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## The Impact of Socioeconomic Status on Pain Severity and Functioning in a Pediatric Rheumatic Pain Population

Tolulope Adetayo  
*University Of Alabama At Birmingham*

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THE IMPACT OF SOCIOECONOMIC STATUS ON PAIN SEVERITY AND  
FUNCTIONING IN A PEDIATRIC RHEUMATIC PAIN POPULATION

by

TOLUPE ADETAYO

DAVID SCHWEBEL, COMMITTEE CHAIR  
BUREL GOODIN  
EMILY WAKEFIELD

A THESIS

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Master of Arts

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# THE IMPACT OF SOCIOECONOMIC STATUS IN PAIN SEVERITY AND FUNCTIONING IN A PEDIATRIC RHEUMATIC PAIN POPULATION

TOLULOPE ADETAYO

MEDICAL/CLINICAL PSYCHOLOGY

## ABSTRACT

**Background:** Low socioeconomic status (SES) may exacerbate pain and impede functioning in children with chronic widespread pain. SES can be categorized as objective or subjective and assessed at individual, family, and neighborhood levels. However, most studies do not assess SES this comprehensively, thus, the true impact of SES on child health is likely unknown. The proposed study examined the unique and interactive effects of different measures of SES on pain severity and functioning in children with rheumatic conditions including juvenile idiopathic arthritis (JIA), juvenile primary fibromyalgia syndrome (JPFS), and non-specific musculoskeletal pain (NSMP). **Methods:** 88 children (32 JIA, 31 JPFS, 25 NSMP) between the ages of 8 and 18 and their caregivers were recruited from a rheumatology clinic. Objective neighborhood-level and subjective individual-level indicators of SES were obtained from parents using the childhood opportunity index (COI) and caregiver reported MacArthur Scale of Subjective Social Status (Caregiver SSS), respectively. In addition to a composite COI score, child-hood opportunity was examined via its three subdomains (i.e., Health & Environment, Education, and Social & Economic). Children reported their pain interference, pain intensity, and physical and psychosocial functioning.

**Results:** Findings on the relationship between SES and pain and functioning were mixed. Total COI was not significantly associated with any of the pain variables, nor did it significantly interact with family SES. However, the Social & Economic domain of COI

moderated the relationship between family SES and pain intensity, such that greater family SES was positively associated with greater pain intensity in children from low COI neighborhoods. While greater COI was associated with *poorer* physical functioning, greater caregiver SSS was associated with *greater* physical functioning. Caregiver SSS was not significantly associated with any other pain-related variables and did not interact with family SES on pain nor functioning.

**Conclusion:** While subjective SES is associated with greater functioning, objective SES is associated with worse functioning and pain. The results of this study highlight the importance of examining SES multidimensionally. Future studies should consider caregiver stress, social support, and caregiver pain responses as potential contributors to functioning in children with rheumatic pain.

Keywords: socioeconomic status, arthritis, fibromyalgia, functioning, pain severity

## TABLE OF CONTENTS

	<i>Page</i>
ABSTRACT.....	ii
LIST OF TABLES.....	vi
LIST OF FIGURES .....	vii
INTRODUCTION .....	1
Background.....	1
Chronic Pain and Functioning .....	1
The Impact of Family Socioeconomic Status .....	2
Objective SES .....	5
Subjective SES.....	7
Study Rationale.....	9
SPECIFIC AIMS AND HYPOTHESES .....	11
METHODS .....	13
Participants .....	13
Study Procedures .....	14
Measures.....	15
Pain Severity .....	15
Functioning .....	15
Socioeconomic Status .....	16
Data Analysis.....	18
Specific Aim I.....	18
Specific Aim II.....	19
Specific Aim III .....	20

RESULTS .....	22
Data Screening .....	22
Observed Power .....	22
Participant Characteristics.....	23
Preliminary Analyses .....	23
Aim I.....	24
Aim II.....	24
Aim II.....	25
Additional Findings.....	26
 DISCUSSION .....	 27
Preliminary Analyses .....	28
Main Aims.. .....	30
 LIST OF REFERENCES .....	 36
 APPENDICES: IRB APPROVAL FORM .....	 63

## LIST OF TABLES

<i>Tables</i>		<i>Page</i>
1	Obtained power for individual aims .....	47
2	Description of study participants .....	48
3	SES differences by race .....	49
4	Differences in pain severity and functioning by disease group .....	50
5	Correlations amongst pain severity, functioning, and SES variables .....	51
6	Hierarchical regression models of relationship between family SES, state-normed COI and clinical pain characteristics.....	52
7	Hierarchical regression models of relationship between Family SES, state-normed COI, and functioning.....	53
8	Hierarchical regression models of relationship between family SES, caregiver SSS, and clinical pain characteristics.....	54
9	Hierarchical regression models of relationship between Family SES, caregiver SSS, and functioning.....	55
10	State normed COI as a moderator of the relationship between family SES and various pain-related variables .....	56
11	Caregiver SSS as a moderator of the relationship between family SES and various pain-related variables .....	57

## LIST OF FIGURES

<i>Figure</i>		<i>Page</i>
1	Categories of Socioeconomic Status for Children and Adolescents .....	58
2	Flow Diagram .....	59
3	Sample distribution of highest household education level .....	60
4	Sample distribution of household income bracket.....	61
5	Moderation effect of State-normed social & economic COI on pain intensity .....	62



## INTRODUCTION

### Background

Chronic widespread pain reportedly affects between 6-24%, or approximately 4.4 to 17.5 million, of children in the United States (Cimmino et al., 2011; Tumin et al., 2018; US Census Bureau, 2019). Chronic widespread pain is a prominent feature of musculoskeletal conditions, such as juvenile primary fibromyalgia syndrome (JPFS) and juvenile idiopathic arthritis (JIA) (Cimmino et al., 2011; Tumin et al., 2018). Although the exact etiologies of JPFS and JIA are unknown, they are thought to stem from disruptions to central pain processing systems, resulting in greater pain sensitivity and reduced functionality (Coles et al., 2021; Upadhyay et al., 2021). In addition to neurobiological deficits, inflammation-induced joint damage also contributes to pain in children with JIA (Barut et al., 2017). However, this pain persists even after introduction of anti-rheumatic drugs, indicating additional pain pathways beyond joint deterioration (Weiss et al., 2014).

### Chronic Pain and Functioning

Greater musculoskeletal pain is highly correlated with decreased functioning across numerous domains: school, cognitive, physical, and psychosocial (Petersen et al., 2009; Upadhyay et al., 2021; Varni et al., 2007). While there is mixed evidence on whether levels of depression and anxiety differ between healthy and rheumatic

populations, evidence suggests psychological functioning affects pain severity (Hanns et al., 2019; Kashikar-Zuck et al., 2008). For example, one study following children diagnosed with JIA over a 1-year period found that early depressive symptoms predicted greater disability and pain over time (Hoff et al., 2006). Multiple studies have also shown that while depressive and anxiety symptoms may not be related to degree of joint damage or inflammation, they are associated with greater pain and lower child-reported health-related quality of life (Margetić et al., 2005; Stevanoic et al., 2013; Stinson et al., 2012). Additionally, when tasked with journaling their emotions, children with JIA noted worse functioning and greater pain following periods of intense negative affect (Schanberg et al., 2005). The efficacy of cognitive behavioral therapy, which targets maladaptive patterns of cognition and emotion, in children with JPFS further highlights the role that psychosocial functioning plays in rheumatic pain populations (Coles & Uziel, 2021). This emotional dysregulation likely contributes to and is exacerbated by the poorer family functioning and compromised peer relationships reported in this population (Conte et al., 2003; Morris et al., 2017; Nelson et al., 2005). Interestingly, although rheumatic populations generally report worse physical functioning, the level of disability seems to differ by condition, where JPFS patients report greater limitations than JIA patients (Connelly et al., 2019). Overall, there is a clear functional deficit that needs to be addressed in rheumatic pain populations to maintain high quality of life.

### The Impact of Socioeconomic Status

As a proxy for financial, social, and educational capital, socioeconomic status (SES) is often cited as a fundamental cause of health inequities (Link & Phelan, 1995;

Oakes & Rossi, 2003). The social networks, knowledge, economic, and health-related resources that higher SES individuals have access to both maintain protective factors and minimize risk. For example, job security and health insurance often go hand in hand, where people who lack the former are often unable to afford medical services. In countries like the United States where the gap between lower and higher classes is on the rise, it is especially important to understand how SES influences health. Returning to the example of health insurance, the high cost of medical services coupled with inadequate insurance coverage can generate out-of-pocket expenses that families from lower SES backgrounds may not be able to afford. Consequently, these families lose access to the preventive examinations, medications, and/or procedures needed to maintain health and reduce morbidity. This increased health risk may be further compounded by additional factors, such as living in a food desert or near environmental toxins. This is just one example of how disparities in health can mirror those in SES, and as such, SES-mediated health inequities should also be seen as social issues to be addressed on a policy level. Thus, research on this subject can help identify areas for reform. However, for adults, typical conceptualizations of SES only involve income, educational attainment, and occupation (Pickett & Pearl, 2001). While these are important contributors to health inequity, they do not fully explain how some individuals with lower SES maintain good health (Chen & Miller, 2013).

Our understanding of SES also gets more complex when investigating health disparities in pediatric populations, as children live within the socioeconomic context of their caregivers. Thus, child SES should be examined along two axes as shown in Figure 1 (Goodman et al., 2007; Holiday et al., 2019; Pickett & Pearl, 2001). At Tier I, SES is

divided into objective and subjective indicators, such that objective indicators are *concrete* measurements of social or economic standing (e.g. income) and subjective indicators describe *perceptions* of social or economic standing (e.g., perception of one's standing in their community or perception of neighborhood quality). At Tier II, SES is assessed at three different levels: individual, family, and neighborhood/community. Note that family and individual levels are combined under the objective SES classification, because children typically share the income of their caregivers. Thus, objective measures of individual and family level SES are difficult to distinguish from one another. As an individual ages and gains independence from their household, these categories become more distinct (e.g., individual vs. household income).

According to the Social Ecological Model of Health, a child's health is influenced by individual, family, and community factors (Earls & Carlson, 2001). Similarly, Palermo and Chambers (2005) identified family functioning, the parent-child interaction, and individual child and parental characteristics (e.g. mood and pain coping) as predictive of functional disability in pediatric pain populations (Palermo & Chambers, 2005). Each of these models purports that a child's health cannot be viewed in a vacuum. Rather, as children are intrinsically tied to their environment, any health-related risk or protective factors must also be considered within these contexts. Thus, to get a richer representation of SES, researchers should utilize a combination of objective and subjective measures at varying levels of influence. For the purposes of this study, we will be operationalizing SES according to objective family-level, objective neighborhood-level, and subjective family-level indicators.

## *Objective SES*

### *Family Level SES*

Children are financially dependent on their caregivers and grow up either with or without access to resources afforded to them by their caregivers. Thus, when measuring family-level SES, caregiver(s) income, education, and occupation are often used (Chen et al., 2002). Amongst nonclinical populations, evidence suggests that children from families with lower SES have greater disease risk (i.e. higher rates of asthma and obesity), worse health behaviors (i.e. poor dietary habits and lack of physical activity), and health consequences into adulthood (Chen et al., 2002; Poulain et al., 2019; Poulton et al., 2002). Amongst pediatric populations that typically endorse pain, lower family SES is associated with worse functioning in children with sickle cell disease, but the results are mixed in children with juvenile idiopathic arthritis (Hoff et al., 2006; Palermo et al., 2008; Verstappen et al., 2015). As it relates to JIA, SES may not moderate disease progression; however, children from lower SES families had worse *perceptions* of their health and treatment efficacy, impaired peer relationships, and poorer school functioning (Verstappen et al., 2015). However, amongst children with polyarticular JIA, household income was associated with greater disease severity, in addition to functional disability (Soulsby et al., 2022). Thus, SES may affect pain severity indirectly. One theory is that the child health-family SES association is mediated via the parent-child relationship (Conger & Donnellan, 2007). For example, the increased stressors associated with having a lower income could limit caregivers' capacity to invest in their child's well-being, and consequently, their child's ability to cope with pain (Conger & Donnellan, 2019).

### *Neighborhood-level SES*

In line with the Social Ecological Model of Health, attempts to contextualize pediatric health beyond the family environment have pushed researchers towards examining neighborhood characteristics. Measures of SES at this level have been shown to correlate to disease and functioning directly or indirectly, even after controlling for family SES (Pickett & Pearl, 2001). High SES neighborhoods are classified by the accessibility of resources (e.g., grocery stores), quality of the built environment (e.g. walkability and availability of parks), average residential income, average educational attainment, etc. (Pickett & Pearl, 2001; Schild et al., 2016). Experimental evidence suggests that children from lower SES neighborhoods are more likely to have dysfunctional descending inhibitory pain pathways, placing them at a higher risk for chronic pain (Morris et al., 2022). These findings are corroborated by greater reports of pain and pain-related disability and lower reported health-related quality of life in lower SES neighborhoods (Palermo et al., 2008; Schild et al., 2016).

