A methodological note on modeling the effects of race: the case of psychological distress

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Summary

Psychological distress is an important indicator of the mental well-being of the population. Findings regarding racial differences in distress are inconclusive but may represent an important pathway through which disparities exist across a number of physical health outcomes. We used data from the 1994 Minority Health Survey, a nationally representative multiracial/ethnic sample of adults in US households, to examine racial/ethnic differences in psychological distress (n = 3623). Our primary study aim was to examine differences between additive and multiplicative models in assessing the influence of income and gender on the race/distress relationship. We hypothesized that additive models do not sufficiently account for potential interactions of race with income and gender, and may therefore mask important differences in distress between racial groups. The results suggest that our hypotheses were supported. After adjusting for income, there were no statistically significant differences in distress levels between racial groups. However, significant differences emerge when multiplicative models are used demonstrating the complexities of the intersection of race, income and gender in predicting psychological distress. Black men and women of higher income status represent a particularly vulnerable group, whereas Hispanic men are especially hardy. We discuss the implications of our findings for future work on racial health disparities. Copyright © 2008 John Wiley & Sons, Ltd.

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Introduction

It has been suggested that disparities exist in the levels of psychological distress experienced between racial/ethnic groups in the United States. Psychological distress is important for at least two reasons. One, it is an indicator of the general

psychological well-being of the population (Zahran, Kobau, Moriarty, Zack, & Giles, 2004); and two, it may represent an important pathway through which racial disparities exist across a number of physical health outcomes (Pratt, Dey, & Cohen, 2007). A review of previous literature indicates conflicting findings regarding racial disparities in psychological distress. Several factors may account for these inconsistencies. First, definitions of psychological distress vary ranging from clinical diagnosis (e.g. depression, schizophrenia, generalized anxiety disorder) to subclinical but disorder-specific symptomatology (most commonly depressed mood) to non-specific distress typically measured by assessing the presence and/or severity of symptoms common to many mental illnesses but together not specific to any one (e.g. depressed mood, anxiety, positive affect, behavioural/emotional control) (Kessler, 1979; Neighbors, 1984; Warheit, Holzer, & Schwab, 1973; Pratt et al., 2007; Skapinakis, 2007; Williams, Takeuchi, & Adair, 1992; Williams, Yu, & Jackson, 1997). These differences in defining (or operationalizing) psychological distress likely Contribute to the inconclusive nature of previous study findings. Further, it has been suggested that whereas clinical diagnosis and disorder-specific symptomatology are useful for determining the prevalence of specific disorders, non-specific measures may better capture the range of psychological suffering in the population given their ability to capture those who are either not distressed enough to meet standard criteria for mental illness (Horwitz, 2007; McVeigh et al., 2006) or do not fit neatly into any one disorder category (Aneshensel, 2002; Dohrenwend, Shrout, Egri, & Mendelsohn, 1980; Mirowsky & Ross, 2002). Rather, they are indicative of suboptimal psychological functioning which studies have shown may have important consequences for numerous physical health outcomes, including coronary heart disease, stroke and diabetes (Cohen, Tyrrell, & Smith, 1993; Gallo & Matthews, 2003; Johnson, 1989; May et al., 2002; Stansfeld, Fuhrer, Shipley, & Marmot, 2002; Rutledge & Hogan, 2002 as well as subsequent mental disorder (Mirowsky & Ross, 2002).

Second, most previous studies examining racial differences in distress have used region-, state- or city-specific samples compromising the generality of study findings and the ability to compare findings across studies (Dohrenwend, 1973; George & Lynch, 2003; Kessler, 1979; McVeigh et al., 2006; Neighbors, 1984; Williams et al., 1992;

Williams et al., 1997). Third, most of these studies have focused on black–white differences and therefore have not been able to ascertain differences that may exist with other race/ethnic groups, particularly Hispanics who represent a rapidly growing population in the United States (Bratter & Eschbach, 2005; McVeigh et al., 2006; Pratt, et al., 2007). Finally, most studies examining racial differences in distress have controlled for income. Studies examining the intersection of race and income suggest that controlling for income may mask important differences between racial/ethnic groups (Cockerham, 1990; Kessler & Neighbors, 1986; Ulbrich, Warheit, & Zimmerman, 1989; Belgrave, Wykle & Choi, 1993).

In this paper, we attempt to overcome the limitations of previous work by using a nationally representative multiracial/ethnic sample to examine the relationship between race/ethnicity and a validated and highly reliable measure of non-specific psychological distress. In addition, we employ both additive and multiplicative (i.e. interaction) models to assess the influence of both income and gender on the race/distress relationship.

