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Triple jeopardy: the joint impact of racial segregation and neighborhood poverty on the mental health of black Americans

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Abstract

Purpose Because segregation may shield blacks from discrimination as well as increase their exposure to concentrated poverty, its net impact on the mental well-being of black Americans is unclear. We investigated the intersection between segregation, neighborhood poverty, race, and psychological well-being.

Methods Using data from the nationally representative 2008–2013 National Health Interview Survey merged with U.S. Census data, we examined the association between black–white metropolitan segregation (D-index and P-index) and psychological distress (a binary indicator based on the Kessler 6 score ≥ 13) for blacks and whites. Furthermore, we assessed whether neighborhood poverty explains and/or modifies the association. Logistic regression models were estimated separately for blacks and whites as well as for each segregation index.

Results Higher D- and P-indices were associated with higher odds of psychological distress for blacks. Neighborhood poverty explained some, but not all, of the association. In models that allowed for the impact of metropolitan segregation to vary by neighborhood poverty, higher segregation was found to be detrimental for blacks who resided in high poverty neighborhoods but not for those living in low poverty neighborhoods. We found no evidence that segregation impacts the mental health of whites—either detrimentally or beneficially—regardless of neighborhood poverty level.

Conclusions The impact of segregation differs by neighborhood poverty and race. The psychological harm of structural racism, resulting in segregation and concentrated poverty, is not additive but multiplicative, reflecting a "triple jeopardy" for blacks, whereby their mental health is detrimentally impacted by the compounded effects of both neighborhood distress and racial segregation.

Keywords Racial segregation · Neighborhood poverty · Mental health

Introduction

In 1999, Former Surgeon General David Satcher remarked that "there is no health without mental health" [1], and indeed, mental illness is associated with the occurrence of several chronic diseases such as obesity, drug addiction, and hypertension [2]. Mental illness also influences socioeconomic status and quality of life indicators, such as family stability [3], with the economic burden of untreated mental illness surpassing the collective cost of heart disease and cancer [4].

Although the current predominant focus is on addressing the biological underpinnings of psychiatric disorders [5], there is still practical value in examining the links between social factors and mental illness, particularly the role of social and economic disadvantage. Several studies indicate that poverty, both at the individual and neighborhood levels, is an important determinant of mental illness in the general population, with both lower individual and neighborhood poverty linked to better mental health [6–9]. However, despite knowing a great deal about the socioeconomic conditions that predicate mental illness in the (predominantly white) general population, we know less about how social and economic factors influence the risk for mental illness for blacks, specifically.

In fact, research on the intersection of race, disadvantage, and mental health has produced a perplexing set of unexpected findings. Despite being a marginalized and

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socioeconomic disadvantaged population with a worse physical health profile than whites, black Americans tend to have lower prevalence of psychological disorders [10]. Factoring into this unintuitive finding is the inconclusive association between socioeconomic status (SES) and mental health for blacks. For example, although some studies have found socioeconomic status (SES) to be a significant predictor of depression and depressive symptoms among blacks, results from other studies have found no association [11–13]. The latter findings are consistent with the argument that blacks are resilient in the face of economic and social adversity with respect to mental health [14]. At the area level, the few studies that have examined neighborhood-level SES in relation with the mental health of blacks have found evidence for a detrimental link between neighborhood socioeconomic deprivation and psychological well-being [15, 16]. For example, experimental evidence from the moving to opportunity study designed to facilitate the movement of low-income adults, the majority of whom were black, from high to low poverty neighborhoods strongly indicated that "moving up" can have a significant positive impact on mental health [8].

One explanation for the association between neighborhood poverty and the occurrence of mental illness among blacks is that living in a severely disadvantaged neighborhood exposes blacks to psychologically toxic factors, such as social disorder or violence [17, 18], that are more distressing and difficult to cope with than individual economic hardship [19]. More insidiously, the link between neighborhood disadvantage and mental illness may be mediated by perceived discrimination, consistent with the framework that concentrated neighborhood disadvantage is a consequence of institutional racism [20]. Rooted in racialized distribution of resources, power, and social status, blacks have been marginalized and relegated to inter-generational exposure to concentrated poverty—along with the associated stigma and prejudice. The constant and daily exposure to the damaging physical and social manifestations of institutional discrimination may be palpable stressors for blacks in disadvantaged communities, leading to unfavorable health behaviors as well as diminished physical and psychological well-being [21–28]. This intersection between neighborhood poverty and institutional racism points to another factor that might raise the risk for mental illness among blacks: racial segregation.

