American Pain Society
RESEARCH
EDUCATION
TREATMENT
ADVOCACY
PUBLISHED BY ELSEVIER

The Journal of Pain, Vol 16, No 9 (September), 2015: pp 873-880
Available online at www.jpain.org and www.sciencedirect.com

# Race Effects on Conditioned Pain Modulation in Youth

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**Abstract:** **Race and ethnicity shape the experience of pain in adults. African Americans typically exhibit greater pain intensity and evoked pain responsiveness than non-Hispanic whites. However, it remains unclear whether there are racial differences in conditioned pain modulation (CPM) and if these are present in youth. CPM refers to a reduction in perceived pain intensity for a test stimulus during application of a conditioning stimulus and may be especially relevant in determining risk for chronic pain. The present study assessed CPM to evoked thermal pain in 78 healthy youth (ages 10–17 years), 51% of whom were African American and 49% of whom were non-Hispanic white. African American youth reported lower mean conditioning pain ratings than non-Hispanic white youth, controlling for mean preconditioning pain ratings, which is consistent with stronger CPM. Multilevel models demonstrated stronger CPM effects in African American than non-Hispanic white youth, as evident in more rapid within-person decreases in pain ratings during the conditioning phase. These findings suggest that diminished CPM likely does not account for the enhanced responsiveness to evoked thermal pain observed in African American youth. These results may have implications for understanding racial differences in chronic pain experienced in adulthood.**

***Perspective:*** ***This study evaluated conditioned pain modulation to evoked thermal pain in African American and non-Hispanic white youth. Findings could have implications for the development of personalized chronic pain treatment strategies that are informed by race and ethnicity.***



***Key words:*** *Race, pain, conditioned pain modulation, diffuse noxious inhibitory control, adolescents.*

Race and ethnicity shape the experience of pain in both clinical and experimental settings. African American adults report greater pain unpleasantness[47] and pain intensity[13] as well as greater evoked pain responsiveness than non-Hispanic whites.[42] However, the mechanisms contributing to a higher prevalence of chronic pain in African Americans compared with non-Hispanic whites[39] remain unclear. Responses to experimental pain stimuli distinguish certain clinical pain populations from healthy controls, correlate with changes in clinical pain, and could reflect preexisting risk markers for the onset of chronic pain.[17] The present study sought to determine whether racial differences in descending pain inhibition are present in youth without chronic pain.

Conditioned pain modulation (CPM), also called diffuse noxious inhibitory controls or "pain inhibits pain," refers to a reduction in perceived pain intensity for a test stimulus during application of a conditioning stimulus to a remote area of the body. Diminished CPM is believed to reflect dysfunction of descending endogenous pain modulatory systems[55] and has been observed in individuals with fibromyalgia,[25,27] irritable bowel

Received March 20, 2015; Revised May 5, 2015; Accepted June 9, 2015.
Research was funded in part by grants from the National Institute of Health (UL1 RR024975/TR000445, U54 RR026140/MD007593, G12 RR003032/MD007586, R01 MH068391, K01 MH101403, RO1 DA017805, R24 DA021471, R01 DA031726, R01 DA037891, R01 HD23264), by NICHD Grant P30HD15052 to the Vanderbilt Kennedy Center for Research on Human Development, by the Endowed Chair in Brain and Behavior Research at Meharry Medical College (U.R.), and by the Betsey R. Bush Endowed Professorship in Behavioral Health at the University of Tennessee (U.R.). These funding agencies had no further role in the study design, data collection, analysis or interpretation of data, writing of the report, or the decision to submit the manuscript for publication.
The authors report no conflicts of interest.
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1526-5900/$36.00

http://dx.doi.org/10.1016/j.jpain.2015.06.001

syndrome,[24,60] temporomandibular disorder,[24] and chronic headache.[38] In addition, diminished CPM in healthy individuals has been linked to increased bodily pain and poorer physical functioning.[16] Hence, diminished CPM has been investigated as a potential mechanism of, or as a biomarker of risk for developing, chronic pain.[55,61]