Methods

Sample

Data for this study come from the 1994 Minority Health Survey (MHS), a cross-sectional telephone survey of a nationally representative sample of non-institutionalized adults ages 18 years and older residing in households within the 48 contiguous US. Data were collected via random digit dialing procedures using a stratified sampling design intended to capture a representative proportion of households from each of three urbanization categories defined by the US Bureau of the Census: (1) central city; (2) suburban; and (3) rural (Hall, 2000). African Americans and Hispanics were oversampled. Post-sampling weights based on the 1993 Current Population Survey were used to correct for oversampling. For the present study, we used the subsample of respondents that self-identified as either being of Hispanic origin or descent or as non-Hispanic African American, white, or Asian or Pacific Islander (API); and for whom we had complete data on psychological distress (n = 3623). The overall response rate for the MHS was 60 per cent. Further details of the sampling design are provided elsewhere (Hall, 2000).

Measures

Psychological distress was measured using the five-item Mental Health Inventory (MHI-5), an abbreviated version of the 18- and 38-item MHIs (Ware, Kosinski, Bayliss, & McHorney, 1995). The MHI was the primary mental health assessment tool used in two classic studies, both conducted by the RAND Corporation: the Health Insurance Experiment (1974–1982) (Newhouse, 1974) and the Medical Outcomes Study (1986–1987) (Hays, Sherbourne, & Mazel, 1995). The MHI-5 has shown a high degree of correlation with both the 18- and 38-item instruments as well as several other measures of psychological well-being including the CES-D and the General Health Questionnaire (Berwick et al., 1991; Hoeymans, 2004; McCabe, Thomas, Brazier, & Coleman, 1996; Shaw, Treglia, Motheral, & Coons, 2000). The five-item version of the scale has been used in numerous studies as a non-specific measure of psychological distress with alpha coefficients ranging from 0.76 to 0.88 (McCabe et al., 1996; Shaw et al., 2000; Stewart, Hays, & Ware, 1988; Williams, 2000). The MHI-5 asks respondents how often, over the past month, they have been a happy person, felt calm and peaceful, been a very nervous person, felt downhearted and or blue, felt so down in the dumps that nothing could cheer them up (Williams, 2000). Responses were coded using a six-point Likert scale ranging from 'never' to 'always' and summed into a psychological distress score ranging from 5 to 30. The two positive valence items (i.e. happy, calm and peaceful) were reverse coded so that higher scores reflected higher levels of distress.

To assure mutually exclusive race/ethnic groups, binary variables were created for each racial ethnic group indicating whether or not (1 = yes, 0 = no) the respondent self-identified as either non-Hispanic white, non-Hispanic black or African American, non-Hispanic Asian, or Hispanic. Respondents self-reporting as Native American or 'other' were excluded from the analysis because of inadequate representation in the data. The MHS categorized respondents into 1 of 8 income categories reflecting respondents' gross annual household income from all sources. Income categories ranged from $7500 or less to $100,000 or over. To retain the income continuum without being restricted to artificial cut-points, we used income as a continuous variable ranging from 1 to 8 with higher numbers reflecting higher income-levels. Gender is a binary variable. Education, marital status, age, health problems, negative life events and household size were included as covariates because of their potential association with psychological distress.

Analysis

In bivariate analyses, correlations, t-tests and analysis of variance tests were used, as appropriate, to examine the characteristics of the study sample and crude measures of association between study variables. In order to examine both the crude effect of race on psychological distress and how the effect of race on distress might vary with the addition of Potential confounders and/or by specifying a race-by-income interaction, we conducted a series of nested multivariate ordinary least squares regressions. Our base unadjusted model examining the main effect of race on psychological distress (Model 1) was specified as follows:

$$Y = \beta_0 + \beta_1 \text{Black} + \beta_2 \text{Hispanic} + \beta_3 \text{API} + e \quad (1)$$

where β_0 is the intercept, or mean level of distress, for the reference group (i.e. whites), β_i is the intercept (i.e. mean) for each of the other racial groups relative to whites, and the p-value indicates whether β_i is significantly different from β_0. This model specification differs from the typical specification that dummy-codes one race variable with several categories representing the various racial/ethnic groups. We specified the model this way to avoid restricting each race group to the same (i.e. fixed) intercept.

Subsequent models build on this base model. In Model 2, we examined how the effect of race on distress varied after adjusting for income and household size. Model 3 added an adjustment for gender. In Model 4, we added three race-by-income interaction terms.

