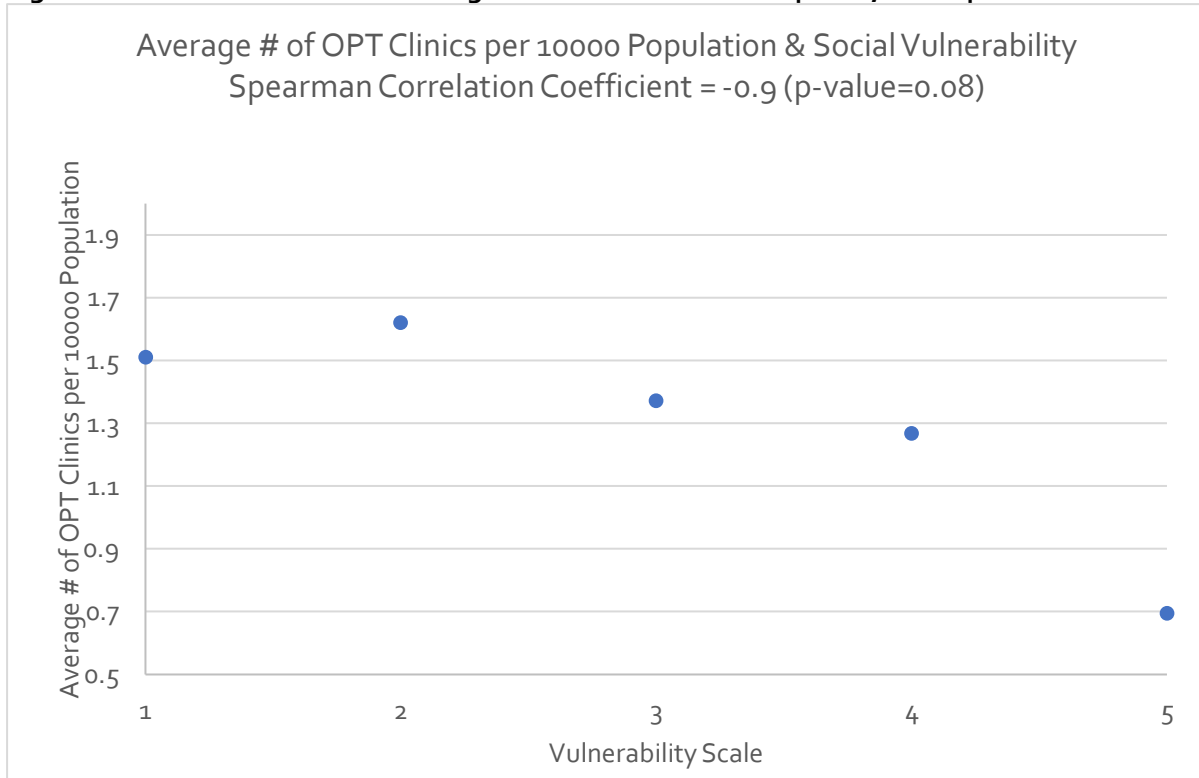
Figure 1: Association between Average Number of OPT Clinics per 10,000 Population & Social

Table 3 depicts the Pearson correlation coefficients between each of the four individual socioeconomic variables and number of OPT clinics per 10 000 population at the census tract

level. All correlations, except for that between % non-whites and number of OPT clinics, are statistically significant.

Table 3: Pearson Correlation Coefficients between the Number of OPT Clinics per 10 000 Population and Poverty, Education, Race and Ethnicity, and Health Insurance Coverage (p-values are Reported in Parentheses); Sample Size: 401.

Socioeconomic Variable	Pearson Correlation Coefficient (p-value)
% of Population Living in Poverty	-0.12 (0.016)
% of Population with Less than or Equal to High School Diploma	-0.16 (0.001)
% Non-whites of Population	-0.07 (0.176)
% of Population Uninsured	-0.17 (0.000)

Table 4 presents the estimates of the linear regression of number of OPT clinics on the four variables comprising the social vulnerability

scale. This multiple regression allows us to identify the correlation between one socioeconomic variable and OPT clinics density

while holding the others constant. As shown in Table 4, percentage of population without health insurance coverage has the strongest correlation with OPT clinics density, holding the other three variables constant. Notably, a 1% increase in the number of uninsured residents in the population in a census tract is associated with a decrease of four OPT clinics, holding poverty, education, and race and ethnicity constant. This is statistically significant at the 1% level (the p-values are calculated based on heteroskedasticity

corrected standard errors). The F-statistic for the overall significance of the regression is 4.036 with a p-value of zero, indicating the four variables are jointly significant at the 1% level, which confirms the strong correlation obtained from using the social vulnerability scale. The relatively low R-squared value suggests that there could be other important variables that affect the OPT clinics density and are not included in this study.