A recent review of racial differences in evoked pain responses highlighted a paucity of studies examining CPM.[42] Although diminished CPM was reported in African Americans compared with non-Hispanic whites in one study of healthy adults,[5] other studies reported no racial differences in CPM in healthy young adults[19] or in middle-aged and older adults.[45] A study of older adults with knee osteoarthritis found significant racial differences in CPM, such that non-Hispanic whites did not evince CPM and African Americans reported higher pain ratings during application of the conditioning stimulus, which is consistent with pain facilitation.[10] These inconsistencies suggest that it is premature to draw firm conclusions regarding the existence of racial differences in CPM. A second gap in the literature is that few studies on evoked pain have been conducted in healthy youth.[2,31,36] One study found that African American youth reported lower evoked pain intensity than did non-Hispanic white youth,[31] and we have recently reported diminished temporal summation of second pain in African American compared with non-Hispanic white youth.[37] To our knowledge, whether racial differences in CPM are present in youth without chronic pain has not been examined.

A prospective study of pain-free individuals revealed that diminished CPM measured preoperatively predicted increased risk for developing chronic postoperative pain[63]; this finding suggests that individual differences in CPM efficiency could help to identify those at risk for developing chronic pain. If healthy African American youth demonstrate impaired CPM relative to non-Hispanic white youth, this might suggest that racial differences in pain responsiveness emerge relatively early in life and may be linked to differences in descending endogenous pain inhibitory systems and predict differential risk for developing chronic pain in the future. Given previous work showing greater evoked pain responsiveness in African Americans compared with non-Hispanic whites, our primary hypothesis in the current cross-sectional study was that African American youth would exhibit diminished CPM compared with non-Hispanic white youth.

# Methods

## *Participants*

Participants were recruited from the Adolescent and Young Adult Health Clinic at the Monroe Carrell Jr. Children's Hospital at Vanderbilt University and from a research recruitment Web site through the Vanderbilt Kennedy Center. The adolescent and young adult clinic provides primary care for youth living in metropolitan Nashville and surrounding counties, including routine annual physical examinations. Study procedures were approved by the Meharry Medical College and Vanderbilt University institutional review boards. All participants and their parents provided written informed assent and consent, respectively, before beginning the study procedures.

Exclusion criteria were as follows: chronic pain (defined as daily clinical pain ≥3 months in duration), use of prescription opioid analgesics, learning difficulties requiring full-time special education services, sunburn or painful dermatological conditions at the time of the laboratory assessment, and pregnancy. All females who reported having had menarche provided urine samples for a pregnancy test before the pain testing protocol (no female participants were excluded because of pregnancy).

## *Measures*

### Demographic Information

Participants provided information on age, sex, and race by self-report.

### Pubertal Maturation

Tanner staging was conducted based on pictorial representations of genital/breast development provided by youth self-report.[32,33] Tanner stages 1 and 2 reflect development up to the onset of puberty, and Tanner stages 3 to 5 reflect postpubertal development. A dichotomous score was derived for each participant (stages 1 or 2 = 0; stages 3–5 = 1). Menarchal status of females was determined by self-report.

### Socioeconomic Status

Socioeconomic status (SES) was calculated using the Hollingshead 4-factor index (Hollingshead AB: Four Factor Index of Social Status. Yale University: Unpublished manuscript, 1975), which is a composite of parents' education and occupation.

### Somatic Symptoms

The Children's Somatization Inventory revised form[56] was used to determine the perceived severity of somatic symptoms (eg, headache, dizziness, nausea, back pain) in the past 2 weeks. Participants reported how much they were bothered by 24 somatic symptoms on a 5-point scale ranging from "not at all" (0) to "a whole lot" (4). Items were summed, and total scores ranged between 0 and 96. In this sample, coefficient $\alpha$ for the Children's Somatization Inventory was .84.

### Pain Catastrophizing

The Pain Catastrophizing Scale for Children[9,51] is a 13-item self-reporting questionnaire assessing the degree to which youth catastrophize about their pain (0 = "not at all" to 4 = "very much"). Items were summed, and total scores ranged between 0 and 52, with higher scores indicating greater catastrophizing. In this sample, coefficient $\alpha$ for the Pain Catastrophizing Scale for Children was .90.