Racial and Weight Discrimination Associations with Pain Intensity and Pain Interference in An Ethnically Diverse Sample of Adults with Obesity: A Baseline Analysis of the Clustered Randomized-Controlled Clinical Trial the Goals for Eating and Moving (GEM) Study

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Abstract

Background: Everyday experiences with racial (RD) and weight discrimination (WD) are risk factors for chronic pain in ethnically diverse adults with obesity. However, the individual or combined effects of RD or WD on pain in adults with obesity is not well understood. There are gender differences and sexual dimorphisms in nociception and pain, but the effect of gender on relationships between RD and WD in ethnically diverse adults with obesity has not been examined. The goals of this study were to: 1) examine whether weight and racial discrimination are associated with pain intensity and interference, and 2) explore gender as a moderator of the effects of WD and RD on pain.

Methods: This is a baseline data analysis from a randomized controlled weight-management trial. Eligible participants were English or Spanish-speaking (ages 18-69 years) and had either a body mass index of $\geq 30 \text{ kg/m}^2$ or $\geq 25 \text{ kg/m}^2$ with weight-related comorbidity. WD and RD were measured using the Experiences of Discrimination questionnaire (EOD). Pain outcome (pain interference and intensity) were measured using the PROMIS 29 adult profile V2.1. Linear regression models were performed to determine the associations between WD, RD, and gender, with pain outcomes.

Results. On average participants reported mild pain interference (T-score: 52.65 ± 10.29) and moderate pain intensity (4.23 ± 3.15 , scale: 0-10). There was a significant interaction effect of RD and gender on pain interference. RD was more strongly associated with pain interference in women ($b = .47$, $SE = .08$, $p < .001$), compared to men ($b = .14$, $SE = .07$, $p = .06$). There were no significant interaction effects between RD and gender on pain intensity, or between WD and gender on pain interference or intensity.

Conclusions: Pain is highly prevalent in adults with obesity, and is impacted by experiences of racial and weight discrimination. Further, discrimination against adults with obesity and chronic pain could exacerbate existing racial disparities in pain and weight management. Asking ethnically diverse adults with obesity about their pain and their experiences of racial and weight discrimination could help clinicians make culturally informed decisions that address barriers to pain relief and weight loss.

Trial Registration: NCT03006328

Background

Discrimination involves negative attitudes or unequal treatment towards individuals based on their characteristics (e.g., race, gender, weight status).(1–3) Research suggests that frequent experiences with discrimination may be a stronger risk factor for pain among racialized groups than their White counterparts,(1) potentially due to Non-Hispanic Black (NHB) and Hispanic/Latino/a/x adults being at risk of multiple forms of discrimination. Particularly NHB and Hispanic/Latino/a/x adults may experience weight-based discrimination in addition to racial discrimination because obesity is highly prevalent among NHB and Latino/a/x adults.(4) Understanding how discrimination may impact pain experiences among individuals with obesity is important given that pain is an established weight-related comorbidity, (5–7) and may further worsen health by functioning as a barrier to weight loss.(8)

Pain disparities associated with racial discrimination (RD) have been studied extensively. RD has been associated with higher pain intensity,(3) more pain-related disability,(3) more bodily pain,(9) and lower pain tolerance.(10) In addition, weight discrimination (WD) is also a prevalent form of discrimination in the U.S.(2, 11–13) and is associated with a wide variety of negative pain-related outcomes, including functional disability,(14) psychiatric comorbidities,(15) weight gain,(16, 17) lower health-related quality of life,(18) and higher mortality.(19) Nonetheless, little is known about the impact of WD on the burden of pain, especially among NHB and Hispanic/Latino/a/x adults with obesity, who tend to be underrepresented in pain studies.

Research investigating multiple forms of discrimination suggest that characteristics that are perceived in society as ‘modifiable’ (e.g. weight) are likely to have a stronger negative effect on psychological health outcomes associated with pain and weight management than discrimination based on ‘non-modifiable’ factors such as race and ethnicity.(20) Other studies found a dose-response relationship between multiple forms of discrimination and cardiovascular risk,(21) and that WD, but not RD, was significantly associated obesity risk.(19) Based on these findings, it is likely multiple forms of discrimination contribute to the burden of pain among NHB and Hispanic/Latino/a/x individuals. However, studies have not partitioned the effects of racial and weight discrimination on the risk of pain and disability.

