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4 **Title:** In-vivo praying and catastrophizing mediate the race differences in experimental pain  
5 sensitivity  
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27 **Running Head:** Praying, catastrophizing, race, and pain  
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30 **Declaration:**

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4 **Abstract**  
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7 Black individuals have a lower tolerance for experimental pain than White individuals. Black and  
8 White individuals also differ in their use of pain coping strategies, which may explain the race  
9 differences in pain sensitivity. We examined the extent to which situation-specific pain coping  
10 mediated Black-White differences in pain sensitivity. We hypothesized that: (1) Black  
11 participants would demonstrate lower pain tolerance than White participants, (2) Black  
12 participants would use different pain coping strategies than White participants, and (3) the  
13 differential use of these strategies would mediate the relationship between race and pain  
14 tolerance. Healthy college undergraduates (N=190) participated in a cold pressor task and then  
15 completed the CSQ-R to assess their situation-specific pain coping. Compared to White  
16 participants, Black participants demonstrated lower pain tolerance, engaged in more situation-  
17 specific catastrophizing and praying, and ignored pain less frequently. Catastrophizing and  
18 praying were inversely related to pain tolerance and were significant mediators of the  
19 relationship between race and pain tolerance. The indirect effect of praying was stronger than  
20 that of catastrophizing. Race differences in pain sensitivity may be due, in part, to differences in  
21 the use of catastrophizing and praying as coping strategies. These results may help guide  
22 treatments addressing maladaptive pain coping.  
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32 **Perspective:**  
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34 This study suggests that race differences in pain sensitivity may be due, in part, to the  
35 differential use of catastrophizing and praying strategies. Psychosocial treatments for pain  
36 should encourage patients to take an active role in their pain management.  
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40 **Keywords:** Race; Catastrophizing; Praying; Experimental Pain; Coping  
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## Introduction

Chronic pain affects approximately 100 million Americans and is associated with \$635 billion in annual medical treatment and lost productivity<sup>25</sup>. Although ubiquitous, the experience of pain differs based on race and ethnicity. Compared to non-Hispanic Whites, Black individuals have a heightened sensitivity to both clinical and experimental pain<sup>6,10,14,34,39,45</sup>. Not only are Black individuals more sensitive to pain, but they report more pain-related interference and disability than non-Hispanic Whites<sup>8,14</sup>. Given the personal and public health burden of chronic pain, it is important to better understand these racial differences in order to optimize pain care for all patients.

Coping is one of the most widely studied psychosocial constructs in pain, and may help explain race differences in pain sensitivity. Racial groups differ in their use of pain coping strategies. Black individuals engage in pain-related praying and catastrophizing more than non-Hispanic Whites, while non-Hispanic Whites more often use ignoring strategies<sup>8,22,26</sup>. These differences may be particularly important to understanding racial differences in pain sensitivity, as previous studies have found that catastrophizing and praying are associated with increased pain sensitivity, while ignoring strategies are associated with less pain<sup>15,26,37</sup>.

Most of the coping literature has focused on the strategies individuals use when they experience pain (i.e., general pain coping). More recently, several studies have examined situation-specific (i.e., in-vivo) pain coping. Unlike general pain coping, situation-specific pain coping refers to the techniques used to manage pain during a specific task, such as an experimental cold pressor task (CPT). For example, several studies found the association between situation-specific catastrophizing, a cognitive-affective response to pain, and experimental pain sensitivity was stronger than that between general coping strategies and pain sensitivity<sup>11,12</sup>. Moreover, Fabian and colleagues found that Blacks reported greater situation-specific catastrophizing, but not general catastrophizing, than Whites and that situational-specific catastrophizing mediated the relationship between race and tolerance for experimental cold pain<sup>16</sup>. Although the relationship between pain, race, and situation-specific catastrophizing has been examined, to our knowledge, no studies have examined other situation-specific coping strategies in the context of race differences in pain sensitivity. Such studies will enhance understanding of racial differences in pain and may eventually lead to individualized clinical approaches targeting these strategies.

