



Published in final edited form as:

Ethn Health. 2021 October ; 26(7): 949–962. doi:10.1080/13557858.2019.1613517.

Developmental timing of initial racial discrimination exposure is associated with cardiovascular health conditions in adulthood

Adolfo G. Cuevas^{a,†}, Thao Ho^{a,†}, Justin Rodgers^b, Danielle DeNufrio^c, Lindsey Alley^d, Jennifer Allen^a, David R. Williams^{b,e}

^aDepartment of Community Health, Tufts University, Medford, MA, USA

^bDepartment of Social and Behavioral Sciences, Harvard T.H. Chan School of Public Health, Boston, MA, USA

^cDepartment of Public Health and Community Medicine, Tufts' School of Medicine, Boston, MA, USA

^dHealthInsight Oregon, Portland, OR, USA

^eDepartment of African and African American Studies, Harvard University, Cambridge, MA, USA

Abstract

Objective: To examine the association between developmental timing of initial exposure to racial discrimination and cardiovascular health conditions.

Design: Using data from the 1995 Detroit Area Study, logistic and negative binomial regression models were used to assess the association between timing of initial exposure to racial/ethnic discrimination, classified as early childhood (0-7), childhood (8-12), adolescence (13-19), and adulthood (>19), on physician-diagnosed cardiovascular health conditions during adulthood. Each analysis adjusted for age, gender, race/ethnicity, income, education, marital status, health-related behaviors, and pre-existing health conditions.

Results: Of the 1,106 participants in the final sample, 520 identified as White and 586 identified as Black. Over half (64%) of the sample experienced at least one major cardiovascular health event at the time of the study, with 39% reporting two or more events. Results from logistic regression models showed that initial exposure to racial discrimination during early childhood was associated with a 2.96 (95%CI:1.15, 7.83) times greater odds of having any cardiovascular-related health condition later in life compared to individuals who reported no discrimination. Results from negative binomial regression models demonstrated that individuals who reported initial exposure to racial discrimination during early childhood and adolescence had a CVD incidence rate that was 1.63 (95%CI:1.11, 2.38) and 1.37 (95%CI:1.10, 1.69) times higher than individuals who reported no discrimination.

CONTACT Adolfo G. Cuevas, adolfo.Cuevas@tufts.edu, Department of Community Health, Tufts University, 574 Boston Ave, Suite 208, Medford, MA 02155, USA.

[†]Denotes co-first authorship.

Disclosure statement

No potential conflict of interest was reported by the authors.

Conclusion: Initial exposure to racial discrimination in early childhood and adolescence may increase the risk of cardiovascular conditions later in life. Clinicians and researchers should consider racial discrimination during childhood as a possible risk factor for illness and disease.

Keywords

cardiovascular health; racial discrimination; developmental trauma; childhood adversity; self-rated health

Introduction

Psychological trauma can result from a moment in time in an individual's life that was perceived by the individual as either physically or emotionally harmful and can have lasting negative implications for the individual's mental, physical, emotional, and spiritual health (National Center for Mental Health Promotion and Youth Violence Prevention 2012; Substance Abuse and Mental Health Services Administration 2014). Adverse events that induce trauma vary from extreme conditions, such as war, humanitarian crises, and natural disasters, to more common events, such as serious injuries or death of a loved one (National Center for Mental Health Promotion and Youth Violence Prevention 2012).

Trauma can cause a wide range of serious effects on physical and mental health. Exposure to traumatic events has been correlated with the development of chronic illnesses such as cardiovascular diseases, gastrointestinal diseases, chronic pain syndromes, depression, anxiety, and various cancers (Kendall-Tackett and Klest 2009), as well as dysregulation of the immune system (Kendall-Tackett and Klest 2009). Moreover, trauma in key developmental periods can accelerate the onset of mental and physical illnesses (D'Andrea et al. 2011; McLaughlin et al. 2016; Slopen, Koenen, and Kubzansky 2012). For instance, a study by Dunn and colleagues found that adults who reported initial exposure to child maltreatment during early childhood had depressive symptoms scores that were 1.5 times higher than adults whose first exposure occurred during middle childhood and were almost twice as high as those first exposed during adolescence (Dunn et al. 2017).

Although the pathways in which developmental trauma and childhood adversity inform physical health are not fully understood, research suggests that stress is a potential avenue. Stress operates within human bodies through the increasing of heart rate, blood pressure, and stress hormones to develop stress response systems (Center on the Developing Child 2012). Harvard University's Center on the Developing Child (2012) distinguishes between three types of stress: positive, tolerable, and toxic stress. In particular, toxic stress can be generated through exposure to strong or persistent adversity (Center on the Developing Child 2012). Toxic stress can induce an individual's stress response system to the point where its recurrent reactions disrupt the functioning of the brain and other organ systems in the body (Center on the Developing Child 2012). Stress can also accelerate cellular aging (Epel et al. 2006) and reduce an individual's ability to manage preexisting stressors (Williams and Mohammed 2009). A reduced ability to manage stress may lead to coping behaviors that result in unhealthy actions, such as smoking, sedentary behavior, and unhealthy diet (Williams and Mohammed 2009). Since most physiological

and psychological growth of the human body occurs during childhood and adolescence, exposure to trauma during this critical period can impede on development and impair an individual's health well into their adult years.

One particular form of trauma is racism. Racism is a societal structure that assigns groups of people to races and infers differential treatment to these groups based on their race (Williams and Mohammed 2009). Racism operates through racial discrimination, a process of differentially treating people based on perceptions of racial and ethnic identity. Discrimination can occur on a variety of interpersonal and institutional levels, such as in the workplace, at educational institutions, and in everyday encounters with other people. Experiences with discrimination thus have the potential to operate as acute (e.g., traumatic events) or chronic events. An increasing body of evidence show that exposure to racial discrimination (particularly at young ages) can lead to a range of cardiovascular disease risks, including hypertension, overweight-related outcomes, and diabetes (Paradies et al. 2015). Race-related trauma is also associated with changes in the brain, which in turn can cause behavioral problems, such as depressive and anxiety symptoms, posttraumatic stress symptoms, and higher rates of social delinquency (Hassouneh and Kulwicky 2007; Kang and Burton 2014).