Segregation, neighborhood poverty, and mental health

An enduring legacy of institutional racism, residential racial segregation has been consistently found to have detrimental effects on the well-being of black Americans. It is hypothesized that segregation is detrimental to blacks primarily, because racial segregation disproportionately exposes blacks to areas of concentrated poverty and all its social and material ills [29, 30]. Previous research has found segregation to be associated with concrete forms of deprivation such as decreased access to quality education, employment opportunities, and healthy foods [31]. While a broad body of evidence has also revealed that segregation is detrimentally associated with a wide range of physical health outcomes in blacks, including birth weight, adult bodyweight, self-rated health, and infant and adult mortality [31], the relationship between black–white segregation and mental health outcomes has been less investigated.

Results from the limited studies that have examined the impact of segregation and racial density on the mental health of blacks are mixed, suggesting that the association between area racial characteristics and mental health is not straightforward. For example, contrary to intuition, Herbst and Lucio (2016) found that blacks who lived in more segregated cities reported higher levels of happiness than blacks in less segregated cities [32]. In addition, Becares, Nazroo, and Jackson (2014) found that residing in neighborhoods with higher black representation can have a protective effect for low-income blacks, lowering their risk for depressive symptoms—that is, until the 85% threshold, whereby the protective association reversed direction and became detrimental [33].

However, racial/ethnic density and segregation, although related and often used interchangeably in the segregation-health literature, are two distinct concepts and should not be conflated. The former reflects the residential concentration of a group in a neighborhood and the latter reflects the extent to which residential neighborhoods of one group are separate from that of another group. Understanding this distinction may help clarify why the literature has commonly found racial/ethnic density to have protective impacts versus the consistent deleterious impacts of segregation [33]. This study examines the impact of structural racism vis-à-vis metropolitan-level black–white residential segregation.

Independent of neighborhood poverty, metropolitan segregation might be harmful through the physical and social separation of groups in and of itself. Consistent with inter-contact theory, interaction between majority and minority groups might serve to reduce prejudice and stereotyping pertaining to both groups [34]. Through social contact, different groups are able to better understand each other's viewpoints, find common footing, and foster shared goals. Conversely, the lack of contact between groups may be harmful for inter-group dynamics, resulting in detrimental consequences for one or more groups. Thus, by minimizing the physical and social interaction between blacks and whites, segregation might lead to heightened racial tensions that increases alienation, breeds resentment, and deepens the social chasm

between blacks and whites across the metropolitan. The perception of discrimination, marginalization, and perpetuation of negative black stereotypes and chronic experience of prejudice may be harmful for the mental health of blacks [19, 24, 25, 27].

However, inter-racial integration and increased contact may not be necessarily beneficial. Increased inter-racial contact may expose blacks to repeated stressors such as discrimination and racism, leading to the adoption of high effort coping behaviors (i.e., John Henryism), which has been found to be linked to poorer health outcomes [35]. In addition, residing in a predominately white neighborhood may increase the psychosocial stigma associated with being a member of a marginalized, minority group within a majority community, which may result in internalized racism and associated detrimental impacts on physical and psychological well-being [21, 24]. Again, while conceptually distinct from segregation, living in racially homogeneous neighborhoods may provide blacks with a sense of community, high levels of social cohesion, and strong networking opportunities as well as protection against daily exposure to racism and discrimination [36].

Adding to the complexity in understanding the link between segregation and mental health is the possibility that metro segregation might not impact a given racial group uniformly if they are exposed to varied social and economic conditions within a metro area. Extant metropolitan segregation-health studies, in almost exclusively estimating the average impacts on health of residents, have implicitly assumed that segregation's impact on well-being is invariant within a given metro area, regardless of the local neighborhood context. This is consistent with the framework that segregation is reflective of structural racism, with pervasive detrimental impacts on minorities within metro areas across all neighborhoods, regardless of the more local context. However, it seems plausible that individuals of the same race within a metro area may have very different experiences depending on the neighborhood conditions, where they reside. That is, blacks who reside in segregated cities, but in neighborhoods that are not characterized by concentrated poverty, may be exposed to a very different risk profile than blacks who reside in poor neighborhoods in the same city. Hence, the level of exposure to concentrated disadvantage and racism at the more local neighborhood level might modify how metropolitan-level segregation impacts mental health. This suggests that the role of metropolitan segregation on the well-being of blacks may differ depending on the more proximal context in which blacks reside. For example, if segregation is harmful, those impacts might be amplified, such that the psychological harm is compounded and worse for those who also reside in a high poverty neighborhood. Conversely, for blacks who reside in non-poor neighborhoods and are able to escape the social and material ills associated with concentrated poverty, segregation may be protective. That is, the purported effects of racial segregation on the mental health of blacks may be conditioned by local neighborhood characteristics.