The goal of the current study was to examine situation-specific coping strategies as potential mediators of the relationship between race and experimental pain sensitivity. We hypothesized that (1) Black participants would engage in praying and catastrophizing strategies more and ignoring strategies less than White participants, and (2) the differential use of situation-specific coping strategies would mediate the relationship between race and pain sensitivity.

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4 **Methods**  
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7 *Participants*  
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9 Participants were 190 healthy undergraduates from Indiana University-Purdue  
10 University Indianapolis (IUPUI). Potential participants were excluded if they met any of the  
11 following exclusion criteria: chronic pain, circulatory problems, hypertension, diabetes, heart or  
12 vascular disease, a history of fainting spells, a seizure disorder, Raynaud’s Disease, Sick Cell  
13 Anemia, a recently sprained or fractured wrist or hand, pregnancy, or previous participation in a  
14 cold pressor pain task (CPT).  
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17 *Procedures*  
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19 All procedures were approved by the University’s Institutional Review Board. Students  
20 interested in participating in the study were contacted via telephone to answer a number of  
21 health-related questions and determine study eligibility. Eligible participants scheduled a time  
22 to complete the study individually in a laboratory at IUPUI.  
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25 Upon arrival, all participants provided informed consent to participate. Next, they  
26 completed a questionnaire to rule out use of analgesic medications within the past 24 hours  
27 and consumption of caffeine and alcohol within the last two hours. Participants who had used  
28 analgesic medications or consumed caffeine or alcohol were rescheduled. Prior to the CPT,  
29 participants completed a computerized demographic questionnaire. During the CPT,  
30 participants were asked to submerge their non-dominant hand up to their wrist into a  
31 circulating bath of 2° Celsius water (Thermo Scientific Arctic Series Refrigerated Bath  
32 Circulator). They were instructed to leave their hand in the water until they could no longer  
33 tolerate the sensation. Participants were asked to say ‘pain’ as soon as they experienced any  
34 painful sensations. While their hand was submerged in the water, participants rated the  
35 intensity of their pain every 10 seconds using written visual analog scales (VAS). When the  
36 participants were no longer able to tolerate the sensation, they were asked to say ‘pain limit’  
37 and complete one last VAS rating upon removing their hand from the water. Participants who  
38 had not reached pain tolerance after three minutes were asked to remove their hand from the  
39 water and make a final VAS rating. After completing the CPT, participants completed a modified  
40 version of the Coping Strategies Questionnaire-Revised (CSQ-R) measuring situation-specific  
41 (“in-vivo”) coping strategy use during the CPT. They were then debriefed and compensated  
42 with either class credit or a \$10 Amazon gift card.  
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52 **COLD PAIN THRESHOLD AND TOLERANCE**

53 Pain threshold was determined by measuring the amount of time in seconds each  
54 participant’s hand remained in the water before saying ‘pain.’ Pain tolerance was the total  
55 number of seconds elapsed at the time of withdrawal from the cold pressor.  
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58 **PAIN INTENSITY**  
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4 During the CPT, participants were prompted every 10 seconds to rate their pain  
5 intensity on a VAS (0-100) with anchors of ‘no pain’ and ‘worst pain imaginable.’

#### 6 PAIN COPING

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8 The *Coping Strategies Questionnaire-Revised* (CSQ-R) is a 27-item self-report measure of  
9 pain-related coping<sup>35</sup>. The CSQ-R consists of six cognitive strategies (diverting attention,  
10 reinterpreting pain sensations, coping self-statements, ignoring pain sensations,  
11 praying/hoping, and catastrophizing) that were retained from the original CSQ. Participants  
12 rated how often they use each strategy to cope with pain from 0 (never do that) to 6 (always do  
13 that). Consistent with previous studies, the instructions for the CSQ-R were revised to measure  
14 situation-specific coping, such that participants were asked to rate how often they used each  
15 strategy to cope with the pain they experienced during the CPT<sup>7,12,20,24</sup>. The CSQ-R has a more  
16 refined factor structure than the original CSQ, with subscale reliability ranging from 0.72 to  
17 0.86<sup>35,36</sup>. The 6-factor structure reported by Hastie, Riley & Fillingim<sup>22</sup> was retained in this  
18 sample with good overall ( $\alpha = 0.85$ ) and subscale (range of  $\alpha = 0.83-0.91$ ) reliability.