As early as 3 years old, children can recognize racial groups and other children on the basis of their race (Feagin and Van Ausdale 2001). Emerging research suggests that children also have the ability to perceive discrimination and attribute unfair treatment to race (Pachter et al. 2010; Pachter and Coll 2009). Children may also inherit notions of discrimination and understand the beliefs that underlie discrimination early on, thus, increasing their awareness and exposure to discrimination early in life (Williams and Mohammed 2009). Despite the paucity of research on racism and child health, perceived discrimination experienced during childhood has been found to be associated with behavioral problems, substance use, depressive symptoms, and low self-esteem (see Pachter and Coll 2009 for review). It has been argued that there are 'critical periods' in early life development that where exposure to traumatic events may have potent effects on health long-term. Little is known as to whether exposure to racism during specific periods (or stages) during life have greater effects on adult health.

In the present study, we examined whether initial exposure to racial discrimination in particular developmental stages was associated with current adulthood health status. The 1995 Detroit Area Study is the only dataset to our knowledge to ask participants when they remember first experiencing racial/ethnic discrimination. We hypothesized that earlier exposure to perceived racial/ethnic discriminatory events would be more strongly correlated with cardiovascular events in adulthood and that there would be a dose-response relationship, such that the earlier the stage of development, the stronger the association with cardiovascular health conditions in adulthood. We further explored whether associations were stronger for Black participants compared to their White counterparts.

This study may shed light onto the significance of identifying racialized trauma early in life. Since childhood onset of chronic diseases disproportionately affect children of ethnic and racial minorities (McLaughlin et al. 2016), discriminatory experiences may play a

role. Examining whether first encounters with discrimination and health outcomes has any relation to stage of development can provide insight into future clinical treatment and interventions.

Methods

Sample

This study draws on the results from the 1995 Detroit Area Study (DAS), an annual tricounty survey of Detroit, MI that surveys adults aged 18 and older residing in households located in the counties of Oakland, Macomb, and Wayne. The DAS consisted of a multistage area probability sample of 1,139 adults who were eligible for participation. Data was collected through face-to-face interviews by graduate students from the University of Michigan and professional interviewers from the Survey Research Center. The response rate was 70%. The final racial breakdown of the sample included: 520 Whites; 586 Blacks; and 33 Asians, Native Americans, and Hispanics. For the purpose of the analyses in this article, only responses from White and Black participants were used. The secondary data analysis was approved by Tufts University's Institutional Review Board.

Measures

Dependent variables—Our main outcome variable, cardiovascular health conditions, was defined as the number of times participants reported 'yes' to the following question: 'Has a doctor or health professional ever told you have ... 1) high blood pressure, 2) stroke, 3) heart attack or other heart problem, 4) blood circulation problem or hardening of the arteries, and/or 5) high cholesterol?'. We also constructed a binary variable measuring the presence of any of the above cardiovascular conditions, which we analyzed in supplementary analyses.

Independent variables—Initial exposure to racial discrimination was measured through two questions on the DAS: 'Thinking over your whole life, do you think that you have ever been treated unfairly or badly because of your race or ethnicity? If so, at what age did you first have an experience like that?'

Responses to these questions were based on participant self-report. Age was reported in years. Following a similar approach to other research (Dunn et al. 2017), we categorized the ages into four groups to identify developmental timing while minimizing recall bias: early childhood (0-7), childhood (8-12), adolescence (13-19), and adulthood (>19). Those who reported no experiences of discrimination were designated as the reference group.

Covariates—Given their demonstrated associations with discrimination and health, age, sex, race, marital status, income, education, smoking, physical activity, and self-reported pre-existing health conditions were included as covariates in the analyses (Williams and Mohammed 2009).

Data analysis

First bivariate associations between the health outcomes and each of the independent variables were examined using chi-square tests for categorical variables and t-tests for continuous variables. Then, logistic and negative binomial regression models were used to assess the relationship between the stage of initial discrimination exposure and each of the binary and count outcome variables, respectively. All models accounted for the sampling design by adding probability weights and adjusted for potential confounding by age, gender, race/ethnicity, income, education, marital status, health-related behaviors, and pre-existing health conditions. Each model had the following general structure: $CVD = \beta_0 + \beta_1 \text{Age of First Discrimination} + \beta_2 X + \epsilon$, where age of discrimination is a five-level categorical variable denoting specific age ranges with no discrimination as the reference group, X is a vector of covariates as described above, and ϵ is error term. The specific structure of the model was dependent on the outcome variable; binary health measures were modeled using logistic regression whereas counts of cardiovascular and chronic health conditions were modeled using negative binomial regression. Negative binomial regression models were used to model the count of CVD events due to the positively skewed nature of this variable. Negative binomial models are a generalization of Poisson models, with an extra parameter to model the over dispersion (UCLA Statistical Consulting Group 2018). We exponentiated the parameters from the negative binomial regression analyses to aid interpretability; therefore, we report incidence rate ratios for these analyses. Multiple imputation was utilized to account for missing observations, yielding an analytic sample of 1,139. In accordance with suggested best practices for MI, the imputation model included all variables used in any aspect of the analysis including all independent and dependent variables, as well as additional variables with a prognostic relationship to variables with missing (Graham 2009). Thirty imputations were used.