$$Y = \beta_0 + \beta_1 \text{Black} + \beta_2 \text{Hispanic} + \beta_3 \text{API} + \beta_4 \text{Income} + \beta_5 \text{Household size} + e \quad (2)$$

$$Y = \beta_0 + \beta_1 \text{Black} + \beta_2 \text{Hispanic} + \beta_3 \text{API} + \beta_4 \text{Income} + \beta_5 \text{Household size} + \beta_6 \text{Gender} + e \quad (3)$$

$$Y = \beta_0 + \beta_1 \text{Black} + \beta_2 \text{Hispanic} + \beta_3 \text{API} + \beta_4 \text{Income} + \beta_5 \text{Household size} + \beta_6 \text{Gender} + \beta_7 \text{Black} \times \text{Income} + \beta_8 \text{Hispanic} \times \text{Income} + \beta_9 \text{API} \times \text{Income} + e \quad (4)$$

$$Y = \beta_0 + \beta_1 \text{Black} + \beta_2 \text{Hispanic} + \beta_3 \text{API} + \beta_4 \text{Income} + \beta_5 \text{Household size} + \beta_6 \text{Gender} + \beta_7 \text{Black} \times \text{Income} + \beta_8 \text{Hispanic} \times \text{Income} + \beta_9 \text{API} \times \text{Income} + \beta_{10} \text{Education} + \beta_{11} \text{Health problems} + e \quad (5)$$

$$
\begin{aligned}
Y = {} & \beta_0 + \beta_1 \text{Black} + \beta_2 \text{Hispanic} + \beta_3 \text{API} + \\
& \beta_4 \text{Income} + \beta_5 \text{Household size} + \\
& \beta_6 \text{Gender} + \beta_7 \text{Black} \times \text{Income} + \\
& \beta_8 \text{Hispanic} \times \text{Income} + \beta_9 \text{API} \times \\
& \text{Income} + \beta_{10} \text{Education} + \\
& \beta_{11} \text{Health problems} + \\
& \beta_{12} \text{Marital status} + \beta_{13} \text{Age} + e
\end{aligned}
\tag{6}
$$

where the β coefficient for each of the interaction terms is the slope of the line indicating the magnitude and direction of the relationship between income and psychological distress for each racial group. Here, the *p*-value indicates whether the slope of the line for each racial group is significantly different from that of whites (reference group). Model 5 provided further adjustment for education and health problems. And the final model (Model 6) adjusted for marital status and age. Marital status and age were added in a step separate based on preliminary analysis suggesting that they have a particularly strong association with both race and psychological distress. Based on the inconclusive nature of previous studies regarding the role of negative life events, we conducted Sobel–Goodman mediation tests to determine the appropriateness of including life events in multivariate models. Our results show that negative life events mediates the race–distress relationship and was, therefore, excluded from final analyses.

To examine the three-way interaction of race with both income and gender, we examined the two-way race-by-income interaction within gender-stratified groups. Whether or not a three-way interaction exists was based on whether the race-by-income interaction was the same across gender sub-groups. All data analyses were conducted using STATA version 9 (Stata Corporation, 2007).

Results

Sample characteristics

Sample characteristics are shown in Table I. Each racial group comprises approximately 27 per cent of the study sample with the exception of Asians, who comprise 16.6 per cent. There are approximately equal numbers of men and women,

Table I. Characteristics of study sample (*n* = 3789).

	Total n (per cent)	White n (per cent)	Black n (per cent)	Hispanic n (per cent)	API n (per cent)
Gender					
Men	1931 (51.4)	582 (52.8)	500 (50.3)	507 (50.9)	306 (50)
Women	1829 (48.6)	520 (47.2)	495 (49.7)	490 (49.1)	306 (50)
Income (mean, SD)	37,901 (28,647)	42,140 (31,047)	33,883 (26,858)	34,914 (25,461)	41,448 (30,223)
Age (mean, SD)	43 (16)	48.4 (17.4)	44.7 (15.7)	39.3 (13.6)	39.1 (13.9)
Marital status					
Married	1954 (52)	616 (56)	412 (41.5)	519 (52.1)	380 (62.3)
Not married	1801 (48)	484 (44)	582 (58.5)	478 (47.9)	230 (37.7)
Education					
Less than high school	1051 (16.2)	111 (10.1)	175 (17.6)	193 (19.5)	112 (19.2)
High school diploma only	1107 (29.7)	362 (32.9)	313 (31.5)	295 (29.7) 299 (30.1)	127 (21.7)
Some college	961 (25.8)	286 (26)	269 (27.1)	205 (20.7)	88 (15)
College graduate	1051 (28.3)	341 (31)	236 (23.8)	718 (73)	258 (44.1)
Employment					
Employed	2516 (68)	702 (64.5)	656 (67.8)	266 (27)	400 (66)
Not employed	1185 (32)	386 (35.5)	312 (32.2)	880 (88.6)	207 (34)
Health problems					
No	3240 (86.5)	923 (84)	831 (83.7)	113 (11.4)	564 (92.8)
Yes	505 (13.5)	176 (16)	162 (16.3)	26.8 (3.9)	44 (7.2)
Negative life events (mean, SD)	26.5 (4.2)	25.7 (3.8)	27.0 (4.2)	11.3 (4.3)	26.4 (5.2)
Psychological distress (mean, SD)	11.0 (4.3)	10.7 (4.2)	11 (4.5)		11 (3.9)

API: Asian/Pacific Islander; SD: standard deviation.

and married and unmarried persons. The majority of the sample is employed (68 per cent), has graduated high school (84 per cent) and is in generally good health with only 14 per cent of people reporting health problems that prevent them from participating fully in normal daily activities such as going to school or work. The average age of the sample is 43 years ranging from 18 to 94 years. Average annual income is $37,901 but varies widely from $3,750 to $125,000.

