Ethnicity and Knee Osteoarthritis: A comparative analysis of pain, function, and pain catastrophizing between South Florida Hispanic and Non-Hispanic Adults

Daniel Quintero, MD
University of Miami- Department of Radiology
Jean Jose, DO, MS
University of Miami- Department of Radiology https://orcid.org/0000-0001-5050-3982
Eric Kholodovsky
University of Miami Miller School of Medicine https://orcid.org/0009-0005-5542-6564
Jacob Jahn
tjj57@miami.edu

University of Miami Miller School of Medicine https://orcid.org/0000-0003-0745-7049
Levi M. Travis
University of Miami Miller School of Medicine https://orcid.org/0009-0000-2113-8189
Joseph P. Costello II
University of Miami Miller School of Medicine https://orcid.org/0000-0002-7132-4067
Olivia Perez
University of Miami Miller School of Medicine https://orcid.org/0000-0001-9523-697X
Alberto J. Caban-Martinez, DO, PhD, MPH
University of Miami- Department of Public Health Sciences https://orcid.org/0000-0002-5960-1308
Thomas M. Best, MD, PhD
University of Miami- Department of Orthopedics, Division of Sports Medicine, UHealth Sports Medicine Institute

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Abstract

Objective:

Race is associated with reporting of pain, coping mechanisms, and disease severity in patients with knee osteoarthritis (KOA). However, few studies have evaluated its importance in ethnicity, particularly the Hispanic population. We compare pain perception (VAS), function (WOMAC), and pain catastrophizing (PCS) between Hispanic **(HP)** and non-Hispanic **(NHWP)** patients stratified by socio-economic status (SES) and K-L grade.

Methods:

A cross-sectional study of patients from a tertiary care clinic between July 2021 and December 2022 was performed. Patients with knee pain, radiographs, and doctor-diagnosis of KOA completed questionnaires in English or Spanish. Descriptive statistics characterized demographic differences between **NHWP** and **HP** in VAS, PCS, and WOMAC. Two one-way analyses of variance evaluated the effect of both ethnicity and sex, with subgroup analyses stratifying by K-L grade. Multivariate general linear models assessed primary outcomes while controlling for confounders.

Results:

HP exhibited higher VAS, PCS, and WOMAC scores compared to **NHWP**. PCS was higher in **HP** ($p = 0.004$, mean = 8.89) than **NHWP** (mean = 4.58), as was **VAS** ($p < 0.001$, mean = 4.28 vs. 2.74) and WOMAC ($p = 0.029$, mean = 27.86 vs. 21.58). These differences remained when controlled for SES and K-L grade. Stratifying by sex and comparing primary outcomes between **HP** and **NHWP**, male **HP** had greater VAS ($p = .021$, mean = 3.83 vs. 2.42) and PCS ($p = .008$, mean = 8.83 vs. 3.35), while female **HP** had greater **VAS** ($p = .019$, mean = 4.62 vs. 3.08) and nonsignificantly greater PCS ($p = .164$, mean = 8.94 vs. 5.92).

Conclusion:

HP with KOA reported greater pain intensity, functional limitation, and PCS compared with **NHWP**, even after adjusting for SES and K-L grade.

INTRODUCTION

Osteoarthritis (OA) is the most common form of arthritis worldwide, with a higher incidence in high-income countries and older individuals. In the United States alone, over 32.5 million individuals have been diagnosed with OA, 3 million of which are Hispanic, an ethnic minority [1–4]. Knee OA (KOA) is the leading cause of lower extremity disability, and as of 2010, was ranked the 11th highest contributor to global disability [5]. Studies including diverse populations are needed to more fully understand the total burden of OA in order to better address unmet needs of both the patient and the medical community serving them.

The diagnosis of OA is usually based on clinical assessment and confirmed by routine plain radiographs[6]. Patients typically report activity-related joint pain that is associated with morning stiffness of less than 30 minutes duration [6, 7]. However, this presentation is not consistent across all patient populations. Like other chronic diseases, the presentation and subsequent morbidity of KOA demonstrates considerable variability across different races and, more recently, ethnicities [8–12]. For example, the Johnston County OA project demonstrated statistically significant differences in both pain severity and radiographic severity (Kellgren and Lawrence [K-L]) scores between African Americans and Caucasians with symptomatic KOA at initial presentation [13, 14]. Other investigators have corroborated this finding by reporting greater pain severity among African Americans compared to non-Hispanic White persons (**NHWP**) with hip and knee OA [15–21]. Both studies utilized race, an observable characteristic with social implications, as the independent variable between groups. Recently, Hoffman et al. denoted that there are no biological differences in pain experience based on race alone yet there are racial biases in the treatment and assessment of pain [22].