Results

As reported in Table 1, participants in the final sample were primarily White (50%), followed by Black (45%) adults aged 18-98 with a median age of about 40 years, mean income of \$38,000 (in 1995 USD), with most having at least a high school education or greater (~80%). Over half (64%) of the sample experienced at least one major cardiovascular health event at the time of the study, with 39% reporting two or more events. Only 30% of participants reported that their physical health was 'fair' or 'poor'. Most (60%) participants reported experiencing no discrimination throughout their entire lifetimes. Of those reporting experiencing incidents of discrimination, 30% recalled experiencing their first discriminatory event after the age of 19 (i.e., adulthood), 39% remembered their first experience of discrimination between the ages of 13-19 (i.e., adolescence), 21% reported their first event occurring between ages 8-12 (i.e., childhood), and 9% reported their first age of discrimination at or less than 7 years old (i.e., early childhood). Tests of significance comparing equivalence of sociodemographic and behavioral variables by developmental timing of initial discrimination exposure revealed that those who reported first experiencing discrimination early in life were among younger adults, Blacks, individuals of lower socioeconomic status, single and divorced vs. married participants, and smokers who consumed a greater number of cigarettes per day compared to smokers who smoked less

(Table 2). Moreover, Whites, older adults, and individuals of higher socioeconomic status were significantly more likely to report 'no discrimination' when queried about their lifetime experiences of discrimination.

Results from logistic regression models showed that reporting an initial exposure to racial discrimination during early childhood was associated with a 2.96 (95%CI: 1.15, 7.83) times greater odds of experiencing cardiovascular-related health conditions later in life compared to individuals who reported no discrimination, after adjusting for age, gender, race/ethnicity, marital status, pre-existing health conditions, socioeconomic status, and health behaviors (see Table 3). There was no evidence that reporting an initial exposure to racial discrimination during childhood (OR: 1.36; 95%CI [0.74,2.48]), adolescence (OR: 1.51; 95%CI [0.92,2.53]), and adulthood (OR: 0.98; 95%CI [0.54,1.72]) significantly increased the odds of experiencing cardiovascular-related health conditions later in life.

Results from negative binomial regression models demonstrated that individuals who reported initial exposure to racial discrimination during early childhood and adolescence had a CVD incidence rate that was 1.63 (95%CI:1.11, 2.38) and 1.37 (95%CI:1.10, 1.69) times higher compared to individuals who reported no discrimination (Table 4). There was no evidence that individuals who reported initial exposure to racial discrimination during childhood (IRR: 1.00 [0.75, 1.34]) and adulthood (IRR:1.02 [0.79, 1.30]) had higher CVD incidence rates compared to the reference group that reported no discrimination. In order to enhance interpretability, model estimates from negative binomial regressions can also be interpreted in terms of predicted means. For example, holding all covariates to their mean values, individuals with initial exposure to racial discrimination during early childhood would have an expected average of 0.90 (0.63, 1.29) CVD-related events over a one-year period, whereas those experiencing initial discrimination during adolescence would have an expected average of 0.77 (0.64, 0.93) CVD-related events over the same period, and those reporting no discrimination would have an expected average of 0.56 (0.50, 0.63) CVD-related conditions per year.

Exploratory analysis

Initial exposure to racial discrimination by race/gender interaction terms did not show any significant interaction effects (data not shown).

Discussion

The purpose of this study was to examine the relationship between developmental timing of initial exposure to racial discrimination and adult health outcomes using data from the 1995 Detroit Area Study. Research suggests that children may be at risk of reporting experiences with trauma and, if at a younger age, may be more susceptible to adverse effects due to not having fully developed healthy mechanisms to cope with traumatic experiences (Sanders-Phillips et al. 2009). Discrimination can act as a form of childhood trauma and may result in poor physical health outcomes later in life (Priest et al. 2013). In our study, compared to those who reported not experiencing any discrimination, we found that those who remember experiencing their first discriminatory event during early childhood (ages 0-7) were more likely to report experiencing cardiovascular health conditions during

adulthood, even after controlling for sociodemographic characteristics and health behaviors. Similar trauma-related studies have found that individuals exposed to child maltreatment during early childhood (ages 0–5) had both depression and PTSD symptoms that were up to twice as high as those exposed during later developmental stages (Dunn et al. 2017). Researchers also suggest that experiencing traumatic events in early childhood may impede a child's ability to master stage-salient developmental tasks, such as biological and social functions, all of which may affect psychological and physical health later in life (Doyle and Cicchetti 2017). Although the mechanisms linking early exposure to racial discrimination and to subsequent health risk remain understudied, our findings suggest that, similar to other traumatic events, experiences of discrimination in early childhood may be more damaging than later exposure to discrimination.

We also found that adults who reported experiencing their first discriminatory event during early childhood and during adolescence (ages 13-19) also reported greater number of cardiovascular health conditions compared to those who reported no discrimination. Our findings suggest that there may be critical periods of when individuals first recall initially experiencing racial discrimination and health. Experiencing racial discrimination during early childhood can be particularly toxic because it is a period of foundational neural changes and connections that impact future cognitive, emotional, and behavioral development (Walker et al. 2011). Stressful conditions during this period can lead to a cascade of developmental deficits that lead to poor psychological and physical health during adulthood (Walker et al. 2011). Adolescence can also be a critical period because adolescents develop cognitive skills to conceptualize and interpret traumatic experiences (Cook et al. 2005; Steinberg 2005). There are also significant developmental changes in the brain during adolescence. Grey matter volume decreases and a greater reliance on the amygdala (a region associated with emotions and impulses) is exhibited at this stage (Giorgio et al. 2010). Experiences of racial discrimination may cause rumination and heightened anticipation of future occurrences of discrimination, risky health behaviors (e.g., poor sleep, smoking), and compromised health (Williams and Mohammed 2009). Stressful life experiences at these stages (early childhood and adolescence) can increase the adverse health effects of discrimination (Stroud et al. 2009). Although the pathways remain unknown, these findings provide key areas for targeted interventions.

