

POLICE BRUTALITY AND EPIGENETIC AGING AMONG AFRICAN AMERICANS: THE
GENDER AND LIFE COURSE PERSPECTIVE

by

CHIH-CHENG LEE

(Under the Direction of Man-Kit (Karlo) Lei)

ABSTRACT

Policing brutality has emerged as a significant component of structural racism, potentially impacting the health of young African American adults. This study utilizes data from the Family and Community Health Study (FACHS) and two crowdsourced datasets to examine the effect of neighborhood police brutality on accelerated epigenetic aging across the life course. Using the OLS regression with clustered-robust standard errors, the present study found that severe law enforcement may be the major cause of negative health outcomes. Policing inequality only contributes little or no influence on accelerated epigenetic aging, while its influence can be explained by the gender difference. Additionally, the life course perspective indicates that the effects of police brutality are less pronounced among older Black adults.

INDEX WORDS: Police violence, Racial discrimination, Epigenetic aging, DNA
methylation, African American, Life course, Gender difference

POLICE BRUTALITY AND EPIGENETIC AGING AMONG AFRICAN AMERICANS: THE
GENDER AND LIFE COURSE PERSPECTIVE

by

CHIH-CHENG LEE

B.S., National Chengchi University, Taiwan, 2020

B.S., National Chengchi University, Taiwan, 2020

A Thesis Submitted to the Graduate Faculty of The University of Georgia in Partial Fulfillment
of the Requirements for the Degree

MASTER OF ARTS

ATHENS, GEORGIA

2025

© 2025

Chih-Cheng Lee

All Rights Reserved

POLICE BRUTALITY AND EPIGENETIC AGING AMONG AFRICAN AMERICANS: THE
GENDER AND LIFE COURSE PERSPECTIVE

by

CHIH-CHENG LEE

Major Professor:	Man-Kit Lei
Committee:	Leslie Gordon Simons
	Thomas McNulty

Electronic Version Approved:

Ron Walcott
Vice Provost for Graduate Education and Dean of the Graduate School
The University of Georgia
May 2025

DEDICATION

To my family members, thank you for your support and understanding. I would not have finished this article if I had not received emotional and financial support from you. To my partner, Winnie Lu, thank you for everything. I could feel very depressed without you throughout this process. To A-Gue, I hope you rest in peace. I am sorry that I was not with you during your last journey. To Pong-Pong and Bi-Phang, thank you for accompanying us in these two years. Please be healthy and happy.

ACKNOWLEDGEMENTS

I would like to extend my deepest gratitude to Dr. Ron Simons. Throughout this process, his wisdom, kindness, and professional knowledge provided invaluable support. The feedback he offered during my proposal defense built the foundation for this study. May he rest in peace. His legacy will live on through the students he mentored.

I am profoundly grateful to my advisor, Dr. Karlo, for his consistent guidance and kind support throughout this journey. My sincere appreciation goes to Dr. Leslie for her helpful feedback and administrative assistance as a graduate coordinator. I extend special thanks to Dr. Thomas for being my committee member during this unexpected transition, offering constructive feedback and kindness.

CONTENTS

CHAPTER

1	INTRODUCTION	1
2	LITERATURE REVIEW	6
	Policing and Health.....	6
	Police Brutality as an Aspect of Surveillance and Structural Racism	9
	DNA Methylation and Epigenetic Aging.....	10
	Gender and Age Differences in Police Brutality.....	11
3	HYPOTHESIS	14
4	DATA AND METHODS.....	15
	Data	15
	Methylation Procedures	18
	Measure	19
	Analytic Strategy	24
5	RESULTS.....	26
6	DISCUSSION	36
	REFERENCE.....	42
	APPENDIX	50
	APPENDIX A. R scripts for calculating neighborhood police brutality	50
	APPENDIX B. Alternative Analysis Using Multilevel Linear Regression Model.....	55
	APPENDIX C. Alternative Analysis Using Multilevel Linear Regression Model.....	59
	APPENDIX D. Distribution of Police Brutality	60