Discrimination-related experiences may impact women and men differently.(1, 22) Some evidence suggests that women are more likely to experience negative pain-related health consequences (e.g., psychological stress, anxiety, and pain catastrophizing)(20, 23) associated with discrimination, potentially due to the use of maladaptive coping strategies.(24) Female body ideals shared within a society may increase women’s risk for encountering WD and exacerbate the negative impact of WD experiences.(13, 25) Gender differences in the association between discrimination and pain are understudied in ethnically diverse populations with obesity, in part, due to an underrepresentation of men in weight management research.(26, 27)

Thus, the primary aim of this study was to examine whether weight and racial discrimination are associated with pain intensity and interference in a racially diverse sample of adults with obesity.(28, 29) Our secondary aim was to explore gender as a moderator of the effects of WD and RD on pain. We hypothesized that more experiences with the combination of RD and WD would be associated with higher pain intensity and greater pain interference. The goal of this analysis is to help identify additional pain mechanisms among individuals with obesity.

Methods

Participants, Study Design, and Setting

This is an analysis of baseline data from a randomized, controlled clinical trial (RCT) to test the efficacy of technology-assisted health coaching intervention on weight management at two diverse urban healthcare systems in New York City: VA New York Harbor Healthcare System Manhattan Campus (VA)

and four Montefiore Medical Group (MMG) primary care practices. The four MMG practices – Bronx East, Castle Hill, Grand Concourse, and University Avenue—are affiliated with the New York City Research and Improvement Networking Group. The trial was registered at clinicaltrials.gov (NCT03006328, December 30, 2016). The sample consisted of 483 primary care patients enrolled in this RCT. Study methods for the clinical trial are published in detail elsewhere.⁽³⁰⁾ All methods were performed in accordance with the relevant guidelines and regulations approved by the Institutional Review Boards at NYU School of Medicine (#16–01445), VA NY Harbor (#01624), and Albert Einstein College of Medicine in collaboration with the Montefiore Health System (#2017–7603). All patients gave their informed consent to the study before data collection began. The data were collected between the years 2017 and 2020. At baseline, research assistants conducted in-person visits with patients to assess body measurements (e.g., height and weight) and administer survey measures. Patients received 25 USD in compensation for completing baseline data assessment.

Recruitment. We used queries of electronic health records through the Veterans Health Information Systems and Technology Architecture (VistA), and Clinical Looking Glass™ (CLG), for the VA and MMG, respectively, to identify potentially eligible patients. The majority of patients at the VA identify as male (90%), compared to 48% across the MMG clinics. Patient population at both sites are diverse with 21–55% of patients identifying as Hispanic/Latino/a/x and 37–53% as NHB. We sent out invitation letters and followed up with telephone calls to assess patients' interest in participation. If the patient was interested, we performed a phone screen survey and conducted a chart review when necessary to determine eligibility. Patients were then scheduled for the baseline visit.

Eligibility. Participants were primary care patients with either a body mass index (BMI) of $\geq 30 \text{ kg/m}^2$ (obese) or $\geq 25 \text{ kg/m}^2$ (overweight) with weight-related comorbidity (e.g., arthritis, sleep apnea, hypertension). Eligible participants were English or Spanish-speaking primary care patients between the ages of 18–69 years old who had at least one visit with their primary care provider in the past 24 months, access to a telephone, and the ability to travel for in-person visits. Patients with conditions or medications that may affect weight change or impact their ability to participate were excluded. Excluded conditions included metastatic cancer, current chemotherapy or cancer treatment, diabetes, active psychosis, psychoactive substance use, Parkinson's disease, or health problems that may prohibit the patient from participating in walking and/or physical activity such as chest tightness, a heart condition, or severe arthritis. Excluded medications were those for weight-loss and antipsychotic medications.⁽³¹⁾ We excluded patients with a history of bariatric surgery or who were being evaluated for bariatric surgery, were pregnant, breastfeeding or planning to become pregnant during the intervention period, or participated in intensive weight management programs (> 4 sessions) in the past year. We also excluded patients who did not have self-reported ability to read English or Spanish at the 5th grade level and those with cognitive limitations that prevented them from adequately participating in a weight management program. Additionally, we did not enroll patients who were not interested in losing weight, as well as any patient whose primary care provider stated that they should not participate.

Measures

Demographic characteristics. Data collected from the baseline questionnaire included information on participant demographics. Questions contained information on patient gender, civil status, employment, education, race and ethnicity.

Racial Discrimination. Participants completed the Experiences of Discrimination questionnaire (EOD),(32) which has been studied in patients with obesity and chronic pain.(10, 21, 33, 34) To assess experiences of discrimination due to race or ethnicity, patients were asked, "Have you ever experienced discrimination, been prevented from doing something, or been hassled or made to feel inferior in any of the following situations because of your race, ethnicity or color?" The frequency of nine discrimination experiences was assessed over a patient's lifetime: "at school"; "getting hired"; "at work"; "getting housing"; "getting medical care"; "getting service at a store or restaurant"; "getting credit", "bank loans or a mortgage"; "on the street or in a public place"; and "from the police or courts". Available answer choices included: *never* (0), *yes, once* (1), *yes, 2–3 times* (2.5), and *yes, 4–5 times or more* (5). (Cronbach's Alpha = .84). We combined answers to a frequency sum score ranging from 0 to 45. Higher scores reflect more experiences with racial discrimination.