We did not find evidence that race moderated the relationship between age of discriminatory events and health outcomes. Nevertheless, Black people and White people may be exposed to different types of stressors and stress-buffering resources throughout the life course, which may bring about different health patterns between the groups. Not only do racial/ethnic minorities experience more common childhood adversities, they also experience unfair treatment based on their race or ethnicity during childhood (Slopen et al. 2016). While our findings suggest that racial discrimination has similar effects for Black people and White people, stress-buffering resources may play an important role. For instance, racial socialization (e.g., healthy self-concept) may have enabled Black participants to cope with discriminatory experiences, whereas White participants may not have not developed effective coping strategies. These effects may later promote unhealthy coping mechanisms, such as smoking, which can lead to poorer health (Sanders-Phillips et al. 2009). Because more racial/ethnic minorities report experiencing race-related childhood

adversities, discrimination in early childhood remains a health risk factor for these groups in particular.

Strengths, limitations, and future directions

To our knowledge, no studies have ever looked specifically at physical health outcomes in relation to developmental timing of initial racial discrimination exposure. In addition to the findings presented here, our study questions may give new insight as to how childhood discrimination may produce physical health disparities among ethnic and racial minorities later in life. Nevertheless, several limitations inhibited our ability to fully interpret our findings. Because racial/ethnic minorities tend to report more discrimination in life, the cumulative impact of discrimination may disproportionately affect them later in life. However, due to the cross-sectional nature of this data set, a life-course perspective could not be applied to the study's design. Prospective research is needed to replicate our current findings and provide longitudinal estimations of the health effects of cumulative exposure to discrimination. The measure to capture initial exposure to discrimination relied on retrospective reporting, which is subject to recall bias. For instance, participants may have had difficulty accurately recalling the age of when they first experienced a race-related negative event. Studies have shown that adults cannot reliably recall details from their childhood memories (Wells, Morrison, and Conway 2014). Memories of childhood trauma also have less sensory details and coherence than positive memories (Berliner et al. 2003). Given that memory declines with age (Ward, Berry, and Shanks 2013), findings based on memory recall need to be interpreted with caution. Nevertheless, retrospective and prospective measures of childhood adversity show moderate agreement of childhood adversities and are both similarly predictive of midlife health outcomes (Reuben et al. 2016). We reduced the impact of recall bias by following a methodological approach of previous research (Dunn et al. 2017) by categorizing the reported ages into four distinct age groups. Another limitation is that we used a dataset from 1995 to 1996. While this may be considered a dated dataset, very few datasets provide the opportunity to examine these questions. We relied on participants' self-reports of physician-diagnosed health conditions, which may be biased. Future research should replicate our analyses using objective measures of health. To our knowledge, this is one of the first studies to examine initial exposure to racial discrimination, categorized in stages of development, and adult health outcomes using the Detroit Area Study data. Future research should aim to collect updated data using similar questions in order to see if results are replicable in more contemporary times.

The findings presented here suggest that age of first discriminatory event could be used as a potential marker for psychosocial and physical stress. Further research should continue to explore the age at which an individual first experiences discrimination through different lenses, such as in specific health outcomes (e.g., cardiovascular diseases) or through gender dynamics of racial discrimination. Future studies that wish to examine initial exposure to discrimination should also consider measuring protective factors during this critical period, as well as other forms of discrimination (e.g., gender, sexuality, ability, religion) that may contribute to negative health behaviors and outcomes later on in life. In addition, researchers should consider examining potential mediators (e.g., health behavior and mental health) to further elucidate the link between early life exposure to discrimination and health.

Conclusion

There is compelling evidence that trauma leads to poor health in adulthood. The developmental timing of these traumatic events can have significant health effects. Racism, particularly initial exposure to discrimination, can be considered a form of trauma that can lead to poor physical health, particularly for racial/ethnic minorities. However, little research has been done to examine the association between initial exposure to racial discrimination and health taking into account stages of development. Findings suggest that initial exposure to racial discrimination during early childhood and adolescence is associated with greater number of cardiovascular health conditions. Moreover, for individuals who first experienced racial discrimination in early childhood were more likely to have a presence of any cardiovascular health condition than those who experienced any discrimination in life. These patterns seem to be similar across racial groups. However, because Black people tend to report more discriminatory experiences across the life course compared to their White counterparts, they are disproportionately affected by these adverse experiences. Clinicians and researchers should consider initial exposure to racial discrimination at particular stages of development as a possible risk factor for illness and disease.

Acknowledgments

The contents of this study are solely the responsibility of the authors and do not necessarily represent the official views of the NIH.

Funding

The development of the manuscript was partially supported by Cancer Disparities Research Network/Geographic Management Program (GMaP) Region 4 funded by 3 P30 CA006927-52S2 and CTSI Mentored Career Development Award (KL2 TR002545).