LIST OF TABLES

	Page
Table 1 Descriptive Statistics.....	30
Table 2. OLS regression models with clustered-robust standard error predicting epigenetic aging for Black young adults (N=449).....	31
Table 3. OLS regression models with clustered-robust standard error predicting epigenetic aging for Black young adults, with interaction between race-specific police-related death rate and gender (N = 449)	32
Table 4. The Effect of police-related non-White death rate on DunedinPACE by Gender, Family and Community Health Study, Waves 2011–2016. Estimates calculated from Model 10 in Table 3.....	33
Table S 1. Multilevel Linear Regression models predicting epigenetic aging for Black young adults (N=449)	55
Table S 2. Multilevel Linear Regression models predicting epigenetic aging for Black young adults, with interaction between race-specific police-related death rate and gender (N = 449)	56
Table S 3. Multilevel Linear Regression models predicting DunedinPACE for Black young adults, with separated sample by male (N = 172) and female (N = 277)	57
Table S 4. Multilevel Linear Regression models predicting epigenetic aging for Black older adults (N = 480)	58
Table S 5 T-test for those excluded for missing data and those remaining for analyses (young adult sample)	59
Table S 6 T-test for those excluded for missing data and those remaining for analyses (older adult sample)	59

LIST OF FIGURES

	Page
Figure 1. The Effect of police-related non-White death rate on DunedinPACE by Gender, Family and Community Health Study, Waves 2011–2016. Estimates calculated from Model 10 in Table 3.	33
Figure S 1 The histogram of overall police brutality in the young adult sample (N=449).....	60
Figure S 2 The histogram of police brutality against Black people in the young adult sample (N=448, an observation was deleted to ease the plotting since it is greater than 80)	60
Figure S 3 The histogram of overall police brutality in the older adult sample (N=480).....	61
Figure S 4 The histogram of police brutality against Black people in the older adult sample (N=480).....	61

CHAPTER 1

INTRODUCTION

In recent years, the pervasive issue of police violence, specifically against African Americans, has sparked widespread outrage and concern to the public, highlighting the urgent need to address the systemic inequalities embedded within law enforcement practices and the criminal justice system (Brunson and Weitzer 2009, Das et al. 2021, Gaston, Fernandes and DeShay 2021, Geier et al. 2024, Gross and Mann 2017, Jee-Lyn Garcia and Sharif 2015, Kramer and Remster 2018, Schwartz and Jahn 2020, Sharara et al. 2021, Zare 2024). In fact, the issue of police violence against African Americans has persisted for decades, resulting in manifold negative experiences and disadvantages for Black communities. In particular, police brutality has become a significant cause of death among young Black males, which highlights the life-threatening consequences of racial disparities in policing (Edwards, Lee and Esposito 2019). Furthermore, official records of police-related deaths, such as the National Vital Statistics System, significantly underestimate the actual scale of this issue (Knox, Lowe and Mummolo 2020). This discrepancy between official data and independent, crowdsourced records accentuates the systemic issue of underreporting police violence. It raises public concerns about transparency and accountability within law enforcement agencies. Such disparities in reporting further underscore how police violence is inevitably linked to structural racism (Mesic et al. 2018). The influence permeates the social structure and government institutions, casting a long shadow over the daily lives of African Americans.

Given the recognition of the risk when encountering officers, direct contact with police has been proven to impair health outcomes among African Americans, which suggests that the contact as a stressor will result in long-term mental and physical health problems (Bandes et al. 2019, Das 2022, Jackson et al. 2019). However, studies also reveal the importance of indirect experiences, where the negative experiences with police from friends or families could be detrimental to individual health (McFarland et al. 2018, Motley, Williamson and Quinn 2024). The finding shows that police violence could have a more profound and prevalent influence on society since it can spread via word of mouth. The information from the television, local newspapers, or other media brings people to the story of the victims, which intrigues their empathy, anger, and fear, while it also serves as traumatic memories among African Americans across the life course (Staggers-Hakim 2018). Furthermore, these shared experiences can be used to make comparisons between different races, especially white people. People may subconsciously compare the number of instances of police brutality against Black and White individuals to evaluate discriminatory policing, while Black people may consider policing inequality to be more severe due to the historical factor of discriminatory policing policies (Vitale 2021). African Americans, therefore, are more likely to perceive police-related experiences, even routine encounters, as potentially threatening and unfair (Brunson 2007). This unfair and fearful feeling, in turn, could lead to mental illness or unhealthy behaviors (Paradies et al. 2015).