#### 19 Data Analysis

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21 Independent samples *t*-tests were used to identify race differences in pain sensitivity  
22 and coping variables. Pearson’s correlations were used to evaluate the bivariate associations  
23 among coping variables and measures of pain sensitivity.

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25 A multiple mediation analysis was conducted to test our hypotheses that coping  
26 strategy use would mediate the association between race and pain tolerance. In a multiple  
27 mediation model, one can test both the overall mediation effect for all mediators included in  
28 the model (i.e., total indirect effect) and the effects of each mediator independently (i.e.,  
29 specific indirect effects). Specific indirect effects are interpreted as the indirect (i.e., mediation)  
30 effect of the independent variable (race) on the dependent variable (pain tolerance) through a  
31 given mediator (coping strategy), controlling for all other mediators in the model<sup>33</sup>. The total  
32 indirect effect is interpreted as the indirect effect of the independent variable on the  
33 dependent variable through all of the mediators in the model. This multiple mediation analysis  
34 was conducted using Preacher and Hayes’ bootstrapping procedures and SPSS Macros<sup>32,33</sup>. The  
35 bootstrapping procedure, unlike the Sobel test, is a nonparametric procedure that does not  
36 assume that the indirect effects (path  $a \times b$ ) of the independent variable on the dependent  
37 variable are normally distributed. The bootstrapped mediation analysis indicates whether the  
38 total effect (path  $c$ ) of race on pain tolerance is composed of a significant direct effect of race  
39 on tolerance (path  $c'$ ) and a significant indirect effect of race on tolerance through one or more  
40 mediators (coping strategies). Path  $a$  denotes the effect of race on the mediator(s), whereas  
41 path  $b$  is the effect of the mediator(s) on pain tolerance. Tests of mediation were based on  
42 3,000 bootstrap resamples to produce the 95% confidence intervals for each candidate  
43 mediator and were used to test the significance of both total and specific indirect effects.

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4 Mediation models are considered significant if zero is not contained within the 95% confidence  
5 intervals<sup>32,33</sup>.  
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## 8 **Results**

### 9 *Participant Characteristics*

10 Participant demographic characteristics can be found in Table 1. The sample consisted  
11 of 190 Black and non-Hispanic White participants. The sample was primarily female (73.7%) and  
12 non-Hispanic White (56.8%). The gender distribution between Black and White participants did  
13 not significantly differ ( $\chi^2_{(1)} = .02, p = .89, \nu = .01$ ). The mean age for Black [23.15 years (7.64)]  
14 and White [21.81 years (6.11)] participants did not significantly differ ( $t_{(188)} = 1.30, p = .19, d =$   
15 .20).  
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### 22 *Race Differences in Pain Sensitivity and Psychological Variables*

23 The results of independent samples *t*-tests (see Table 2) indicated that Black  
24 participants exhibited a lower pain tolerance ( $t_{(188)} = 4.85, p < .01; d = 0.69$ ) and reported less  
25 pain at tolerance ( $t_{(186)} = -2.18, p < .05; d = 0.38$ ) than did White participants. There were no  
26 significant race differences in pain threshold ( $t_{(188)} = -0.44, p = .66, d = 0.07$ ). Black participants  
27 engaged in situation-specific catastrophizing ( $t_{(188)} = -0.38, p < .01, d = 0.56$ ) and praying ( $t_{(188)} =$   
28  $-8.13, p < .01, d = 1.25$ ) more than White participants, while White participants ignored pain  
29 more frequently than Blacks ( $t_{(188)} = 3.25, p < .01, d = .48$ ). There were no significant race  
30 differences in the use of distraction, distancing, or coping self-statements (all *p* values  $> .05$ ).  
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### 37 *Bivariate Associations Between Pain and Psychological Variables*