Unfortunately, operationalizations of objective, neighborhood-level SES in pediatric research often rely on caregiver metrics (i.e. median income, housing quality, and average educational attainment) as proxies. This is likely because it can be difficult to distinguish a child's objective SES from that of their caregivers. While the aforementioned SES indicators are crucial neighborhood-level influences, we are also missing out on important child-relevant predictors, such as the prevalence of high-quality primary schools or daycares. As such, it can be helpful to instead conceptualize objective, neighborhood-level SES in terms of childhood opportunity. Childhood opportunity reflects the neighborhood resources and conditions necessary for a child's healthy

development (Acevedo-Garcia et al., 2020). This study will utilize the childhood opportunity index (COI), which was developed to evaluate the health and environmental, educational, and social and economic assets present in a child's neighborhood (Diversity Data Kids, 2021). Higher risk for emergency room visits, poorer physical and emotional functioning, and exposure to violence and discrimination are some examples of how living in a lower opportunity neighborhood could exacerbate symptoms in pediatric pain populations (Chen & Patterson, 2006; Kersten et al., 2018; Morris et al., 2022). Unfortunately, these effects can be long-lasting, as childhood opportunity strongly predicts socioeconomic mobility (Acevedo-Garcia et al., 2020). In fact, children from lower SES backgrounds with the same family income could have a \$16,000/year difference in income at age 35 depending on the opportunity level of the neighborhood they grew up in (Acevedo-Garcia et al., 2020). Thus, barriers to health-related resources faced in childhood do not cease to exist once a child leaves their neighborhood. Instead, these barriers continue to impede the ability to acquire health-related assets as an adult. This could exacerbate stress and disability amongst individuals already struggling with conditions such as chronic pain.

### *Subjective SES*

Subjective indicators of SES represent an individual's perception of their own, family, or neighborhood (e.g., perceived safety) characteristics relative to some comparison group. For example, subjective social status (SSS) captures one's appraisal of their social standing compared to others in their community. Although SSS is associated with both household income and education in adults, it is uniquely correlated with both

psychological and physical functioning, and there is evidence to suggest that SSS may be an even *better* predictor of functioning than objective indicators (Sing-Manoux et al., 2005; Wen et al., 2006). Sing-Manoux and colleagues (2005) propose that SSS is a more precise measure of SES, because participants likely consider both their economic and social standings in their ranking. Furthermore, compared to more absolute measures, such as income, SSS is a measure of hierarchical rank. One only has to look towards research that has shown negative associations between social media usage (of which social comparisons are inherent) and mental health to see the role that negative perceptions of one's relative standing can have on their health (Karim et al., 2020).

There is a well-established relationship between SSS and health in adults, where every drop in SSS is followed by a similar decrease in health-related quality of life (Choi et al., 2015). SSS has also been shown to influence analgesic medication usage, chronic pain, and depressive symptoms (Hoebel et al., 2013; Mu et al., 2022; Wakefield et al., 2016). Perceived stress may be one of the underlying mechanisms through which SSS impedes or protects health-related quality of life in children with chronic pain.

Individuals who rated themselves as being in a lower social class than their peers also tended to report greater stress levels (Theresa et al., 2014). Stress can contribute directly or indirectly to pain through disruptions of immunological processes (which is thought to induce inflammation and pain), overstimulation of the sympathetic nervous system, and the usage of maladaptive health behaviors as a means of coping (Yaribeygi et al., 2017).

Studies on caregiver-reported SSS in clinical populations also indicate a stress-mediation model of pain and functioning (Senn et al., 2014). On average, caregivers of children with chronic illnesses report greater stress levels and worse mental health than



those of healthier children (Cousino & Hazen, 2013; Roy et al., 2019). These findings coincide with the Social Ecological Model of Health, which highlights how parental wellbeing influences the parent-child relationship and greater family dynamics within the home (Earls & Carlson, 2001). Thus, it comes as no surprise that there tends to be more conflict and worse communication in the families of children with chronic pain (Palermo et al., 2014). Chronic illness-related stress does not just stop at the parent, as longitudinal research on families with rheumatic pain conditions found that parental stress predicted child stress reactivity and reported child stress (Ryan et al., 2010; Ursache et al., 2015).

Additionally, caregiver SSS was associated with diminished cognitive functioning in children (Ursache et al., 2015). Deficits in cognitive skills such as inhibition and working memory may serve as another mechanism through which SSS influences pediatric pain. Studies examining the efficacy of distraction in mitigating pain indicate that greater engagement of executive skills (working memory, inhibition, and shifting) was correlated with greater pain tolerance (Bjekić et al., 2017; Terrighena et al., 2016). Although, these studies examined acute pain, their findings may elucidate cognitive coping mechanisms that also apply to chronic pain. Interestingly, one study did not find a correlation between caregiver SSS and child physical or psychosocial health-related quality of life, although it should be noted that in contrast to the other studies mentioned, this study was conducted on a healthy sample of children (Kim et al., 2018).

### *Study Rationale*

The literature is clear on the physical and psychosocial challenges that children with rheumatic pain experience. We also know that families of lower SES are placed at a

significant disadvantage when it comes to maintaining health and wellness, disadvantages that are exacerbated when also dealing with the chronic illness-related stressors.

Although there is limited research linking objective, family-level SES to worse functioning in children with JIA, the results of these studies are mixed and are nonexistent amongst those with JPFS. Additionally, there is little research that examines how various types of SES indicators differentially and interactively influence pain severity and functioning in children with painful rheumatic conditions. The proposed study aims to address these gaps by considering the various social and economic contexts that serve to protect and aggravate health in children.

## SPECIFIC AIMS AND HYPOTHESES

**AIM I:** To examine the influence of an objective neighborhood-level measure of socioeconomic status (SES) on child pain severity and functioning.

**Hypothesis I.A:** Independent from family SES and child's mood, greater childhood opportunity (COI) will be associated with less pain intensity and less pain interference.

**Hypothesis I.B:** Independent from family SES, pain intensity and pain interference, greater COI will be associated with greater physical and psychosocial functioning.

**AIM II:** To examine the effect of a subjective neighborhood-informed measure of caregiver's subjective social status (SSS) on child pain severity and functioning.

**Hypothesis II.A:** Independent from family SES and child's mood, greater caregiver SSS will be associated with less pain intensity and less pain interference.

**Hypothesis II.B:** Independent from family SES and child's pain intensity and pain interference, greater caregiver SSS will be associated with greater physical and psychosocial functioning

**AIM III:** To examine the interactive effects of family SES, COI, and caregiver SSS (i.e., family SES x COI, family SES x caregiver SSS) on child pain severity and functioning. More specifically, does the strength of the relationship between family SES and pain

severity and functioning meaningfully differ according to COI and/or caregiver's reported SSS (i.e., effect moderation)?

**Hypothesis III.A:** There will be evidence of significant moderation effects, such that children with low family SES and low caregiver SSS or COI will have the greatest pain severity and poorest functioning.

## METHODS

The current study is a secondary data analysis of the Predictors and Disparities with Pain (PANDDA-P) study (unpublished dissertation; PI: Kathryn Thompson), which examined the relationship between caregiver behaviors and child pain characteristics. This project was reviewed and approved by the Institutional Review Board at UAB.

### Participants

A total of 117 children aged 8 to 18 and their caregivers were recruited from a rheumatology clinic and the community. Medical providers identified participants with rheumatic pain as either having JIA (n=32), JPFS (n=31), or a non-specific, chronic musculoskeletal pain condition (NSMP; n=25). Children without chronic pain (n=29) were recruited from a pool of families that indicated interest in being contacted to participate in research at a local university. Children without chronic pain were originally included in the PANDDA-P study as controls. However, they were omitted from the present study given the interest in objective and subjective indicators of SES in relation to chronic pain severity, interference, and functioning. The final sample, therefore, included 88 children (and their caregivers) with painful rheumatic conditions. Participants were excluded if the child 1) had past or present high blood pressure, 2) was under 8 or over 18 years old, 3) had a past or present neurological condition, 4) had an intellectual disability that would prevent them from independently filling out their questionnaires, 5) had past

or present cardiovascular disease, 6) was pregnant at the time of the study, or 7) had endorsed suicidal or homicidal ideation within the past 12 months. Caregivers and children consented and assented, respectively, to participate in the research study.

### Study Procedures

Children and caregivers completed a set of questionnaires that asked them about their experiences with chronic pain, pain coping, child's physical, emotional, school, and social functioning, family life, as well as objective and subjective indicators of SES. Children also completed a brief quantitative sensory testing (QST) battery, including a mechanical temporal summation and cold-pressor task. Children were then asked to complete a 7-night sleep diary and their sleep cycles were monitored using an actigraphy watch (Ancoli-Israel et al., 2003; Sadeh & Acebo, 2002). See Figure 2 for a flow diagram depicting matriculation through the original PANNDA-P study. The current study will be limited to the questionnaires completed during the clinic session and will not address QST or any of the sleep variables.

### Measures

#### *Pain Severity*

##### *Pediatric Pain Interference-Short form v2 8a*

The PROMIS Pain Interference short-form v2 8a is an eight-item, child-reported measure of pain-related consequences. Children aged 8 to 18 are asked to indicate how often their pain impacted their lives on a scale of 1 to 5 (1=never, 5= almost always) over the past 7 days. This highly reliable measure ( $\alpha=.91$ ) was developed by the NIH for use

in a variety of chronic health conditions and has been validated in pediatric pain populations (Fussner et al., 2019; Kashikar-Zuck et al., 2016; Varni et al., 2010).

### *Pain Intensity*

Children were asked to rate their pain on a scale of 0 to 100 (0=no pain, 100=most intense pain possible) on the day of their appointment.

### *Functioning*

#### *Pediatric Quality of Life (Peds-QL)*

The PedsQL is a 23-item self-report measure that assesses health related quality of life across four domains (physical, emotional, social, and school functioning) in children and adolescents (Varni & Seid, 2001). This is a developmentally appropriate measure with separate forms for 8-12 and 13-18 year-olds. The PedsQL is highly reliable and has been validated to determine disease severity within chronically ill populations, including in children with JIA (Młyńczyk et al., 2022). In addition to the four dimensional domains, scores can be divided into physical (physical functioning,  $\alpha=0.83$  for 8-12 years old and 0.90 for 13-18 years old) and psychosocial (emotional, social, and school functioning,  $\alpha=0.80$  for 8-12 years old and  $\alpha=0.89$  for 13-18 years old) summary scores (Varni & Seid, 2001), where higher scores indicate better functioning.

## *Socioeconomic Status*

### *Objective Measures*

*Family-level SES.* As has been done in other studies utilizing family SES, family SES was operationalized using total household income and highest obtained parental educational degree (Pickett & Pearl, 2001). Caregivers were asked to choose from ranges of household income (\$0-9,999 to \$100,000 or greater) and their own and partner's educational attainment (no degree to professional or doctorate degree). Z-scores for income and education were obtained and averaged together to create a unitary measure of family-level SES (Roubinov, 2018).

*Childhood Opportunity Index Scores.* The Childhood Opportunity Index (COI) 2.0 is a measure of neighborhood-level SES. Neighborhoods are defined based on 2010 census tracts, which divided the country into 72,000 physically bounded (e.g. by water ways or highways) areas, each with approximately 4,000 residents. The COI comprises 29 different indicators (e.g., neighborhood walkability, third grade math average) that are weighted based on their predictive ability for health and economic trajectories, standardized, and aggregated into one of three domains: Health & Environment, Education, Social & Economic. The Health & Environment domain measures toxin exposures (e.g., industrial pollutants in air, water, or soil) and aspects of the built environment that promote health and wellness (e.g., access to green space). The Education domain captures the quality of current education centers and higher educational attainment (e.g., college enrollment in nearby institutions). Finally, the Social & Economic domain assesses economic opportunities related to income, housing,



employment, and public assistance programs (e.g., percentage households receiving cash public assistance or food stamps). In 2015, each neighborhood was assigned a percentile rank between 1 (lowest opportunity) and 100 (highest opportunity), which served as its opportunity score. COI scores can be normed based on national, state, or metro-level data, where the child's neighborhood is ranked with all neighborhoods in the United States, state, or city that they reside in, respectively.

For this study, we opted to use more locally based COI scores, so that comparisons could be made more easily with the community-based SSS measure (see below). However, metro-normed data was only available for the largest 100 cities in the United States. In an effort to maximize the sample size, state-normed COI scores were used instead. Census tracts were determined from family addresses and then overall state-normed COI scores were identified from the COI database (Diversity Data Kids, 2021).

### *Subjective Measures*

*MacArthur Scale of Subjective Social Status - Community.* Parents were asked to fill out the MacArthur Scale of Subjective Social Status (SSS), which gauges perceptions of social standing within their community. Parents were presented with a ladder that symbolized their community. The bottom rung of the ladder represented people with the lowest standing in their community, while the top rung represented people with the highest standing in their community. They were then instructed to place an X on the rung that best characterized their SSS. The MacArthur SSS scale has adequate test-retest reliability ( $r = 0.62$ ; Operario et al., 2004).