On average, whites fare better than the total sample across a number of social characteristics. They have a higher average income and more of them are married and have graduated from high school ($p = 0.000$). Asians are similar in this regard. In addition to faring better on the aforementioned characteristics, far more Asians are college graduates compared with both the total sample and all other race groups ($p = 0.000$). They also exhibit fewer health problems ($p = 0.000$). Blacks and Hispanics, on the other hand, have lower average incomes than the total sample and fewer of them have graduated from college ($p = 0.000$). Of all race groups, fewer blacks are married ($p = 0.000$).

Nested multivariate results

Multivariate analyses examined the subsample of MHS participants who responded to each of the items comprising the MHI-5 and for whom we had data for each of the other study variables ($n = 3587$). We examined the effects of race on psychological distress in nested multivariate models to examine both the unadjusted effect of race on distress and the extent to which that effect varies with the addition of other variables expected to confound the race/distress relationship. We were particularly interested in how the main effect of race on distress might vary after interacting race with income given the primary reliance of previous work on using additive effects to demonstrate the race/distress relationship when accounting for income.

Full sample.   Results for the full sample are presented in Table II. In Model 1, we examined the unadjusted effect of race on psychological distress which shows Hispanics and blacks reporting significantly higher adjusted mean levels of distress compared with whites. Model 2 shows that after adjusting for income, blacks' and Hispanics' level of distress remain higher than whites, but not significantly so. Income, on the other hand, shows

a significant inverse relationship with psychological distress such that distress decreases as income increases. Next, we adjusted for gender (Model 3), which did not affect the effect of race on psychological distress.

In the next model (Model 4), we added interaction terms to examine whether the relationship between race and distress varies across the income gradient. These data show a significant interaction effect for blacks such that the previously reported inverse relationship between income and psychological distress is stronger for blacks than it is for whites. Further, the difference in average distress scores between blacks and whites re-emerges; and the magnitude of this difference is considerably higher once the interactions are included in the model. These data indicate that the greater distress levels reported by blacks are most pronounced at lower income levels.

Further adjustment for education and health problems (Model 5) attenuates the mean difference in psychological distress between blacks and whites; however, the effect for Hispanics re-emerges. Finally, we added marital status and age (Model 6) and found that the only significant race effect remaining was the income-by-race interaction among blacks.

Gender stratified groups: three-way interaction test.   Our next set of results reports the findings of gender-stratified analyses where we again used nested models to examine the three-way interaction of race with both income and gender (Tables III and IV) in predicting risk for psychological distress. As described above, whether or not a three-way interaction exists is based on whether the two-way race-by-income interaction is consistent across gender subgroups.

Nested results for men.   Similar to the findings reported for the full sample, among men the addition of income reduces all race effects to non-significance (Model 2, Table III). However, after adding the race-by-income interaction (Model 3), sizeable racial differences in average distress scores are observed for black and Hispanic men, both having significantly higher adjusted mean levels of distress than white men. The race-by-income interaction is also significant indicating that the previously reported inverse income–distress relationship is stronger for black men than for white men, as was observed among the full sample. Also consistent with the findings for the full sample, the addition of education and

Table II. Nested multivariate regression of psychological distress on race for full sample ($n = 3587$).

	Model 1: race		Model 2: income		Model 3: gender		Model 4: Race × Income		Model 5: education and health problems		Model 6: marital status and age	
	β	SE	β	SE	β	SE	β	SE	β	SE	β	ED
Black	0.32*	0.19	0.06	0.19	0.04	0.19	0.80*	0.44	0.71	0.44	0.52	0.43
Hispanic	0.58***	0.19	0.32	0.19	0.31	0.19	0.64	0.47	0.92**	0.46	0.55	0.46
API	0.24	0.22	0.12	0.22	0.09	0.22	−0.53	0.55	−0.05	0.54	−0.14	0.54
Income	—	—	−0.44****	0.04	−0.41****	0.04	−0.36****	0.07	−0.23****	0.07	−0.17***	0.07
Household size	—	—	0.13**	0.05	0.13***	0.05	0.13***	0.05	0.15***	0.05	0.12**	0.06
Gender	—	—	—	—	0.84****	0.14	0.83****	0.14	0.79****	0.14	0.78****	0.14
Black × Income	—	—	—	—	—	—	−0.19**	0.10	−0.16	0.10	−0.16*	0.10
Hispanic × Income	—	—	—	—	—	—	−0.08	0.10	−0.12	0.10	−0.11	0.10
API × Income	—	—	—	—	—	—	0.14	0.11	0.08	0.11	0.05	0.11
Education	—	—	—	—	—	—	—	—	−0.18***	0.06	−0.24****	0.06
Health problems	—	—	—	—	—	—	—	—	2.20****	0.21	2.38****	0.21
Marital status	—	—	—	—	—	—	—	—	—	—	0.71****	0.16
Age	—	—	—	—	—	—	—	—	—	—	−0.03****	0.00
Adjusted R^2												0.10