Despite the mechanism of police brutality on health outcomes has been widely studied in different fields, there is no previous study linking the relationship between neighborhood police brutality and epigenetic aging. Previous studies predominantly focus on how police encounters or brutality influence both physical and mental health, and these health outcomes are mainly

measured by self-reported measures (McFarland, Geller and McFarland 2019, Sewell and Jefferson 2016, Sewell 2017, Sewell et al. 2021, Talbert 2023). Although this type of measure worked well in assessing health disparities, it does not provide detailed information about biological processes. Namely, the measure could be biased if the symptoms did not emerge. Other than that, self-reported physical health could be confounded by mental and emotional status, which reduces the accuracy of evaluating body status (Franks, Gold and Fiscella 2003, Idler and Cartwright 2018). Recently, more and more health studies have turned to utilizing aging biomarkers for measuring physical health status (Harris and Schorpp 2018, Simons et al. 2021a). One of the most promising aging biomarkers/indexes is epigenetic aging, which is calculated by the extent of DNA methylation. Compared to other biomarkers, the epigenetic outcomes can be more profound and extensive since they can potentially be inherited by the next generations (Fitz-James and Cavalli 2022). A previous study (Das 2022) examined the influence of childhood police encounters on accelerated epigenetic aging among older adults, providing a primary exploration of the mechanism of the relationship between the contact of law enforcement and health disparities. However, the underrepresented black population in the study, which is more vulnerable to policing affairs, requires researchers to conduct further investigation on the effect of violence on these minorities. Additionally, Lopes et al. (2015) suggest that indirect exposure to violence could have a larger impact on health than direct encounters. Therefore, we propose that the chronic stress associated with neighborhood policing brutality could lead to more widespread epigenetic changes within affected populations, especially for African Americans.

Moreover, since Black young men have the highest police-related mortality (Edwards, Lee and Esposito 2019), the influence of police violence should be more profound among this group.

As a label in structural racism, Black men are more likely to experience varied levels of discrimination in their daily lives. Police unfair treatment is one of the consequences. Compared to females or other racial/ethnic groups, the high risk of being killed by police among Black young men could raise their fears and anxiety (Aymer 2016, McFarland et al. 2018). However, as a member of Black communities, Black women are also deeply influenced by structural racism (Alang et al. 2023). In particular, when combined with sexism, racism can have a harmful effect on Black women, suggesting that the consequences they face may be unique compared to those experienced by Black men (Talbert 2023). On the other hand, older Black adults experienced different historical contexts. Although they may be exposed to the same degree of police violence or racial discrimination nowadays, it could result in different health outcomes compared to young Black adults. There is no previous study discussing this difference.

In the present study, we utilize the Family and Community Health Study (FACHS) and crowdsourced dataset (i.e. Fatal Encounters and Mapping Police Violence) to examine the relationship between police brutality and biological aging. To assess police violence, we employ race-specific police-related death rates. The impact of epigenetic aging is measured using two distinct biological aging indexes – GrimAge and DunedinPACE - as dependent variables to ensure robust results. The ordinary least square regression model with clustered-robust standard errors is applied to investigate the main effect of neighborhood police brutality among African American young adults. Furthermore, we explore the gender effect to determine whether policing inequality exerts a more pervasive and profound influence on African American young men. Lastly, the analysis would be extended to the sample of African American older adults, aiming to identify sensitive periods in the lives of African Americans. This multi-faceted approach allows

for a nuanced understanding of how structural inequalities in policing may contribute to accelerated biological aging in affected communities.

CHAPTER 2

LITERATURE REVIEW

Policing and Health

There is increasing literature in different fields, such as sociology, public health, criminology, and other social science subjects, examining how policing behaviors are linked to poor health outcomes, particularly among Black people and communities (Alang et al. 2017, Bor et al. 2018, Browning et al. 2021, Brunson and Weitzer 2009, Das 2022, Jackson et al. 2019, McFarland, Taylor and McFarland 2018, McFarland et al. 2018, McFarland, Geller and McFarland 2019, Sewell and Jefferson 2016, Sewell 2017, Sewell, Jefferson and Lee 2016, Simckes et al. 2021). The "weathering" hypothesis provides a potential explanation for this relationship (Geronimus et al. 2006, McEwen and Stellar 1993, Simons et al. 2021b). It explains the latent biological mechanism of how environmental factors (i.e. policing) could cause physiological distress. This hypothesis takes a cumulative stress perspective, suggesting that repeated environmental challenges could expose the individual to stressful feelings, increasing or fluctuating their neural or neuroendocrine response (Sosoo, MacCormack and Neblett Jr 2022). If the neural or neuroendocrine response remains high or fluctuates consistently over time, it could lead to premature aging due to the potentially harmful effects of instability on the human body. An appealing aspect of this hypothesis is that it provides a theoretical pathway for how environmental elements raise psychological issues and how mental status influences physical health outcomes.