38 Pearson correlations among pain and psychological variables are shown in Table 3.  
39 Situation-specific catastrophizing ( $r = -0.34, p < .01$ ) and praying ( $r = -0.40, p < .05$ ) were  
40 negatively related to pain tolerance, while situation-specific ignoring ( $r = 0.29, p < .01$ ) and  
41 distancing ( $r = 0.15, p < .05$ ) were positively associated with pain tolerance. Pain intensity at  
42 tolerance was not significantly associated with any of the coping strategies (all *p* values  $> .05$ ).  
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### 47 *Mediation*

48 The potential mediating role of coping strategy use in the association between race and  
49 pain tolerance was examined using a bias-corrected (BC) bootstrapped multiple mediation  
50 analysis with 3000 bootstrap re-samples. Results of the multiple mediation analysis indicated  
51 that in-vivo coping accounted for 29% of the variance in pain tolerance and significantly  
52 mediated the relationship between race and pain tolerance (see Table 4). Results also indicated  
53 significant effects of race on catastrophizing, praying, and ignoring ( $t = 3.78, p < .01; t = 8.51, p$   
54  $< .01; t = -3.25, p < .01$ ; respectively) and significant direct effects of catastrophizing and praying  
55 on pain tolerance ( $t = -3.18, p < .01; t = -4.40, p < .01$ ; respectively). The indirect effects of both  
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4 catastrophizing and praying were significant, as the 95% CI did not include zero. Thus, both  
5 catastrophizing and praying individually mediated the association between race and pain  
6 tolerance. Finally, the 95% CI was examined for the contrast between the indirect effects of  
7 catastrophizing and praying to determine whether the indirect effects of catastrophizing and  
8 praying were significantly different from each other. The 95% CI did not include zero, indicating  
9 that the indirect effect of praying was statistically different than the indirect effect of  
10 catastrophizing (see Table 4). Although this analysis does not identify which effect is larger, an  
11 ocular inspection of the point estimates of each indirect effect indicates that the indirect effect  
12 of praying is stronger than the indirect effect of catastrophizing. These findings indicated that  
13 the effect of race on pain tolerance was mediated by overall coping strategy use but more  
14 specifically by the use of catastrophizing and praying, with the strongest indirect effect through  
15 praying.  
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## 23 Discussion