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$; **** $p < 0.001$.
Black (1 = yes, 2 = no); Hispanic (1 = yes, 2 = no); API (1 = yes, 2 = no); gender (1 = women, 2 = men); health problems (1 = yes, 2 = no); marital status (1 = not married, 0 = married).
API: Asian/Pacific Islander; SE: standard error.

Table III. Nested multivariate regression of psychological distress on race among men (three-way interaction test; $n = 1842$).

	Model 1: race		Model 2: income		Model 3: Race × Income interactions		Model 4: education and health problems		Model 5: marital status and age	
	β	SE	β	SE	β	SE	β	SE	β	SE
Black	0.26	0.24	0.02	0.24	1.37**	0.62	1.35**	0.61	1.28**	0.61
Hispanic	0.61***	0.24	0.35	0.25	1.37**	0.64	1.45**	0.63	1.20**	0.62
API	0.53*	0.29	0.39	0.29	0.33	0.76	0.71	0.75	0.79	0.75
Income	—	—	−0.41****	0.05	−0.27***	0.09	−0.18**	0.09	−0.12	0.09
Household size	—	—	0.05	0.07	0.05	0.07	0.07	0.07	0.06	0.08
Black × Income	—	—	—	—	−0.31**	0.13	−0.29**	0.13	−0.30**	0.13
Hispanic × Income	—	—	—	—	−0.23*	0.13	−0.23*	0.13	−0.22*	0.13
API × Income	—	—	—	—	0.02	0.16	−0.01	0.15	−0.08	0.15
Education	—	—	—	—	—	—	−0.08	0.08	−0.12	0.08
Health problems	—	—	—	—	—	—	2.10****	0.29	2.30****	0.29
Marital status	—	—	—	—	—	—	—	—	0.55***	0.21
Age	—	—	—	—	—	—	—	—	−0.03****	0.01
Adjusted R^2										0.09

$* p < 0.10$; $** p < 0.05$; $*** p < 0.01$; $**** p < 0.001$.
Black (1 = yes, 2 = no); Hispanic (1 = yes, 2 = no); API (1 = yes, 2 = no); gender (1 = women, 2 = men); health problems (1 = yes, 0 = no); marital status (1 = not married, 0 = married).
API: Asian/Pacific Islander; SE: standard error.

Table IV. Nested multivariate regression of psychological distress on race among women (three-way interaction test; $n = 1745$).

	Model 1: race		Model 2: income		Model 3: income–race interactions		Model 4: education and health problems		Model 5: marital status and age	
	β	SE	β	SE	β	SE	β	SE	β	SE
Black	0.30	0.28	0.05	0.28	0.26	0.64	0.11	0.63	−0.17	0.62
Hispanic	0.50*	0.29	0.22	0.29	−0.09	0.69	0.38	0.68	−0.10	0.67
API	−0.12	0.33	−0.28	0.34	−1.34*	0.80	−0.80	0.78	−1.06	0.78
Income	—	—	−0.41****	0.06	−0.46****	0.10	−0.28***	0.11	−0.21**	0.11
Household size	—	—	0.23***	0.08	0.24***	0.08	0.25***	0.08	0.18	0.09
Black × Income	—	—	—	—	−0.07	0.15	−0.01	0.15	−0.03	0.15
Hispanic × Income	—	—	—	—	0.08	0.15	−0.03	0.15	0.00	0.15
API × Income	—	—	—	—	0.25	0.17	0.15	0.17	0.16	0.17
Education	—	—	—	—	—	—	−0.28***	0.10	−0.39****	0.10
Health problems	—	—	—	—	—	—	2.29****	0.30	2.46****	0.30
Marital status	—	—	—	—	—	—	—	—	0.92****	0.24
Age	—	—	—	—	—	—	—	—	−0.04****	0.01
Adjusted R^2										0.09

$* p < 0.10$; $** p < 0.05$; $*** p < 0.01$; $**** p < 0.001$.
Black (1 = yes, 2 = no); Hispanic (1 = yes, 2 = no); API (1 = yes, 2 = no); gender (1 = women, 2 = men); health problems (1 = yes, 0 = no); marital status (1 = not married, 0 = married).
API: Asian/Pacific Islander; SE: standard error.

health problems exacerbates the Hispanic–white difference in distress (Model 4). Importantly, after including further adjustments for marital status and age, significant differences remain for both the average difference in distress between racial groups and the race-by-income interaction for both black and Hispanic men (Model 5). Of note, income and education are not significant independent predictors of distress among men.