Apart from social contextual factors influencing the mental health of blacks, there remains the question of how segregation and poverty impacts whites. Because of their privileged status, it is unclear whether segregation undermines (through increased racial tension, fear, and resentment), benefits (through entitlement and empowerment via exclusion), or has negligible impact on the mental health of whites. If segregation was to benefit the mental health of whites, then conceivably, residing in poor or affluent neighborhoods would temper or augment these benefits, respectively. Thus, neighborhood poverty might modify the impact of metro segregation for both blacks and whites, such that the associations between segregation and mental health differ by neighborhood poverty levels.

Research questions

Determining under what conditions segregation can be protective or injurious to mental health for specific racial populations can help elucidate the potential mechanisms through which the residential separation of racial groups impacts psychological well-being. As such, we assess the independent and joint roles of black–white segregation and neighborhood poverty on mental health for black and white Americans. Specifically, for each racial group separately, we examine (1) the association between metropolitan segregation and general psychological distress; (2) whether neighborhood poverty explains the association; and (3) whether neighborhood poverty modifies the association.

Methods

Data

Our analyses are based on data from the 2008–2013 Integrated Health Interview Series, a version of the National Health Interview Survey (NHIS) data that harmonizes variables across years [37]. The NHIS is an annual cross-sectional survey that collects a broad range of health and socioeconomic information on a nationally representative sample of the civilian noninstitutionalized population of the United States. Individual-level NHIS data were merged with Census data via restricted geocodes by the National Center for Health Statistics Research Data Center through special contract. Census tract and metropolitan-level variables were derived from the 2000 and 2010 decennial censuses, and 2005–2009 American Community Survey (ACS) 5-year

estimates. Values for inter-census and ACS years were derived from linear interpolation.

We restrict our analyses to U.S. born non-Hispanic black and white individuals aged 25 and over residing in metropolitan areas with at least 5,000 blacks and a total population of more than 100,000. Our analytical sample size included over 16,000 blacks and 56,000 whites residing in approximately 200 metro areas.

Psychological distress

Our mental health outcome is the Kessler 6 (K6) scale, a measure of non-specific psychological distress. Non-specific psychological distress is considered a reactive disorder that arises from external stressors, which may be sensitive to contextual factors and inter-racial group relationships [38]. The K6 is derived from six questions reflecting manifestations of non-specific psychological distress; respondents were asked how often during the past 30 days, they felt (1) so sad that nothing could cheer you up, (2) nervous, (3) restless or fidgety, (4) hopeless (5) that everything was an effort, and (6) worthless. Each response was assigned a score based on the reported frequency: 0 for "none of the time"; 1 for "a little of the time"; 2 for "some of the time"; 3 for "most of the time"; and 4 for "all of the time". Scores were summed, resulting in a K6 scale ranging from 0 to 24, with higher values indicating greater psychological distress. Individuals who score 13 or greater are considered to be experiencing severe psychological distress [39]. Thus, we specify our measure of psychological distress as a binary indicator (≥ 13 vs < 13).

Segregation measures

The metropolitan area is a conventional spatial level to measure segregation, as it reflects the area over which the housing and labor markets operate. Metropolitan segregation thus assesses the distribution of racial groups across neighborhoods within the metro area.

We utilize two common measures of metropolitan segregation used in segregation-health research: the D- and P-indices [40]. The D-index reflects the dimension of evenness and assesses how uniformly the racial composition of neighborhoods is distributed. In this study, the value of the D-index indicates the percentage of blacks in the metro area that would need to move to a different neighborhood to have an even distribution of blacks across neighborhoods within the metro area. The P-index reflects the dimension of exposure and captures the potential contact (or noncontact) level of one group with another. Thus, the P-index measures the extent to which blacks, on average, are residentially isolated from whites in a metro. Both indices range from 0 to 1.0, with higher levels reflecting higher levels of segregation.

Neighborhood poverty

Our neighborhood-level exposure of interest is neighborhood poverty, defined as the proportion of residents below the federal poverty level in a census tract. We specify three levels of neighborhood poverty, consistent with prior studies in the neighborhood literature: low ($< 10\%$ poor: ref), medium (10 to $< 20\%$ poor), and high ($\geq 20\%$ poor) [e.g., 41].