## Data Analysis

Data were screened for normality, outliers, and missingness and descriptive statistics were obtained for all variables. To assess bivariate relationships between key variables, zero-order Pearson's correlations were examined. Additionally, given that the sample included three different clinical populations and evidence that Black and Brown children tend to have lower objective SES, preliminary t-tests were conducted to determine whether there were significant differences in SES according to race and/or disease group. Race was dummy-coded with White children as the reference group ( $0=White$ ,  $1=Black$ ;  $0=White$ ,  $1=Multiracial$ ; and  $0=White$ ,  $1=Other$ ) and disease group was dummy-coded with JIA as the reference group ( $0=JIA$ ,  $1=JPFS$  and  $0=JIA$ ,  $1=NSMP$ ), since JIA is a more well-defined condition than NSMP and JPFS. For each of our specific aims, guidelines from Cohen (1988) were used to interpret  $\beta$  effect sizes (.1 = small, .3 = medium, .5 = large).

### *Specific Aim 1*

To examine the influence of an objective neighborhood-level measure of socioeconomic status (SES) on child pain severity and functioning.

**Hypothesis 1.A: Independent from family SES and child's mood, greater COI will be associated with less pain intensity and less pain interference.**

*Analysis Plan: To test this hypothesis, two separate hierarchical regression analyses (one for pain intensity and one for pain interference) were run, with child's mood (PedsQL emotional functioning subscore), disease group, and race as the first step, family SES as the second step, and overall COI as the third step.*

**Hypothesis I.B: Independent from family SES, pain intensity and pain interference, greater COI will be associated with greater physical and psychosocial (emotional, social, and school) functioning.**

*Analysis Plan: To test this hypothesis, two separate hierarchical regression analyses (one for physical functioning and one for psychosocial functioning) were run, with disease group, race, pain intensity, and pain interference as the first step, family SES as the second step, and overall COI as the third step.*

#### *Specific Aim II*

To examine the effect of a subjective neighborhood-informed measure of caregiver's subjective social status (SSS) on child pain severity and functioning.

**Hypothesis II.A: Independent from family SES and child's mood, greater caregiver SSS will be associated with less pain intensity and less pain interference.**

*Analysis Plan: To test this hypothesis, two separate hierarchical regression analyses (one for pain intensity and one for pain interference) were run, with child's mood (PedsQL emotional functioning subscore), race, and disease group as the first step, family SES as the second step, and SSS as the third step.*

**Hypothesis II.B: Independent from family SES and child's pain intensity and pain interference, greater caregiver SSS will be associated with greater physical and psychosocial (emotional, social, and school) functioning.**

*Analysis Plan: To test this hypothesis, two separate hierarchical regression analyses (one for physical and one for psychosocial functioning) were run, with disease*

*group, race, pain intensity, and pain interference as the first step, family SES as the second step, and SSS as the third step.*

### *Specific Aim III*

To examine the interactive effects of family SES, COI, and SSS (i.e., family SES x COI, family SES x SSS) on child pain severity and functioning. More specifically, does the strength of the relationship between family SES and pain severity and functioning meaningfully differ according to COI and/or caregiver's reported SSS (i.e., effect moderation)?

**Hypothesis III.A: There will be evidence of significant moderation effects, such that children with low family SES and low caregiver SSS or COI will have the greatest pain severity and poorest functioning.**

*Analysis Plan: To achieve this aim, the PROCESS macro created and described by Hayes was used to examine whether the relationship between family SES and pain severity (intensity and interference) as well as functioning (physical and psychosocial) is significantly moderated by COI and/or SSS (Hayes, 2022). Due to the frequent use of family SES in the literature and the interest in understanding how other indicators of SES impact health, COI and SSS were chosen as the moderators.*

Prior to running these analyses, we checked assumptions of multiple linear regression for each dependent variable. All assumptions were met with a few exceptions. The distributions of residuals for the current pain intensity and physical functioning variables were positively skewed. However, attempts to transform the data were unsuccessful. Kurtosis and skewness values were within acceptable limits; thus, the

original distributions were preserved and there were no major violations to the assumption of normality of residuals (Hair et al., 2010). Additionally, there was greater variability in the distribution of the residuals for physical functioning, suggesting a potential violation of the homoscedasticity assumption. While this violation may result in reduced power, the associated analyses should be valid due to the robustness of ordinary least squares regression (Lumley et al., 2002). Thus, all indicated analyses were considered appropriate for use in the current sample.

## RESULTS

### Data Screening

Prior to analyses, data were checked for normality, outliers, and missingness. Examination of univariate distributions did not indicate skewed distributions for any of the variables. One outlier was identified for the Family SES variable (absolute score of 2.712, > 3 SD above the mean). However, this outlier was not determined to be influential, so it was not removed or truncated. Of the 88 participants, 6 (6.81%), had some missing data. However, most of these participants were missing observations on only 1 or 2 variables and only 1.46% of the sample's total data points were missing. Comparisons between missing and complete cases indicated that the pattern of missing data was Missing Completely at Random, indicating that no differences were found between participants with missing and complete data. To improve the power of our analyses, missing values for psychosocial health summary score, physical health summary score, family SES, and community SSS were imputed using Hot Deck Imputation (Little & Rubin, 2022; Myers, 2011).

### Observed Power

The power of each analysis was determined using G\*Power 3 (Faul et al., 2009). The parameters used were as follows: alpha was set to 0.05, desired power was set to 0.8, and total sample size was set to 88. Effect sizes were calculated using partial  $R^2$  obtained

from the analyses. In accordance with hypotheses IA and IIA, there are 6 control variables (2 dummy-coded disease groups, 3 dummy-coded racial groups), child mood as measured by the PedsQL emotional functioning sub-score) and two independent variables (family SES, COI/SSS). In accordance with hypotheses IB and IIB, there are nine control variables (2 dummy-coded disease groups, 3 dummy-coded racial groups, pain interference, pain intensity). For all conducted analyses, the obtained power was exceedingly less than the recommended 0.8, suggesting that the analyses are severely underpowered. See Table 1 for the obtained power analyses of our individual aims.

### Participant Characteristics

A summary of participant characteristics is shown in Table 2. Recruited children ranged in age from 8-18 years ( $M = 13.9$  years). The sample of children self-identified predominantly as White (76.1%) and female (68.2%). Preliminary analyses showed that none of the SES measures differed by disease group or sex. However, White participants had significantly higher Family SES,  $t(86) = 3.878, p < 0.001$ , and childhood opportunity,  $t(86) = 2.06, p = 0.04$ , compared to Black participants (Table 3). No racial differences were found in caregivers' reports of their social status relative to those in their community,  $t(86) = 0.18, p = 0.87$ . As shown in Figures 3 and 4, the present sample predominantly reflected higher income and college-educated backgrounds among households and caregivers, respectively. The median household income bracket was \$50,000-\$74,999 and 71.3% of sampled caregivers received some level of college education.

### Preliminary Analyses

According to the one-way ANOVA analyses, children with JPFS reported the greatest current pain intensity,  $F(2, 85) = 12.80, p < 0.001$ , and pain interference,  $F(2, 85) = 13.62, p < 0.001$ , and poorest psychosocial,  $F(2, 85) = 12.87, p < 0.001$ , and physical functioning,  $F(2, 85) = 14.26, p < 0.001$  (Table 4). A summary of the correlations between the SES variables and pain-related characteristics is shown in Table 5. Greater family SES was correlated with higher state-normed COI,  $r(87) = 0.411, p < 0.001$ , and higher caregiver SSS,  $r(87) = 0.341, p < 0.001$ . However, state-normed COI was *not* significantly related to caregiver SSS,  $r(87) = 0.066, p = 0.539$ . None of the SES variables was significantly correlated with any of the pain or functional variables, with the exception of state-normed COI. Greater COI was significantly associated with poorer physical functioning,  $r(87) = -0.262, p = 0.014$ .

### Aim I

Tables 6 and 7 show the results of three-step hierarchical regression models examining the associations of state-normed COI with clinical pain severity and functioning. Based on this analysis, there was a marginally significant relationship between state-normed COI and physical functioning,  $\beta = -0.11, p = .075$ , such that greater state-normed COI was associated with poorer physical functioning. In contrast, state-normed COI was not uniquely associated with current pain intensity, pain interference, nor psychosocial functioning.



## Aim II

As shown in Table 8, there was a marginally significant effect of caregiver SSS on pain interference ( $\beta = 0.18, p = 0.071$ ), where higher caregiver SSS was associated with greater pain interference. However, caregiver SSS was not uniquely correlated with current pain intensity. As depicted in Table 9, we also examined associations between caregiver SSS and psychosocial and physical functioning. Caregiver SSS was not associated with psychosocial functioning. However, there was a small effect on physical functioning, such that greater caregiver SSS was associated with greater child-reported physical functioning above and beyond Family SES and clinical pain severity ( $\beta = 0.18, p = 0.005$ ).

## Aim III

Tables 10 and 11 depict the results of the moderation analyses, where state-normed COI and caregiver SSS were examined as moderators of the relationship between family SES and pain severity and functioning. The relationship between state-normed COI and physical functioning was only marginally significant when entered as part of a hierarchical regression model (see AIM II results). However, the moderation model revealed a main effect of state-normed COI on physical functioning, such that greater state-normed COI was associated with poorer physical functioning ( $\beta = -0.27, p = 0.01$ ). State-normed COI did not moderate the relationship between family SES and any of the pain or functional variables. Similarly, while the interaction on pain interference did not reach statistical significance, there was a marginally significant main effect of caregiver SSS on pain interference,  $\beta = 0.18, p = 0.089$ . However, caregiver SSS did not moderate

the relationship between family SES and current pain intensity, psychosocial functioning, nor physical functioning.

### Additional Findings

Given our usage of a composite COI score, we conducted three exploratory moderation analyses to see if COI would interact with family SES at the domain level (i.e., Health and Environment, Education, Social & Economic) for any of our clinical pain or functional variables. These results showed a significant interaction between family SES and the Social & Economic COI domain on current pain intensity,  $t = 2.05$ ,  $p = 0.024$ ). Follow-up 95% Johnson-Neyman regions of significance analyses indicated that greater family SES was associated with greater pain intensity *only* when Social and Economic COI had a score of 30.19 or below (12.79% of the sample). This relationship persisted even after controlling for emotional functioning. Approximately 4.74% of the variance in child-reported psychosocial functioning was explained by the interaction of caregiver SSS with family SES. Figure 5 shows a graphical depiction of this interaction.

## DISCUSSION

Despite its reputation as a social determinant of health, SES does not unilaterally dictate a child's psychological and physical wellbeing. To make such an assumption would ignore the demographic and protective factors that moderate the effects of SES, as well as the numerous approaches to measuring SES, and their interactions within individual, family, and community contexts. Unfortunately, studies of the effects of SES in children particularly fall victim to this trap, as the complexity of SES is often reduced to individual, objective indicators of caregiver resources (i.e., income, educational attainment, occupation). Thus, the current study adds to the current literature by not only comparing the impact of multiple context-specific measures of SES, but also by including childhood opportunity as a child-specific, neighborhood-level SES indicator. Contrary to our hypotheses, family SES was not associated with any of the pain or functional variables of interest. However, childhood opportunity and caregiver SSS were associated with physical functioning. The Social and Economic domain of the COI also moderated the relationship between family SES and psychosocial functioning. Thus, different measures of SES differentially correlate with specific pediatric health indicators. Findings from the preliminary and main analyses reiterate the importance of considering one's target demographic and of distinguishing between these different types of SES.

## Preliminary Analyses

As part of the initial analyses, correlations amongst the key variables were assessed. Consistent with our hypotheses, family-level SES was positively correlated with both childhood opportunity and caregiver-reported subjective social status. The present study corroborates previous literature that suggests neighborhood SES is associated with household income and predictive of a child's future earnings (Chetty et al., 2016; Moss et al., 2021; Acevedo-Garcia et al., 2020). This makes sense as higher taxable household incomes would fund and promote many of the indicators that contribute to childhood opportunity (e.g., safer neighborhood facilities, parks, higher teacher salaries, etc.). Additionally, higher housing costs present barriers for economically disadvantaged families to live in higher SES neighborhoods (Acevedo-Garcia et al., 2020).

The positive relationship between family SES and caregiver SSS, suggests that more objective SES indicators may contribute to an individual's perception of their social status. Previous studies provide mixed evidence on whether objective indicators of SES are associated with participants' perceptions of their social standing. Studies that demonstrated that these two constructs were separate but related examined income and education separately (Huang et al., 2017; Navarro-Carrillo et al., 2020). Thus, the present study's use of a composite family SES variable did not seem to mask the individual contributions of one's income and education to perceptions of social standing. Other evidence suggests that the relationship between objective SES and subjective SES may be sex-moderated, where objective indicators of SES, namely wealth and educational attainment, are more strongly correlated with SSS in men compared to women

(Demakakos et al., 2008; Shaked, 2016; Singh-Manoux et al., 2015). While the present study found a relationship between family SES and SSS amongst predominantly female caregivers, this correlation was weaker compared to that of family SES and COI – two objective indicators. Thus, this may support Demakokos and colleagues' (2008) theory that women may more greatly consider psychosocial factors as significant contributors to their social rank compared to men. Interestingly, COI and caregiver SSS were not correlated with one another. However, COI is a composite of child-relevant SES constructs, which may be less salient for an adult, and thus, less involved in their perceived social ranking. Alternatively, given that caregivers were asked to indicate their SES relative to others in their *community*, it is possible that their peers had similar COI scores. Consequently, they may have relied more on other factors, such as family SES, to determine their relative ranking.