Weight Discrimination. We assess experienced discrimination due to weight similar to previous studies, which included diverse representative samples.(15, 21, 25, 35) Participants were administered a question from Wave 2 of the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC), which were based on the EOD survey.(32) Participants answered the question, "In the last 12 months, how often did you experience discrimination because of your weight?". The frequency of five scenarios was examined: "in your ability to obtain healthcare or health insurance coverage"; "in the way you were treated when you receive care"; "in public settings, like on the street", "in restaurants or stores or on public transportation like buses or airplanes"; "in obtaining a job, or getting admitted to a school or training program"; and "in any other situation, like in the courts or by the police or when obtaining housing". The response options were *Almost never* (1), *Sometimes* (2), *Fairly Often* (3), and *Very Often* (4). If participants responded *Sometimes*, *Fairly often*, or *Very Often* to any of the questions, we categorized them as reporting weight discrimination. We created a dichotomous variable coding: no reported weight-based discrimination (0) and reported weight-based discrimination (1) for each patient (Cronbach's Alpha = .65). This categorization approach is also consistent with previous studies.(36)

Pain measurement. The pain interference and pain intensity scales of the Patient-Reported Outcomes Measurement Information System (PROMIS) 29 adult profile V2.1 were used to measure chronic pain. The PROMIS-29 has been widely used including in populations with obesity and chronic pain.(37–43) Participants answered four questions addressing pain interference (Cronbach's Alpha = .94): "In the past 7 days, how much did pain interfere with your day to day activities", "work around the house", "your ability to participate in social activities", "with your household chores". Responses were on a scale from one to five, and defined as: *not at all* (1), *a little bit* (2), *somewhat* (3), *quite a bit* (4), *very much* (5). We combined answers to a raw sum score with a minimum of 4 and a maximum of 20. For each participant, we

translated the total raw score into a T-score, which has a mean of 50 and a standard deviation (*SD*) of 10, based on calibration testing performed on a large sample of the general population.(44) A person with a T-score of 40 is, therefore, one *SD* below the average for the United States general population. Additionally, participants rated their pain intensity (“How would you rate your pain on average?”) on a scale from *no pain*(0) to *extreme pain*(10).

BMI. Participants’ BMI was calculated by dividing their weight in kilograms (kg) by the square of their height in meters (m), expressed as kg/m². Body weight and height were collected at baseline. The patients’ height was assessed once using the SECA 213 Portable Height, and the measurements were rounded up to the nearest 0.50 centimeter (cm). Patients were asked to modify hairstyles and remove their shoes as well as any extraneous clothing, if possible. Baseline height was measured twice, and the average was used for analysis. Patient weight measurements were obtained via the HealthOMeter 349KLX Digital Medical Weight Scale using a standardized protocol, which included weighing the patients twice without shoes or heavy garments. Weight was measured twice to the nearest 0.10 pound (lbs.). If the first two weights differed by 0.50 lbs. or more, we repeated the measurement once more and took the average of the two measures closest in value.

Statistical Analysis

Demographic characteristics were summarized using descriptive statistics, with mean and standard deviation for continuous variables or frequencies and percentages for categorical variables. Differences in pain scores and RD scores by demographic characteristics were compared by the Mann–Whitney U test for dichotomous variables, and the Kruskal-Wallis test for categorical variables with more than two levels. Pairwise comparisons were done using Bonferroni correction. Differences in WD by demographic characteristics were compared using the Chi-squared test. Associations between pain scores and race or ethnic discrimination scores were quantified by Spearman’s rho correlation coefficient (r_s). Differences in pain scores by weight discrimination group were compared by the Mann–Whitney U test. We used simultaneous linear regression models to examine independent relationships between WD, RD, and gender and pain intensity and pain interference. We also analyzed the interaction effects of WD, RD, and gender on pain intensity and interference. We chose this model because we have no theoretical basis for considering any variable to be prior to any other. We added BMI, age, and race as confounding variables because they have been shown to be related to discrimination measures (independent variables)(45, 46) and pain measures (dependent variables)(47, 48) in previous research. Race was classified into four categories using indicator variables: Hispanic, Non-Hispanic White (reference group), Non-Hispanic Black, and Non-Hispanic Other. In our sample, enrollment site was associated with both RD and pain interference score and was, hence, also entered as a covariate (Table 1). We entered all main effects and 2- and 3- way interactions among WD, RD, and gender as predictors, with BMI, age and enrollment site entered as covariates. If an interaction effect was significant (at the $p > .05$ level), lower-order interactions and main effects nested beneath were not interpreted. Significant interactions were probed and plotted with the PROCESS macro for SPSS (version 3.04). A two-sided p -value < 0.05 was considered to be

statistically significant, and all analyses were conducted using IBM SPSS Statistics for Windows, Version 25.0 (Armonk, NY: IBM Corp).