Ethnicity, on the other hand, may or may not carry a different race; however, the term attempts to capture the culture of people in a given geographic region, including their language, heritage, religion and customs [15]. Hollingshead et al. discussed how ethnicity is involved in the processing and reporting of pain [23, 24]. Moreover, a recent study observed that Hispanic persons **(HP)** report greater pain sensitivity and less pain tolerance than **NHWP** [23]. Furthermore, a study by Wang studied four different ethnicities (East Asian, African American, Hispanic and Caucasian) and found differences in pain sensitivity between ethnicity after capsaicin administration [25, 26]. Finally, Levy et al. highlighted differences in symptom severity on presentation for a well-known chronic illness, alcoholic liver disease, between Caucasian and Hispanics [27].

Although current data is limited, in addition to studies indicating an association between pain experience, disease severity, and ethnicity, there are findings specific in Hispanics with chronic pain regarding pain intensity and coping mechanisms. Studies utilizing population-based data from the third National Health and Nutrition Examination Survey (NHANES-III) demonstrated that **HP** with self- reported arthritis are twice as likely to self-report symptoms of activity limitation when compared to **NHWP** [2]. **HPs** with an assigned diagnosis of arthritis also tend to report greater pain scores as measured by the Visual Analog Scale (VAS) [15]. Furthermore, when compared to **NHWP**, **HPs** have a greater propensity to utilize pain-catastrophizing coping mechanisms to address any physical manifestation of chronic pain [15, 24]. Previous studies have highlighted the psychosocial aspect of arthritic pain and how implications in socioeconomic, psychological, and environmental factors have a substantial influence on an individual's perception of their self-efficacy and quality of life [26–28].

One maladaptive strategy utilized more commonly in Hispanics for coping with chronic pain is pain catastrophizing. This is a tendency to develop a belief that the pain will not resolve (Helplessness), a constant repetitive dwelling on the negative aspects of the pain (Rumination) and exaggerating/ falsely intensifying the perceived pain stimulus (magnification). Greater pain catastrophizing is associated with greater pain and functional limitation. Additionally, greater pain catastrophizing has been independently associated with lower socio-economic status [9, 29–32]. Green et al. expanded on this claim and underlined that neighborhood socioeconomic status mediated chronic pain experience in younger White and Black individuals [33]. They argued neighborhood socioeconomic status (NSES) mediated the pain experience differences identified between races. Therefore, to explore if differences in pain experiences existed between ethnicity, NSES or a surrogate measure may be noteworthy [31, 33].

The role of socioeconomic factors and variation in values, attitudes, and beliefs regarding medical treatments are not well understood. To our knowledge, there are limited data investigating **HP** with KOA. One recent study has shown that **HP** reported higher pain and symptom scores despite fewer changes on plain radiographs compared with **NHWP** with KOA [34]. The purpose of the present study was to determine if there are differences in pain catastrophizing, functional limitation, and pain severity between **HP** and **NHWP** with KOA after adjusting for socioeconomic status (SES) and radiographic disease severity. Investigating a convenience sample of patients from southern Florida, a region somewhat unique with its high prevalence of **HP**, our hypothesis is that there are differences in reporting of pain catastrophizing, pain severity, and functional limitations between the two ethnicities that will persist after controlling for covariates including SES and KL grade.

METHODS

Study population and Data Source

All procedures were approved by the University of Miami Institutional Review Board (IRB). Study participants were recruited between July 1st, 2021 and December 22nd, 2022 from our tertiary care medical center in Miami-Dade County, Florida via convenient sampling contingent on investigator (DQ, SH, JPC) availability and patient willingness. Patient eligibility was limited to those eligible to be seen at our clinic (valid insurance coverage, age greater than 18) presenting for the first time to our clinic with knee pain and/or stiffness and subsequently diagnosed with KOA by history, physical exam, and weight-bearing knee radiographs (i.e., AP, lateral and skyline Merchant views). Clinical OA was determined by a sports medicine attending (TMB) during the encounter. OA grade was determined by a blinded musculoskeletal radiologist (J Jose) using the KL grading system (4). Location of OA (tibiofemoral and/or patellofemoral) was also noted. Following patient consent, one of four interviewers (DQ, SH, JPC, EK) administered a series of standard questionnaires in either English or Spanish depending on patient preference. All required data were collected using REDCap, an electronic data capture tool hosted at the University of Miami. The data were handled by a single investigator (DQ), de-identified by random sequence software using a university- approved computer and stored on an encrypted hard drive.

