Retrospective Analysis

No Differences in Pain Scores and Treatment Response in Patients from Different Socioeconomic Areas Within the City of Chicago

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Background: It is well established that the experience of chronic pain significantly differs among ethnic-racial groups. There is mixed evidence to suggest that societal influences may contribute to pain prevalence among cultural groups and their treatment response. One possible explanation for differences in pain experience are the differences in socioeconomic status among patients with chronic pain.

Objective: To determine whether there is any difference in pain scores or treatment responses among patients with different socioeconomic status.

Study Design: Retrospective analysis.

Setting: Outpatient pain clinic.

Methods: After approval from the Advocate Healthcare Institutional Review Board, we included 1,149 patients treated for different chronic pain conditions who were followed for at least 12 months. Patients were stratified into quartiles determined by median income according to ZIP code. Results: Of the sampled patients, 207 patients lived in ZIP codes with median incomes > $51,294; 515 in ZIP codes with median incomes between $40,083 and $51,294; 332 in ZIP codes with median incomes between $30,625 and $40,083; and 95 in ZIP codes with median incomes < $30,625. Groups differed in age ($P = 0.047$), race ($P < 0.001$), body mass index (BMI) ($P = 0.019$), utilization of opioid medications ($P = 0.011$), morphine milligram equivalents (MME) on first visit ($P = 0.036$), and utilization of membrane stabilizers such as gabapentin ($P = 0.019$). There were no significant differences among groups in terms of gender ($P = 0.531$), type of pain experienced (P = 0.679), or time since pain onset ($P = 0.174$). Groups were treated similarly, with no statistically significant differences in the proportions of patients who had taken various nonopioid medications throughout their treatment course other than membrane stabilizers, the number of patients who received interventional pain management procedures, or MME at last visit. Average pretreatment numeric rating scale pain scores were not significantly different among quartiles ($P = 0.079$), posttreatment pain scores ($P = 0.767$), and subjective percent improvement ($P = 0.434$).

Limitations: This is a single center study and may have limitations in extrapolating to the general population.

Conclusion: The results of our study show that there are no differences in pain perception or treatment responses in patients from different socioeconomic statuses despite differences among groups in age, BMI, race, utilization of opioid medications, and MME at first visit. Patients at this pain practice appear to have been treated with similar modalities regardless of socioeconomic status.

Key words: Pain experience, pain perception, treatment response, opioid utilization, socioeconomic status, income, race, ethnicity

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It is well established that the experience of chronic pain significantly differs among ethnic-racial groups (1). Disparities in pain perception, assessment, and treatment can be seen in all settings and all types of pain (2). There are numerous factors that can contribute to disparities in pain perception including patient factors, a patient's health care provider, and the health care system (2). It is apparent that racial and ethnic minorities are undertreated for pain as compared to their white counterparts (2-5). The Institute of Medicine described 2 sources of disparities in health care for minority populations: 1) "Health care systems and the legal and regulatory climate in which they operate and 2) Discrimination" (2,6).

Provider biases have been shown to contribute to disparities in health care among minorities and patients of low socioeconomic status (7). Stemming from research of cognitive psychologists, providers have a disconnect between the desire to treat patients equally while simultaneously being subconsciously influenced by race/ethnicity and socioeconomic status (8). These disconnects between intentions and implicit biases interfere with the ability to understand a patient's specific situation and can lead to differences in treatment planning.

There is mixed evidence to suggest that societal influences may contribute to pain prevalence among cultural groups and their treatment response (9). One possible explanation for differences in pain experience are differences in socioeconomic status. Socioeconomic status has been linked to variability in pain outcomes (7,10). Independently from race, numerous studies have shown that lower socioeconomic status is linked to worsened pain and disability (7,10). The aim of our study was to find if there is any difference in pain scores or treatment responses among patients with different socioeconomic status estimated by median income according to ZIP code.