Results

Participant Characteristics

Our sample was balanced in gender (56.3% female; 43.7% male) and the average age was 49.66 year ($SD=12.07$). The average BMI was 34.83 kg/m² ($SD=6.18$), which falls in the obese range ($BMI \geq 30$). Almost half of all participants identified as NHB (43.7%) and a little less than half of the participants (40.8%) reported their ethnicity as Hispanic/Latino/a/x. Pain interference had an average T-value of 52.65 ($SD = 10.29$). Pain intensity was 4.23 on average ($SD = 3.15$), and 59.1% of participants reported a pain intensity of 4 or higher on a scale from 0 to 10. Most participants worked full-time or part-time (62.7%). Approximately one-third (33.6%) of participants graduated from a 4-year college with 10% having earned a professional or graduate degree. Almost half (39.3%) of all patients were single/never married, and a similar number (36.2%) were married or in a marriage-like relationship (Table 1).

Differences in Pain Interference and Pain Intensity

Participants enrolled at the VA NY Harbor site reported higher pain interference than participants enrolled at MMG clinics. Patients who were unemployed or looking for work reported higher pain interference than patients who worked full-time. Retired patients experienced greater pain interference compared to patients who worked full or part-time. We did not observe differences in pain scores between gender, racial/ethnic groups, or marital status (Table 1).

Differences in Race and Weight-Based Discrimination

Participants enrolled in at the VA NY Harbor site reported more instances of RD than those enrolled at MMG clinics. Men-identifying participants' average RD scores that were 1.52 times greater than women-identifying participants. Further, NHB had RD scores that were greater than 2.0 times the average score reported by both Non-Hispanic White and Hispanic/Latino/a/x individuals. We did not observe differences in gender, racial/ethnic groups, employment, education, and between those who reported WD and those who did not report WD (Table 1).

Table 1 Participant Characteristics in Pain Outcomes (Intensity and Interference), Racial Discrimination (RD), and Weight Discrimination (WD)						
	Total (n=483)	Pain Intensity	Pain Inter- ference		No WD	WD
				RD		
Enrollment Site						
MMG	241 (49.9%)	4.00 (3.30) ¹	50.98 (9.84)^{1*}	4.91 (6.53)^{1*}	205 (85.1%) ⁴	36 (14.9%) ⁴
VA	242 (50.1%)	4.48 (2.97) ¹	54.35 (10.46)^{1*}	9.32 (9.93)^{1*}	194 (80.1%) ⁴	48 (19.9%) ⁴
Gender						
Women	273 (56.4%)	4.21 (3.22) ¹	52.11 (10.26) ¹	5.79 (7.54)^{1*}	224 (82.3%) ⁴	48 (17.7%) ⁴
Men	211 (43.6%)	4.28 (3.05) ¹	53.40 (10.29) ¹	8.81 (9.71)^{1*}	175 (82.9%) ⁴	36 (17.1%) ⁴
Race/Ethnicity						
Non-Hispanic Black	211 (43.6%)	4.17 (3.17) ²	53.03 (10.44) ²	10.26 (10.07)^{2,a,b}	169 (80.5%) ⁴	41 (19.5%) ⁴
Non-Hispanic White	48 (9.9%)	4.08 (2.77) ²	53.10 (10.83) ²	3.83 (5.66)^{2,a}	39 (81.2%) ⁴	9 (18.8%) ⁴
Non-Hispanic Other	26 (5.4%)	3.56 (3.03) ²	51.27 (12.63) ²	6.76 (8.29) ²	22 (84.0%) ⁴	4 (16.0%) ⁴
Hispanic/Latino/a/x	197 (40.7%)	4.45 (3.21) ²	52.39 (9.71) ²	4.66 (6.44)^{2,b}	167 (84.8%) ⁴	30 (15.2%) ⁴
Employment Status						
Working full-time	247 (51.0%)	3.92 (3.13) ²	51.05 (9.55)^{2,a,b}	6.62 (7.95) ²	206 (83.7%) ⁴	40 (16.3%) ⁴
Working part-time	56 (11.6%)	3.95 (3.30) ²	50.19 (9.42)^{2,c}	4.49 (6.02) ²	51 (91.1%) ⁴	5 (8.9%) ⁴
Unemployed or laid off/Looking for work	62 (12.7%)	4.92 (2.93) ²	55.41 (10.30)^{2,b}	8.83 (10.14) ²	46 (74.8%) ⁴	16 (25.2%) ⁴
Student	15 (3.1%)	3.37 (2.91) ²	53.59 (10.74) ²	5.23 (6.96) ²	12 (80.0%) ⁴	3 (20.0%) ⁴