Survey Instrument and Study Measures

We administered a 61-item study questionnaire during the clinical encounter to collect information about participants' sociodemographic characteristics, including age, sex, occupation, smoking status, ethnicity, and body mass index. As part of the questionnaire, we issued the Charles comorbidity index (CCI) to quantify participants' chronic comorbid conditions. Nineteen different conditions were assessed among study participants including, myocardial infarction, congestive heart failure, peripheral vascular disease, cerebrovascular disease (except hemiplegia), dementia, chronic pulmonary disease, connective tissue disease, ulcer disease, mild liver disease, diabetes (without complications), diabetes with end organ damage, hemiplegia, moderate or severe renal disease, solid tumor (metastatic and non-metastatic), leukemia, lymphoma, multiple myeloma, moderate or severe liver disease, and HIV infection. The presence of individual diseases was quantified using a weighted point system and added to produce a single value per participant [31].

Patient pain scores were quantified at the time of presentation to the clinic using a scale from 0 to 10 (visual analog scale - VAS). Before answering, the patient was told that 0 represented being pain-free and 10 represented the worse pain imaginable. We also administered a standardized pain catastrophizing scale (PCS) questionnaire. This scale was developed to assess three components of catastrophizing: rumination, magnification, and helplessness [32]. The scale included 13 validated questions that required responses on a point scale of 0 to 4, and the scores were summed to produce a single value representing the total pain catastrophizing exhibited by each participant [32]. Participant functional limitation was assessed using the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) [8].

Spanish Validation and Testing Administration

Investigator (DQ) is qualified per IRB requirements to gather consent and subsequently administered the 61-item questionnaire in Spanish to study participants. All questionnaires CCI, PCS,VAS and WOMAC were previously validated in Spanish [35–39].

Geocoding Socioeconomic Status

We replicated the approach used by *Feldman et al*. and utilized the Geographic Information System (GIS) to geocode individual home addresses [29]. For each patient's individual address, we obtained a Federal Information Processing Standard (FIPS) code and linked it to U.S. Census and American Community Survey data at the block group level. The block group is the smallest geographic unit for which the variables are published. For each block, we collected the Neighborhood Socioeconomic Status (NSES) Index, a previously validated measure for socioeconomic status [40]. This measure includes unemployment (percentage of persons ≥ 16 years of age in the labor force who are unemployed and actively seeking work), income (percentage of persons below the federally defined poverty line and median household income), wealth (median value of owner-occupied homes), education (percentage of persons aged > 25 with less than a 12th-grade education and percentage of persons aged > 25 years with at least four years of college) and crowding (percentage of households containing ≥ 1 person per room). SES index scores were reported on a scale of 0 to 100. NSES index values for each identified block pertaining to a single ethnicity were averaged and reported as a mean and standard deviation.

Data Analysis

Continuous values were reported as the mean and standard deviation for each sample. For descriptive data defined by dichotomous selection, the total percentage within a category was reported.

Comparisons

Sample means were compared between groups via Student's T-test for comparison of means. Comparisons of the study parameter that failed F-testing required a Mann-Whitney test for averages of unequally distributed sample values. Statistical comparisons of survey data were performed with GraphPad Prism Version 9.4.1 software (GraphPad Software, San Diego, California USA,).

Sub-group Analysis

Descriptive statistics were generated for the data sample with means, medians, standard deviations, and percentiles computed for continuous variables, and counts, means, and medians computed for categorical variables. The three primary dependent variables evaluated included VAS (1–10 scale), PCS, and WOMAC. K-L grade was evaluated as both an independent variable, and as a secondary dependent variable given specific secondary independent variables (Age, BMI, etc.) may influence disease severity radiographically.

ANOVA Analysis

Two one-way analyses of variance (ANOVA) were performed to evaluate the effect of both dichotomous independent variables: Ethnicity (**NHWP** or **HP**) and Sex (M or F). WOMAC, PCS, VAS, and K-L grade were analyzed as dependent variables. One-way ANOVAs were also performed comparing WOMAC, PCS, and VAS of ethnicities while stratifying by K-L grade and Sex. A one-way ANOVA was performed comparing the effect of K-L grade on WOMAC, PCS, and VAS, while stratifying by Ethnicity. One-way ANOVAs were also performed to compare means of Age, Height, CCI, and SES between **NHWP** and **HP**.

Nonparametric Tests

Nonparametric analyses including median tests and Mann-Whitney tests were used for comparisons of variables with significant outliers and unequally distributed sample values.

Linear Regressions

Linear regressions were performed to evaluate the effects of all continuous or scale independent variables (SES, CCI, Height, BMI, and Age) on each of the three primary dependent variables, as well as K-L grade. Observed cumulative probability was plotted against expected cumulative probability. Standardized residuals were plotted in histogram form to validate sample distribution, and standardized predicted residuals were plotted against actual standardized residuals to check validity of each regression model.