Covariates

Individual-level covariates include: sex (binary), age (continuous), marital status (married, never married, and other), employment status (employed, unemployment, and not in the labor force), family income to poverty ratio (< 2, ≥ 2), education level (no high school, high school, associate degree, and bachelors +), and number of children in the household (0, 1, 2, and 3 +). Controls for metropolitan-level characteristics include: total population (natural logged), percent black, and percent poor. We further control for region of country (Northeast, North Central/Midwest, South, and West).

Statistical analysis

We estimate a series of logistic regression models, stratifying all analyses by race. We first estimate the crude association between black segregation and K6, adjusting only for the individual-level factors age and gender, which are not influenced by segregation, survey year to account for period effects, and metropolitan characteristics (Model 1). Next, to investigate whether neighborhood disadvantage helps to explain the relationship between segregation and psychological distress, we add neighborhood poverty as a control (Model 2). These estimates provide the overall average effect of segregation on psychological distress, net of neighborhood poverty, for the entire metropolitan area. However, because segregation may result in differential effects, depending on the level of neighborhood disadvantage, we then add an interaction term between metropolitan segregation and neighborhood poverty (Model 3). This strategy provides separate estimates for segregation by neighborhood poverty level. Finally, we adjust for individual characteristics: education, family income to poverty ratio, marital status, employment status, and number of children in the household (Model 4).

The regression models are estimated for each metropolitan segregation measure and racial group separately. All models account for the NHIS's complex survey design using surveylogistic procedures in SAS, with robust standard errors. We specify clustering at the primary sampling unit, which in the NHIS geographically approximates a county or metropolitan area [42]. This specification assumes independence of observations across metro areas but allows for

correlation within. Consequently, our modeling strategy provides consistent standard error estimators and valid confidence intervals, though perhaps with some efficiency loss (i.e., the variance of our proposed estimator is larger than that of random effect model).

Results

Descriptive characteristics for blacks and whites are presented in Table 1. Compared to whites, blacks disproportionately reside in higher poverty neighborhoods in metropolitan areas that are more segregated and with a greater proportion of blacks. Blacks consistently have lower SES across several measures, including income, education, employment status, and female-headed household. With respect to patterns across K6 levels, for both blacks and whites, those who score 13 or greater tend to disproportionately reside in female-headed households and high neighborhood poverty areas, have lower income levels, less education, and do not participate in the labor force.

Table 2 presents results from logistic regression models examining the association between metro segregation, neighborhood poverty, and psychological distress stratified by race. We first report the results for blacks, and then for whites. The top panel reports results for the D-index and the bottom panel reports results for the P-Index. The base model (Model 1) indicates that blacks who reside in more segregated metro areas are more likely to report psychological distress; each 10 percentage point increase in the D- and P-indices is associated with a 22% and 16% increase, respectively, in the odds of having psychological distress. Adjusting for neighborhood poverty attenuates the increased odds, such that they are now non-significant, with a p value $< 10\%$.

Impact of segregation by neighborhood poverty level

When allowing for the impact of segregation to vary across neighborhood poverty level, differential segregation effects across neighborhood poverty levels are discerned (Model 3). The greater than one odds ratios for the segregation and neighborhood poverty interaction terms for blacks indicate that the relationship between segregation and psychological distress is more detrimental in medium and high poverty neighborhoods, compared to low poverty neighborhoods.

Indeed, the total estimated effects of segregation (Table 3) reveal that significant detrimental associations for blacks are only observed in high poverty neighborhoods for both the D- and P-indices (Table 3: Model 3); each 10 percentage point increase in the D- and P-indices is associated with an 26% and 19% increase, respectively, in the odds of having psychological distress. Estimates remained relatively stable after adjusting for individual characteristics; although the results for the P-index were somewhat attenuated, with a p value now at less than 10% (Table 3: Model 4).

With respect to whites, no association between segregation and psychological distress was found—either overall or by neighborhood poverty level. There was also no evidence to indicate that neighborhood poverty plays a moderating role. However, whites (as well as blacks) in medium and high poverty neighborhoods are more likely to report psychological distress than those living in low poverty neighborhoods. In supplementary analyses (results not shown), inferences were not significantly changed with the addition of neighborhood black density (i.e., neighborhood % black) as a control variable.

Discussion

Results revealed that the association between segregation and mental health not only differs by race, but also by level of exposure to neighborhood poverty. While we found no evidence that segregation impacts the mental health of whites—either detrimentally or beneficially—higher segregation is associated with higher likelihood of psychological distress for blacks, on average. Adjusting for neighborhood poverty accounted for some of the relationship.