Finally, mean comparisons revealed racial differences in SES. As hypothesized, Black children sampled in the current study were more likely to reside in less advantaged neighborhoods. On average, Black children live in neighborhoods with an opportunity score that is less than 1/3 that of White and Asian children, a disparity that reflects similar gaps in income between Black and White families (Acevedo-Garcia et al., 2020; William et al., 2016). However, even within the same income bracket, more than three times as many Black children than White children living below the poverty level reside in very low opportunity neighborhoods (Acevedo-Garcia et al., 2020). Thus, childhood opportunity seems to highlight socioeconomic inequalities better than family SES. In contrast to these more objective SES measures, there was no significant racial discrepancy in caregiver-reported SSS. Thus, relative to their peers, Black caregivers did

not have a worse perception of their social status than White caregivers. In fact, in their study, Shaked and colleagues (2016) found that not only did Black participants report *higher* SSS than their White counterparts, but that objective indicators (i.e., employment and education) were less likely to influence perceptions of their social standing.

### Main Aims

The main objectives of the current study were three-fold: 1) evaluate the relationship between neighborhood SES child pain severity and functioning, 2) evaluate the relationship between caregiver SSS and child pain severity and functioning, and 3) evaluate neighborhood SES and caregiver SSS as moderators of the relationship between family SES and child pain severity and functioning. Contrary to hypotheses, none of our SES variables were related to psychosocial functioning. This provides some evidence against the caregiver-stress mediated model of child pain, which contradicts findings from previous studies. For example, longitudinal studies indicate that neighborhood SES was associated with greater psychological stress, poorer social skills, and greater emotional reactivity in children (Chen & Patterson, 2006; Decarlo et al., 2011; Strickhouser et al., 2020). Similarly, prior evidence highlights the role that stress may play in exacerbating the burden of low caregiver SSS, as greater maternal perceptions of social standing reflect higher levels of social support and buffer against the high levels of stress associated with having a child with chronic pain (Demakokos et al., 2008; Michelson et al., 2016; Ozbay et al., 2007). Consequently, these caregivers are thought to have the cognitive and emotional resources needed to foster protective management of chronic pain in their children (Earls & Carlson, 2001; Palermo & Chambers, 2005;

Palermo et al., 2008; Palermo et al., 2008; Sil et al., 2021). More research on the effects of caregiver stress should be conducted to further elucidate the mechanism underlying the relationships between various pain-related characteristics and SES.

In regard to clinical pain, previous studies indicate that lower SES neighborhoods are associated with a higher incidence and severity of chronic pain in adults and impaired pain modulatory pathways and greater pain-related disability in children (Davies et al., 2009; Fuentes et al., 2007; Morris et al., 2021; Rassa et al., 2021; Schild et al., 2016; Ulirsch, et al., 2014). The study's finding that greater caregiver SSS is correlated with greater physical functioning corroborates this past research. However, additional results suggest that higher SES may actually be correlated with *poorer* functionality and *greater* pain. For example, despite being associated with better physical functioning, greater caregiver SSS was marginally correlated with greater pain interference. Physical functioning and pain interference are highly correlated with one another, so their potentially contrasting dynamics with caregiver SSS is interesting. Perhaps children with high caregiver SSS feel that they are able to engage in physically demanding activities, but some of the more emotional or cognitive components associated with pain interference (e.g., being angry or difficulties paying attention when in pain) are more challenging.

Additionally, measuring COI at the general vs. domain level reveals two main observations. First, while childhood opportunity was not *uniquely* related to physical functioning, a significant main effect emerged while conducting the moderation analysis described in Aim III, such that greater neighborhood opportunity was related to *poorer* physical functioning. Second, when measured using the Social and Economic domain,

childhood opportunity moderated the relationship between family SES and pain intensity, such that for children from neighborhoods with fewer social and economic resources, greater family SES was associated with greater pain intensity. Thus, overall, children from disadvantaged neighborhoods report better physical functioning, suggesting some underlying mechanism of resilience compared to children from more advantaged neighborhoods. For example, children from low opportunity neighborhoods are at greater risk for exposure to environmental stressors, which may better prepare them to manage their chronic pain condition and maintain physical activity (Chen & Patterson, 2006; Hillard et al., 2015; Kersten et al., 2018; Morris et al., 2022). Additionally, parental pain responses may differ based on household income or education level. For example, children with chronic pain routinely report greater school absenteeism (Noll et al., 2000). Those from higher SES backgrounds may be able to afford more visits to the doctor's office, providing more opportunity for physician-endorsed absences from school. If parents negatively reinforce a child's pain (e.g., exempting them from attending school or completing chores), then their child is less likely to engage in valued activities, including more physical pursuits, which could induce poorer physical functioning (Wagoner et al., 2022).

Interestingly, we also see a divergence within lower SES neighborhoods with limited social and economic resources (e.g., few public assistance programs), where children with more educated and higher-income caregivers report more severe pain. Greater family SES would afford parents an opportunity to capitalize on assets within their communities, regardless of their scarcity. The extra cushion provided by these networks may buffer some of the resilience-building, but not deleterious facets (e.g.,



access to greenspace) of the community and foster more solicitous caregiver responses to the child's pain.

Although this study offers interesting insights into the role that SES plays in pediatric pain, there are some weaknesses that could be improved upon in future studies. First, the study was severely underpowered. A larger sample size may clarify whether the marginally significant relationships reflected actual effects or were due to error. However, effect sizes should be considered, as these marginal relationships may be too weak to be considered clinically meaningful.

Another limitation is the sample's lack of diversity in caregiver sex and child and caregiver race, which have been shown to moderate the impact of SES (Singh-Manoux et al., 2015; Demakakos et al., 2008; Shaked, 2016; Xie et al., 2021). Future studies should examine sex, race, and geographic location as moderators of the different SES indicators and psychosocial and physical health. Additionally, greater ranges in family SES would improve the external validity of the present results. For example, there were few participants at the lower end of the distribution for annual household income. At the upper end, annual household income is capped at \$100,000 and above. The resources available to a household making \$100,000 would be astronomically different from one making \$250,000 or \$800,000 annually. Thus, the family SES composite score is not as sensitive as it could be.

Finally, children with suicidal ideation were excluded from the present study for safety and risk mitigation purposes. Children with chronic illness are at greater risk for comorbid depression and suicidal ideation (Greydanus et al., 2010; van Tilburg et al., 2011). By excluding children with severe psychological distress, children with the

greatest functional disability may have also been excluded. Given that low SES increases exposure to environmental stress, it would be elucidating to understand the potential role that SES plays in high-risk pediatric pain populations (Bøe et al., 2014).

In addition to all of the proposed improvements to the current study, future researchers may consider examining both caregiver pain responses and stress as potential mediators of the relationship between SES and child health. The stress caused by low social and economic resources may impede caregiver well-being, which is associated with worse coping in children with chronic pain (Bøe, et al., 2014; Conger & Donnellan, 2019). Caregivers may respond to this stress through greater pain catastrophizing, which is associated with decreased engagement in activities amongst chronic pain populations (Wagoner et al., 2022). In particular, it would be interesting to see whether caregiver stress related to low neighborhood and family SES is buffered by higher subjective social status. Subjective social status may be an easier target for intervention compared to neighborhood and family SES, which require wider-scale policy and institutional changes. Additionally, given group differences in the decision-making process underlying one's social status ranking, it would be interesting to collect participants' high and low anchors. For example, a caregiver who places a lawyer at the top of the ladder likely values different status symbols than one who places a teacher at the top of their ladder. We also acknowledge that caregiver stress is not limited to SES. Individual (e.g., employment status, marital status) and family (e.g., family cohesion) factors may further compound or buffer SES-related stress and should be examined as potential contributors to caregiver burden.

Similarly, future studies could examine direct influences of social support through use of a child-reported measure of SSS, such as the MacArthur Scale of Subjective Social Status for Youth (Goodman et al., 2021). The salience of different sources of social support change with age, where children first develop social competence through family interactions and become more socially reliant on peers as they enter adolescence (Serrano-Villar et al., 2017; Ellis & Zarbatany, 2017; Nelson et al., 2005; Spitz et al., 2020). Thus, a developmental approach would be most appropriate for this type of research. Overall, this study supports the use of a more nuanced conceptualization of SES. Attempts to achieve social and economic equity would benefit from this more contextual approach.

## LIST OF REFERENCES

- Acevedo-Garcia, D., Noelke, C., McArdle, N., Sofer, N., Hardy, E. F., Weiner, M., Baek, M., Huntington, N., Huber, R., & Reece, J. (2020). Racial and ethnic inequities in children's neighborhoods: Evidence from the new child opportunity index 2.0. *Health Affairs*, 39(10), 1693–1701. <https://doi.org/10.1377/hlthaff.2020.00735>
- Alabama Department of Health. (2010). *Rural Health: At a Glance*. Alabama Department of Health. <https://www.alabamapublichealth.gov/ruralhealth/at-a-glance.html>
- Ancoli-Israel, S., Cole, R., Alessi, C., Chambers, M., Moorcroft, W., & Pollak, C. P. (2003). The role of actigraphy in the study of sleep and circadian rhythms. *Sleep*, 26(3), 342-392. <https://doi.org/10.1093/SLEEP/26.3.342>
- Barut, K., Adrovic, A., Şahin, S., & Kasapçopur, Ö. (2017). Juvenile Idiopathic Arthritis. *Balkan Medical Journal*, 34(2), 90–101. <https://doi.org/10.4274/balkanmedj.2017.0111>
- Birnie, K. A., Parker, J. A., & Chambers, C. T. (2014). Relevance of water temperature, apparatus, and age to children's pain during the cold pressor task. *Pain Practice*, 16(1), 46-56. doi:10.1111/papr.12257
- Bjekić, J., Živanović, M., Purić, D., Oosterman, J. M., & Filipović, S. R. (2017). Pain and executive functions: A unique relationship between Stroop task and experimentally induced pain. *Psychological Research*, 82(3), 580-589. doi:10.1007/s00426-016-0838-2e
- Bøe, T., Sivertsen, B., Heiervang, E., Goodman, R., Lundervold, A. J., & Hysing, M. (2014). Socioeconomic status and child mental health: the role of parental emotional well-being and parenting practices. *Journal of Abnormal Child psychology*. 42(5), 705–715. <https://doi.org/10.1007/s10802-013-9818-9>
- Chen, E., Matthews, K. A., & Boyce, W. T. (2002). Socioeconomic differences in children's health: how and why do these relationships change with age?. *Psychological Bulletin*, 128(2), 295–329. <https://doi.org/10.1037/0033-2909.128.2.295>
- Chen, E., & Miller, G. E. (2013). Socioeconomic status and health: mediating and moderating factors. *Annual Review of Clinical Psychology*, 9, 723–749. <https://doi.org/10.1146/annurev-clinpsy-050212-185634>

- Chen, E., & Paterson, L. Q. (2006). Neighborhood, family, and subjective socioeconomic status: How do they relate to adolescent health? *Health Psychology, 25*(6), 704–714.
- Chetty, R., Hendren, N., & Kats, L. F. (2016). The effects of exposure to better neighborhoods on children: New evidence from the moving to opportunity experiment. *American Economic Review, 106*(4), 855-902.
- Choi, Y., Kim, J.-H., & Park, E.-C. (2015). The effect of subjective and objective social class on health-related quality of life: New paradigm using longitudinal analysis. *Health and Quality of Life Outcomes, 13*(1). <https://doi.org/10.1186/s12955-015-0319-0>
- Cimmino, M. A., Ferrone, C., & Cutolo, M. (2011). Epidemiology of chronic musculoskeletal pain. *Best Practice & Research: Clinical Rheumatology, 25*(2), 173–183. <https://doi.org/10.1016/j.berh.2010.01.012>
- Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences*. Academic Press.
- Coles, M. L., & Uziel, Y. (2021). Juvenile primary fibromyalgia syndrome: A review-treatment and prognosis. *Pediatric Rheumatology Online Journal, 19*(1), 74. <https://doi-org.ezproxy3.lhl.uab.edu/10.1186/s12969-021-00529-x>
- Coles, M. L., Weissmann, R., & Uziel, Y. (2021). Juvenile primary fibromyalgia syndrome: Epidemiology, etiology, pathogenesis, clinical manifestations and diagnosis. *Pediatric Rheumatology Online Journal, 19*(1), 22. <https://doi.org/10.1186/s12969-021-00493-6>
- Conger, R. D., & Donnellan, M. B. (2007). An interactionist perspective on the socioeconomic context of human development. *Annual Review of Psychology, 58*, 175–199. <https://doi.org/10.1146/annurev.psych.58.110405.085551>
- Connelly, M., Weiss, J. E., & for the CARRA Registry Investigators (2019). Pain, functional disability, and their association in juvenile fibromyalgia compared to other pediatric rheumatic diseases. *Pediatric Rheumatology Online Journal, 17*(1), 72. <https://doi-org.ezproxy3.lhl.uab.edu/10.1186/s12969-019-0375-9>
- Conte, P. M., Walco, G. A., & Kimura, Y. (2003). Temperament and stress response in children with juvenile primary fibromyalgia syndrome. *Arthritis and Rheumatism, 48*(10), 2923–2930. <https://doi.org/10.1002/art.11244>
- Cousino, M. K., & Hazen, R. A. (2013). Parenting stress among caregivers of children with chronic illness: A systematic review. *Journal of Pediatric Psychology, 38*(8), 809–828. <https://doi.org/10.1093/jpepsy/jst049>