Multivariate Analysis

Multivariate general linear models were computed for primary independent variables and their interaction between each other and various secondary independent variables, including key continuous variables. Selected variables were based on the results of one-way ANOVAs and linear regressions, which demonstrated isolated effects of particular independent variables and therefore had to be cross-analyzed with primary independent variables to see interaction and confounding effects. Variables found to have potential confounding effects on primary independent variables, such as socioeconomic status and K-L grade, were then tested in multivariate general linear models as covariates both separately and in the same model. Post-hoc Tukey and Bonferroni tests were computed for analyses that contained 3 or more subgroups, which for this sample included only K-L grade. Similarly, univariate general linear models were computed for primary independent variables and secondary independent variables found to have statistically significant effects on VAS, PCS, or WOMAC.

Graphs were created to demonstrate both the effects of primary independent variables, as well as primary independent variables stratified by other variables shown to have significant or non-significant effect on VAS, PCS, or WOMAC. Scatterplots were generated to demonstrate correlation and R^2 values of linear regressions. Mean and median plots were generated, depending on the scale of the dependent variable and the vulnerability of the variable to have significant outliers, such as PCS. All graphs were generated using IBM SPSS statistics version 29.0.2.0 or Microsoft Excel version 16.83.

All statistical analysis was conducted using IBM SPSS Statistics version 29.0.2.0. Statistical significance was considered alpha values < 0.05 and within a 95% confidence interval.

RESULTS

Outcomes by Ethnicity

VAS, PCS, and WOMAC were greater in **HP** when compared to **NHWP** (**Table 1**, Fig. 1). The mean PCS score was greater in **HP** ($p = 0.004$) at 8.89 (STE = 0.814, CI = 95% [7.28–10.50]) while **NHWP** had a mean PCS of 4.58 (STE = 0.862, CI = 95% [2.85–6.31]). For VAS, the mean was again greater in **HP** ($p < 0.001$) at 4.28 (STE = 0.236, CI = 95% [3.81–4.74]) while **NHWP** had a mean VAS rating of 2.74 (STE = 0.313, CI = 95% [2.11–3.37]). The mean WOMAC in **HP** was greater than **NHWP** ($p = 0.029$) with an average of 27.86 (STE = 1.536, CI = 95% [24.82–30.89]) in **HP** and 21.58 (STE = 1.960, CI = 95% [17.64–25.52]) in **NHWP**. K-L grade demonstrated no difference between **HP** and **NHWP** ($p = 0.581$) with mean grades of 1.66 (STE = 0.096, CI = 95% [17.64–25.52]) and 1.76 (STE = 1.960, CI = 95% [17.64–25.52]) respectively. When stratifying by ethnicity, K-L grade showed no significant effect on VAS, PCS, or WOMAC in **NHWP**. However, increased K-L grade showed a significant increase in VAS, PCS, and WOMAC in **HP** (**Table 2**). Population sizes for **NWHP** at each K-L grade ranged from n = 5 to n = 17, while in **HP** they ranged from n = 14 to n = 52 (**Table 3**).

In terms of secondary demographic characteristics, height (STE = .577, CI = 95% [66.56–68.88], p = .006), Age (STE = 1.521, CI = 95% [57.12–63.24], p = .028), and SES (STE = 2.33, CI = 95% [59.09–68.45], p

< .001) in **NHWP** were all significantly greater when compared to Height (STE = .328, CI = 95% [65.28–66.57]), Age (STE = .920, CI = 95% [54.36-58.00]), and SES (STE = 1.11, CI = 95% [53.03–57.39]) in **HP** (Table 1). Otherwise, BMI was less (p = .048) in **NHWP** (STE = .783, CI = 95% [26.25–29.40]) when compared to **HP** (STE = .533, CI = 95% [28.80-30.91]). There was no difference in CCI (p = .450) between **NWHP** (STE = .218, CI = 95% [1.50–2.38]) and **HP** (STE = .137, CI = 95% [1.47–2.01]). Subjects with tricompartmental disease had significantly lower VAS than Patellofemoral (p = .002) or Patellofemoral + Medial (p = .001) locations. Controlling for location, VAS (p = .005), PCS (p = .030), and WOMAC (p = .033) remained greater in **HP** compared to **NHWP**. Ethnicity*K-L grade yields no difference in WOMAC (p = 0.345), PCS (p = 0.292), or VAS (p = 0.322). Stratifying primary outcomes with ethnicity with SES analyzed as a covariate demonstrated a similar difference in PCS (p = 0.008) and VAS (p = 0.003) as reported previously, however in this condition WOMAC is no longer different between **NHWP** and **HP** (p = 0.066). When K-L grade is tested as a covariate, WOMAC (p = 0.016), PCS (p = 0.003), and VAS (p < 0.001) remain significantly greater in **HP**. A model with both SES and K-L grade as covariates maintains and strengthens the statistical difference between **NHWP** and **HP** in WOMAC (p = 0.033), PCS (p = 0.005), and VAS (p < 0.001) when compared to solely SES as a covariate.