In analyses that allowed the association between segregation and psychological distress to vary by neighborhood disadvantage, segregation was not found to be harmful for blacks who resided in low poverty neighborhoods. In fact, although estimates were imprecise, the direction of estimates is suggestive of a salutatory association, pointing to the plausibility that segregation can be benign or even protective for blacks who escape the trappings of concentrated poverty. In stark contrast, we find evidence for a "triple jeopardy" in which occupying three positions of disadvantage: being a black racial minority, residing in a high poverty neighborhood, and residing in a highly racially segregated metro area, results in a compounded, deleterious impact on well-being. That is, the damaging impacts of concentrated poverty on psychological health become more and more severe as the level of segregation increases for blacks, but not for whites. Thus, for blacks, the psychological damage of segregation and concentrated poverty is multiplicative, not additive. This points to the central role that neighborhood poverty plays in shaping the impact of racial segregation and the importance of examining the joint impact of segregation and concentrated poverty. Our findings of possible divergent impacts of segregation provide additional support of past findings on the duality of segregation's role on black health in which segregation can be detrimental or protective, depending on specific conditions [30, 33].

Table 1 Weighted descriptive characteristics (percentage or mean value) by race and K6 level

Characteristics	Blacks		Whites	
K6	< 13	≥ 13	< 13	≥ 13
N	15,720	731	54,092	1933
Neighborhood poverty				
Low	22.26	11.57	51.56	35.16
Medium	25.26	23.06	27.80	34.64
High	52.48	65.37	20.64	30.19
Individual-level covariates				
Mean age	47.75 (15.00)	45.55 (12.49)	50.81 (15.73)	49.77 (14.09)
Female	55.83	63.96	51.11	57.84
Family income/poverty ratio				
< 2	40.87	72.74	16.67	50.47
Female-headed household	14.93	18.85	3.30	6.58
Education				
No HS	15.35	33.00	7.19	22.21
HS	50.86	53.54	42.55	54.95
AA	11.81	9.18	11.72	10.90
Bachelors+	21.98	4.28	38.54	11.94
Marital status				
Married	45.65	33.36	69.65	53.09
Never married	28.37	37.29	12.05	14.86
Other	25.98	29.35	18.30	32.05
Employment status				
Employed	60.75	26.44	65.78	29.29
Unemployed	8.72	13.44	3.85	10.99
NILF	30.52	60.13	30.37	59.72
Number of children in household				
None	62.12	64.07	68.62	71.02
One	16.66	14.27	13.14	14.42
Two	12.22	12.52	12.37	8.61
Three+	9.00	9.15	5.87	5.96
Region				
Northeast	14.59	13.42	21.07	17.51
North Central/Midwest	20.03	18.63	25.53	26.49
South	56.48	57.94	35.59	38.89
West	8.90	10.02	17.81	17.11
Metropolitan-level characteristics				
Black–white segregation	Black		White	
D-Index	0.59 (0.12)		0.57 (0.12)	
P-Index	0.56 (0.16)		0.44 (0.20)	
SP-Index	0.33 (0.18)		0.26 (0.20)	
Covariates				
LN Population	14.47 (1.35)		14.29 (1.33)	
% Black	20.55 (10.44)		13.44 (8.89)	
% Poor	13.92 (3.38)		13.35 (3.03)	

Why we only observe detrimental impacts of segregation in high poverty neighborhoods raises questions regarding whether the nature of disadvantage in poor neighborhoods is different and more severe across communities that are highly segregated compared to those that are not. While investigating the distribution of resources in segregated versus non-segregated communities and its consequences for poor communities and minority health is out of the scope of this