- Davies, K. A., Silman, A. J., Macfarlane, G. J., Nicholl, B. I., Dickens, C., Morriss, R., Ray, D., & McBeth, J. (2009). The association between neighbourhood socioeconomic status and the onset of chronic widespread pain: Results from the EPIFUND study. *European Journal of Pain*, *13*(6), 635–640. <https://doi.org/10.1016/j.ejpain.2008.07.003>
- DeCarlo Santiago, C., Wadsworth, M. E., & Stump, J. (2011). Socioeconomic status, neighborhood disadvantage, and poverty-related stress: Prospective effects on psychological syndromes among diverse low-income families. *Journal of Economic Psychology*, *32*(2), 218–230. <https://doi.org/10.1016/j.joep.2009.10.008>
- Demakakos, P., Nazroo, J., Breeze, E., & Marmot, M. (2008). Socioeconomic status and health: The role of subjective social status. *Social Science & Medicine*, *67*(2), 330–340. <https://doi.org/10.1016/j.socscimed.2008.03.038>
- Demeter, N., Pud, D., & Josman, N. (2018). Cognitive components predict virtual reality-induced analgesia: Repeated measures in healthy subjects, *Frontiers in Robotics and AI*, *4*. doi: 10.3389/frobt.2017.00070f
- Diversity Data Kids. (2021). [Childhood Opportunity Index Map]. Institute for Child, Youth and Family Policy, Heller School for Social Policy and Management, Brandeis University. <https://www.diversitydatakids.org/maps/#/explorer/tracts/0/15/10,15//xc/n/1.0.14/41.541/-95.136/3.52/>
- Earls, F., & Carlson, M. (2001). The social ecology of child health and well-being. *Annual Review of Public Health*, *22*(1), 143–166. <https://doi.org/10.1146/annurev.publhealth.22.1.143>
- Ellis, W. E., & Zarbatany, L. (2017). Understanding processes of peer clique influence in late childhood and early adolescence. *Child Development Perspectives*, *11*(4), 227–232. <https://doi.org/10.1111/cdep.12248>
- Faul, F., Erdfelder, E., Buchner, A., & Lang, A.-G. (2009). Statistical power analyses using G\*Power 3.1: Tests for correlation and regression analyses. *Behavior Research Methods*, *41*(4), 1149–1160. <https://doi.org/10.3758/brm.41.4.1149>
- Fuentes, M., Hart-Johnson, T., & Green, C. R. (2007). The association among neighborhood socioeconomic status, race and chronic pain in black and white older adults. *Journal of the National Medical Association*, *99*(10), 1160–1169.
- Fussner, L. M., Black, W. R., Lynch-Jordan, A., Morgan, E. M., Ting, T. V., & Kashikar-Zuck, S. (2019). Utility of the PROMIS pediatric pain interference scale in juvenile fibromyalgia. *Journal of Pediatric Psychology*, *44*(4), 436–441. <https://doi.org/10.1093/jpepsy/jsy110>

- Goodman, E., Adler, N. E., Kawachi, I., Frazier, A. L., Huang, B., & Colditz, G. A. (2001). Adolescents' perceptions of social status: Development and evaluation of a new indicator. *Pediatrics*, *108*(2), e31-e31.
- Goodman, E., Huang, B., Schafer-Kalkhoff, T., & Adler, N. E. (2007). Perceived socioeconomic status: A new type of identity that influences adolescents' self-rated health. *The Journal of Adolescent Health*, *41*(5), 479–487. <https://doi.org/10.1016/j.jadohealth.2007.05.020>
- Greydanus, D., Patel, D., & Pratt, H. (2010). Suicide risk in adolescents with chronic illness: implications for primary care and specialty pediatric practice: A review. *Developmental Medicine and Child Neurology*. *52*(12), 1083–1087. <https://doi.org/10.1111/j.1469-8749.2010.03771.x>
- Hair, J., Black, W. C., Babin, B. J., & Anderson, R. E. (2010) *Multivariate data analysis* (7th ed.). Pearson Educational International.
- Hanns, L., Radziszewska, A., Suffield, L., Josephs, F., Chaplin, H., Peckham, H., Sen, D., Christie, D., Carvalho, L. A., & Ioannou, Y. (2020). Association of anxiety with pain and disability but not with increased measures of inflammation in adolescent patients with juvenile idiopathic arthritis. *Arthritis Care & Research*, *72*(9), 1266–1274. <https://doi.org/10.1002/acr.24006>
- Hayes, A. F. (2022). Introduction to mediation, moderation, and conditional process analysis: A regression-based approach. The Guilford Press.
- Hilliard, M. E., McQuaid, E. L., Nabors, L., & Hood, K. K. (2015). Resilience in youth and families living with pediatric health and developmental conditions: Introduction to the special issue on resilience. *Journal of Pediatric Psychology*, *40*(9), 835–839. <https://doi.org/10.1093/jpepsy/jsv072>
- Hoebel, J., Kuntz, B., Müters, S., & Lampert, T. (2013). Subjective social status and health-related quality of life among adults in Germany. Results from the German General Social Survey (ALLBUS 2010). *Gesundheitswesen*, *75*(10), 643–651. <https://doi.org/10.1055/s-0032-1333211>
- Hoff, A. L., Palermo, T. M., Schluchter, M., Zbracki, K., & Drotar, D. (2006). Longitudinal relationships of depressive symptoms to pain intensity and functional disability among children with disease-related pain. *Journal of Pediatric Psychology*, *31*(10), 1046–1056. <https://doi.org/10.1093/jpepsy/jsi076>
- Holliday, S. B., Dubowitz, T., Ghosh-Dastidar, B., Beckman, R., Buysse, D., Hale, L., Buman, M., & Troxel, W. (2019). Do sleep and psychological distress mediate the association between neighborhood factors and pain? *Pain Medicine*, *20*, 278–289.

- Huang, S., Hou, J., Sun, L., Dou, D., Liu, X., & Zhang, H. (2017). The effects of objective and subjective socioeconomic status on subjective well-being among rural-to-urban migrants in China: The moderating role of subjective social mobility. *Frontiers in Psychology*, 8, 819. <https://doi.org/10.3389/fpsyg.2017.00819>
- Karim, F., Oyewande, A. A., Abdalla, L. F., Chaudhry Ehsanullah, R., & Khan, S. (2020). Social media use and its connection to mental health: A systematic review. *Cureus*, 12(6), e8627. <https://doi.org/10.7759/cureus.8627>
- Kashikar-Zuck, S., Carle, A., Barnett, K., Goldschneider, K. R., Sherry, D. D., Mara, C. A., Cunningham, N., Farrell, J., Tress, J., & DeWitt, E. M. (2016). Longitudinal evaluation of Patient Reported Outcomes Measurement Information Systems (PROMIS) measures in pediatric chronic pain. *Pain*, 157(2), 339. <https://doi.org/10.1097/j.pain.0000000000000378>
- Kersten, E. E., Adler, N. E., Gottlieb, L., Jutte, D. P., Robinson, S., Roundfield, K., & LeWinn, K. Z. (2018). Neighborhood child opportunity and individual-level pediatric acute care use and diagnoses. *Pediatrics*, 141(5), e20172309. <https://doi.org/10.1542/peds.2017-2309>
- Kim, K. W., Wallander, J. L., Peskin, M., Cuccaro, P., Elliott, M. N., & Schuster, M. A. (2017). Associations between parental SES and children's health-related quality of life: The role of objective and subjective social status. *Journal of Pediatric Psychology*, 43(5), 534–542. <https://doi.org/10.1093/jpepsy/jsx139>
- Little, R.J.A & Rubin, D. B. (2002). *Statistical analysis with missing data*. John Wiley & Sons.
- Lumley, T., Diehr, P., Emerson, S., & Chen, L. (2002). The importance of the normality assumption in large public health data sets. *Annual Review Public Health*, 23, 1151–169.
- Magerl, W., Wilk, S. H., & Treede, R.-D. (1998). Secondary hyperalgesia and perceptual wind-up following intradermal injection of capsaicin in humans. *Pain*, 74(2-3), 257-268. [https://doi.org/10.1016/S0304-3959\(97\)00177-2](https://doi.org/10.1016/S0304-3959(97)00177-2)
- Mardia, K. V. (1971). The effect of nonnormality on some multivariate tests and robustness to nonnormality in the linear model. *Biometrika*, 58(1), 105–121. <https://doi.org/10.2307/2334321>
- Margetić, B., Aukst-Margetić, B., Bilić, E., Jelusić, M., & Tambić Bukovac, L. (2005). Depression, anxiety and pain in children with juvenile idiopathic arthritis (JIA). *European Psychiatry: The Journal of the Association of European Psychiatrists*, 20(3), 274–276. <https://doi.org/10.1016/j.eurpsy.2004.12.014>



- Menard, S. W. (2002). *Applied logistic regression analysis*. Sage.
- Michelson, N., Riis, J.L., & Johnson, S.B. (2016). Subjective social status and psychological distress in mothers of young children. *Maternal Child Health Journal*, *20*, 2019–2029. <https://doi.org/10.1007/s10995-016-2027-8>
- Młyńczyk, J., Abramowicz, P., Stawicki, M. K., & Konstantynowicz, J. (2022). Non-disease specific patient-reported outcome measures of health-related quality of life in juvenile idiopathic arthritis: A systematic review of current research and practice. *Rheumatology International*, *42*(2), 191–203.
- Morris, M. C., Bruehl, S., Stone, A. L., Garber, J., Smith, C., Palermo, T. M., & Walker, L. S. (2022). Place and pain: association between neighborhood SES and quantitative sensory testing responses in youth with functional abdominal pain. *Journal of Pediatric Psychology*, *47*(4), 446–455. <https://doi.org/10.1093/jpepsy/jsab113>
- Morris, A. S., Silk, J. S., Steinberg, L., Myers, S. S., & Robinson, L. R. (2007). The role of the family context in the development of emotion regulation. *Social Development*, *16*(2), 361–388. <https://doi.org/10.1111/j.1467-9507.2007.00389.x>
- Moss, J.L., Johnson, N.J., Yu, M., Altekruise, S. F., & Cronin, K. A. (2021). Comparisons of individual- and area-level socioeconomic status as proxies for individual-level measures: Evidence from the Mortality Disparities in American Communities study. *Population Health Metrics*, *19*(1), (2021). <https://doi.org/10.1186/s12963-020-00244-x>
- Mu, C., Jester, D. J., Cawthon, P. M., Stone, K. L., & Lee, S. (2022). Subjective social status moderates back pain and mental health in older men. *Aging & Mental Health*, *26*(4), 810–817. <https://doi.org/10.1080/13607863.2021.1899133>
- Myers, T. A. (2011). Goodbye, listwise deletion: Presenting hot deck imputation as an easy and effective tool for handling missing data. *Communication Methods and Measures*, *5*(4), 297–310. <https://doi.org/10.1080/19312458.2011.624490>
- Navarro-Carrillo, G., Alonso-Ferres, M., Moya, M., & Valor-Segura, I. (2020). Socioeconomic status and psychological well-being: revisiting the role of subjective socioeconomic status. *Frontiers in Psychology*, *11*, 1303. <https://doi.org/10.3389/fpsyg.2020.01303>
- Nelson, E.E., Leibenluft, E., McClure, E.B., & Pine, D.S. (2005). The social re-orientation of adolescence: A neuroscience perspective on the process and its relation to psychopathology. *Psychological Medicine*, *35*, 163–174.