Table 4: Linear Regression of # of OPT Clinics on Poverty, Education, Race, and Health Insurance Coverage

Independent Variable	Coefficient	(p-value)
% of Population Living in Poverty	-0.326	(0.553)
% of Population with Less than or Equal to High School Diploma	-0.714	(0.182)
% Minority of Population	0.475	(0.239)
% of Population Uninsured	-4.029***	(0.006)
F-Statistic	4.063	0.000***
p-value on the F-Statistic		0.000***
R Square	0.04	
Number of Observations	401	
***significant at 1% level		

Table 5 presents the coefficients (log odds) and the odds ratios from the ordered Logit regression of number of OPT clinics on the four socioeconomic variables. As with the linear regression, percentage of population without health insurance coverage is statistically significant at the 5% level. Its coefficient of -0.114 indicates that a 1% increase in the number of uninsured residents in the population is associated with a decrease of 0.114 in the log

odds of having more OPT clinics. The log odds translate into an odds ratio of 0.892, which indicates that as the number of uninsured residents increases by 1%, the odds of having more OPT clinics is less than the odds of having fewer OPT clinics. The likelihood-ratio chi-squared value is 16.34 with a p-value of 0.026, indicating the four variables are jointly significant at the 5% level.

Table 5: Ordered Logit Regression of# OPT clinics on Poverty, Education, Race and Health Insurance Coverage

Independent Variable	Coefficient (p-value)	Odds Ratio
% of Population Living in Poverty	-0.316 (0.830)	0.729
% of Population with Less than or Equal to High School Diploma	-1.399 (0.212)	0.247
% Minority of Population	0.874 (0.421)	2.397
% of Population Uninsured	-0.114** (0.012)	0.892
LR Chiz	16.34**	
p-value on the Chiz-Statistic	0.026	
Number of Observations	401	
**significant at 5% level		

Table 6 shows the average marginal effects of % uninsured on the number of OPT clinics. The 0.024 average marginal effect number indicates that a 1% increase in the number of uninsured residents in the population is associated with a 2.4% increase in the probability of having zero OPT clinics. It is borderline significant at the 1% level. The -0.010, -0.009, -0.003, and -0.001 average marginal effect numbers indicate that a

1% increase in uninsured is associated with a 1%, 0.9%, 0.3%, and 0.1% decreases in the probability of having one, two, three, and four OPT clinics, respectively. They are significant at the 1%, 5%, and 10% levels. The pattern suggests that as the percentage of uninsured residents goes up, it becomes more likely to have no OPT clinics, and less likely to have more OPT clinics.

Table 6: Average Marginal Effects of % Uninsured on # of OPT Clinics from Ordered Logit

# of OPT Clinics per 10,000 Population	Average Marginal Effect of % Uninsured	p-value
0	0.024	0.010
1	-0.010	0.010
2	-0.009	0.015
3	-0.003	0.036
4	-0.001	0.092
5	0.000	0.352
Number of Observations	401	

OPT clinic acceptance of Medicaid insurance

Twenty percent of the population in the region have Medicaid insurance coverage, however only 26.4% of OPT clinics accept all Medicaid plans available. Some Medicaid plans but not others were accepted by 46.4% of OPT clinics

and 27.3% of clinics do not accept any Medicaid reimbursement for OPT services. Table 7 shows the breakdown of number of clinics in each of the five vulnerability categories and whether the clinics accept all Medicaid insurance plans, some

plans or no plans

Table 7: Clinics that accept Medicaid by social vulnerability of tract

Vulnerability	# of Census Tracts	Total # of OPT Clinics	# of Clinics that Do Not Accept Medicaid	# of Clinics that Accept Some Medicaid	# of Clinics that Accept All Medicaid
1	94 (23.4%)	65	29	21	15
2	113 (28.2%)	70	7	50	13
3	74 (18.4%)	35	9	12	14
4	60 (15%)	34	8	15	11
5	60 (15%)	16	7	4	5
Total	---	220	60 (27.3%)	102 (46.4%)	58 (26.4%)