Table 2 Logistic regression results for K6 ≥ 13 stratified by race

	Black				White			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
D-INDEX	1.22* [1.03, 1.44]	1.17+ [0.99, 1.37]	0.87 [0.67, 1.13]	0.90 [0.69, 1.16]	1.03 [0.95, 1.11]	1.03 [0.96, 1.11]	1.00 [0.91, 1.10]	1.01 [0.92, 1.11]
D-INDEX*medium neighborhood poverty			1.37* [1.03, 1.82]	1.36* [1.04, 1.77]			0.97 [0.87, 1.08]	1.00 [0.90, 1.12]
D-INDEX*high neighborhood poverty			1.45** [1.12, 1.87]	1.35* [1.05, 1.74]			1.09 [0.97, 1.21]	1.08 [0.96, 1.21]
Medium neighborhood poverty		1.67** [1.15, 2.42]	1.80* [1.20, 2.71]	1.45+ [0.97, 2.18]		1.72** [1.45, 2.04]	1.71** [1.44, 2.04]	1.26** [1.07, 1.49]
High neighborhood poverty		2.32** [1.67, 3.23]	2.50** [1.73, 3.60]	1.46+ [0.99, 2.15]		1.95** [1.66, 2.29]	1.97** [1.68, 2.32]	1.29** [1.10, 1.51]
P-INDEX	1.16* [1.00, 1.33]	1.13+ [0.99, 1.31]	1.03 [0.84, 1.27]	1.03 [0.83, 1.28]	1.02 [0.95, 1.09]	1.03 [0.96, 1.10]	1.03 [0.95, 1.10]	1.02 [0.95, 1.10]
P-INDEX*medium neighborhood poverty			1.03 [0.83, 1.30]	1.05 [0.84, 1.31]			1.00 [0.93, 1.06]	1.00 [0.93, 1.06]
P-INDEX*high neighborhood poverty			1.15 [0.96, 1.38]	1.13 [0.94, 1.37]			1.00 [0.94, 1.07]	1.01 [0.94, 1.08]
Medium neighborhood poverty		1.67** [1.15, 2.43]	1.68* [1.12, 2.52]	1.37 [0.91, 2.06]		1.72** [1.45, 2.04]	1.72** [1.45, 2.04]	1.27** [1.07, 1.49]
High neighborhood poverty		2.35** [1.69, 3.28]	2.41** [1.69, 3.44]	1.42+ [0.97, 2.08]		1.95** [1.66, 2.29]	1.95** [1.66, 2.30]	1.28** [1.09, 1.50]

Adjustments

Model 1: age, sex, msa %black, msa population, msa %poor, region, year

Model 2: M1 + neighborhood poverty

Model 3: M2 + neighborhood poverty*segregation

Model 4: M3 + family income/poverty ratio, education, marital status, labor force, # children, female-headed household

Neighborhood poverty estimates for Models 3 and 4 reflect differences at segregation race-specific sample mean

ORs for the D-index and P-index represent a 10 percentage point change

^{+}p value < 0.10; *p value < 0.05; **p value < 0.01

Table 3 Total segregation estimates by neighborhood poverty for K6 ≥ 13 stratified by race

	Black		White	
	Model 3	Model 4	Model 3	Model 4
D-INDEX in low neighborhood poverty	0.87 [0.67, 1.13]	0.90 [0.69, 1.16]	1.00 [0.91, 1.10]	1.01 [0.92, 1.11]
D-INDEX in medium neighborhood poverty	1.19 [0.97, 1.48]	1.22+ [0.97, 1.52]	1.02 [0.92, 1.13]	1.02 [0.92, 1.12]
D-INDEX in high neighborhood poverty	1.26* [1.05, 1.51]	1.22* [1.01, 1.47]	1.08 [0.98, 1.19]	1.09+ [0.99, 1.20]
P-INDEX in low neighborhood poverty	1.03 [0.84, 1.27]	1.03 [0.83, 1.28]	1.03 [0.95, 1.10]	1.02 [0.95, 1.10]
P-INDEX in medium neighborhood poverty	1.07 [0.89, 1.28]	1.08 [0.89, 1.32]	1.02 [0.94, 1.11]	1.02 [0.94, 1.10]
P-INDEX in high neighborhood poverty	1.19* [1.03, 1.38]	1.17+ [1.00, 1.37]	1.03 [0.96, 1.11]	1.03 [0.95, 1.11]

Adjustments

Model 3: age, sex, msa %black, msa population, msa %poor, region, year, neighborhood poverty, and neighborhood poverty*segregation

Model 4: M3 + family income/poverty ratio, education, marital status, labor force, # children, and female-headed household

ORs for the D-index and P-index indices represent a 10 percentage point change

^{+}p value < 0.10; *p value < 0.05; **p value < 0.01

study, it calls attention to the importance of understanding the intersection of structural racism, concentrated poverty, and health disparities.