References

- Berliner Lucy, Hyman Ira, Thomas Ayanna, and Fitzgerald Monica. 2003. "Children's Memory for Trauma and Positive Experiences." *Journal of Traumatic Stress* 16 (3): 229–236. doi:10.1023/A:1023787805970. [PubMed: 12816334]
- Center on the Developing Child. 2012. "Toxic Stress." <https://developingchild.harvard.edu/science/key-concepts/toxic-stress/>.
- Cook Alexandra, Spinazzola Joseph, Ford Julian, Lanktree Cheryl, Blaustein Margaret, Cloitre Marylene, DeRosa Ruth, et al. 2005. "Complex trauma in children and adolescents." *Psychiatric Annals* 35 (5): 390–398.
- D'Andrea Wendy, Sharma Ritu, Zelechowski Amanda D., and Spinazzola Joseph. 2011. "Physical Health Problems After Single Trauma Exposure: When Stress Takes Root in the Body." *Journal of the American Psychiatric Nurses Association* 17 (6): 378–392. doi:10.1177/1078390311425187. [PubMed: 22142975]
- Doyle Colleen, and Cicchetti Dante. 2017. "From the Cradle to the Grave: The Effect of Adverse Caregiving Environments on Attachment and Relationships Throughout the Lifespan." *Clinical Psychology: Science and Practice* 24 (2): 203–217. doi:10.1111/cpsp.12192. [PubMed: 28924334]
- Dunn Erin C., Nishimi Kristen, Powers Abigail, and Bradley Bekh. 2017. "Is Developmental Timing of Trauma Exposure Associated with Depressive and Post-Traumatic Stress Disorder Symptoms in Adulthood?" *Journal of Psychiatric Research* 84 (1): 119–127. doi:10.1016/j.jpsychires.2016.09.004. [PubMed: 27728852]
- Epel E, Lin J, Wilhelm F, Wolkowitz O, Cawthon R, Adler N, Dolbier C, Mendes W, and Blackburn E. 2006. "Cell Aging in Relation to Stress Arousal and Cardiovascular Disease

- Risk Factors." *Psychoneuroendocrinology* 31 (3): 277–287. doi:10.1016/j.psyneuen.2005.08.011. [PubMed: 16298085]
- Feagin Joe R., and Van Ausdale Debra. 2001. *The first R: How children learn race and racism*. Lanham, MD: Rowman & Littlefield Publishers.
- Giorgio Antonio, Watkins Kate E., Chadwick Martin, James S, Winmill Louise, Douaud Gwenaëlle, De Stefano Nicola, et al. 2010. "Longitudinal changes in grey and white matter during adolescence." *Neuroimage* 49 (1): 94–103. [PubMed: 19679191]
- Graham John W. 2009. "Missing Data Analysis: Making it Work in the Real World." *Annual Review of Psychology* 60: 549–576. doi:10.1146/annurev.psych.58.110405.085530.
- Hassouneh Dena M., and Kulwicky Anahid. 2007. "Mental Health, Discrimination, and Trauma in Arab Muslim Women Living in the US: A Pilot Study." *Mental Health, Religion & Culture* 10 (3): 257–262. doi:10.1080/13694670600630556.
- Kang Hye-Kyung, and Burton David L.. 2014. "Effects of Racial Discrimination, Childhood Trauma, and Trauma Symptoms on Juvenile Delinquency in African American Incarcerated Youth." *Journal of Aggression, Maltreatment & Trauma* 23 (10): 1109–1125. doi:10.1080/10926771.2014.968272.
- Kendall-Tackett Kathleen, and Klest Bridget. 2009. "Causal Mechanisms and Multidirectional Pathways Between Trauma, Dissociation, and Health." *Journal of Trauma & Dissociation* 10 (2): 129–134. doi:10.1080/15299730802624510. [PubMed: 19333844]
- McLaughlin Katie A., Basu Archana, Walsh Kate, Slopen Natalie, Sumner Jennifer A., Koenen Karestan C., and Keyes Katherine M.. 2016. "Childhood Exposure to Violence and Chronic Physical Conditions in a National Sample of US Adolescents." *Psychosomatic Medicine* 78 (9): 1072–1083. doi:10.1097/PSY.0000000000000366. [PubMed: 27428855]
- National Center for Mental Health Promotion and Youth Violence. 2012. "Childhood Trauma and Its Effects on Healthy Development." http://justice.aksummit.com/PDF/081712_childhood_trauma.pdf.
- Pachter Lee M., and Coll Cynthia García. 2009. "Racism and child health: a review of the literature and future directions." *Journal of developmental and behavioral pediatrics: JDBP* 30 (3): 255–263. [PubMed: 19525720]
- Pachter Lee M., Szalacha Laura A., Bernstein Bruce A., and Coll Cynthia García. 2010. "Perceptions of Racism in Children and Youth (PRaCY): Properties of a self-report instrument for research on children's health and development." *Ethnicity & Health* 15 (1): 33–46. [PubMed: 20013438]
- Paradies Yin, Ben Jehonathan, Denson Nida, Elias Amanuel, Priest Naomi, Pieterse Alex, Gupta Arpana, Kelaher Margaret, and Gee Gilbert. 2015. "Racism as a Determinant of Health: A Systematic Review and Meta-Analysis." Edited by Hills Robert K. *PLOS ONE* 10 (9): e0138511. doi:10.1371/journal.pone.0138511. [PubMed: 26398658]
- Priest Naomi, Paradies Yin, Trenerry Brigid, Truong Mandy, Karlsen Saffron, and Kelly Yvonne. 2013. "A Systematic Review of Studies Examining the Relationship between Reported Racism and Health and Wellbeing for Children and Young People." *Social Science & Medicine* 95 (10): 115–127. doi:10.1016/j.socscimed.2012.11.031. [PubMed: 23312306]
- Reuben Aaron, Moffitt Terrie E., Caspi Avshalom, Belsky Daniel W., Harrington Honalee, Schroeder Felix, Hogan Sean, Ramrakha Sandhya, Poulton Richie, and Danese Andrea. 2016. "Lest we forget: comparing retrospective and prospective assessments of adverse childhood experiences in the prediction of adult health." *Journal of Child Psychology and Psychiatry* 57 (10): 1103–1112. [PubMed: 27647050]
- Sanders-Phillips Kathy, Settles-Reaves Beverlyn, Walker Doren, and Brownlow Janeese. 2009. "Social Inequality and Racial Discrimination: Risk Factors for Health Disparities in Children of Color." *Pediatrics* 124 (Supplement 3): S176–S186. doi:10.1542/peds.2009-1100E. [PubMed: 19861468]
- Slopen Natalie, Koenen Karestan C., and Kubzansky Laura D.. 2012. "Childhood Adversity and Immune and Inflammatory Biomarkers Associated with Cardiovascular Risk in Youth: A Systematic Review." *Brain, Behavior, and Immunity* 26 (2): 239–250. doi:10.1016/j.bbi.2011.11.003.
- Slopen Natalie, Shonkoff Jack P., Albert Michelle A., Yoshikawa Hirokazu, Jacobs Aryana, Stoltz Rebecca, and Williams David R.. 2016. "Racial Disparities in Child Adversity in the U.S."