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25 There are well-documented race differences in experimental pain sensitivity, with Black  
26 individuals having a lower tolerance than White individuals for heat, cold, and ischemic  
27 pain<sup>6,13,14,46</sup>. Various psychosocial factors may account for these differences. We examined  
28 situation-specific (i.e., in-vivo) pain coping strategies as potential mediators of the association  
29 between race and experimental pain sensitivity. We found that, compared to Whites, Blacks  
30 demonstrated a lower tolerance to experimental cold pain, and this difference was mediated by  
31 race differences in situation-specific coping. More specifically, race differences in pain tolerance  
32 were mediated by race differences in situation-specific catastrophizing and praying. Black  
33 participants catastrophized and prayed more than White participants during the CPT, and these  
34 differences were associated with a lower pain tolerance demonstrated by Black participants.  
35 When compared directly, the relationship between race and pain tolerance was more strongly  
36 associated with the use of praying than catastrophizing.  
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43 Consistent with our hypotheses, there were several race differences in the use of  
44 situation-specific pain coping strategies. Compared to Whites, Black participants engaged in  
45 more catastrophizing and praying but less ignoring strategies. This is consistent with previous  
46 literature examining general (i.e., dispositional) pain coping<sup>8,22,26</sup>. The current study provides  
47 novel information about race differences in situation-specific coping strategies, which, to date,  
48 have only been reported for catastrophizing.  
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52 Results of our multiple mediation analysis indicate that Black participants not only  
53 prayed and catastrophized more than Whites in response to pain, but that these differences  
54 may help explain why Blacks had a lower pain tolerance than Whites. This is consistent with a  
55 previous investigation identifying general catastrophizing as a mediator of the race differences  
56 in pain sensitivity<sup>17</sup>. Pain catastrophizing, as measured by the CSQ, is a passive, cognitive coping  
57 strategy involving perceptions of helplessness (e.g., “It’s terrible and I think it’s never going to  
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4 get any better.”)<sup>37</sup>. Pain catastrophizing is suggested to increase pain sensitivity through  
5 enhanced attention to painful stimuli as well as heightened emotional responses to pain.  
6 Indeed, catastrophizing has been associated with increased activity in brain areas related to  
7 anticipation of pain, attention to pain, and emotional aspects of pain and motor control<sup>21,38</sup>.  
8 Those who catastrophize about pain preferentially process pain-related information and  
9 interpret even ambiguous sensations as painful<sup>41</sup>. Taken together with previous findings, our  
10 results suggest that one reason Blacks are more sensitive to pain than Whites may be their  
11 tendency to catastrophize more.  
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16 It is interesting to note, however, that the mediation effect of praying was more robust  
17 than that of catastrophizing. The church plays a central role within the Black community.  
18 Compared to Whites, Blacks attend church more, read religious materials more, listen to  
19 religious programs more, request prayer from others more, self identify as more religious, and  
20 place higher importance on religion<sup>9</sup>. Thus, Blacks might be expected to pray more than Whites  
21 in general and in response to situational stressors such as illness, discrimination, and  
22 socioeconomic hardship that affect Blacks at higher rates than Whites<sup>3, 19,23,27,28,40</sup>. Our finding  
23 that Black participants prayed more in response to pain is consistent with this body of  
24 literature.  
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30 Although the race differences in prayer and religion are well defined, the mechanism of  
31 how praying impacts pain sensitivity is less clear. Perhaps it is an effect driven by our  
32 measurement of prayer as a coping strategy. Prayer, as measured by the CSQ, is a passive  
33 coping strategy associated with avoidance<sup>1,30</sup>. Previous research suggests that passive coping  
34 and avoidance are related to worse pain and functioning and increased rates of  
35 disability<sup>4,5,30,31,44</sup>. Thus, Blacks’ more frequent engagement in a passive type of prayer (i.e.,  
36 praying for pain to stop) may reduce their ability to tolerate pain. Whether such an effect is  
37 driven by prayer, per se, or the fact that this type of prayer is passive in nature remains to be  
38 known. Future studies should consider alternative measures of prayer, such as the Prayer  
39 Functions Scale<sup>2</sup> or the Multidimensional Prayer Inventory<sup>29</sup>, that more broadly conceptualize  
40 prayer beyond passive strategies; such work would facilitate better understanding of its  
41 relationship to pain, and more specifically as a putative mechanism of race differences in pain  
42 sensitivity. Furthermore, because there are racial differences in religious affiliation<sup>9</sup>, future  
43 investigations should examine religious affiliation as a potential moderator of the relationship  
44 between race, praying, and pain.  
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52 These results have potentially important clinical implications. Geisser and colleagues  
53 provide evidence to suggest that maladaptive coping is a more important determinant in pain  
54 sensitivity than is adaptive coping<sup>18</sup>. One implication is that psychosocial treatments for chronic  
55 pain may need to focus more on reducing maladaptive coping; increasing adaptive coping  
56 should be a secondary goal. Indeed, reducing catastrophic cognitions is already a primary focus  
57 of some psychological treatments for pain<sup>42,43</sup>. Our results support this clinical emphasis.  
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4 Although praying has also been linked to greater pain sensitivity, we do not recommend that  
5 clinicians attempt to dissuade patients from praying. Not only is there insufficient scientific  
6 support for such an attempt, but it would also likely backfire, alienate the patient, and harm the  
7 clinical relationship. Rather, it seems reasonable and consistent with the evidence to encourage  
8 patients to take a more active role in their treatment, which may include adopting a more  
9 active type of prayer in the context of pain. Instead of using prayer to passively seek pain  
10 reduction or elimination, patients could be encouraged to achieve greater empowerment from  
11 their higher power, such as praying for the strength to overcome their pain and/or persist in  
12 valued life activities in the midst of pain. Such an emphasis is consistent with current evidence  
13 and the spirit of patient-centered care.  
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19 Several limitations should be considered when interpreting these findings. Because the  
20 study sample was comprised of healthy college-aged adults, generalizing these results to  
21 chronic pain patients may be limited. Relatedly, the relationship between race and coping with  
22 acute experimentally-induced pain may differ from that of chronic pain. Future research should  
23 examine race differences in situation-specific coping use within a chronic pain population,  
24 perhaps during a pain flare. We examined only one method of experimental pain – the cold  
25 pressor task; thus, future studies should attempt to replicate these findings in other  
26 experimental modalities (e.g., heat, pressure). Additionally, because we did not measure  
27 general (i.e., trait level) pain coping, these results do not speak to its relationships to race and  
28 pain sensitivity. Finally, it is possible that differences in pain sensitivity actually drove the racial  
29 differences in coping strategies. Future studies could experimentally manipulate the use of  
30 coping strategies to elucidate the causal nature of the relationship between race, pain, and  
31 coping.  
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38 Despite these limitations, our study provides new insights into the putative mechanisms  
39 that underlie the associations between race and pain sensitivity. We found that compared to  
40 White individuals, Black individuals demonstrated a lower tolerance for experimental cold pain,  
41 which may be related to their increased use of praying and catastrophizing as pain coping  
42 strategies. Our results suggest that in addition to focusing on reducing catastrophic  
43 cognitions<sup>42,43</sup>, psychosocial treatments for chronic pain should encourage patients to take a  
44 more active role in their treatment rather than passively praying for relief. Further, the present  
45 findings support the need to examine a broader conceptualization of prayer in order to  
46 elucidate the aspects of prayer that influence pain sensitivity.  
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**Figure Legend**