Nested results for women. Among women (Table IV), Model 1 shows Hispanics reporting

higher adjusted mean levels of psychological distress than whites. This effect is reduced to non-significance with the addition of income and household size and does not re-emerge as it did among men. Effects among black women are not significant. With the addition of the race-by-income interaction, API women report significantly lower levels of distress than white women (Model 3). This is the only indication of a significant difference in distress levels between APIs and whites. No significant differences between APIs and whites were found in either the full sample or among men. Among women, there were no statistically significant differences in distress levels between racial groups in the fully adjusted model.

All interaction analyses described above were examined using the global test of interaction (i.e. multiplicative term in the regression model). In order to more fully examine these interactions, we examined the income–distress relationship within the eight race-gender subgroups (data not shown). In these analyses, we found a significant crossover effect among black women. Black women report lower levels of psychological distress than white women at low income levels and higher distress at higher income levels. This crossover may account for the lack of a significant race-by-income interaction among women using the global interaction test. Black men report higher levels of distress than white men at the low and high extremes of the income gradient, with significant differences observed at higher income levels only. Results for Hispanics show Hispanic men reporting higher distress than white men at lower income levels and lower distress at higher income levels. Only effects at higher income levels are statistically significant. Hispanic women report higher distress levels across the income gradient, though differences at the extremes of the income gradient are not significant. No other significant differences in distress were found.

Discussion

We examined a cross-sectional multiracial/ethnic sample of adults in US households to assess the intersection of race, income and gender in predicting nonspecific psychological distress. Our primary study aim was to examine differences between additive and multiplicative models in modeling risk for psychological distress between racial/ethnic groups in the United States. We hypothesized that additive models do not sufficiently account for potential interactions of race with income and gender, and may therefore mask important differences in distress between racial groups. The results suggest that our hypotheses were supported. First, after adjusting for income in the additive model, there were no statistically significant differences in distress levels between racial groups. This finding is common to studies using additive models to examine racial differences in distress adjusting for income or education (Kessler, 1979; Mirowsky & Ross, 1980; Neighbors, 1984; Williams et al., 1997). However, when the race-by-income interaction term was added to the model, significant racial differences in distress were observed. We found that racial differences in psychological distress varied by income-level, and demonstrate a path toward convergence as income increases with blacks reporting higher levels of distress compared with whites. We found five previous studies examining the interaction of race with income in predicting risk for non-specific psychological distress among adults in the United States (Bratter & Eschbach, 2005; Cockerham, 1990; Kessler & Neighbors, 1986; McVeigh et al., 2006; Ulbrich et al., 1989). Three of these studies showed a significant race-by-income interaction (Cockerham, 1990; Kessler & Neighbors, 1986; Ulbrich et al., 1989). These three studies examined black–white differences in distress. Two corroborate our findings that blacks have higher distress levels than whites and that compared with whites, blacks experience a greater decline in distress with increasing income (Kessler & Neighbors 1986; Ulbrich et al., 1989). Of the two studies not showing significant race-by-income interactions, only one used a national sample (Bratter & Eschbach, 2005). However, this study used a measure of distress designed to capture those most likely have a diagnosable mental illness (Kessler et al., 2002) and may, therefore, underestimate the degree of psychological distress in the population.

We found no studies that have examined the interaction of race with both income and gender in predicting psychological distress. By examining this three-way interaction, important differences in distress by race were observed that otherwise would not have been found. The finding of a significant crossover effect among black women is of particular salience because it is inconsistent with much of the previous literature showing either no black–white differences in distress or lower distress levels among blacks compared with whites. One potential explanation for the greater distress

levels among white women at lower income-levels is status-inconsistency, 'the degree to which an individual's rank or position on important societal status hierarchies are at a comparable level' (Jackson, 1962). Jackson's seminal study (1962) of status inconsistency and psychological stress showed that inconsistent persons characterized by low achieved status and high attributed status report significantly higher levels of psychosocial stress compared with status-consistent groups. In particular, he shows higher symptom levels for groups whose racial/ethnic rank is superior to their social class rank. Previous studies also show that compared with men, women tend to have lower incomes for their occupational grade; and that these inconsistencies are related to disease outcomes (Peter, Gassler, & Geyer, 2007). Also consistent with our findings, Jackson further suggests that inconsistent groups characterized by high achieved status and low attributed status (e.g. high-income black women) will have fewer symptoms than those of opposite inconsistency (e.g. low-income white women), but will still have more symptoms than consistent groups (e.g. high-income white women). This hypothesis may also help explain the higher distress levels reported by black men at higher income levels. Findings among Hispanic men are not consistent with the status inconsistency hypothesis, but may reflect important factors such as various forms of social support and stress-coping style that, in spite of the discrimination this group experiences, have paradoxically been shown to improve their outcomes (Farley, Galves, Dickinson, & Perez Mde, 2005; Markides & Coreil, 1986). Another possibility is that different racial/ethnic/cultural groups may manifest distress differently (e.g. substance use, violent behaviour, suppressed emotion) (Aneshensel, 2002; Markides & Coreil, 1986) potentially resulting in biased distress estimates. This remains an empirical question.