- American Journal of Preventive Medicine 50 (1): 47–56. doi:10.1016/j.amepre.2015.06.013. [PubMed: 26342634]
- Steinberg Laurence. 2005. “Cognitive and affective development in adolescence.” Trends in Cognitive Sciences 9 (2): 69–74. [PubMed: 15668099]
- Stroud Laura R., Foster Elizabeth, Papandonatos George D., Handwerger Kathryn, Granger Douglas A., Kivlighan Katie T., and Niaura Raymond. 2009. “Stress response and the adolescent transition: Performance versus peer rejection stressors.” Development and Psychopathology 21 (1): 47–68. [PubMed: 19144222]
- Substance Abuse and Mental Health Services Administration. 2014. “Chapter 3: Understanding the Impact of Trauma.” In Trauma-Informed Care in Behavioral Health Sciences. Vol. 57. Treatment Improvement Protocol (TIP) Series. Substance Abuse and Mental Health Services Administration (US).
- UCLA Statistical Consulting Group. “Negative Binomial Regression.” Accessed June 1, 2018. <https://stats.idre.ucla.edu/sas/dae/negative-binomial-regression/>.
- Walker Susan P., Wachs Theodore D., Grantham-McGregor Sally, Black Maureen M., Nelson Charles A., Huffman Sandra L., Baker-Henningham Helen, Chang Susan M., Hamadani Jena D., Lozoff Betsy, Gardner Julie M. Meeks, Powell Christine A., Rahman Atif, Richter Linda. 2011. “Inequality in early childhood: risk and protective factors for early child development.” The Lancet 378 (9799): 1325–1338.
- Ward E, Berry C, and Shanks D. 2013. “Age effects on explicit and implicit memory.” Frontiers in Psychology 4 (639): 1–11. [PubMed: 23382719]
- Wells Christine, Morrison Catriona M., and Conway Martin A.. 2014. “Adult Recollections of Childhood Memories: What Details Can Be Recalled?” Quarterly Journal of Experimental Psychology 67 (7): 1249–1261. doi:10.1080/17470218.2013.856451.
- Williams David R., and Mohammed Selina A.. 2009. “Discrimination and Racial Disparities in Health: Evidence and Needed Research.” Journal of Behavioral Medicine 32 (1): 20–47. doi:10.1007/s10865-008-9185-0. [PubMed: 19030981]

Table 1.Descriptive statistics of detroit sample ($n = 1,106$).

| | N (%) |
|---------------------------------|-----------|
| Age | |
| 18–32 | 290 (26%) |
| 33–59 | 543 (49%) |
| 60–97 | 273 (25%) |
| Gender | |
| Male | 413 (41%) |
| Female | 693 (69%) |
| Race | |
| White | 520 (47%) |
| Black | 586 (53%) |
| Income | |
| <\$20,000 | 317 (29%) |
| \$20,000–<\$50,000 | 373 (34%) |
| \$50,000–<\$75,000 | 233 (21%) |
| >\$75,000 | 183 (17%) |
| Education | |
| <H.S. | 183 (17%) |
| H.S./GED | 329 (30%) |
| Some college | 349 (32%) |
| College graduate | 245 (22%) |
| Marital Status | |
| Married/LTR | 496 (45%) |
| Divorced/Separated/Widowed | 338 (30%) |
| Single/Never Married | 272 (25%) |
| Smoking status | |
| Current | 319 (29%) |
| Former/Never | 787 (71%) |
| Smoking frequency (cigs/day) | |
| 0 | 787 (71%) |
| 1–10 (1/2 pack/day or less) | 138 (13%) |
| 11–20 (1/2 to 1 pack/day) | 128 (12%) |
| 21–70 (more than 1 pack/day) | 53 (5%) |
| Physical Activity (minutes/day) | |
| 0 | 589 (53%) |
| 1–5 | 277 (25%) |
| 5–10 | 159 (14%) |
| 10–35 | 81 (7%) |
| CVD (yes) | 509 (46%) |
| CVD (count) | |

| | <i>N</i> (%) |
|---|--------------|
| 0 | 597 (54%) |
| 1 | 295 (27%) |
| 2 | 130 (12%) |
| 3–5 | 84 (8%) |
| Initial Exposure to Racial Discrimination | |
| <7 years | 39 (4%) |
| 8–12 | 91 (8%) |
| 13–19 | 174 (16%) |
| >19 | 132 (12%) |
| No discrimination | 670 (60%) |

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Table 2.Descriptive statistics by initial exposure to racial discrimination ($n = 1,106$).