*Figure 1.* The mediating effect of coping strategies in the association between race and pain tolerance.

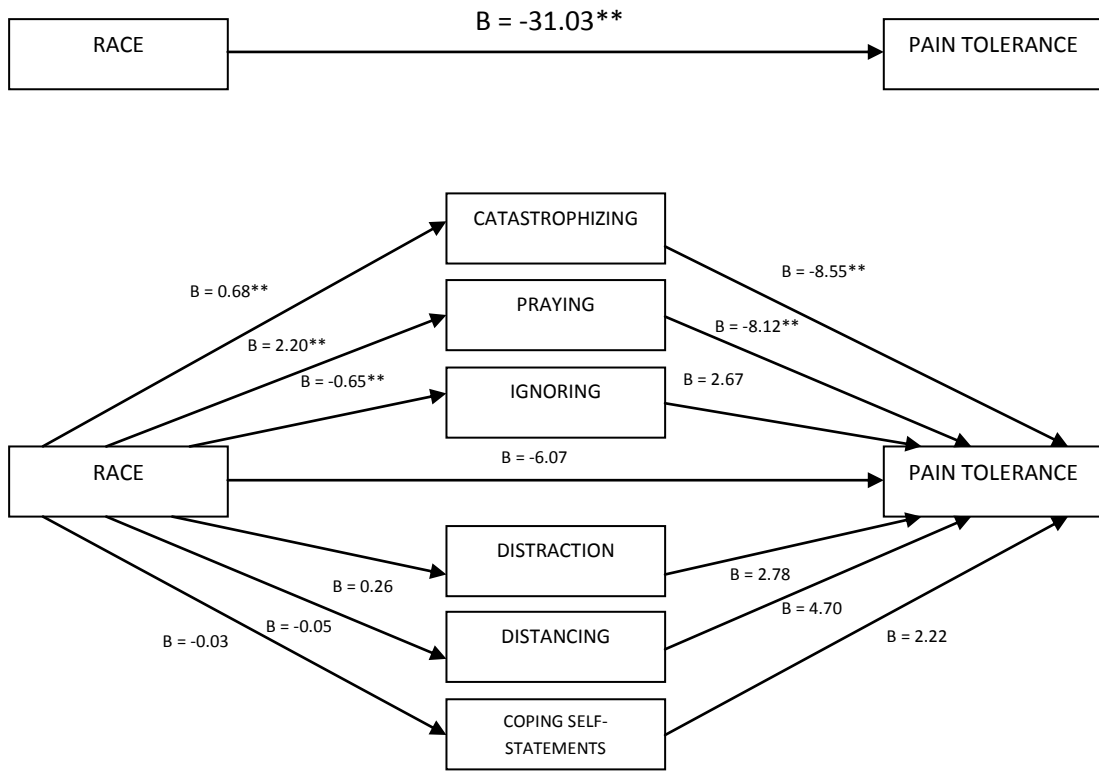
*Table 1:* Participant demographic characteristics