Keeping house or raising children full time	13 (2.7%)	4.23 (4.02) ²	51.60 (10.85) ²	6.54 (9.66) ²	10 (76.9%) ⁴	3 (23.1%) ⁴
Retired	91 (18.8%)	4.91 (3.02) ²	56.77 (11.20)^{2,a,c}	9.35 (10.42) ²	74 (81.3%) ⁴	17 (18.7%) ⁴
Education						
Grades 5 through 11	20 (4.0%)	4.70 (3.67) ²	51.48 (9.96) ²	3.15 (5.72) ²	16 (80.0%) ⁴	4 (20.0%) ⁴
Grade 12 or GED	112 (22.9%)	4.57 (3.38) ²	52.93 (10.38) ²	6.26 (9.35) ²	89 (80.2%) ⁴	22 (19.8%) ⁴
Associates degree	58 (11.9%)	3.07 (2.99)^{2,a}	51.14 (10.76) ²	6.81 (6.86) ²	52 (89.7%) ⁴	6 (10.3%) ⁴
Some college	133 (27.2%)	4.69 (3.12)^{2,a}	53.39 (10.42) ²	7.20 (8.03) ²	109 (83.7%) ⁴	21 (16.3%) ⁴
College 4 years	102 (20.9%)	3.89 (2.85) ²	52.72 (9.77) ²	7.65 (9.29) ²	83 (83.0%) ⁴	17 (17.0%) ⁴
Some graduate or professional training	12 (2.5%)	4.25 (3.08) ²	53.51 (11.79) ²	10.88 (9.89) ²	7 (58.3%) ⁴	5 (41.7%) ⁴
Graduate or Professional degree	50 (10.2%)	4.28 (2.91) ²	52.25 (10.31) ²	8.63 (9.74) ²	41 (82.0%) ⁴	9 (18.0%) ⁴
Marital Status						
Single/Never Married	190 (39.3%)	3.87 (3.23) ²	52.18 (10.70) ²	7.11 (7.83) ²	153 (80.5%) ⁴	37 (19.5%) ⁴
Married or marriage-like relationship	175 (36.2%)	4.51 (3.09) ²	53.01 (9.85) ²	6.81 (9.38) ²	152 (86.9%) ⁴	23 (13.1%) ⁴
Separated	23 (4.6%)	4.14 (3.09) ²	51.45 (10.10) ²	5.93 (8.29) ²	18 (77.3%) ⁴	5 (22.7%) ⁴
Divorced	82 (17.0%)	4.23 (3.08) ²	52.38 (10.02) ²	7.42 (8.74) ²	66 (81.5%) ⁴	15 (18.5%) ⁴
Widowed	13 (2.7%)	6.00 (2.65) ²	58.57 (11.32) ²	10.62 (11.21) ²	9 (69.2%) ⁴	4 (30.8%) ⁴

Note. RD = racial discrimination, WD = weight discrimination

Hispanic/Latino/a/x of any race including Black ($n = 25$), White/Caucasian ($n = 26$), None ($n = 137$); Multiple ($n = 8$), and Tainos Indian ($n = 1$). All other race categories are assumed to be non-Hispanic; Other include Asian ($n = 5$); American Indian/Alaskan Native ($n = 1$), Native-Hawaiian/Pacific Islander ($n = 2$), Multiple ($n = 9$), None ($n = 6$), West Indian ($n = 2$), and Middle Eastern ($n = 1$).

¹Mann–Whitney U tests, ²Kruskal-Wallis tests, ⁴Chi-Square test.

* $p < .05$ (two-tailed). Pairwise comparisons used Bonferroni correction. Means sharing a common subscript (a, a, a) are statistically different at $p > .05$.

Aim 1: Characterize association between RD, WD, and pain.

RD was positively correlated with greater pain interference, $r_s = .27$, $p < .001$, and higher pain intensity scores, $r_s = .16$, $p = .001$. Similarly, patients who experienced WD reported greater pain interference, ($M = 57.18$, $SD = 9.98$ vs. $M = 51.75$, $SD = 10.11$), $Z = -4.43$, $p < .001$, and higher pain intensity scores, ($M = 5.29$, $SD = 2.78$ vs. $M = 4.03$, $SD = 3.17$), $Z = -3.41$, $p = .001$, compared with those who did not report WD. After adjusting for BMI, age, and enrollment site, findings from the linear regression analysis showed that only RD predicted greater pain interference (Table 2), and higher pain intensity (Table 3). Interestingly, there was no significant interaction effect between RD and WD on pain outcomes (Tables 2 & 3).

Aim 2: Explore gender as a moderator of the association between RD, WD, and pain interference and intensity.