Outcomes by Sex

VAS (p = .031) and WOMAC (p = .008) was greater in females when compared to males. Mean VAS in females was 4.27 (STE = .277, CI = 95% [3.73–4.82]) while in males it was 3.42 (STE = .278, CI = 95% [2.86–3.97]). Mean WOMAC in females was 29.28 (STE = 1.694, CI = 95% [25.92–32.64]) and in males was 22.63 (STE = 1.824, CI = 95% [19.00-26.25]). Neither PCS (p = .436) nor K-L grade (p = .737) was significantly different between sexes. However, mean PCS was greater in females ($\bar{x}$=8.25, STE = .906, CI = 95% [6.46–10.05]) when compared to males ($\bar{x}$=7.22, STE = .955, CI = 95% [5.33–9.12]). Analysis of means by Sex*Ethnicity yields no significant difference between WOMAC (.886), PCS (.393), nor VAS (p = .930).

Stratifying by sex and comparing means of primary outcomes was performed (**Table 4)**. In males, **HP** ($\bar{x}$=3.83, STE = .352, CI = 95% [3.13–4.53]) had greater mean VAS (p = .021) than **NHWP** ($\bar{x}$=2.42, STE = .360, CI = 95% [1.68–3.16]). Male **HP** ($\bar{x}$=8.83, STE = 1.260, CI = 95% [6.31–11.34]) had greater PCS (p = .008) than **NHWP** ($\bar{x}$=3.35, STE = .776, CI = 95% [1.75–4.95]) **(Fig. 5**). Male **HP** ($\bar{x}$=24.38, STE = 2.265, CI = 95% [19.85–28.91]) had nonsignificantly greater WOMAC (p = .136) than **NHWP** ($\bar{x}$=18.38, STE = 2.870, CI = 95% [12.47–24.30]). Female **HP** ($\bar{x}$=4.62, STE = .315, CI = 95% [4.00-5.25]) had greater mean VAS (p = .019) than female **NHWP** ($\bar{x}$=3.08, STE = .521, CI = 95% [2.01–4.16]). In females, there was no significant difference between **HP** and **NHWP** in PCS (p = .164) or WOMAC (p = .177); the mean and median for both were not significantly greater in **HP** females compared to **NHWP** females. Median comparisons yield the same results, in which median VAS in females are different between **HP** and **NHWP** while median PCS and WOMAC scores in **HP** females do not significantly differ from **NHWP**.

Outcomes by SES, CCI, Height, BMI, Age, and KOA Location

Comparison of socioeconomic status (SES) by group ethnicity demonstrated a statistically significant difference between the normalized socio-economic status index of **HP** and **NHWP** ($p = < 0.0001$) non-Hispanics more commonly resided in more affluent communities, had greater income and reported greater values in the remaining 8 parameters accounted for in the NSES index. On average, non-Hispanics on average had an NSES value of 66.9 +/- 12.4 while Hispanics resided in areas with an average NSES value of 55.5 +/- 13.6 (Fig. 2).

Despite these findings, neither SES ($p = 0.091$), CCI ($p = 0.052$), Height($p = 0.173$), BMI($p = 0.474$), or Age ($p = 0.537$), had any significant relationship with VAS. BMI demonstrated a direct linear relationship with PCS ($p = 0.012$), with a R^2 value of 0.038 and an unstandardized beta value of 0.276. SES ($p = 0.676$), CCI ($p = 0.849$), Height($p = 0.228$), and Age ($p = 0.977$), showed no relationship with PCS. BMI demonstrated a positive relationship with WOMAC as well ($p < 0.001$), with a R^2 value of 0.058 and an unstandardized beta value of 0.676. None of SES ($p = 0.382$), CCI ($p = 0.895$), Height($p = 0.0.59$), nor Age ($p = 0.111$), had a relationship with WOMAC. Both Age ($p < 0.001$, $R^2 = 0.207$, $B = 0.045$) and BMI ($p < 0.001$, $R^2 = 0.052$, $B = 0.045$) were positively associated with K-L grade. R^2 value 0.207 for Age, and 0.052 for BMI. SES demonstrated a negative association with VAS ($p = 0.028$, $R^2 = 0.025$, $B= -0.03$), but no significant relationship with PCS ($p = 0.190$), WOMAC ($p = 0.116$), or K-L grade ($p = 0.353$). When SES is modeled with VAS and stratified by ethnicity, the significant linear relationship no longer exists (Table 5).

In the **HP** group, there was a comparable prevalence of tricompartmental, medial, and bicompartmental (medial and patellofemoral) OA with percentages of 37%, 31%, and 25% respectively. For the **NHWP** group, 64% of subjects' radiographs demonstrated tricompartmental OA, 24% depicted medial compartment OA and 7% were bicompartmental (medial and patellofemoral) (**Table 6**).