| | Age of Initial Exposure to Racial Discrimination | | | | No Discr. | P value |
|---------------------------------|--|----------|-----------|----------|-----------|---------|
| | 0-7 | 8-12 | 13-19 | >19 | | |
| Age | | | | | | 0.0012 |
| 18-32 | 11 (4%) | 15 (5%) | 47 (16%) | 39 (13%) | 178 (61%) | |
| 33-59 | 25 (5%) | 54 (10%) | 89 (16%) | 72 (13%) | 303 (56%) | |
| 60-97 | 3 (1%) | 22 (8%) | 38 (14%) | 21 (8%) | 189 (69%) | |
| Gender | | | | | | 0.1480 |
| Male | 15 (4%) | 39 (9%) | 76 (18%) | 51 (12%) | 232 (56%) | |
| Female | 24 (4%) | 52 (8%) | 98 (14%) | 81 (12%) | 438 (63%) | |
| Race | | | | | | <0.001 |
| White | 5 (1%) | 11 (2%) | 22 (4%) | 41 (8%) | 441 (85%) | |
| Black | 34 (6%) | 80 (14%) | 152 (26%) | 91 (16%) | 229 (39%) | |
| Income | | | | | | 0.0643 |
| <\$20,000 | 14 (4%) | 22 (7%) | 55 (17%) | 42 (13%) | 184 (58%) | |
| \$20,000-<\$50,000 | 15 (4%) | 30 (8%) | 61 (16%) | 45 (12%) | 222 (60%) | |
| \$50,000-<\$75,000 | 5 (2%) | 26 (11%) | 32 (14%) | 27 (12%) | 143 (61%) | |
| >\$75,000 | 5 (3%) | 13 (7%) | 26 (14%) | 18 (10%) | 121 (66%) | |
| Education | | | | | | 0.0404 |
| <H.S. | 5 (3%) | 14 (8%) | 25 (14%) | 18 (10%) | 121 (66%) | |
| H.S./GED | 9 (3%) | 19 (6%) | 52 (16%) | 32 (10%) | 217 (66%) | |
| Some college | 15 (4%) | 35 (10%) | 60 (17%) | 59 (17%) | 180 (52%) | |
| College graduate | 10 (4%) | 23 (9%) | 37 (15%) | 23 (9%) | 152 (62%) | |
| Marital Status | | | | | | 0.0068 |
| Married/LTR | 12 (2%) | 41 (8%) | 63 (13%) | 58 (12%) | 322 (65%) | |
| Divorced/Separated/Widowed | 11 (3%) | 28 (8%) | 63 (19%) | 41 (12%) | 195 (58%) | |
| Single/Never Married | 16 (6%) | 22 (8%) | 48 (18%) | 33 (12%) | 153 (56%) | |
| Smoking status | | | | | | 0.4527 |
| Current | 27 (3%) | 63 (8%) | 117 (15%) | 90 (11%) | 490 (62%) | |
| Former/Never | 12 (4%) | 28 (9%) | 57 (18%) | 42 (13%) | 180 (56%) | |
| Smoking frequency (cigs/day) | | | | | | 0.0123 |
| 0 | 27 (3%) | 63 (8%) | 117 (15%) | 90 (11%) | 490 (62%) | |
| 1-10 (1/2 pack/day or less) | 7 (5%) | 16 (12%) | 27 (20%) | 14 (10%) | 74 (54%) | |
| 11-20 (1/2 to 1 pack/day) | 5 (4%) | 11 (9%) | 19 (15%) | 25 (20%) | 68 (53%) | |
| 21-70 (more than 1 pack/day) | 0 (0%) | 1 (0%) | 11 (2%) | 3 (6%) | 38 (72%) | |
| Physical Activity (minutes/day) | | | | | | 0.2213 |
| 0 | 19 (3%) | 49 (8%) | 88 (15%) | 73 (12%) | 360 (61%) | |
| 1-5 | 8 (3%) | 21 (8%) | 46 (17%) | 29 (11%) | 173 (63%) | |
| 5-10 | 8 (5%) | 14 (9%) | 22 (14%) | 25 (16%) | 90 (57%) | |
| 10-35 | 4 (5%) | 7 (9%) | 18 (22%) | 5 (6%) | 47 (58%) | |
| CVD (yes) | 21 (4%) | 44 (9%) | 85 (17%) | 54 (11%) | 305 (60%) | 0.8159 |

| | Age of Initial Exposure to Racial Discrimination | | | | | <i>P</i> value |
|-------------|--|----------|----------|----------|-----------|----------------|
| | 0–7 | 8–12 | 13–19 | >19 | No Discr. | |
| CVD (count) | | | | | | |
| 0 | 18 (3%) | 47 (8%) | 89 (15%) | 78 (13%) | 365 (61%) | |
| 1 | 13 (4%) | 30 (10%) | 45 (15%) | 32 (11%) | 175 (59%) | |
| 2 | 4 (3%) | 10 (8%) | 21 (16%) | 14 (11%) | 81 (62%) | |
| 3–5 | 4 (5%) | 4 (5%) | 19 (23%) | 8 (10%) | 49 (58%) | |

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Table 3.

Association between initial exposure to racial discrimination and binary experiencing any cardiovascular health problems among black and white participants in the detroit study ($n = 1,106$).