Obviously, one of the most essential consequences of police violence is its negative impact on mental health. Studies have consistently shown that Black people exposed to police violence are at high risk of various psychological problems, including depression (Jackson et al. 2024), anxiety (Alang, McAlpine and McClain 2021), post-traumatic stress disorder (Jackson et al. 2019), and other psychological distress (Sewell, Jefferson and Lee 2016). Notably, the influence of police violence on mental well-being can be extended beyond those who directly encounter it (Lopes et al. 2015, Motley, Williamson and Quinn 2024). Their family members, friends, and entire communities could also be affected, because individuals have to deal with the trauma of witnessing or hearing about police brutality against people they care about. Furthermore, experiencing police violence indirectly may have a similar or even greater influence on mental health (Haile et al. 2023, Lopes et al. 2015, McFarland, Geller and McFarland 2019, Zimmerman and Posick 2016), since the influence permeates their daily lives, unlike the occasional direct encounters. As Sewell et al. (2016) indicate, living under surveillance could result in chronic stress. The stress is accompanied by fear and humiliation from the police contacts, which could be detrimental to mental well-being. It would lead to feelings of powerlessness, anger, and distrust in law enforcement and other formal institutions. The distrust would facilitate systematically avoiding the use of medical resources, further impairing their physical health (Carbonaro 2022).

Previous studies also investigate the direct influence of policing inequality on racial disparities in physical health (Browning et al. 2021, Das 2022, McFarland, Taylor and McFarland 2018, McFarland et al. 2018, Sewell and Jefferson 2016, Sewell 2017, Sewell et al. 2021). The stress induced by policing inequality/police lethal use of force could influence a series of physiological processes (Sosoo, MacCormack and Neblett Jr 2022), and increase the

risk of chronic disease, including high blood pressure, stroke (Talbert 2023), diabetes (Sewell 2017) , and obesity (McFarland, Taylor and McFarland 2018). The findings of the correlation between policing inequality and chronic disease suggest that the mechanism is a gradual process. Therefore, understanding the biological process rather than the onset of the symptoms could be more essential and precise. A recent study examined how exposure to police violence altered cortisol levels (Browning et al. 2021). Cortisol is a type of steroid hormone released by adrenal glands, and it could represent the stress level a person experiences. Similarly, another study claims that unfair treatment by police could shorten telomere length (McFarland et al. 2018). The telomeres are considered a biological indicator of aging, since it will shorten with cell replication and be impaired as age increases (Blackburn 2000). All these studies suggest that police killings increase the stress level, and over time, it would accelerate the aging process within the human body among African Americans.

Despite the fact that policing behaviors are negatively correlated with health outcomes, previous studies used different perspectives to examine the mechanism. The first type of study simply viewed policing behaviors as harsh encounters or surveillance, which could result in trauma and anxiety among individuals (Geller et al. 2014). It could also be the stigmatization for individuals and lead to social isolation (Das 2022). On the other hand, policing behaviors are considered race-related, and race-specific policing outcomes are the fundamental cause of health disparities between races (Bailey, Feldman and Bassett 2021). Police brutality toward a specific race/ethnicity could significantly impact the health outcomes for individuals in the population (Bor et al. 2018, Browning et al. 2021). That is, from this perspective, police brutality is a dimension of racism, leading to intergenerational trauma among minorities (Bryant-Davis et al. 2017). Sewell (2017) investigated the associations between police violence and illness from both

perspectives and found that either the overall use of force or racial disparities in the use of force is positively correlated with poor health outcomes.