Linear regression analysis revealed a significant interaction effect of RD X Gender on pain interference (Table 2). Among woman-identifying participants, RD was more strongly associated with pain interference $b = .47$, $SE = .08$, $CI [.303 \text{ to } .629]$, compared to the association among men-identifying participants, $b = .14$, $SE = .07$, $CI [-.005 \text{ to } .282]$ (Table 2, Figure 1a). There were also a significant interaction effect between RD X Gender on pain intensity (Table 3). RD was associated with pain intensity among women-identifying participants but not in men-identifying participants, $b = .08$, $SE = .03$, $p = .001$ 95% $CI [.033 \text{ to } .136]$, but not in men, $b = .03$, $SE = .02$, $p = .29$ 95% $CI [-.021 \text{ to } .070]$ (Figure 1b). The interactions between WD X Gender on pain interference or pain intensity were not significant (Tables 2 & 3).

Table 2 *Pain Interference*

	<i>Standardized Beta</i>	<i>SE</i>	<i>t</i>	<i>p</i>	<i>F</i>	<i>df</i>	<i>p</i>	<i>Adj. R2</i>
Model					6.01	12	<.001*	0.11
Gender ^a	0.06	1.39	0.96	0.34				
WD ^f	0.10	2.11	1.25	0.21				
RD	0.46	0.11	4.89	<.001*				
RDxWD	-0.14	0.12	-1.61	0.11				
RDxGender	-0.30	0.12	-3.30	0.001*				
WDxGender	0.07	2.72	1.09	0.28				

Note.

^a 0 = female, 1 = male, ^b0 = VA, 1 = MMG, ^c0 = Non-Hispanic White, 1 = Non-Hispanic Black, ^d0 = White, 1 = Hispanic/Latino/a/x, ^e0 = White, 1 = Non-Hispanic Other, ^f0 = no WD, 1 = WD.

* $p < .05$

Table 3 *Pain Intensity*

	<i>Standardized Beta</i>	<i>SE</i>	<i>t</i>	<i>p</i>	<i>F</i>	<i>df</i>	<i>p</i>	<i>Adj. R2</i>
Model					2.95	12	.001*	0.05
Gender ^a	0.01	0.44	0.15	0.88				
WD ^f	0.06	0.67	0.73	0.47				
RD	0.29	0.04	2.10	0.004*				
RDxWD	-0.10	0.04	-1.06	0.29				
RDxGender	-0.21	0.04	-2.20	0.03*				
WDxGender	0.10	0.86	1.41	0.16				

Note. ^a 0 = female, 1 = male, ^b0 = VA, 1 = MMG, ^c0 = Non-Hispanic White, 1 = Non-Hispanic Black, ^d0 = White, 1 = Hispanic/Latino/a/x, ^e0 = White, 1 = Non-Hispanic Other, ^f0 = no WD, 1 = WD.

Age, race, and BMI were entered as covariates. For complete model statistics, see supplemental materials.

* $p < .05$

Discussion

The current study characterized the relationships between experiences with two types of discrimination (racial, weight) and pain outcomes, and investigated if gender moderated these associations. Results from this study confirm a high prevalence (59.1%) of moderate pain (4 out of 10 or higher) and pain interference in adults with obesity (Mean t-score = 52.65). Also, experiences with racial discrimination (RD) are significant predictors of pain intensity and pain interference in well represented sample of NHB and Hispanic/Latino/a/x adults with obesity having various chronic pain conditions. Further, the association between pain interference and racial discrimination is moderated by gender identity. These results suggest that in an ethnically diverse sample of adults with obesity, men report more frequent experiences with racial discrimination. However, the association between the frequency of experiences with racial discrimination and pain interference is stronger in women. Another key finding is that participants who reported to have experienced weight discrimination had significantly greater pain

interference, higher pain intensity, more experiences with racial discrimination, and higher BMI. However, weight discrimination was not a significant predictor of pain intensity or pain interference after statistical adjustment for experiences with racial discrimination, age, and BMI. From these findings, we can infer that weight and racial discrimination are experientially distinct phenomena, and thus, have a differential impact on the pain experience in adults with obesity. Surprisingly, there were no racial or gender differences in pain intensity or pain interference. To our knowledge, this is the first investigation that investigated gender-based differences in the relationships between racial and weight discrimination on pain in a large sample of NHB and Hispanic/Latino/a/x adults with obesity.