Limitations

To the best of our knowledge, this is the first study using nationally representative data to examine the interconnected

roles of metropolitan segregation and neighborhood poverty on the mental health of black and white Americans. However, limitations of this study include the cross-sectional nature of our data, which did not allow us to assess the directionality of the associations. Because temporal ordering could not be established, it may be that individuals with prior mental health conditions may be more likely to reside in poorer, more segregated communities. In addition, like all self-report measures of psychological symptoms, the K6 is susceptible to effects of social desirability and concerns about the stigma of mental illness, which may vary across race and hamper direct comparisons. However, because our analyses were stratified by race, estimates of the association between segregation, neighborhood poverty, and mental health among blacks and whites would not be affected by differential social desirability across race. Moreover, there may also be some advantages to using self-report data as mental illness among marginalized populations, including blacks, have been over diagnosed or misdiagnosed due to racial bias in clinical decision making [43]. In the context of this study, self-report measures of psychological distress may be less prone to racial bias than assessments made by mental health professionals.

Conclusions

Our results underscore the importance of applying a more nuanced analysis of segregation and the pivotal role of concentrated poverty areas. Distinguishing the impacts of segregation versus neighborhood disadvantage and recognizing that metropolitan-level segregation's impacts may be heterogeneous under different neighborhood conditions is vital to understanding and addressing the root causes of the black health disadvantage. Given the intractability of segregation in the U.S., our findings suggest that the reduction of concentrated poverty can be a viable and effective target to help reduce the risk for mental illness for both blacks and whites.

Compliance with ethical standards

Conflict of interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

References

1. US Department of Health and Human Services (1999) Mental health: A report of the Surgeon General (DHHS Pub. No. SMA 96-3098). Rockville, MD: US Department of Health and Human Services. Substance Abuse and Mental Health Administration, Center for Mental Health Services, National Institutes of Health, National Institute of Mental Health
2. Forman-Hoffman VL, Muhuri PK, Novak SP, Pemberton MR, Ault KL, Mannix D (2014) Psychological distress and mortality among adults in the US household population. CBHSQ Data Rev 27:824–830
3. Kessler RC, Walters EE, Forthofer MS (1998) The social consequences of psychiatric disorders, III: probability of marital stability. Am J Psychiatry 155(8):1092–1096
4. Goetzel RZ, Long SR, Ozminkowski RJ, Hawkins K, Wang S, Lynch W (2004) Health, absence, disability, and presenteeism cost estimates of certain physical and mental health conditions affecting US employers. J Occup Environ Med 46(4):398–412
5. Uher R, McGuffin P (2008) The moderation by the serotonin transporter gene of environmental adversity in the aetiology of mental illness: review and methodological analysis. Mol Psychiatry 13(2):131
6. Vick B, Jones K, Mitra S (2012) Poverty and severe psychiatric disorder in the U.S.: evidence from the Medical Expenditure Panel Survey. J Ment Health Policy Econ 15(2):83–96
7. Compton MT, Shim RS (2015) The social determinants of mental health. Focus 13(4):419–425
8. Ludwig J, Duncan GJ, Gennetian LA et al (2012) Neighborhood effects on the long-term well-being of low-income adults. Science 337(6101):1505–1510
9. Costello EJ, Compton SN, Keeler G, Angold A (2003) Relationships between poverty and psychopathology: a natural experiment. Jama 290(15):2023–2029
10. Barnes DM, Bates LM (2017) Do racial patterns in psychological distress shed light on the Black–White depression paradox? A systematic review. Soc Psychiatry Psychiatr Epidemiol 52(8):913–928
11. Williams DR, Gonzalez HM, Neighbors H et al (2007) Prevalence and distribution of major depressive disorder in African Americans, Caribbean blacks, and non-Hispanic whites: results from the National Survey of American Life. Arch Gen Psychiatry 64(3):305–315
12. Ennis NE, Hobfoll SE, Schröder KE (2000) Money doesn't talk, it swears: how economic stress and resistance resources impact inner-city women's depressive mood. Am J Community Psychol 28(2):149–173
13. Hudson DL, Neighbors HW, Geronimus AT, Jackson JS (2012) The relationship between socioeconomic position and depression among a US nationally representative sample of African Americans. Soc Psychiatry Psychiatr Epidemiol 47(3):373–381
14. Keyes CL (2009) The Black–White paradox in health: flourishing in the face of social inequality and discrimination. J Personal 77(6):1677–1706
15. Muntaner C, Eaton WW, Miech R, O'Campo P (2004) Socioeconomic position and major mental disorders. Epidemiol Rev 26:53–62
16. Cutrona CE, Russell DW, Hessling RM, Brown PA, Murry V (2000) Direct and moderating effects of community context on the psychological well-being of African American women. J Personal Soc Psychol 79(6):1088
17. Cutrona CE, Wallace G, Wesner KA (2006) Neighborhood characteristics and depression: an examination of stress processes. Curr Direct Psychol Sci 15(4):188–192
18. Grant KE, McCormick A, Poindexter L et al (2005) Exposure to violence and parenting as mediators between poverty and psychological symptoms in urban African American adolescents. J Adoles 28(4):507–521
19. Williams R, Williams-Morris D (2000) R. Racism and mental health: the African American experience. Ethn Health 5(3–4):243–268
20. Riley AR (2018) Neighborhood disadvantage, residential segregation, and beyond—lessons for studying structural racism and health. J Racial Ethn Health Dispar 5(2):357–365