Police Brutality as an Aspect of Surveillance and Structural Racism

The direct encounters and indirect contact with police violence measure two different aspects of discrimination experiences (Haile et al. 2023). Investigating the influence of direct encounters aims to understand the mechanism of subjective stressors (Krieger 2014), which explores the effect of interpersonal discrimination experience. For example, Alang et al. (2021) found that the negative experience of direct police encounters could lead to anxiety, especially for minorities. Other studies also suggest that direct police encounters could lead to depressive symptoms (Jackson et al. 2024), PTSD (Jackson et al. 2019), substance use (Jackson, Testa and Boccio 2022), shorter telomeres (McFarland et al. 2018), obesity (McFarland, Taylor and McFarland 2018), and accelerated aging (Das 2022).

Instead, indirect contact at the neighborhood level tries to assess police violence as an ecological exposure (Haile et al. 2023). The exposure could be decomposed into two major parts: surveillance (Sewell, Jefferson and Lee 2016) and structural racism (Williams and Mohammed 2013). Living under surveillance has been proven to be detrimental to health outcomes among African American individuals since it could lead to hypervigilance (Himmelstein et al. 2015). The increase in surveillance could also be consistent with the efforts to evade it (Brayne 2014), which may reduce people's willingness to interact with the surveilling institutions, including hospitals and educational institutions. The decline in willingness, in turn, would minimize the accessibility of medical resources and raise the possibility of engaging in risky and unhealthy behaviors, resulting in negative health outcomes. On the other hand, structural discrimination could have a larger and more profound influence since it is a cross-generational societal

phenomenon (Krieger 2014). Although there is no standard definition of structural racism, previous studies have indicated that police violence is an essential dimension of structural racism (Bailey et al. 2017, Bailey, Feldman and Bassett 2021). The other dimensions of structural racism have been proven to be related to the police shooting rates of victims not known to be armed (Mesic et al. 2018). A study using a national representative dataset also suggests that perceiving negative cultural images of Black people is correlated with attitudes toward support of police violence (Hadden et al. 2018). These studies reveal that police violence is a part of structural racism and there is a need to include it in health disparity research (Bailey et al. 2017). In fact, previous studies have shown that indirect contact with police violence at the neighborhood level could lead to poor mental health (Bor et al. 2018), cardiovascular diseases (Sewell 2017, Talbert 2023), and physiological distress (Browning et al. 2021).

DNA Methylation and Epigenetic Aging

Researchers have started investigating how exposure to stressors, such as structural racism or police brutality, leads to accelerating biological aging processes (Carter et al. 2019, Das 2022, Lim, Nzegwu and Wright 2022, Martz et al. 2024, Simons et al. 2021b). Among these studies, evaluating the degree of epigenetic changes is the most promising method to assess the progress of aging (Simons et al. 2021a). Epigenetic regulation influences genome expression, and one of the latent mechanisms is DNA methylation (Koch and Wagner 2011). The process of DNA methylation involves the transfer of a methyl group onto a DNA segment at a CpG site. It could inhibit gene expression of a DNA segment without altering its sequence (Jaenisch and Bird 2003). Previous studies state that stress response mechanisms would manifest through modulated gene expression, indicating epigenetic regulation and methylation could be the consequence of living under stress (De Nadal, Ammerer and Posas 2011). Importantly, these epigenetic changes

may not be limited to the individuals directly experiencing the stressors but could potentially be inherited by future generations (Fitz-James and Cavalli 2022).

Acknowledging that age is closely related to DNA methylation (Koch and Wagner 2011), researchers started to develop epigenetic aging indexes based on DNA methylation. The first generation of epigenetic aging indexes involves predicting the chronological age by methylation (Hannum et al. 2013, Horvath 2013). In these studies, the authors have confirmed the age-related CpG sites. Methylation increases in some of these sites with the increase in age, while it may also decrease in other CpG sites. However, researchers are increasingly interested in exploring the relationship between methylation and morbidity as the development of epigenetic indexes. “GrimAge” is the most prevalent second-generation epigenetic index used in social science and public health (Lu et al. 2019). It uncovers 1,030 CpG sites that can predict seven types of plasma proteins, where these plasma proteins are closely associated with mortality or morbidity. Notably, the index integrates the surrogate biomarkers of smoking pack-years to account for the influence of risk behaviors on aging. It has been proven that GrimAge has stronger predictability on aging than other epigenetic clocks (McCrory et al. 2021). Despite the success of the second-generation indexes in estimating biological aging, the dynamic mechanism of the aging process is still unclear for researchers. Therefore, a research group started to use the longitudinal dataset for assessing the “pace of aging,” which is called “DunedinPACE” (Belsky et al. 2022). This third-generation epigenetic clock also shows great predictability on morbidity, disability, and mortality. When controlling GrimAge in the model, DunedinPACE still has independent influences on age-related factors. It has been considered the most promising indicator of aging in social science research (Beach et al. 2022b).