- Noll, R.B., Kozlowski, K., Gerhardt, C., Vannatta, K., Taylor, J., & Passo, M. (2000). Social, emotional, and behavioral functioning of children with juvenile rheumatoid arthritis. *Arthritis and Rheumatism*, 43(6), 1387-1396.
- Oakes, J. M., & Rossi, P. H. (2003). The measurement of SES in health research: Current practice and steps toward a new approach. *Social Science & Medicine* (1982), 56(4), 769–784. [https://doi.org/10.1016/s0277-9536\(02\)00073-4](https://doi.org/10.1016/s0277-9536(02)00073-4)
- Operario, D., Adler, N. E., & Williams, D. R. (2004). Subjective social status: Reliability and predictive utility for global health. *Psychology & Health*, 19(2), 237–246. <https://doi.org/10.1080/08870440310001638098>
- Ozday, F., Johnson, D. C., Dimoulas, E., Morgan, C. A., Charney, D., & Southwick, S. (2007). Social support and resilience to stress: From neurobiology to clinical practice. *Psychiatry*, 4(5), 35–40.
- Palermo, T. M., & Chambers, C. T. (2005). Parent and family factors in pediatric chronic pain and disability: An integrative approach. *Pain*, 119(1-3), 1–4. <https://doi.org/10.1016/j.pain.2005.10.027>
- Palermo, T. M., Riley, C. A., & Mitchell, B. A. (2008). Daily functioning and quality of life in children with sickle cell disease pain: Relationship with family and neighborhood socioeconomic distress. *The Journal of Pain*, 9(9), 833–840. <https://doi.org/10.1016/j.jpain.2008.04.002>
- Palermo, T. M., Valrie, C. R., & Karlson, C. W. (2014). Family and parent influences on pediatric chronic pain: A developmental perspective. *The American Psychologist*, 69(2), 142–152. <https://doi.org/10.1037/a0035216>
- Petersen, S., Hägglöf, B. L., & Bergström, E. I. (2009). Impaired health-related quality of life in children with recurrent pain. *Pediatrics*, 124(4), e759–e767. <https://doi.org/10.1542/peds.2008-1546>
- Pickett, K. E., & Pearl, M. (2001). Multilevel analyses of neighbourhood socioeconomic context and health outcomes: a critical review. *Journal of Epidemiology and Community Health*, 55(2), 111–122. <https://doi.org/10.1136/jech.55.2.111>
- Poulain, T., Vogel, M., Sobek, C., Hilbert, A., Körner, A., & Kiess, W. (2019). Associations between socio-economic status and child health: Findings of a large German cohort study. *International Journal of Environmental Research and Public Health*, 16(5), 677. <https://doi.org/10.3390/ijerph16050677>
- Poulton, R., Caspi, A., Milne, B. J., Thomson, W. M., Taylor, A., Sears, M. R., & Moffitt, T. E. (2002). Association between children's experience of socioeconomic disadvantage and adult health: A life-course study. *Lancet*, 360(9346), 1640–1645. [https://doi.org/10.1016/S0140-6736\(02\)11602-3](https://doi.org/10.1016/S0140-6736(02)11602-3)

- Rassu, F. S., McFadden, M., Aaron, R., Wegener, S. T., Ephraim, P. L., Lane, E., Brennan, G., Minick K. I., Fritz, J. M., Skolasky, R. L. (2021). The relationship between neighborhood deprivation and perceived changes for pain-related experiences among US patients with chronic low back pain during the COVID-19 pandemic. *Pain Medicine*, 22(11), 2550-2565. <https://doi.org/10.1093/pm/pnab179>
- Roubinov, D. S., Hagan, M. J., Boyce, W. T., Adler, N. E., & Bush, N. R. (2018). Family socioeconomic status, cortisol, and physical health in early childhood: The role of advantageous neighborhood characteristics. *Psychosomatic Medicine*, 80(5), 492–501. <https://doi.org/10.1097/PSY.0000000000000585>
- Roy, A. L., Isaia, A., & Li-Grining, C. P. (2019). Making meaning from money: Subjective social status and young children's behavior problems. *Journal of Family Psychology*, 33(2), 240–245. <https://doi.org/10.1037/fam0000487>
- Ryan, J. L., Ramsey, R. R., Fedele, D. A., Mullins, L. L., Chaney, J. M., & Jarvis, J. N. (2010). A longitudinal examination of the parent–child distress relationship in children with juvenile rheumatic disease. *Rehabilitation Psychology*, 55(3), 286-291. <https://doi.org/10.1037/a0020182>
- Rubin, D. B. (1987). *Multiple imputation for nonresponse in surveys*. John Wiley.
- Sadeh, A., & Acebo, C. (2002). The role of actigraphy in sleep medicine. *Sleep medicine reviews*, 6(2), 113-124. <https://doi.org/10.1053/smr.2001.0182>
- Schanberg, L. E., Gil, K. M., Anthony, K. K., Yow, E., & Rochon, J. (2005). Pain, stiffness, and fatigue in juvenile polyarticular arthritis: Contemporaneous stressful events and mood as predictors. *Arthritis & Rheumatism*, 52(4), 1196–1204. <https://doi.org/10.1002/art.20952>
- Schild, C., Reed, E. A., Hingston, T., Dennis, C. H., & Wilson, A. C. (2016). Neighborhood characteristics: Influences on pain and physical function in youth at risk for chronic pain. *Children (Basel, Switzerland)*, 3(4), 35. <https://doi.org/10.3390/children3040035>
- Senn, T. E., Walsh, J. L., & Carey, M. P. (2014). The mediating roles of perceived stress and health behaviors in the relation between objective, subjective, and neighborhood socioeconomic status and perceived health. *Annals of Behavioral Medicine*, 48(2), 215–224. <https://doi.org/10.1007/s12160-014-9591-1>
- Serrano-Villar, M., Huang, KY., & Calzada, E.J. (2017). Social support, parenting, and social emotional development in young Mexican and Dominican American children. *Child Psychiatry Hum Dev* 48, 597–609.

- Shaked, D., Williams, M., Evans, M. K., & Zonderman, A. B. (2016). Indicators of subjective social status: Differential associations across race and sex. *SSM - population health*, 2, 700–707. <https://doi.org/10.1016/j.ssmph.2016.09.009>
- Sil, S., Woodward, K. E., Johnson, Y. L., Dampier, C., & Cohen, L. L. (2021). Parental psychosocial distress in pediatric sickle cell disease and chronic pain. *Journal of Pediatric Psychology*, 46(5), 557–569. <https://doi.org/10.1093/jpepsy/jsaa130>
- Singh-Manoux, A., Marmot, M. G., & Adler, N. E. (2005). Does subjective social status predict health and change in health status better than objective status?. *Psychosomatic Medicine*, 67(6), 855–861. <https://doi.org/10.1097/01.psy.0000188434.52941.a0>
- Soulsby, W.D., Balmuri, N., Cooley, V., Gerber, L., Lawson, E., Goodman, S., Onel, K., & Mehta, B. (2022). Social determinants of health influence disease activity and functional disability in Polyarticular Juvenile Idiopathic Arthritis. *Pediatric Rheumatology*, 20(18). <https://doi.org/10.1186/s12969-022-00676-9>
- Spitz, A., Winkler Metzke, C., & Steinhausen, H. C. (2020). Development of Perceived Familial and Non-familial Support in Adolescence; Findings From a Community-Based Longitudinal Study. *Frontiers in psychology*, 11, 486915. <https://doi.org/10.3389/fpsyg.2020.486915>
- Stevanovic, D., & Susic, G. (2013). Health-related quality of life and emotional problems in juvenile idiopathic arthritis. *Quality of Life Research: An International Journal of Quality of Life Aspects of Treatment, Care & Rehabilitation*, 22(3), 607–612. <https://doi-org.ezproxy3.lhl.uab.edu/10.1007/s11136-012-0172-0>
- Stinson, J. N., Luca, N. J. C., & Jibb, L. A. (2012). Assessment and management of pain in juvenile idiopathic arthritis. *Pain Research and Management*, 17(6), 391–396. <https://doi.org/10.1155/2012/237258>
- Strickhouser, J. E., & Sutin, A. R. (2020). Family and neighborhood socioeconomic status and temperament development from childhood to adolescence. *Journal of Personality*, 88(3), 515–529. <https://doi.org/10.1111/jopy.12507>
- Thompson, K. A. (2021). *Predictors and disparities associated with pain (PANDDA-P) study: A comparison of pediatric rheumatology patients* [Unpublished manuscript]. Department of Psychology. University of Alabama at Birmingham, Birmingham, AL, United States.
- Terrighena, E. L., Shao, R., & Lee, T. M. (2017). Impact of concurrent cognitive processing on cold pain perception: Implications for pain management and its neurobiological basis. *Applied Neuropsychology: Adult*, 24(1), 81–91. <https://doi.org/10.1080/23279095.2015.1100618>

- Tumin, D., Drees, D., Miller, R., Wrona, S., Hayes, D., Jr, Tobias, J. D., & Bhalla, T. (2018). Health care utilization and costs associated with pediatric chronic pain. *The Journal of Pain, 19*(9), 973–982. <https://doi.org/10.1016/j.jpain.2018.03.012>
- Ulirsch, J. C., Weaver, M. A., Bortsov, A. V., Soward, A. C., Swor, R. A., Peak, D. A., Jones, J. S., Rathlev, N. K., Lee, D. C., Domeier, R. M., Hendry, P. L., & McLean, S. A. (2014). No man is an island: Living in a disadvantaged neighborhood influences chronic pain development after motor vehicle collision. *Pain, 155*(10), 2116–2123. <https://doi.org/10.1016/j.pain.2014.07.025>
- Upadhyay, J., Lemme, J., Cay, M., Van Der Heijden, H., Sibai, D., Goodlett, B., Lo, J., Hoyt, K., Taylor, M., Hazen, M. M., Halyabar, O., Meidan, E., Schreiber, R., Chang, M. H., Nigrovic, P. A., Jaimes, C., Henderson, L. A., Ecklund, K., & Sundel, R. P. (2021). A multidisciplinary assessment of pain in juvenile idiopathic arthritis. *Seminars in Arthritis and Rheumatism, 51*(4), 700–711. <https://doi.org/10.1016/j.semarthrit.2021.05.011>
- Ursache, A., Noble, K. G., & Blair, C. (2015). Socioeconomic Status, Subjective Social Status, and Perceived Stress: Associations with Stress Physiology and Executive Functioning. *Behavioral medicine, 41*(3), 145–154. <https://doi.org/10.1080/08964289.2015.1024604>
- U.S. Census Bureau (2019). *POP1 child population: number of children (in millions) in the United States by age, 1950-2020 and projected 2021-2050*. Retrieved from <https://www.childstats.gov/americaschildren/tables/pop1.asp>
- van Tilburg, M. A., Spence, N. J., Whitehead, W. E., Bangdiwala, S., & Goldston, D. B. (2011). Chronic pain in adolescents is associated with suicidal thoughts and behaviors. *The Journal of Pain, 12*(10), 1032–1039. <https://doi.org/10.1016/j.jpain.2011.03.004>
- Varni, J. W., Limbers, C. A., & Burwinkle, T. M. (2007). Impaired health-related quality of life in children and adolescents with chronic conditions: a comparative analysis of 10 disease clusters and 33 disease categories/severities utilizing the PedsQL 4.0 Generic Core Scales. *Health and Quality of Life Outcomes, 5*, 43. <https://doi.org/10.1186/1477-7525-5-43>
- Varni, J. W., Seid, M., & Kurtin, P. S. (2001). PedsQL 4.0: reliability and validity of the Pediatric Quality of Life Inventory version 4.0 generic core scales in healthy and patient populations. *Medical Care, 39*(8), 800–812. <https://doi.org/10.1097/00005650-200108000-00006>
- Varni, J. W., Stucky, B. D., Thissen, D., Dewitt, E. M., Irwin, D. E., Lai, J. S., Yeatts, K., & Dewalt, D. A. (2010). PROMIS pediatric pain interference scale: An item response theory analysis of the pediatric pain item bank. *The Journal of Pain, 11*(11), 1109–1119.