DISCUSSION

Our results support the hypothesis that there are disparities in geographic location, and therefore, access, of OPT care for more socially vulnerable populations (Table 2, Figure 1a). Educational attainment, poverty, race and having health insurance are each negatively correlated with access to OPT (Table 5). When combined in the social vulnerability scale, the correlation is strongly negative (Spearman -0.9). This supports prior research that suggests that an interplay of factors and environment is likely as lived experience is a complex combination of factors.¹² Linear regression (Table 4) shows that the percentage of uninsured population has a significantly negative correlation with OPT clinic density. The low R-squared value is not surprising as access to care is multidimensional and here we focus on one aspect of access and its relation to social vulnerability. The ordered logit regression results (Tables 5 and 6) support the linear regression and Pearson correlations. Previous studies also found disparities in access for socially vulnerable groups. Some of this work focused on disease specific groups of population^{13,14} while others investigated rural and urban disparities.^{9,12,15} We did not focus on one group of patients with an identified condition or limit our data to only urban or rural counties. In this way we investigated general population access to OPT.

People with Medicaid insurance (as opposed to private insurance or Medicare insurance) also face the added burden of finding a clinic that accepts this insurance to cover their out-patient rehabilitation needs (Table 7). Our results show that only 26.4% of 220 clinics surveyed accept all Medicaid insurance plans available in this region of northeast Pennsylvania. This holds true whether a person lives in a census tract of relatively higher or lower social vulnerability. Prior literature^{12, 14-18} has found similar results in Medicaid acceptance rates for OPT services and medical appointments.¹⁹⁻²¹ Shedding light on difficulties getting through the OPT clinic door for the population with Medicaid insurance and those who are uninsured will help make PT's more aware of the structural determinants of health and perhaps encourage advocacy and novel solutions. Recently, Davenport²² called for advocacy efforts to develop business models for access to physical therapy that do not rely on patient ability to pay for the service. In 2021 the APTA published a position paper strongly urging the US Congress to pass the Primary Health Services Enhancement Act²³ to provide funding for OPT service provision in Federally Qualified Health Centers (a safety net provider service) which would increase opportunity for access to OPT care for people that are medically underserved.



Strengths of our study include that we used a large data set of over 1.6 million people in previously unstudied diverse geographic areas. We used robust secondary data from the US Census. Limitations include that we only tested for geographic location of clinics. While this is in line with the original scope stated, we did not account for people traveling to clinics in census tracts other than where they reside, this could be addressed in future work using geospatial analysis. A second limitation may be an undercount of the Medicaid acceptance rate which may have had the unintended effect of overestimating the number of clinics that do not accept the insurance. In calling OPT clinics by phone using a mock patient to ask if Medicaid was accepted, there was no opportunity to determine individual benefits. Consumer input in the form of interviews, focus groups, or surveys would serve to better understand population demand for care. It could be argued that supply meets current demand and further investigation to understand the need, awareness and understanding the population has of OPT services and potential that PT may positively impact their health would be of value. Lastly, our results are not generalizable to other regions therefore solutions offered are local. However, replication of the study over time could be of

interest to track changes. In summary, our work shows a clear association between high social vulnerability and lack of geographic access to OPT clinics in a large area of 1.6 million people with a mix of urban and rural counties in NEPA. Lack of geographic access to care is further exacerbated for those with Medicaid insurance. This data analysis can be utilized to drive a community needs assessment in collaboration with the local public health department to improve access in our local highest socially vulnerable underserved areas. Dissemination of this work will also serve to shed light on the disparity.

CONCLUSION

This work describes a strong negative association between increased population social vulnerability and decreased OPT clinic geographic density and distribution. We have also shown that the burden of finding OPT is amplified for those persons with Medicaid insurance and the uninsured population. Our analysis allows us an opportunity to use data to drive future clinic and service development. Several policy level actions are recommended. Further research using spatial analysis may be of value

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