Gender and Age Differences in Police Brutality

Typically, females have higher longevity than males (Nakamura and Miyao 2008). There are two possible explanations for this difference. First, from a biological perspective, men and women have distinct physiological mechanisms (Hägg and Jylhävä 2021). The chromosomal-linked mechanisms and hormonal effects work differently within men's and women's bodies, leading to lower epigenetic aging among women (Li et al. 2020). On the other hand, social and environmental factors are other essential causes. Compared to males, females are more likely to engage in health-related behaviors (Liang et al. 1999). Also, females are less likely to do risky behaviors that increase their stress and lead to death (Hirschberger et al. 2002).

Given the perspective of social and environmental factors, since males and females have distinguished experiences with police brutality, it would result in differences in health outcomes. A previous study states that exposure to police brutality events causes more depressive symptoms among Black females (Motley Jr, Chen and Motley 2023). After police contact, females are more likely to exhibit system avoidance, reducing their opportunities to receive medical resources and leading to poor health outcomes (Carbonaro 2022). Combined with the “weathering” hypothesis, it suggests that police brutality could have a higher influence on accelerating biological aging among Black females. Another study also found corresponding evidence that females have greater risks of age-related diseases, such as diabetes, high blood pressure, and obesity (Sewell et al. 2021). It appears that these findings are aligned with the overall prevalence of higher depression among Black females than males (Williams et al. 2007). However, since Black young men are at the highest risk of police-related killings (Edwards, Lee and Esposito 2019), receiving information about police brutality may bring more fear to them (Aymer 2016). Sewell et al. (2016) found that male residents in aggressively surveilled neighborhoods have more psychological distress and nervousness. Correspondingly, McFarlan et

al. (2018) investigated the influence of feeling unfair treatment by police on their telomere length, in which they found a significant result among males but not females. Therefore, it seems like there is no conclusion about the results of gender differences.

In terms of the influence of police violence on epigenetic aging over the life course, there is still a significant gap in the literature. On the one hand, early adulthood is a sensitive stage with a higher risk of police killings (Arnett 2000). People may be more likely to be influenced by police brutality on biological aging in this period. On the other hand, compared to Black young adults, people in middle age or older adults may be accustomed to discrimination (Ayalon and Gum 2011), leading to a small effect of police brutality on the aging process. However, there is still a need for evidence to verify the mechanism, and the present study aims to address this blank.

CHAPTER 3

HYPOTHESIS

Given the theory and mechanism discussed above, the present study proposes the following hypotheses:

H1: Overall police brutality (surveillance) in the community has a significant influence on accelerated epigenetic aging among Black young adults.

H2: Race/ethnic-specified police brutality in the community has different influences on accelerated epigenetic aging among Black young adults, in which police brutality against Black people (structural racism) has the most significant impact.

H3: The influence of policing brutality on accelerated epigenetic aging is moderated by gender.

H4: Police brutality in the neighborhood has a significant influence on accelerated epigenetic aging among Black older adults, but the effect is smaller than the Black young adults have.

CHAPTER 4

DATA AND METHODS

Data

The Family and Community Health Study (FACHS) commenced in 1997 and has since been a longitudinal study involving numerous African American families in both Georgia and Iowa. Families were enumerated from lists compiled by community coordinators in Georgia and by school officials in Iowa. Potential participant families were chosen randomly, and 72% of the families on the recruitment lists attended this study. During the first wave, 889 target participants were, on average, aged ten, with 78.6% of them (N=699) being reinterviewed at Wave 6 in 2011-2012. In 2015-2016, the 7th Wave began collecting individual blood samples to extract biomarkers, with 449 participants consenting to provide them. Of the 449 study participants, a subset did not provide residential addresses across the three waves of data collection: 76 in Wave 4, 67 in Wave 5, and 92 in Wave 6. To address this missing data, we employed an assumption of residential stability. Specifically, when a participant's address was missing in a given wave, we assumed they maintained the same residence as reported in the most recent wave. This approach was feasible because all participants provided their addresses in at least one wave, thereby eliminating completely missing cases under this assumption. The final sample size for the young adult sample is 449, with 172 males and 277 females. We did not see a significant difference between the patients included in this study (N = 449) and the patients not included (N = 107) (See APPENDIX C), except for the years of being educated. The sample used for analysis has