- Verstappen, S. M., Cobb, J., Foster, H. E., Fu, B., Baidam, E., Wedderburn, L. R., Davidson, J. E., Ioannou, J., Chieng, A., Hyrich, K. L., & Thomson, W. (2015). The association between low socioeconomic status with high physical limitations and low illness self-perception in patients with juvenile idiopathic arthritis: Results from the Childhood Arthritis Prospective Study. *Arthritis Care & Research*, 67(3), 382–389. <https://doi.org/10.1002/acr.22466>
- Wakefield, J. R., Sani, F., Madhok, V., Norbury, M., & Dugard, P. (2016). The pain of low status: the relationship between subjective socio-economic status and analgesic prescriptions in a Scottish community sample. *Psychology, Health & Medicine*, 21(1), 27–37. <https://doi.org/10.1080/13548506.2015.1009377>
- Weiss, J. E., Luca, N. J., Boneparth, A., & Stinson, J. (2014). Assessment and management of pain in juvenile idiopathic arthritis. *Paediatric Drugs*, 16(6), 473–481. <https://doi-org.ezproxy3.lhl.uab.edu/10.1007/s40272-014-0094-0>
- Wen, M., Hawkey, L. C., & Cacioppo, J. T. (2006). Objective and perceived neighborhood environment, individual SES and psychosocial factors, and self-rated health: An analysis of older adults in Cook County, Illinois. *Social Science & Medicine* (1982), 63(10), 2575–2590. <https://doi.org/10.1016/j.socscimed.2006.06.025>
- Wolfe, F., Ross, K., Anderson, J., Russell, I. J., & Hebert, L. (1995). The prevalence and characteristics of fibromyalgia in the general population. *Arthritis and Rheumatism*, 38(1), 19–28. <https://doi.org/10.1002/art.1780380104>
- Xie, S., Hubbard, R. A., & Himes, B. E. (2020). Neighborhood-level measures of socioeconomic status are more correlated with individual-level measures in urban areas compared with less urban areas. *Annals of Epidemiology*, 43(4), 37–43. <https://doi.org/10.1016/j.annepidem.2020.01.012>
- Yaribeygi, H., Panahi, Y., Sahraei, H., Johnston, T. P., & Sahebkar, A. (2017). The impact of stress on body function: A review. *EXCLI Journal*, 16, 1057–1072. <https://doi.org/10.17179/excli2017-480>

**Table 1.** Obtained Power for Individual Aims.

Aim	Dependent Variable	SES Indicator	
		COI	SSS
I and II	Pain Intensity	0.28	0.32
	Pain Interference	0.45	0.45
	Psychosocial Functioning	0.11	0.15
	Physical Functioning	0.39	0.65
III	Pain Intensity	0.07	0.09
	Pain Interference	0.16	0.07
	Psychosocial Functioning	0.11	0.17
	Physical Functioning	0.06	0.13

**Table 2.** Description of study participants.

Variable	Total n = 88 % M (SD)	Range of Observed Scores (Min – Max)
Child's Age	13.9 (2.4)	8-18
Child's Sex		
Female	68.2	
Child's Race		
White	76.1	
Black	13.6	
Multiracial	8.0	
Other	2.3	
Disease Group		
JIA	36.4	
JPFS	35.2	
NSCP	28.4	
Family SES	-0.04 (.90)	-2.71 – 1.12
State-normed COI	62.88 (28.14)	3 – 100
Caregiver SSS	6.19 (2.11)	2 – 10
Pain Interference	54.86 (8.87)	34 – 75.70
Pain Intensity	27.49 (26.95)	0 – 95
Psychosocial Functioning	68.02 (16.47)	31.67 – 100
Physical Functioning	60.32 (22.66)	12.50 – 100



**Table 3.** SES differences by race.

Variable	Race <sup>a</sup>		<i>t</i> (df)	Sig.
	White M (SE)	Black M (SE)		
Family SES	0.69 (0.066)	0.35 (0.91)	3.88(86)	<0.001
State-normed COI	65.29 (26.67)	47.58 (33.42)	2.06(86)	0.04
Caregiver SSS	6.20 (2.10)	6.08 (2.27)	0.18(86)	0.87

<sup>a</sup>Other and Multiracial categories were excluded from analyses due to small n

**Table 4.** Differences in pain severity and functioning by disease group.

Variable	Disease Group			<i>F</i> (df1, df2)
	JIA M (SE)	JPFS M (SE)	NSCP M (SE)	
Pain Intensity <sup>a,b,c</sup>	17.94 (3.59)	44.97 (4.98)	18.04 (3.48)	12.80(2,85)**
Pain Interference <sup>a</sup>	50.49 (1.57)	60.54 (1.09)	53.44 (1.64)	13.62(2,85)**
Psychosocial Functioning <sup>a</sup>	75.25 (2.55)	57.47 (2.51)	71.83 (3.10)	12.87(2,85)**
Physical Functioning <sup>a</sup>	70.65 (4.00)	45.23 (3.48)	65.80 (3.24)	14.26(2,85)**

<sup>a</sup>JPFS differs from JIA <sup>b</sup>NSCP differs from JIA <sup>c</sup>NSCP differs from JPFS

\**p*<.05 \*\**p*<.001

**Table 5.** Correlations amongst pain severity, functioning, and SES variables.

<b>Variable</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
1. Family SES	--	--	--	--	--	--
2. State-normed COI	0.41**	--	--	--	--	--
3. Caregiver SSS	0.34**	0.07	--	--	--	--
4. Pain Interference	0.01	0.17	0.01	--	--	--
5. Pain Intensity	0.01	0.17	0.49	0.45**	--	--
6. Psychosocial Functioning	0.15	-0.14	0.01	-0.65**	-0.35**	--
7. Physical Functioning	-0.07	-.26*	0.05	-0.81**	-0.58**	0.55**

\*p&lt;.05 \*\*p&lt;.001

**Table 6.** Hierarchical regression models of relationship between family SES, state-normed COI, and clinical pain characteristics.

Step	Variables	Pain Intensity			Pain Interference		
		$\Delta R^2$	B (SE)	$\beta$	$\Delta R^2$	B (SE)	$\beta$
1		.275			.402		
	Black <sup>a</sup>		5.98 (7.79)	0.077		0.88 (2.30)	0.034
	Multiracial <sup>a</sup>		-9.51 (9.66)	-0.096		-3.15 (2.86)	-0.098
	Other <sup>b</sup>		-15.10 (17.61)	-0.084		-4.99 (5.21)	-0.085
	Emotional Functioning JPFS <sup>b</sup>		-0.18 (0.13)	-0.153		-0.16 (0.04)	-0.418
	NSCP <sup>b</sup>		22.69 (6.91)**	0.402**		6.45 (2.05)**	0.351**
			-0.70 (6.78)	-0.012		1.96 (2.00)	0.101
2	Family SES	.005	2.27 (3.18)	0.075	.005	0.72 (0.94)	0.073
3	State- normed COI	.002	0.15 (0.11)	0.149	.010	0.04 (0.03)	0.11

\*p &lt; .05 \*\* p &lt; .01

<sup>a</sup> White is the reference group<sup>b</sup> JIA is the reference group

**Table 7.** Hierarchical regression models of relationship between Family SES, state-normed COI, and functioning.

Step	Variables	Psychosocial Functioning			Physical Functioning		
		$\Delta R^2$	B (SE)	$\beta$	$\Delta R^2$	B (SE)	$\beta$
1		.505			.733		
	Black <sup>a</sup>		-2.96 (3.92)	-0.062		4.29 (3.95)	0.065
	Multiracial <sup>a</sup>		-2.53 (4.90)	-0.042		6.63 (4.94)	0.080
	Other <sup>a</sup>		-22.13 (8.78)*	-0.201*		15.44 (8.86)	0.102
	Pain Intensity		-0.01 (0.06)	-0.008		-0.20 (0.06)**	-0.238**
	Pain Interference		-1.04 (0.18)**	-		-1.70 (0.18)**	-0.664**
	JPFS <sup>b</sup>		-6.18 (3.69)	-0.180		-3.77 (3.73)	-0.080
	NSCP <sup>b</sup>		1.06 (3.37)	0.029		-1.40 (3.40)	-0.028
2	Family SES	.007	1.75 (1.59)	0.096	.002	-1.14 (1.61)	-0.046
3	State-normed COI	.005	-0.04 (0.05)	-0.076	.010	-0.10 (0.05)	-0.119

\*p &lt; .05 \*\* p &lt; .01

<sup>a</sup> White is the reference group<sup>b</sup> JIA is the reference group

**Table 8.** Hierarchical regression models of relationship between family SES, caregiver SSS, and clinical pain characteristics.

Step	Variables	Pain Intensity			Pain Interference		
		$\Delta R^2$	B (SE)	$\beta$	$\Delta R^2$	B (SE)	$\beta$
1		.275			.402		
	Black <sup>a</sup>		5.98 (7.79)	0.077		0.88 (2.30)	0.034
	Multiracial <sup>a</sup>		-9.51 (9.66)	-0.96		-3.15 (2.86)	-0.098
	Other <sup>a</sup>		-15.10 (17.61)	-0.084		-4.99 (5.21)	-0.085
	Emotional Functioning JPFS <sup>b</sup>		-0.18 (0.13) 22.69 (6.91)**	-0.153  0.402**		-0.16 (0.04)** 6.45 (2.05)**	-0.418**  0.351**
	NSCP <sup>b</sup>		-0.70 (6.78)	-0.012		1.95 (2.00)	0.101
2	Family SES	.005	2.27 (3.18)	0.075	.005	0.72 (0.94)	0.073
3	Caregiver SSS	.010	1.47 (1.39)	0.113	.024	0.74 (0.41)	0.175

\*p &lt; .05 \*\* p &lt; .01

<sup>a</sup> White is the reference group<sup>b</sup> JIA is the reference group

**Table 9.** Hierarchical regression models of relationship between Family SES, caregiver SSS, and functioning.

Step	Variables	Psychosocial Functioning			Physical Functioning		
		$\Delta R^2$	B (SE)	$\beta$	$\Delta R^2$	B (SE)	$\beta$
1		.505			.733		
	Black <sup>a</sup>		-2.96 (3.92)	-0.062		4.29 (3.95)	0.065
	Multiracial <sup>a</sup>		-2.53 (4.90)	-0.042		6.63 (4.94)	0.080
	Other <sup>a</sup>		-22.13 (8.78)*	-0.201*		15.44 (8.86)	0.102
	Pain Intensity		-0.01 (0.06)	-0.008		-0.20 (0.06)**	- 0.238 **
	Pain Interference		-1.04 (0.18)**	- 0.560**		-1.70 (0.18)**	- 0.664 **
	JPFS <sup>b</sup>		-6.18 (3.69)	-0.180		-3.77 (3.73)	-0.080
	NSCP <sup>b</sup>		1.06 (3.37)	-0.029		-1.40 (3.40)	-0.028
2	Family SES	.007	1.75 (1.59)	0.096	.002	-1.14 (1.61)	-0.046
3	Caregiver SSS	.000	-0.13 (0.68)	-0.016	.026	1.91 (0.63)**	0.178

\*p &lt; .05 \*\* p &lt; .01

<sup>a</sup> White is the reference group<sup>b</sup> JIA is the reference group

**Table 10.** State normed COI as a moderator of the relationship between family SES and various pain-related variables.

Variables	Pain Intensity			Pain Interference			Psychosocial Functioning			Physical Functioning		
	R <sup>2</sup>	B (SE)	β	R <sup>2</sup>	B (SE)	β	R <sup>2</sup>	B (SE)	β	R <sup>2</sup>	B (SE)	β
JPFS <sup>a</sup>	.28	25.54 (6.32)**	.95**	.29	9.80 (2.07)**	1.10**	.30	-15.69 (3.82)**	-	.37	-25.18 (4.99)**	-1.11**
NSCP <sup>a</sup>		0.23 (6.59)*	.01*		3.05 (2.15)	.34		-1.97 (3.99)	-.12		-6.76 (5.21)	-.30
Black <sup>b</sup>		8.62 (8.19)	.32		1.84 (2.68)	.21		-3.84 (4.96)	-.23		-1.93 (6.48)	-.09
Multiracial <sup>b</sup>		-9.49 (9.88)	-.35		-2.97 (3.23)	-.33		2.10 (5.98)	.13		13.52 (7.81)	.60
Other <sup>b</sup>		-12.81 (17.99)	-.48		-3.47 (5.88)	-.39		-15.66 (10.90)	-.95		24.74 (14.23)	1.09
Family SES		0.58 (3.41)	.02		0.20 (1.12)	.02		2.11 (2.07)	.12		-0.40 (2.70)	-.02
State-normed COI		0.17 (0.10)	.18		0.05 (0.03)	.17		-0.10 (0.06)	-.17		-0.21 (0.08)*	-.27*
Family SES x State-normed COI		0.04 (0.12)	.05		-0.04 (0.04)	-.11		0.05 (0.07)	.08		0.028 (0.10)	.03

\*p < .05 \*\* p < .01

<sup>a</sup> JIA is the reference group

<sup>b</sup> White is the reference group



**Table 11.** Caregiver SSS as a moderator of the relationship between family SES and various pain-related variables.

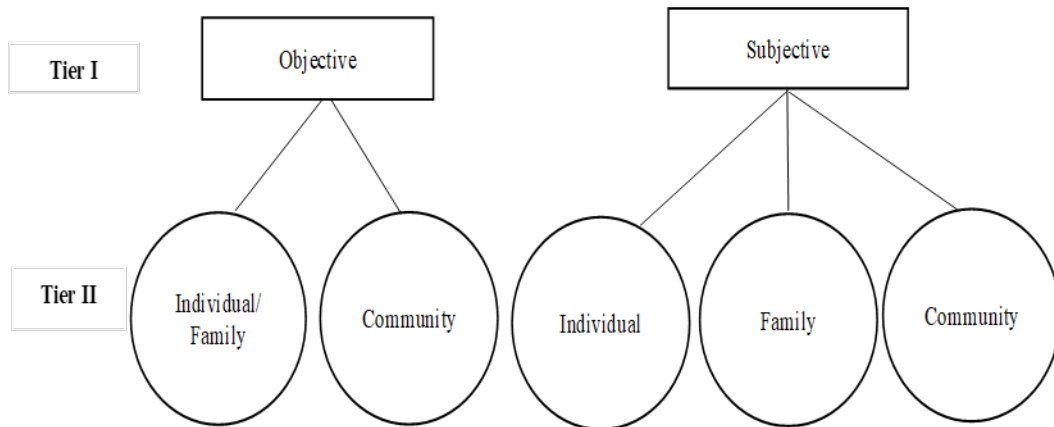
Variables	Pain Intensity			Pain Interference			Psychosocial Functioning			Physical Functioning		
	R <sup>2</sup>	B (SE)	β	R <sup>2</sup>	B (SE)	β	R <sup>2</sup>	B (SE)	β	R <sup>2</sup>	B (SE)	β
JPFS <sup>a</sup>	.27	27.80 (6.42)**	1.03**	.29	10.66 (2.08)**	1.20**	.29	-17.07 (3.87)**	-	.32	-26.42 (5.22)**	-1.17**
NSCP <sup>a</sup>		1.58 (6.87)	.06		3.67 (2.23)	.41		-3.37 (4.14)	-0.20		-26.42 (5.22)	-0.33
Black <sup>b</sup>		7.28 (8.29)	.27		-0.88 (2.69)	.10		-2.67 (4.99)	-0.16		-0.97 (6.74)	-0.04
Multiracial <sup>b</sup>		-8.86 (10.16)	-.33		-2.81 (3.30)	-.32		2.50 (6.12)	.15		13.48 (8.25)	.60
Other <sup>b</sup>		-8.60 (17.74)	-.32		-0.51 (5.75)	-.06		-20.12 (10.68)	-1.22		18.92 (14.41)	.84
Family SES		2.09 (3.34)	.07		0.45 (1.08)	.05		1.17 (2.01)	.06		-3.86 (2.72)	-.15
Caregiver SSS		1.33 (1.37)	.10		0.77 (0.44)	.18		-1.07 (0.82)	-.14		0.02 (1.11)	.02
Family SES x Caregiver SSS		0.70 (1.33)	.05		0.18 (0.43)	.04		-0.77 (0.80)	-.09		-0.84 (1.08)	-.07