*Table 2:* Race differences in pain sensitivity and psychological variables

*Table 3:* Pearson's correlations among pain sensitivity and situation-specific coping

*Table 4:* Bootstrapped multiple mediation analysis testing indirect effects of race on pain tolerance through pain coping

Figure 1. The mediating effect of coping strategies in the association between race and pain tolerance.



\* $p < .05$

\*\* $p < .01$

B = unstandardized regression coefficients

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Table 1. Participant Demographic Characteristics

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Variable	Black (N = 82)	White (N = 108)	<i>p</i> value
Age (years)	23.15 ± 7.64	21.81 ± 6.11	0.19
Female (%)	60 (73.2)	80 (74.1)	1.00

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Table 2. Race Differences in Pain Sensitivity and Psychological Variables

Variable	Black (N = 82)	White (N = 108)	<i>t</i> -value	Cohen's <i>d</i>
Pain Threshold (seconds)	18.45 ± 16.53	17.27 ± 19.06	-0.44	0.07
Pain Tolerance (seconds)	48.99 ± 37.89	80.03 ± 50.36	4.85**	0.69
Distraction	3.10 ± 1.60	2.85 ± 1.43	-1.16	0.17
Catastrophizing	3.24 ± 1.27	2.56 ± 1.19	-3.78**	0.56
Ignoring	3.34 ± 1.36	3.98 ± 1.35	3.25**	0.48
Distancing	2.54 ± 1.60	2.59 ± 1.47	0.21	0.03
Self-statements	5.08 ± 1.40	5.11 ± 1.14	0.14	0.02
Praying	4.59 ± 2.09	2.39 ± 1.48	-8.13**	1.25
Pain Rating at Tolerance	72.94 ± 25.58	80.24 ± 18.26	2.18*	0.33

\*  $p < 0.05$

\*\*  $p < 0.01$



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Table 3. Pearson's Correlations Among Pain Sensitivity and Situation-Specific Coping

Variable	1	2	3	4	5	6	7	8
1 Pain Threshold	---							
2 Pain Tolerance	0.280**	---						
3 Distraction	0.109	0.031	---					
4 Catastrophizing	-0.103	-0.341**	0.057	---				
5 Ignoring	0.036	0.288**	0.305**	-0.268**	---			
6 Distancing	-0.012	0.145*	0.331**	0.164*	0.464**	---		
7 Coping Self-statements	0.055	0.117	0.152*	-0.057	0.421**	0.183*	---	
8 Praying	-0.05	-0.402**	0.342**	0.293**	-0.043	0.125	0.078	---
9 Pain at Tolerance	-0.005	-0.061	-0.098	0.098	0.001	-0.030	0.009	-0.105

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

Table 4. Bootstrapped Multiple Mediation Analysis Testing Indirect Effects of Race on Pain Tolerance through Pain Coping

	Point Estimate	Bootstrapping BC 95% CI	
		Lower	Upper
<b>Indirect Effects</b>			
Total	-24.96	-36.16	-15.87
Catastrophizing	-5.80	-11.16	-2.44
Praying	-17.87	-27.35	-10.22
Ignoring	-1.72	-7.18	1.60
Distraction	0.71	-0.37	3.84
Distancing	-0.22	-3.50	1.81
Coping Self-statements	-0.06	-1.97	0.84
<b>Contrast</b>			
Catastrophizing vs. Praying	12.07	3.49	22.01