DISCUSSION

In the present study, we recruited three times as many **HP** compared to **NHWP** with KOA. Our sample accurately reflects the ethnicity distribution of people in southeastern Florida and builds upon recent studies that, for the first time to our knowledge, begin to elucidate the burden of KOA in **HP** [34, 41]. In the current study, **HP** reported greater VAS, PCS and WOMAC scores compared to **NHWP**. Perhaps more importantly, these differences persisted after controlling for socioeconomic status and KOA severity, further highlighting the clinical significance of ethnicity in caring for patients with KOA.

Previous studies have demonstrated that Non-Hispanic Blacks report greater values for PCS, VAS, and WOMAC in comparison to **NHWP** with KOA, similar to our findings for **HP** [42–46]. These observations are consistent with the findings from 3 other groups [22, 47, 48]. The *Dunlop et al*. study noted non-Hispanic black and Hispanic older adults reported having symptomatic arthritis at a substantially higher frequency than did non-Hispanic whites [49]. Hollingshead underlined the prevalence of pain catastrophizing in Hispanic adults and reviewed that there are specific cultural values such as religiosity and spirituality that promote an external locus of control for pain experience [23]. Fabian et al. explored these cultural differences and found that catastrophizing varied by ethnicity, with African Americans reporting greater catastrophizing than Asian/Pacific Islanders and Caucasians [50]. The authors also found that situational catastrophizing significantly mediated pain intensity [50]. Similarly, Bishop et al. associated intensification of pain and a greater level of pain catastrophizing for individuals with chronic low back pain [38]. Dagenias et al. conducted a systematic review for acute lower back pain and arrived at the same conclusion; PCS and pain intensity were positively associated [51]. Furthermore, Miller et al. noted that pain catastrophizing is positively associated with pain experience and functional limitation [52]. Moreover, this association is influenced by ethnicity even after accounting for social economic status (SES) and disease severity [52].

To evaluate SES as a possible mediator of pain, pain catastrophizing, and functional limitation in patients with KOA, we utilized GIS software to create a heatmap of patient residence and overlayed this information with census block data. Interestingly we identified that Hispanics tended to be more concentrated in lower SES communities that were situated more inland within Miami-Dade County, Fla. Non-Hispanic participants tended to reside closer to the county coastline and tended to have greater SES status. Yet, after pairing individuals based on NSES value, Hispanics reported greater pain, pain catastrophizing, and functional limitations. These differences can likely be explained in part by two prior investigations using the Catastrophizing subscale of the CSQ* that found individuals of Hispanic ethnicity with chronic pain used catastrophizing as a coping method more than **NHWP** [44, 52]. Moreover, our study did not analyze the relationships between NSES and PCSs within group therefore a statement of SES and PCS correlation would be inappropriate. Nevertheless, work by Feldman and others have noted that lower SES is usually associated with greater PCS scores possibly due to reduced access to healthcare, inadequate treatment, or specific occupational hazards [29].

As K-L grade increased, a worsening VAS, PCS, and WOMAC trend was seen in both **NHWP** and **HP**, though this trend is only significant for each outcome in **HP**. Interestingly, Hispanic subjects had a greater prevalence of OA in the medial and patellofemoral compartments when compared with the **NHWP**. We propose that this difference in anatomic distribution among ethnic groups may help to account for the differences in VAS [44]. Further study is needed however to confirm our theory and how that may affect treatment.

As with any study, there are limitations. First, our data collection was carried out at a tertiary clinic, making our patient population biased to those who can access our healthcare center including availability, transportation, and insurance. Second, when utilizing NSES data we inferred individual SES based on neighborhood values which are an approximation and do not report the individual's level of education, type of occupation nor individual disposable income among other characteristics. Accordingly, this measurement may be subject to error. In the same vein, our analysis was restricted to Miami-Dade County and failed to include 9 individual **NHWP** who lived in Broward County and 1 individual who lived in Colorado. Given the limited sample size in the sub analysis (n = 40), the inclusion of these individuals would likely have influenced study results. Moreover, we used a cross-sectional study design where our evaluation of pain was at single time point that is likely not representative of the individual patient's overall pain experience. Our study however has several strengths. Participant sampling was conducted in Miami-Dade County, Florida, with a large diaspora of the Hispanic population providing greater access to this minority population and to our knowledge the largest sample size to date of this minority group. Our data collection tools have been validated for Hispanic persons and were administered in a culturally competent manner. Finally, our GIS application for NSES has been previously utilized as a measure for SES in various populations, including Hispanic persons.