Though one might assert, given these findings, that it is not race per se that predicts psychological distress but rather income and gender, we assert that the effect of race can not be properly examined without simultaneously considering both income and gender. As Belgrave, Wykle and Choi (1993) describe, '. . . *adding* [emphasis added] these additional variables . . . appears to complicate and cloud independent main effects due to the indirect relationships and hidden confounders that exist among these variables . . .'. Our data support this assertion showing that not only is it imperative to consider the simultaneous

effects of race, income and gender, but doing so in a way that takes full account of their synergy is key. Most previous studies have used additive models to examine racial differences in psychological distress. These studies are inconclusive. Some previous studies show that once income is adjusted no significant racial differences in psychological distress exist (Kessler, 1979; Williams et al., 1997). Other studies provide evidence of racial differences in distress with some showing advantages for whites and others showing advantages for blacks and/or Hispanics (Kessler, 1979; Neighbors, 1984; Pratt et al., 2007; Williams et al., 1997; Zahran et al., 2004). Few studies have explicitly modeled the interaction of race with income or gender.

Thus compared with previous studies, our study has several strengths that make it a significant contribution to the existing literature on racial differences in distress. As mentioned above, this is the first study to examine the three-way interaction of race with both income and gender in predicting risk for psychological distress among US adults. Secondly, this study uses a multiracial/ethnic sample where most previous studies have been restricted to black–white differences. Thirdly, we expand on previous work by examining racial differences in distress using a nationally representative sample. Finally, we use a continuous nonspecific measure of psychological distress which, as previously described, may better capture the range of psychological suffering in the population. In sum, our findings both replicate and extend the findings of previous studies examining the interaction of race with income in predicting psychological distress. Details of these studies in comparison with ours are provided in Table V.

The results of this study should be considered in light of the study's limitations. These data are from 1994. In comparison with 2000 Census population estimates, our sample has a slightly higher rate of employment, fewer married persons, more education and a slightly higher mean income (not shown). Similarly, compared with nonrespondents, MHS respondents have higher levels of income, education and employment (Hall, 2000). This is likely because of the 60 per cent response rate. Although moderate, this response rate is considered adequate for telephone surveys (Keeter, Miller, Kohut, Groves, & Presser, 2000) and is not uncommon for several recurring national telephone surveys (CASRO, 1982). However, this may have resulted in more conservative levels of distress in the study sample than

Table V. Comparison of studies examining the interaction of race with income in predicting non-specific psychological distress.

Author and date	Data source	Study sample	Psychological distress measure	α	Predictors and covariates	Interactions tested	Analytic method	Study findings
Kessler and Neighbors, 1986	Pooled data from eight different epidemiologic surveys	Various: US ages 21+(3); New Haven, CT ages 21+; US ages 25–74 (2); Kansas City, MO ages 18+; Chicago, IL ages 18–65	Various measures assessing depression and non-specific somatization: General Well Being Scale, Hopkins Symptom Checklist, CESD, Gurin Scale, Zung Scale, Langner psychophysiologic subscale, Study-Specific Scale.	Various	Race (0 = white, 1 = black) Income and education	(1) race × income (2) race × education	Ordinary least squares regression: (1) race + income + education, (2) race × income (3) race × education Analyses repeated in subgroups of: (1) young versus old, (2) men versus women, (3) urban versus rural, (4) married versus not married	<u>Additive models</u> (1) after controlling for socioeconomic status (SES), effect of race on depression remains significant but less positive, (2) effect of race on somatization negative but not significant, <u>Interaction results</u> (1) blacks have higher distress levels than whites, (2) racial differences greater for low versus higher income persons for depression and somatization, (3) racial differences greater for more versus less educated persons for depressed mood.
Ulbrich, Warheit, and Zimmerman, 1989	1984 telephone probability sample of adults in north central Florida (in-person interview)	2098 black and white men and women ages 18+ (n = 450 black and 1,648 white)	Summary score of a 20-item psychophysiologic stress index	0.80	Race (0 = black, 1 = white) SES (household income, education, occupational status), stressful life events, gender, age, marital status	(1) race × income (2) race × education (3) race × occupation	Ordinary least squares regression stratified by race and age: (1) race × each indicator of SES, (2) race × occupational status, (3) life events + covariates by race within SES category (low, mid)	<u>Significant race × income interaction</u> (1) psychological distress decreases with increasing income, (2) blacks report higher distress than whites at lower income levels, (3) effect of income on distress stronger for blacks compared with whites such that distress levels converge at higher income levels <u>Significant race × occupational status interaction:</u> (1) crossover effect with blacks having higher distress levels at lower occupational status and higher distress levels at higher occupational status.