less education by years than the sample excluded, which could lead to biased estimates. However, the difference is less than a year so the biases may not have a significant influence. When using having an equal or higher than a high school degree to represent education, it does not show a significant difference ($t = -.866$, $p = .387$).

Similarly, the FACHS dataset collected the sample from the caregivers of the young participants. In 2018-2019, almost 500 families still remained in the sample, and about 600 participants who still live in Georgia and Iowa were eligible to attend the current study. Among these participants, 480 agreed to provide their blood samples. Applying the same approach used for the young adults, the missing location provided at Wave 6 is imputed by the address provided in the nearest wave and the address provided by their children, resulting in no missing values. There is no difference between the population included and not included in the demographic characteristics, such as sex, education, and income (See APPENDIX C).

The Fatal Encounters database was employed to assess police brutality across various regions (Burghart 2016). This dataset encompasses police-related fatalities starting from 2000, including demographic and location information of the victims. The project primarily relies on three methods: paid researchers, public records requests, and crowdsourced data, with paid researchers contributing approximately 85% of the data as of June 2015. The process involves aggregating information from existing databases, such as KilledByPolice or Los Angeles Times' The Homicide Report, and individual contributors, followed by complete verification and cross-checking against published sources. Crowdsourced data undergoes rigorous validation against media reports and public records before inclusion. All recorded deaths were included in the present study, with the exception of those classified as suicides. The reason for excluding the suicide cases is that the goal of this study is to assess the policing inequality in the use of force.

Although this dataset includes all the deaths with the witness of officers, encompassing all the information is not aligned with our goal. While suicide committed with police presence could be due to pressure from the power status, the influence of direct use of force is more interesting and profound to researchers and people. Also, since the data is sourced from media and the internet, it enables researchers to examine people's exposure to discussions on these platforms about the unfair treatment of police violence. The Fatal Encounters dataset can be found at <https://fatalencounters.org/> (the present study downloaded it in July 2024).

The other dataset used for supplement in the present study is the Mapping Police Violence database (Sinyangwe, McKesson and Elzie 2021). The database was founded in 2013. As for 2022, there have been more than 30,000 deaths reported. Unlike the cases in the Fatal Encounters that involve every death that occurred in the presence of officers, the Mapping Police Violence only contains the deaths due to direct use of force. The information is primarily sourced from the official police use of force data collection programs, as well as from the crowdsourced database, the Fatal Encounters. In particular, the project aims to investigate social media, obituaries, criminal records, police reports, and other sources to identify the race of victims, increasing the data quality. However, although the quality of the Mapping Police Violence is higher, it does not provide the cases from 2011 to 2012. Given the interest in police-related deaths between 2011 and 2015, the present study utilized the Fatal Encounters as the primary dataset, while Mapping Police Violence is considered supplementary information for ensuring comprehensive estimates. The Mapping Police Violence dataset can be found at <https://mappingpoliceviolence.org/> (the present study downloaded it in July 2024).

There are some concerns regarding these databases, including transparency, measurement error, and researcher bias. First, the data collection process was untransparent, and researchers

found it hard to reproduce the dataset. Second, the new alerts were tracked manually so some incidents could be missed. Also, the alerts rely highly on online records, so if the new media did not report the cases on their website, the victim data could be dropped from the database. Last but not least, the project did not provide standard training for their researchers, so there could be differences across different coders.