CONCLUSION

Disparities in the treatment of patients with OA involving different racial, ethnic, and socioeconomic groups are well described and continue to rise [53]. We examined the pain experience of **HP** and **NHWP** presenting with symptomatic KOA and demonstrated that differences between the 2 groups are significant for VAS, PCS and WOMAC. More importantly, after adjusting for socioeconomic status and K-L grade, these differences persisted. This observation questions the effect of both K-L grade and NSES on pain, function, and pain catastrophizing coping for individuals with KOA. Given that the treatment of individuals with OA is based largely on patient reported symptoms, our findings suggest including a PCS inventory that provides information to the expected severity pain experience may be of value in the assessment and treatment of these patients.

Declarations

Authors' contributions: DQ and TMB conceived the study, participated in its design, coordination, performed statistical analyses, and co-drafted the manuscript. EK, DQ, SH, OP, JPC, J Jahn, AJCM, and TMB collected field data, entered study data, and assisted in interpretation of study results. DQ and LMT performed the statistical analysis and statistical interpretation. DQ, EK, J Jose, J Jahn, LMT, OP, JPC, AJCM and TMB interpreted study results, and helped with the manuscript draft. All authors read, revised, and approved the final manuscript.

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Tables

Tables 1 to 6 are available in the Supplementary Files section.

Figures

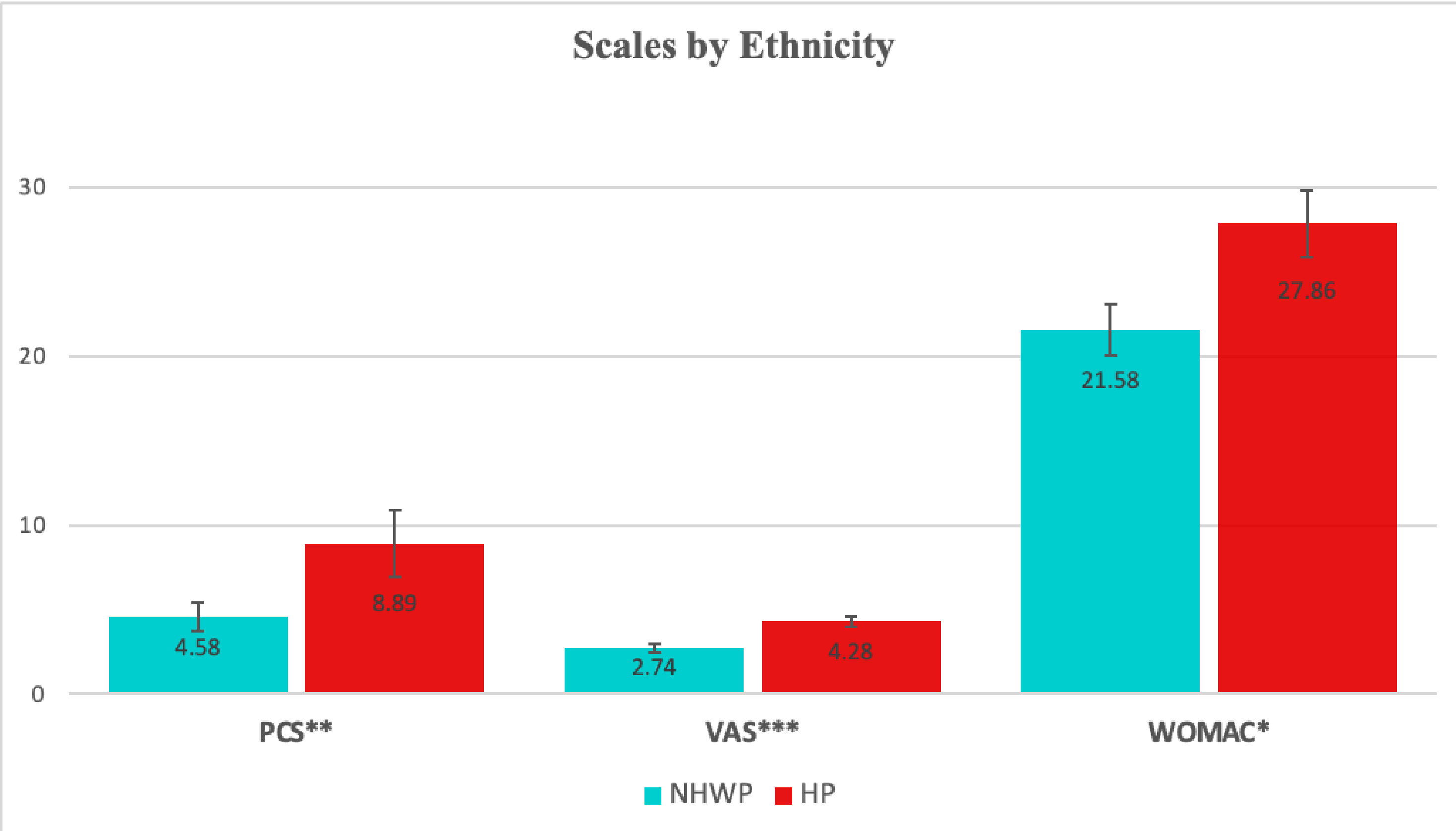

Figure 1

Comparison of outcomes PCS, VAS, WOMAC between HP and NHWP. Values with asterisk (*) indicate significance. p values for (*)= <.05, (**)=<.01, (***)=<.001.