Adults with obesity have a disproportionate burden of chronic pain, and NHB and Approximately 75% of adults with obesity have chronic pain compared with 20.4% of the U.S. population.(49) Recent data in the United States have also shown that the age-adjusted prevalence of chronic pain is higher in women and military veterans.(49) Results from this study show a high prevalence of self-reported pain in a diverse sample of participants in a behavioral weight loss program, consistent with previous studies.(50) While NHB and Hispanic/Latino/a/x adults are known to have a disproportionately higher obesity prevalence, (51) there were no significant differences in pain intensity or pain interference between racial groups in our study population. This contrasts with previous findings of higher self-reported pain in NHB, Hispanic/Latino/a/x, and Asian compared with NHW participants (cite), though the results are inconsistent. Chronic pain prevalence is higher in NHB adults compared with NHW adults(52) in experimental(53, 54) and clinical(55, 56) settings. Further, Hispanic/Latino/a/x adults, particularly older adults, tend to have lower pain ratings and report less interference with functional activities compared with NHB and NHW adults.(57–59) Zettel-Watson et al. showed that 60% of older Mexican-American adults reported pain at multiple body sites, moderate to severe pain intensity, and that pain interfered with their normal work over the past four weeks.(57) Importantly, although pain is associated with health outcomes that are critical to the success of behavioral weight loss programs,(50) it is often unaddressed in weight management.(60) Our results highlight the need to query the magnitude and impact of pain so that pain interventions could be successfully incorporated into a weight management program. Moreover, given the underrepresentation of NHB and Hispanic/Latino/a/x individuals with obesity in pain studies, our findings suggest that experiences of discrimination specific to race/ethnicity and weight are salient features of the pain experience in this population that warrant further investigation.

Experiences with racial discrimination on NHB adults have deleterious effects on pain, obesity, and other health outcomes.(1, 9, 10, 23, 34, 59, 61–63) However, experiences with racial discrimination in Hispanic/Latino/a/x and other racialized groups are not well described. NHB adults in the current study reported more experiences of racial discrimination than Non-Hispanic White adults,(1, 9, 10, 23, 59, 63) and more frequent experiences with racial discrimination were significantly associated with a higher pain intensity and more pain interference after adjusting for confounding variables. Altered nociceptive processing (e.g., heat pain tolerance), psychological factors, and sex/gender differences have been implicated as possible mechanisms underlying the relationship between racial discrimination and pain in NHB adults.(23, 33, 53, 64–66) Our findings that NHB study participants reported more experiences of racial discrimination than Hispanic/Latino/a/x participants. These results suggest that NHB and

Hispanic/Latino/a/s groups have different experiences with racial discrimination that may influence how discrimination based on race affect pain responses.(57) A potential reason for the differences in the reported instances of racial discrimination between NHB and Hispanic/Latino/a/x adults with obesity in the current study could be that Hispanic/Latino/a/x adults are not often specifically asked about the salient features of their experiences with racial discrimination such as language concordance, level of acculturation, and immigration status.(67) In previous studies, Hispanic/Latino/a/x adults have been asked about their experiences with racial or ethnic discrimination and its impact on pain in the context of access to primary care,(68) provider bias,(68) patient-provider language discordance, and immigration status.(69) Level of acculturation and assimilation into the dominant culture have also been cited as mechanisms of discrimination by providers in a sample of Mexican-Americans.(70) Furthermore, the omnipresent fear of deportation - regardless of citizenship status - is significantly associated with pain-related outcomes, specifically stress and depression, as well as missed appointments for pain treatment. (69) These findings suggest a limitation in the way that questions about experiences with discrimination are asked to Hispanic/Latino/a/x adults. Thus, it is prudent to employ multimodal approaches to the examination of the impact of racial discrimination on pain in NHB and Hispanic/Latino/a/x adults with obesity. Moreover, one might consider asking specific questions related to fear of deportation and level of acculturation to ethnically diverse adults with obesity and chronic pain that have an immigrant experience.

Although sex and gender differences in the prevalence and trajectory of select chronic pain conditions have been well established,(71–82) studies reporting gender differences in the relationships between racial discrimination and pain outcomes in ethnically diverse pain populations have been sparse and inconclusive. In a robust sample of primary care patients with chronic musculoskeletal pain, women reported greater pain interference than men.(83) The majority of the female cohort (54%) were NHB women. Terry et al. found that despite reporting more experiences with racial discrimination, there were no significant relationships to pain in older NHB men with knee osteoarthritis.(23) Conversely, in a sample of older NHB men (military veterans), racial discrimination was a significant predictor of bodily pain.(9) Notably, NHB and Hispanic/Latino/a/x men with obesity are frequently underrepresented in pain studies, so sex and gender differences in pain interference and experiences with racial discrimination are particularly not well understood in these patient populations. The current study shows that the association between racial discrimination, pain interference, and pain intensity is stronger in women-identifying participants with obesity whom identify as NHB or Hispanic/Latino/a/x. Previous findings from a large, multi-ethnic cohort show significant relationships between experiences with racial discrimination and bodily pain in Japanese, Chinese, African American, Caucasian, and Hispanic women, but they did not compare their experiences to men.(59) In the same study, NHB women also reported having more frequent experiences with racial discrimination whereas Hispanic/Latino/a/x women reported the lowest frequency.(59) Conversely, Hispanic/Latino/a/x women had the highest pain ratings at baseline compared with NHB, NHW, Japanese, Chinese women (52). Dugan et al. posited that other forms of discrimination, particularly related to gender and English fluency, could have also been captured by the EOD in their study cohort though not directly assessed.(59)