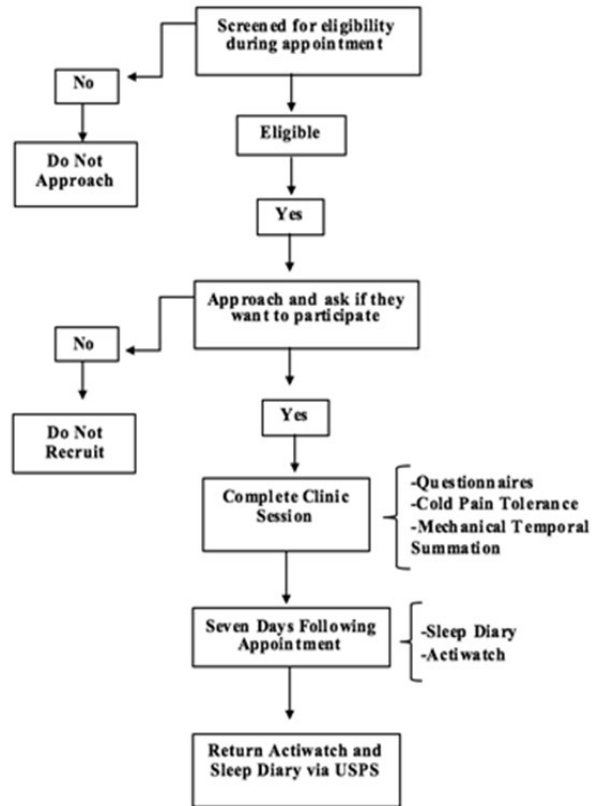
\*p < .05 \*\* p < .001

<sup>a</sup> JIA is the reference group

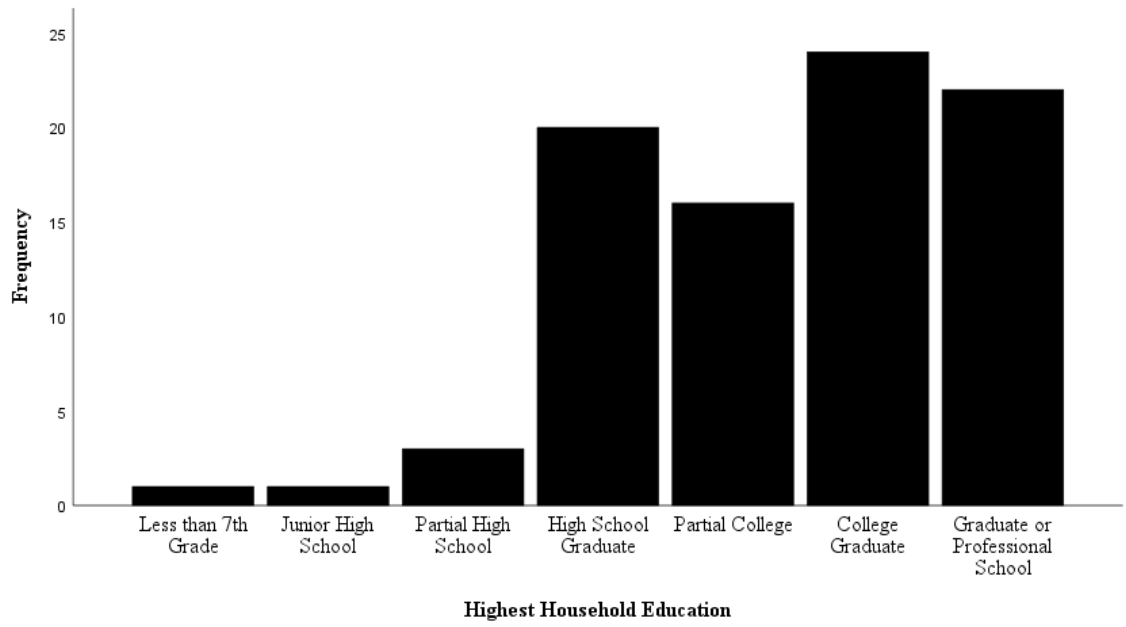
<sup>b</sup> White is the reference group

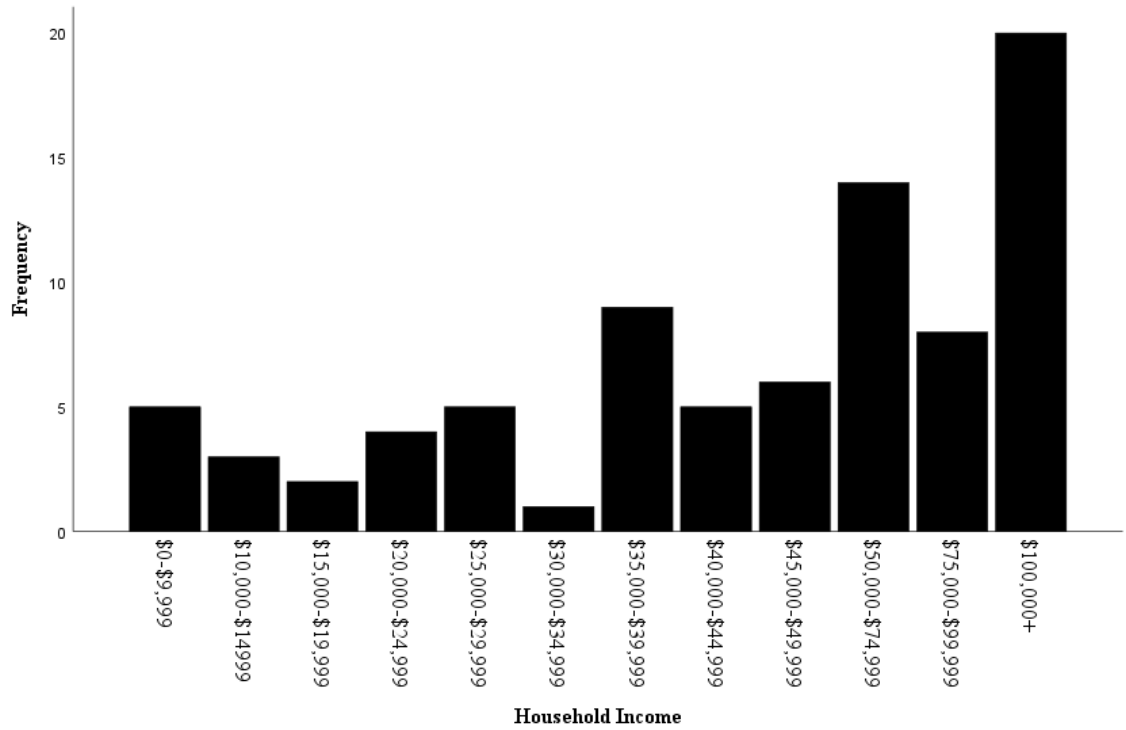
**Figure 1.** Categories of socioeconomic status for children and adolescents.

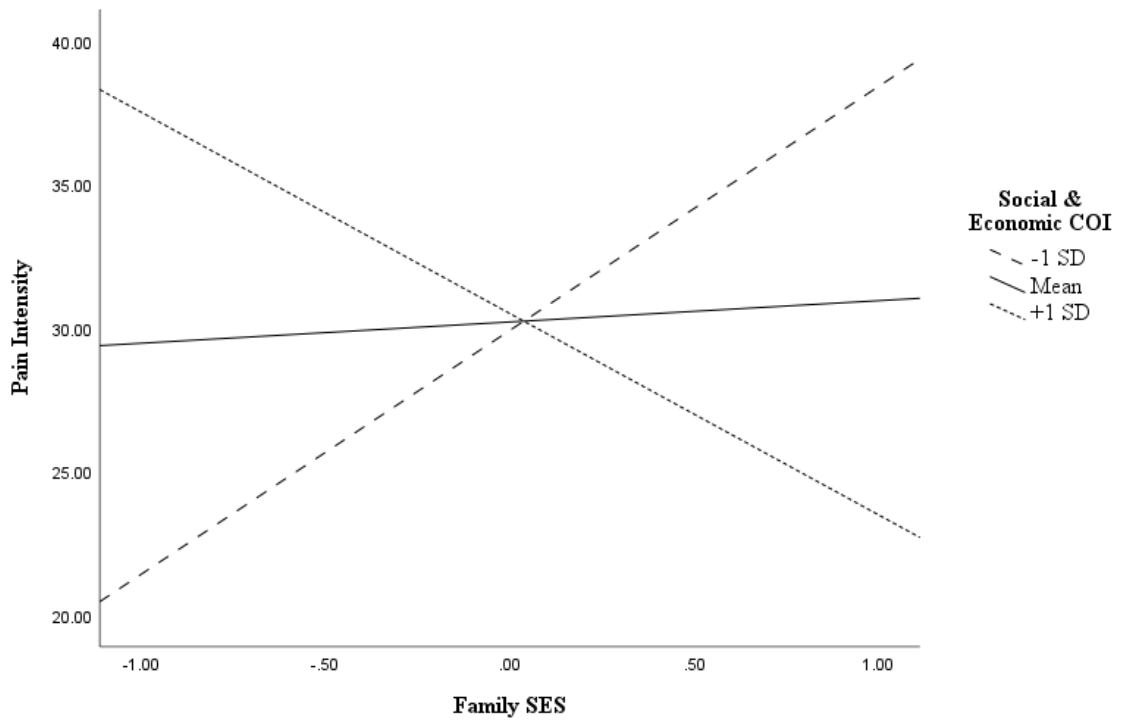


**Figure 2.** Flow diagram.

**Figure 3.** Sample distribution of highest household education level.



**Figure 4.** Sample distribution of household income bracket.

**Figure 5.** Moderation effect of State-normed social & economic COI on pain intensity.

APPENDIX  
IRB APPROVAL FORM



Office of the Institutional Review Board for Human Use

470 Administration Building  
701 20th Street South  
Birmingham, AL 35294-0104  
205.934.3789 | Fax 205.934.1301 |  
irb@uab.edu

### APPROVAL LETTER

**TO:** Gowey, Marissa

**FROM:** University of Alabama at Birmingham Institutional Review Board  
Federalwide Assurance # FWA00005960  
IORG Registration # IRB00000196 (IRB 01)  
IORG Registration # IRB00000726 (IRB 02)  
IORG Registration # IRB00012550 (IRB 03)

**DATE:** 31-Aug-2021

**RE:** IRB-300002719  
IRB-300002719-031  
Predictors and Disparities Associated with Pain Severity (PANDDA-P Study)

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The IRB reviewed and approved the Personnel Amendment submitted on 30-Aug-2021 for the above referenced project. The review was conducted in accordance with UAB's Assurance of Compliance approved by the Department of Health and Human Services.

**Type of Review:** Expedited  
**Expedited Categories:** 2, 5,  
**Determination:** Approved  
**Approval Date:** 31-Aug-2021  
**Expiration Date:** 30-Aug-2024

Although annual continuing review is not required for this project, the principal investigator is still responsible for (1) obtaining IRB approval for any modifications before implementing those changes except when necessary to eliminate apparent immediate hazards to the subject, and (2) submitting reportable problems to the IRB. Please see the IRB Guidebook for more information on these topics.

**The following apply to this project related to informed consent and/or assent:**

- Waiver (Partial) of HIPAA
- Waiver of 24 Hour Waiting Period

**Documents Included in Review:**

- IRB PERSONNEL EFORM



To access stamped consent/assent forms (full and expedited protocols only) and/or other approved documents:

1. Open your protocol in IRAP.
2. On the Submissions page, open the submission corresponding to this approval letter. NOTE: The Determination for the submission will be "Approved."
3. In the list of documents, select and download the desired approved documents. The stamped consent/assent form(s) will be listed with a category of Consent/Assent Document (CF, AF, Info Sheet, Phone Script, etc.)