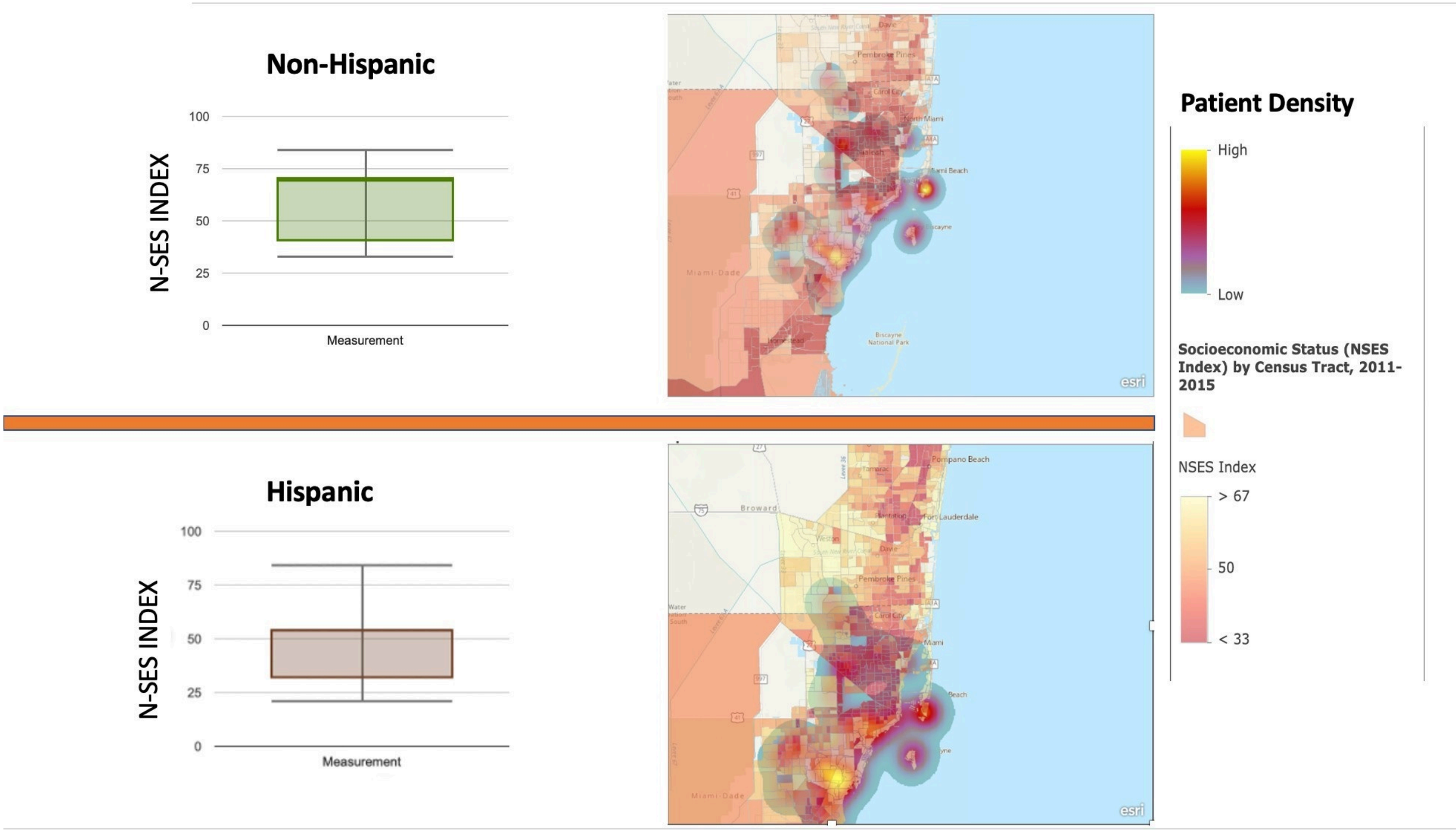

Figure 2

Box and Whisker plot of Neighborhood Socioeconomic Status (NSES) Index, adjacent are heat maps representative of participant address location overlayed on block-distributions for Miami-Dade County, Florida.

Supplementary Files

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- Tables1to6.docx