21. Forman TA (2003) The social psychological costs of racial segmentation in the workplace: a study of African Americans' well-being. J Health Soc Behav 1:332–352
22. Carliner H, Delker E, Fink DS, Keyes KM, Hasin DS (2016) Racial discrimination, socioeconomic position, and illicit drug use among US Blacks. Soc Psychiatry Psychiatr Epidemiol 51(4):551–560
23. Dailey AB, Kasl SV, Holford TR, Lewis TT, Jones BA (2010) Neighborhood-and individual-level socioeconomic variation in perceptions of racial discrimination. Ethn Health 15(2):145–163
24. Williams DR, Mohammed SA, Leavell J, Collins C (2010) Race, socioeconomic status, and health: complexities, ongoing challenges, and research opportunities. Ann N Y Acad Sci 1186(1):69–101
25. Clark R, Anderson NB, Clark VR, Williams DR (1999) Racism as a stressor for African Americans: a biopsychosocial model. Am Psychol 54(10):805
26. Dolezsar CM, McGrath JJ, Herzig AJ, Miller SB (2014) Perceived racial discrimination and hypertension: a comprehensive systematic review. Health Psychol 33(1):20
27. Pascoe EA, Smart Richman L (2009) Perceived discrimination and health: a meta-analytic review. Psychol Bull 135(4):531
28. Black LL, Johnson R, VanHoose L (2015) The relationship between perceived racism/discrimination and health among black American women: a review of the literature from 2003 to 2013. J Racial Ethn Health Dispar 2(1):11–20
29. Massey DS, Denton NA (1993) American apartheid: segregation and the making of the underclass. Harvard University Press, Harvard
30. Do DP, Frank R, Iceland J (2017) Black-white metropolitan segregation and self-rated health: investigating the role of neighborhood poverty. Soc Sci Med 187:85–92
31. Kramer MR, Hogue CR (2009) Is segregation bad for your health? Epidemiol Rev 31(1):178–194
32. Herbst CM, Lucio J (2016) Happy in the hood? The impact of residential segregation on self-reported happiness. J Reg Sci 56(3):494–521
33. Bécares L, Nazroo J, Jackson J (2014) Ethnic density and depressive symptoms among African Americans: threshold and differential effects across social and demographic subgroups. Am J Public Health 104(12):2334–2341
34. Pettigrew TF, Tropp LR (2006) A meta-analytic test of intergroup contact theory. J Personal Soc Psychol 90(5):751
35. Hudson DL, Neighbors HW, Geronimus AT, Jackson JS (2016) Racial discrimination, John Henryism, and depression among African Americans. J Black Psychol 42(3):221–243
36. Bécares L, Nazroo J, Stafford M (2009) The buffering effects of ethnic density on experienced racism and health. Health Place 15(3):700–708
37. Blewett LA, Rivera Drew JA, Griffin R, King ML, Williams KCW (2016) IPUMS health surveys: national health interview survey, version 6.2. University of Minnesota, Minneapolis. https://doi.org/10.18128/D18070.V18126.18122
38. Kessler RC, Neighbors HW (1986) A new perspective on the relationships among race, social class, and psychological distress. J Health Soc Behav 1:107–115
39. Kessler RC, Andrews G, Colpe LJ et al (2002) Short screening scales to monitor population prevalences and trends in non-specific psychological distress. Psychol Med 32(6):959–976
40. Massey DS, Denton NA (1988) The dimensions of residential segregation. Soc Forces 67(2):281–315
41. Kravitz-Wirtz N (2016) A discrete-time analysis of the effects of more prolonged exposure to neighborhood poverty on the risk of smoking initiation by age 25. Soc Sci Med 148:79–92
42. Blewett LA, Drew JAR, Griffin R, King ML, Williams KCW (2016) PUMS health surveys: National Health Interview Survey, Version 6.2.. In: Minnesota Uo, ed. Minneapolis
43. Snowden LR (2003) Bias in mental health assessment and intervention: theory and evidence. Am J Public Health 93(2):239–243