Methods

Following approval from the Advocate Healthcare Institutional Review Board, a retrospective analysis of 1,149 patients treated for different chronic pain conditions was performed. Patients included were followed for at least 12 months. In-depth chart reviews of patients at the Chicago Anesthesia Pain Specialists clinic were utilized to collect demographic, treatment, and treatment response data from November 2013 through September 2020. Patient health information was protected via utilization of secure computers.

Patients were categorized into 4 groups of pain types: low back pain, neck pain, osteoarthritic pain, or other/multiple types of pain. Race/ethnicity was recorded and categorized into white, Hispanic, African American, Asian, other, or unspecified. Patients were interviewed at each visit and were asked to quantify pain on a numeric rating scale (NRS) for both pre- and posttreatment pain scores, as well as subjective percentage improvement. Various pharmaceutical and interventional treatment modalities were identified and recorded. Opioid utilization at any time throughout treatment was identified and morphine milligram equivalents (MMEs) at first and last visit were calculated using MDCalc (11).

Patients were stratified into quartiles (Q1-Q4) determined by median income by ZIP code according to Zip Atlas (12). The IBM SPSS 27 software (IBM Corporation, Armonk, NY) was used to analyze the collected data. Crosstabs with χ^2 analysis was utilized to identify differences between socioeconomic quartiles. Frequency tables were utilized to identify proportions of patients with various nominal variables. One sample t-tests were utilized to calculate mean numerical variables within each respective quartile. Differences were considered significant with a *P*-value of $P < 0.05$. Upon chart review, patient entries with incomplete data were excluded from the analyses.

Results

Study Population

Of the sampled patients, Q1 includes 207 patients in ZIP codes with median income > $51,294; Q2 includes 515 patients in ZIP codes with median income between $40,083 and $51,294; Q3 includes 332 patients in ZIP codes with median income between $30,625 and $40,083; and Q4 includes 95 patients in ZIP codes with median income < $30,625. The average age of patients from Q1-Q4 was 64.7, 62, 61.1, and 62.1 years respectively. The age of patients was significantly different among groups, showing the oldest patients coming from the wealthiest neighborhoods (Table 1).

Income quartiles also significantly differed in race/ethnicity ($P < 0.001$). The majority of patients from the wealthiest neighborhoods were white (59.4%). Q2 zip codes had the highest proportion of Hispanic patients (43.3%) followed by whites (37.7%). Patients in the Q3 neighborhoods consisted of 36.1% white, 25% Hispanic, and 22.3% African American patients. The poorest neighborhoods had predominantly African

American (51.6%) patients. Asian representation was low throughout all quartiles (Table 2).

Average body mass index (BMI [kg/m^2]) increased as income decreased from Q1-Q3 with a small decrease in BMI from Q3 to Q4 (Table 1). There were no significant differences in gender, with the majority of patients being women in all groups (Table 3).

The majority of patients in all quartiles were treated for low back pain followed by other/multiple types of pain, with no statistically significant difference in types of pain experienced among quartiles (P = 0.679) (Table 4). The proportions of patients who were treated for neck or osteoarthritic pain were smaller throughout the study population (Table 4). The average time since the onset of pain was similar among groups as well (Table 5).

Treatment Course

Opioid utilization at any point during a treatment course was significantly different among quartiles (P = 0.011) and was highest in patients living in Q3 income ZIP codes (67.2%) (Table 6). There was no particular correlation between income and opioid use. Q3 neighborhoods also had the highest MME at their first visit (26.2) (Table 7). Groups were all similar in MME at last visit (Table 7). On average, patients in Q3 ZIP codes had the highest MME at first visit and took significantly less opioid dosages at last visit compared to the first visit (MME mean difference -6.9, P = 0.006) (Table 7). Other quartiles had similar MMEs at first and last visits (Table 7).

Utilization of membrane stabilizers such as gabapentin and pregabalin was significantly different among quartiles (P = 0.019) and showed an increase from Q1-Q3 and a decrease from Q3 to Q4 (Table 6). Other than membrane stabilizers, all quartiles were similar in the proportions of patients who took various nonopioid medications including: nonsteroidal anti-inflammatory drugs, tricyclic antidepressants, muscle relaxants, benzodiazepines, and other psychiatric medications (Table 6). There were also no differences among groups in the proportion of patients who underwent steroid injections or other interventions such as radiofrequency ablations, spinal cord stimulators, and onabotulinumtoxinA injections (Table 8).