| | Model 1: Any CVD (yes/no) | | | Model 2: Any CVD (yes/no) | | | Model 3: Any CVD (yes/no) | | |
|--------------------------------------|---------------------------|-------------|-------------|---------------------------|-------------|-------------|---------------------------|-------------|-------------|
| | OR (95%CI) | P value | (Reference) | OR (95%CI) | P value | (Reference) | OR (95%CI) | P value | (Reference) |
| Discrimination Age (0–7) | 1.94 (0.95, 3.96) | 0.0688 | (Reference) | 2.97 (1.16, 7.61) | 0.0235 | (Reference) | 2.96 (1.15, 7.83) | 0.0250 | (Reference) |
| Discrimination Age (8–12) | 0.94 (0.59, 1.69) | 0.7987 | (Reference) | 1.36 (0.75, 2.47) | 0.3042 | (Reference) | 1.36 (0.74, 2.48) | 0.3173 | (Reference) |
| Discrimination Age (13–19) | 1.09 (0.77, 1.61) | 0.6265 | (Reference) | 1.51 (0.92, 2.52) | 0.1023 | (Reference) | 1.51 (0.92, 2.53) | 0.1109 | (Reference) |
| Discrimination Age (>19) | 0.70 (0.45, 0.1.11) | 0.1341 | (Reference) | 0.99 (0.55, 1.72) | 0.9595 | (Reference) | 0.98 (0.54, 1.72) | 0.9509 | (Reference) |
| Discrimination Age (None) | (Reference) | (Reference) | (Reference) | (Reference) | (Reference) | (Reference) | (Reference) | (Reference) | (Reference) |
| Age (years) | 1.07 (1.07, 1.07) | 0.0000 | (Reference) | 1.06 (1.06, 1.06) | 0.0000 | (Reference) | 1.06 (1.06, 1.07) | 0.0000 | (Reference) |
| Sex (female vs. male) | 1.12 (1.12, 1.13) | 0.1860 | (Reference) | 1.21 (1.19, 1.22) | 0.2844 | (Reference) | 1.22 (1.2, 1.23) | 0.2698 | (Reference) |
| Race (black vs. white) | 1.05 (1.01, 1.07) | 0.5963 | (Reference) | 1.18 (1.09, 1.31) | 0.4084 | (Reference) | 1.17 (1.08, 1.31) | 0.4353 | (Reference) |
| Education (years) | | | | 0.97 (0.96, 1.00) | 0.4810 | (Reference) | 0.98 (0.96, 1) | 0.5647 | (Reference) |
| Income (dollars) | | | | 0.99 (0.99, 1.00) | 0.6618 | (Reference) | 1 (1, 1) | 0.6812 | (Reference) |
| Marital Status (married vs. single) | | | | 1.24 (1.14, 1.39) | 0.3896 | (Reference) | 1.24 (1.13, 1.39) | 0.4120 | (Reference) |
| Marital Status (divorced vs. single) | | | | 1.47 (1.42, 1.52) | 0.1689 | (Reference) | 1.46 (1.42, 1.51) | 0.1845 | (Reference) |
| Smoking (cigs/day) | | | | | | | 1.00 (0.99, 1.02) | 0.5430 | (Reference) |
| Physical activity (activities/week) | | | | | | | 0.99 (0.97, 1.00) | 0.8570 | (Reference) |

Notes on methodology: Multiple imputation utilized to impute missing values, yielding a final analytic sample of 1,106. The imputation model included any independent or dependent variable used in any of our statistical models. Each analysis utilized 20 imputations. Models adjusted for age, sex, race, marital status, income, education, smoking, and physical activity, and accounted for sampling weights.

Table 4.

Associations between initial exposure to racial discrimination and count of cardiovascular health conditions among black and white participants in the detroit study ($n = 1,106$).

| | Model 1 | | Model 2 | | Model 3 | |
|--------------------------------------|-------------------|-------------|-------------------|-------------|-------------------|-------------|
| | IRR (95%CI) | P value | IRR (95%CI) | P value | IRR (95%CI) | P value |
| Discrimination Age (0-7) | 1.50 (1.03, 2.20) | 0.0362 | 1.59 (1.08, 2.33) | 0.0156 | 1.63 (1.11, 2.38) | 0.0111 |
| Discrimination Age (8-12) | 0.97 (1.37, 1.30) | 0.8556 | 1.00 (0.74, 1.34) | 0.9687 | 1.00 (0.75, 1.34) | 0.9559 |
| Discrimination Age (13-19) | 1.32 (1.07, 1.64) | 0.0107 | 1.37 (1.10, 1.69) | 0.0042 | 1.37 (1.10, 1.69) | 0.0039 |
| Discrimination Age (>19) | 1.04 (1.22, 1.34) | 0.7221 | 1.02 (0.80, 1.30) | 0.9595 | 1.02 (0.79, 1.30) | 0.8379 |
| Discrimination Age (None) | (Reference) | (Reference) | (Reference) | (Reference) | (Reference) | (Reference) |
| Age (years) | 1.03 (1.03, 1.04) | <0.001 | 1.03 (1.03, 1.04) | <0.001 | 1.03 (1.03, 1.04) | <0.001 |
| Sex (female vs. male) | 1.09 (0.95, 1.31) | 0.2169 | 1.07 (0.92, 1.25) | 0.3386 | 1.07 (0.91, 1.24) | 0.3899 |
| Race (black vs. white) | 1.02 (0.98, 1.17) | 0.7949 | 0.95 (0.80, 1.13) | 0.5982 | 0.95 (0.80, 1.13) | 0.6074 |
| Education (years) | | | 0.98 (0.96, 1.01) | 0.5982 | 0.99 (0.96, 1.02) | 0.4510 |
| Income (dollars) | | | 1.00 (1.00, 1.00) | 0.0014 | 1.00 (1.00, 1.00) | 0.0022 |
| Marital Status (married vs. single) | | | 1.30 (1.03, 1.64) | 0.0286 | 1.27 (1.01, 1.61) | 0.0453 |
| Marital Status (divorced vs. single) | | | 1.20 (0.94, 1.71) | 0.1318 | 1.18 (0.92, 1.52) | 0.1791 |
| Smoking (cigs/day) | | | | | 1.00 (0.99, 1.01) | 0.1651 |
| Physical activity (activities/week) | | | | | 0.98 (0.97, 1.00) | 0.1400 |

Notes on methodology: Results derive from negative binomial regression models adjusting for age, sex, race, marital status, income, education, smoking, and physical activity, and accounted for sampling weights. Multiple imputation was utilized to impute missing values, yielding a final analytic sample of 1,106. The imputation model included any independent or dependent variable used in any of our statistical models. Each analysis utilized 20 imputations.