Study	Data source	Measure	α	Variables	Interactions	Analysis	Findings
Cockerham, 1990	1985 telephone probability sample of Illinois households (telephone interview)	Eight psychological and psychosomatic items from the Langner index were summed and dichotomized into high scores (psychological distress) and low scores (psychological well being)	0.74	Race (1 = black, 0 = white) SES (education, household income), age, gender, employment status, marital status	(1) race × income (2) race × education	Nested multiple regression: (Step 1) race, (Step 2) age, gender, marital status, (Step 3) education, income, and employment status, (Step 4) black × education, black × income	Additive models (1) Blacks report lower distress levels than whites. Effects not significant. Significant race × income interaction (1) blacks report lower distress levels than whites, (2) psychological distress decreases with increasing income, (3) effects stronger for blacks compared with whites.
Bratter and Eschbach, 2005	1997–2001 pooled data from a national probability sample of the non-institutionalized adult US population (NHIS)	K-6: 'During the past 30 days, how often did you feel (1) so sad nothing could cheer you up, (2) nervous, (3) restless or fidgety, (4) hopeless, (5) that everything was an effort, (6) worthless. Scale developed to maximize precision in the 90th–99th percentile range of clinical disorder	0.89	Race = white, black, Native American, Asian/Pacific Islander, Mexican, Puerto Rican, Cuban, other Hispanic, mixed, other SES (family income, education, employment), age, gender, acculturation (length of time in US, language use), marital status, self-reported chronic illness	(1) race × gender (2) race × income (3) race × education (4) race × employment	Nested multiple linear regression: (I) Nested regression of predictor variables: (Step 1) age, gender, (Step 2) race, (Step 3) acculturation, (Step 4) SES, (Step 5) marital status, (Step 6) chronic illness; (II) simultaneous estimation of race × each set of covariates	Additive models (1) after controlling for covariates, blacks, Asians, and Mexicans report lower distress than whites, with the biggest racial gap between blacks and whites, (2) Puerto Ricans and racially mixed persons report higher distress than whites. Race × SES Interaction results (1) no significant race × income interactions, (2) significant positive race × employment interaction for Puerto Ricans, (3) significant race × education interaction for Mexicans and Puerto Ricans only, (4) no significant race × SES interactions for blacks or other Hispanics.

Table V. Continued

Author and date	Data source	Study sample	Psychological distress measure	α	Predictors and covariates	Interactions tested	Analytic method	Study findings
Nuru-Jeter, Williams, and LaVeist, 2008	1994 Minority Health Survey: national probability sample of the non-institutionalized adult US population (telephone interview)	3,789 men and women ages 18+ of varying racial/ethnic background: white, black, Hispanic, Native American, Asian/Pacific Islander, other.	MHI-5: How often over the past month have you (1) been a happy person, (2) felt calm and peaceful, (3) been a nervous person, (4) felt down-hearted and blue, (5) felt so down in the dumps nothing could cheer you up?	0.88	Race: white, black, Hispanic, Asian/Pacific Islander Income, gender, household size, education, employment status, age, marital status, health problems, negative life events	(1) race × income (2) race × gender (3) race × income × gender	Nested multiple linear regression: (I) (Step 1) race, (Step 2) income, household size, (Step 3) gender, (Step 4) race × income, (Step 5) education, health problems, (Step 6) marital status, age (II) Nested multiple linear regression (same as above) by gender subgroup	Additive models (1) Blacks and Hispanics report higher distress than whites (unadjusted), (2) No significant effect of race on distress after controlling for income Interaction results (full sample) (1) significant race × income interaction such that distress levels decline more with increasing income for blacks compared with whites. Interaction results (gender sub-groups) Men: (1) blacks and Hispanics report higher adjusted mean levels of distress compared with whites, (2) significant race × income interaction with distress levels decreasing more with increasing income among blacks and Hispanics than among whites. Women: (1) no significant racial differences in adjusted mean levels of distress, (2) no significant interaction effects.

what might be observed among the general population. Consequently, our findings may underestimate the effect of race on distress at the lower end of the income gradient. Examining this issue in a sample with more low-income respondents may prove worthwhile in ascertaining a more complete understanding of effects at the lower end of the income gradient.

When examining racial differences in health, the common strategy is to control for income, gender and other factors expected to modify the effect of race. This study underscores the importance of using multiplicative models to more fully account for the interactive nature of race with these other variables. We demonstrate that not doing so prevents us from fully understanding how race operates and conceals its role in the creation and preservation of disparities; and offer this as an approach for examining racial health disparities more broadly.

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