Treatment Response

Average pretreatment NRS pain scores were not significantly different among quartiles (Table 5). Patients appeared to have similar responses to treatment as well with no differences in posttreatment pain scores or subjective percentage improvement (Table 5).

Discussion

Socioeconomic and racial disparities in health care are apparent throughout the United States. However, the effect of socioeconomic status on pain perception and response to treatment are not well documented. Our study shows that severity of pain before and after treatment does not differ significantly across different levels of income.

Pain perception and treatment response were similar among income quartiles despite a number of significant differences in demographics. Firstly, groups differed in average age, with patients from wealthier

Table 1. *Age and body mass index (BMI) per quartile.*

Quartile	Age (mean)	BMI (mean)
Q1	64.7	29.2
Q2	62	30.5
Q3	61.1	31.2
Q4	62.1	30.7
	P = 0.047	P = 0.019

Table 2. *Proportion of race/ethnicity per quartile.*

Quartile	White	Hispanic	African American	Asian	Other	Unspecified	Total
Q1	123 (59.4%)	22 (10.6%)	23 (11.1%)	4 (1.9%)	20 (9.7%)	15 (7.2%)	207
Q2	194 (37.7%)	223 (43.3%)	32 (6.2%)	8 (1.6%)	27 (5.2%)	31 (6%)	515
Q3	120 (36.1%)	83 (25%)	74 (22.3%)	4 (1.2%)	34 (10.2%)	17 (5.1%)	332
Q4	16 (16.8%)	11 (11.6%)	49 (51.6%)	2 (2.1%)	9 (9.5%)	8 (8.4%)	95
Total	453	339	178	18	90	71	1149
	P < 0.001						

Table 3. *Gender demographics per quartile.*

Quartile	Men	Women
Q1	85 (41.1%)	122 (58.9%)
Q2	202 (39.2%)	311 (60.4%)
Q3	119 (35.8%)	212 (63.9%)
Q4	33 (34.7%)	62 (65.3%)
Total	439	707
	$P = 0.531$	

neighborhoods being older on average. Several studies have demonstrated that severity of pain and symptom distress decreases with age (13-15). Yoon et al (13) in 2021 showed in a randomized controlled trial that mean pain scores and symptom distress scales significantly differed among 230 hospice patients with chronic cancer pain ($P < 0.001$ and $P = 0.004$ respectively) despite similarities in patient-related barriers to managing pain such as concern about addiction, tolerance, telling their provider about their pain, and side effects of analgesics. Despite differences in age among income quartiles, we did not find any differences in pain scores or treatment response.

Table 4. *Type of pain per quartile.*

Quartile	Low Back Pain	Neck Pain	Osteoarthritis	Other/Multiple
Q1	121 (58.5%)	24 (11.6%)	4 (1.9%)	58 (28%)
Q2	323 (62.7%)	53 (10.3%)	7 (1.4%)	132 (25.6%)
Q3	218 (65.7%)	28 (8.4%)	3 (0.9%)	83 (25%)
Q4	67 (70.5%)	7 (7.4%)	2 (2.1%)	19 (20%)
Total	729	112	16	292
	$P = 0.679$			

Table 5. *Pain duration, scores, improvement, and total visits per quartile.*

Quartile	Time Since Pain Onset (months)	Pretreatment NRS (mean)	Posttreatment NRS (mean)	Pain Difference (mean)	Percent Improvement (mean, %)	Subjective Improvement (mean, %)	Number of Visits (mean)
Q1	56.5	7.6	4.1	3.5	46.3	60.9	15.9
Q2	43.8	7.9	4.3	3.7	45.9	59.3	15.6
Q3	47.1	8	4.2	3.8	48.6	62.4	17.1
Q4	43.9	7.9	4.3	3.5	44.7	60.7	14.5
	$P = 0.174$	$P = 0.079$	$P = 0.767$	$P = 0.327$	$P = 0.412$	$P = 0.434$	$P = 0.478$