Some purported mechanisms for the gender differences in the relationships between experiences with racial discrimination and pain interference are related to differences in affective dimensions of pain such as coping, pain self-efficacy, and pain beliefs.(23, 71, 72, 84–92) Pain catastrophizing, a cluster of negative emotions related to magnification, rumination, and helplessness around pain,(93) and perceived stress have been found to moderate the association between discrimination, pain intensity, and pain interference in women when demographic variables are controlled.(23) Although stress was not measured in this investigation, women participants may have experienced stress more intensely than their male counterparts which could explain greater pain interference reported from women despite reporting less discrimination than men.(23) Surprisingly, there were no race or gender differences in pain interference in our sample population. However, the impact of adiposity and body image are under recognized forms of discrimination that may influence the chronicity and management of chronic pain, and should be assessed in pain and weight management.

Weight discrimination is increasingly recognized as a social determinant of health. Racial and weight discrimination have been identified as the most common forms of repeated daily forms of discrimination in racially and ethnically diverse populations of adults with obesity.(94) Importantly, weight discrimination is associated with increases in BMI, and weight gain.(16) The current study shows that participants who identify as NHB or Hispanic/Latino/a/x were able to disentangle their experiences with weight discrimination from their experiences with racial discrimination. Gee et al. reported similar findings in a large cohort of Asian ethnic groups in the context of increased BMI.(95) The group found that weight discrimination was significantly associated with increased BMI. Further, the associations between racial discrimination and BMI were significant when controlling for the influence of weight discrimination. Of note, the majority of participants in the sample were not classified as having obesity using World Health Organization (WHO) criteria (< 10%). Other researchers have reported that NHB participants cited body appearance, in addition to racial discrimination, as a potential reason for their experiences with discrimination.(1, 2) In the current study, weight discrimination was not associated with pain outcomes after statistical adjustment though participants that reported having experiences with weight discrimination had significantly higher pain intensity, greater pain interference, and more experiences with racial discrimination. A potential reason for these discrepant findings is that the number of participants reporting experiences with weight discrimination were underrepresented in the total study population (< 25%). Thus, we may have been underpowered to analyze the contribution of weight discrimination to the variance in pain intensity and interference. Mehok and colleagues suggest that patients' weight and gender identity influenced observers' perceptions of pain severity, the rate of referral for physical therapy services, and recommendations to engage in physical activity as an adjuvant therapy for pain control. (96)

There were some limitations associated with the study. First, this is a secondary data analysis; study participants were not recruited based on the presence or absence of a regional or widespread musculoskeletal pain condition. However, our findings may be more generalizable to adult populations with obesity. Secondly, we did not include clinical or laboratory-based assessments of other

biopsychosocial aspects of chronic pain. Lastly, we did not assess anticipatory or enacted discrimination which could have different relationships to pain intensity or pain interference.

In summary, the current study found that pain is prevalent in adults with obesity participating in a comprehensive behavioral weight management program. Further, we have expanded on results from previous studies that further characterize racial and gender differences in the experiences with racial and weight discrimination in a robust sample of ethnically diverse adults with obesity. Asking participants in pain and weight management interventions about their experiences with racial or weight discrimination could help clinicians make culturally informed decisions that address barriers to pain relief and weight loss. Future studies should build on these findings by investigating whether training providers to ask about and validate experiences of racial and weight discrimination has prognostic and therapeutic benefits. Additionally, clinicians and researchers could collaboratively develop and clinically validate intervention targets that account for frequent experiences with racial and weight discrimination.

Declarations

Ethics approval: All study procedures were approved by the Institutional Review Boards at NYU School of Medicine (#i16–01445), VA New York Harbor (#01624), and Albert Einstein College of Medicine in collaboration with the Montefiore Health System (#2017-7603). All methods were performed in accordance with the relevant guidelines and regulations. Written informed consent was obtained by all participants prior to any data collection.

Consent for publication: Not applicable.

Availability of data and materials: The datasets and materials used and/or analysed during the current study available from the corresponding author on reasonable request.

Competing Interests: The authors declare no competing interests.

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Author Contributions: EM, MJ, and SW developed the study hypotheses and study design. SW and EB performed the data collection. BW and SW performed the data analysis and interpretation under the guidance of EM, MJ, and JR. EM, SW, GC, EB, and RT drafted the manuscript, and MJ, NB, and JR provided critical revisions. All authors approved the final version of the paper for submission.

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Figures

a)

b)

Figure 1

Pain interference scores (a) and pain intensity scores (b) by experiences of racial discrimination for self-identified gender groups. Note. Pain interference T-scores (a) and pain intensity scores (b) of participants who self-identified as male (cisgender men) or female (cisgender women) are shown for low (- 1 SD) and high (+ 1 SD) self-reported racial discrimination (RD).

Supplementary Files

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