Table 6. *Pharmacologic therapy per quartile.*

Quartile	Opioid	Membrane Stabilizer	NSAID	Muscle Relaxant	Tricyclic Antidepressant	Benzodiazepine	Other Psych
Q1	130 (62.8%)	64 (30.9%)	113 (54.6%)	55 (26.6%)	9 (4.3%)	47 (22.7%)	59 (28.5%)
Q2	290 (56.3%)	208 (40.4%)	287 (55.7%)	142 (27.6%)	30 (5.8%)	102 (19.8%)	133 (25.8%)
Q3	223 (67.2%)	148 (44.6%)	181 (54.5%)	109 (32.8%)	17 (5.1%)	78 (23.5%)	84 (25.3%)
Q4	60 (63.2%)	37 (38.9%)	50 (52.6%)	32 (33.7%)	3 (3.2%)	16 (16.8%)	25 (26.3%)
	$P = 0.011$	$P = 0.019$	$P = 0.946$	$P = 0.234$	$P = 0.676$	$P = 0.380$	$P = 0.855$

Table 7. *Morphine milligram equivalents at first and last visit per quartile.*

Quartile	MME First Visit (mean)	MME Last Visit (mean)	MME Difference (First to Last Visit, mean)
Q1	22.8	21	1.8
Q2	17.3	17.4	-0.1
Q3	26.2	19.3	6.9
Q4	16.2	17.2	-1
	$P = 0.036$	$P = 0.696$	

Table 8. *Interventional therapies per quartile.*

Quartile	Steroid Injection	Other Intervention
Q1	178 (86%)	56 (27.1%)
Q2	461 (89.5%)	137 (26.6%)
Q3	284 (85.5%)	84 (25.3%)
Q4	85 (89.5%)	20 (21.1%)
	$P = 0.303$	$P = 0.705$

Our study population was also significantly different across income quartiles in race/ethnicity. Numerous studies have attempted to describe the differences in pain perception among races and ethnic groups. A review of data by Green et al (16) from a tertiary care pain center in 2012 included 3,730 patients. Their review identified race as well as neighborhood socioeconomic status as major factors in chronic pain outcomes (16). An earlier 2003 study by Green et al (17), a retrospective analysis of 2,040 white and African American patients undergoing treatment at a multidisciplinary pain center, found higher rates of depressive and posttraumatic stress symptoms in African American patients (17). They showed significant differences in pain and health status between groups (17). The authors concluded that chronic pain affects quality of life and health status differently for African Americans compared to white American patients (17).

Similar findings have been demonstrated in various studies such as that by Cano et al (18) in 2006 (18). In addition, a more recent cross-sectional secondary analysis by Dhingra et al (19) in 2018 showed no clinically significant differences in health-related quality of life among patients with chronic pain patients. The authors mentioned that prior studies showing differences did not control for other race-related factors that could affect health-related quality of life such as education, income, and employment (19). They concluded that it was more likely that the differences in pain-related quality of life are due to confounding with other variables and less likely race/ethnicity specifically (19).

In our study population, there were significantly different proportions of different ethnic groups in each income quartile. Our data suggest that income and socioeconomic status do not contribute to differences in pain experiences among ethnic/racial groups. Perhaps differences in pain perception among racial/ethnic groups has more to do with the differences in education, employment, or other factors than just income. Lerman et al (20) in 2018 attempted to analyze the role of negative cognition and its relationship between ethnicity, sleep, and pain among 156 women with temporomandibular joint disorder. Their randomized controlled trial identified pain catastrophizing as a potential link between race/ethnicity and pain perception (20).

The Institute of Medicine identified discrimination as a factor that results in racial and ethnic disparities in health care (2,6). In an attempt to tackle disparities that provider bias causes with regards to pain, a 2019 randomized controlled trial by Hirsh et al (7) found that online interventional training, including feedback and increased contact with minority and low-income patients, decreased treatment bias (7). Providers who were identified to have biases for race and socioeconomic factors were randomized to either intervention or control groups (7). Online training was tailored for individual providers and addressed their racial and socioeconomic biases (7). The study found that compared to the control group, providers who underwent the online intervention had 85% lower odds of treatment bias toward African American patients and 76% lower odds of bias towards low socioeconomic status patients (7). Our data indicate that patients were treated with very similar modalities regardless of income. Perhaps this pain practice minimized discriminatory factors in the treatment of pain, which resulted in similar pain perception and treatment responses among patients.

Opioid medications are commonly utilized for the treatment of chronic pain. In our study, the majority of patients in all quartiles were treated with opioid medications at some point throughout their treatment course. The proportions of patients who used opioid medications were significantly different among groups with the highest proportion in Q3 ZIP codes (67.4%). Patients living in Q3 ZIP codes also had the highest

MMEs at their first visit (26.2; $P = 0.036$). There is no particular correlation between opioid use and income in our study. Further analyses investigating the reason for higher opioid utilization in this population is warranted.

Patients in all quartiles took similar amounts of MMEs at their last visit. This suggests that patients were placed on a similar treatment regimen regardless of their socioeconomic status and their opioid consumption at first visit. This is further demonstrated by the fact that patients in Q3 ZIP codes took significantly fewer MMEs at their last visit compared to their first (MME difference 6.9). All other groups had similar MMEs at the first compared to last visit, and the MME at last visit was similar among all quartiles.

Evidence for the equal treatment of patients across quartiles is also apparent in the proportions of patients who underwent interventional procedures and in those who took various nonopioid medications such as nonsteroidal anti-inflammatory drugs, tricyclic antidepressants, muscle relaxants, benzodiazepines, and other psychiatric medications. The only other treatment modality that reached statistical significance was the proportion of patients who took membrane stabilizers, which was lowest in the wealthiest ZIP codes. There was no correlation between income and use of membrane stabilizers. Further studies aimed at aversion or attraction to particular medications should be performed to better characterize why patients may be more likely to utilize particular treatment modalities. In regard to membrane stabilizers, it could be postulated that the higher average age in Q1 neighborhoods makes this population more sensitive to negative side effects, such as drowsiness. As a retrospective study utilizing chart review, we have limited information regarding whether or not patients had tried any medication or treatment prior to their first visit at this practice.

Encouragement of weight loss is a key component of chronic pain regimens. Obesity and overweight patients account for up to 45% of the burden of osteoarthritic and spinal pain patients (21,22). Mean BMI in our study population was significantly different among quartiles. Average BMI ranged from 29.2 to 31.2, with the highest BMIs in Q3. The highest proportion (45%) of patients in the study came from Q2 ZIP codes. This can be explained by the location of the pain practice. ZIP codes surrounding the pain practice are mostly in the top 50% of median income. Patients in Q3 accounted for 29% of the patients in this study, and patients from the wealthiest ZIP codes only accounted for 18% of the study population, despite the pain practice being located in a Q1 ZIP code. This data suggest that patients with higher BMIs, on average, traveled from lower income ZIP codes to make up nearly 30% of our study population. This higher-than-expected proportion of patients could be a result of the increased burden of chronic pain among those with higher BMIs. Interestingly though, pain perception at first visit and response to treatment did not differ among income quartiles regardless of the difference in BMI. This suggests that BMI can account for a higher likelihood of experiencing chronic pain but does not affect the severity of pain or treatment response.

Limitations

This is a single center study and may have limitations in extrapolation to the general population. In addition, quartiles were determined by median income, giving the possibility of outliers on either end of the spectrum of individual patient income. The socioeconomic status of individual patients may exceed the limits imposed by their ZIP code quartile.

Conclusion

The results of our study show that there were no differences in pain perception or treatment response in patients from different socioeconomic areas despite differences among groups in age, race, BMI, utilization of opioid medications, and MME at first visit. Patients at this pain practice all appear to have been treated with similar modalities regardless of socioeconomic status.

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