Despite the concerns about these datasets, they still provide useful insights when assessing police violence. For example, if a researcher wants to analyze police brutality using official records from police departments or the Bureau of Justice Statistics' Arrest-Related Deaths program, they could probably receive an underestimated number of police-related deaths. On the other hand, the crowdsourced database could provide a more comprehensive estimate of the victims, where the data from the news media could uncover the under-reported cases (Finch et al. 2019). In particular, until now, there are still no reliable nationwide official records of the police use of lethal force data available for researchers. Although the Federal Bureau of Investigation started to collect police use of force data in 2019, the report rate is only about 40% of the overall law-enforcement agencies. In contrast, the two crowdsourced databases used in the present study began to collect on police-related lethal events in 2013. The Fatal Encounters even added the cases from 2000 to 2012 retrospectively, which provides a 20-year longitudinal dataset for researchers to investigate police brutality. In consequence, Fatal Encounters and Mapping Police Violence are still considered the most impartial and comprehensive datasets for evaluating police-related death events.

Methylation Procedures

The received blood samples were checked for proper anticoagulation and diluted with phosphate-buffered saline. Mononuclear cells were isolated using a centrifuge with ficoll,

washed, and preserved in a DMSO/RPMI solution at 8.0°C. The University of Minnesota Genome Center (<http://genomics.umn.edu/>) conducted the genome-wide DNA methylation analysis using the Infinium MethylationEpic Beadchip (Illumina, San Diego, CA, USA), following the manufacturer's protocol. The potential batch effects were minimized by randomly assigning participants to 16 sample “slides/chips.” Two “batches/plates” were created by grouping eight slides into a single plate, one of which was bisulfite. Each plate includes a replicated sample of DNA to assess batch variation and ensure the specimens were correctly handled. The average correlation of beta values between plates was greater than 0.99. The R packages “MethyLumi,” “WateRmelon,” and “IlluminaHumanMethylationEPICanno.ilm10b2.hg19” were utilized to normalize the resulting data – DASEN – as the protocols used in the previous study (Beach et al. 2022a). The criteria for quality control are based on the detected p-value of the probes. If there were more than 1% of the probes in the sample had p-values less than 0.05, the sample would be removed, resulting in 858,924 of the 866,091 probes retained. An inspection of complete bisulfite conversion was made, and the Illumina Genome Studio Methylation Module (Version 3.2) was applied to determine the average β values for each targeted CpG residue. The β values for each site were calculated by the number of methylated probes divided by the total number of probes, resulting in a value ranging from 0 (unmethylated) to 1 (fully methylated) (Triche Jr et al. 2013). Other details can be found in Simons et al. (2021).

Measure

Accelerated Epigenetic Aging.

Two different epigenetic aging indexes were applied to assess the health outcomes: GrimAge (Lu et al. 2019) and DunedinPACE (Belsky et al. 2022). The GrimAge is a second-

generation epigenetic clock. Compared to the first-generation clocks, which are calculated by predicting the actual age, the second-generation clocks rely on investigating the correlation between methylation and health risk scores. In consequence, the nature of this relationship to health risks allows researchers to assess physical health objectively. Previous studies have shown that GrimAge is related to manifold health outcomes, including all-cause mortality (McCrory et al. 2021), coronary heart disease (Lu et al. 2019), cancer, cognitive ability (Hillary et al. 2021), etc. On the other hand, DunedinPACE is considered the third-generation epigenetic clock, which examines the “pace” of biological aging. Unlike previous generations, the longitudinal data of biomarkers was applied to compute the third-generation clock. Similar to GrimAge, DunedinPACE is also proven to be related to various health risks (Belsky et al. 2022, Savin et al. 2024).

Different resources were utilized to calculate these two clocks. An online platform “New Methylation Age Calculator” (<http://dnamage.genetics.ucla.edu/>) was applied to analyze GrimAge scores, using the Advanced Analysis normalize data options. The resulting GrimAge values were regressed on the participants’ chronological ages. The unstandardized residuals generated from the regression were called “accelerated GrimAge (GrimAgeAccel),” where a positive number indicates that biological aging is higher than expected growth. It in turn measures accelerated epigenetic aging. For DunedinPACE, it is calculated by the algorithm the developers provided at <https://github.com/danbelsky>, (January 1, 2022). The value of 1 on the DunedinPACE indicates that, on average, the biological aging of an individual increases 1 year within a year, which is aligned with the chronological age. That is, if the value is greater than one, it suggests accelerated aging. The detailed calculation process can be found in the previous studies (Beach et al. 2022b, Berg et al. 2022, Lei et al. 2022).

Police Brutality.

The definition of police brutality in the present study is “the excessive and lethal use of force from officers against unarmed individuals, regardless of the approach used.” Specifically, the present study wants to examine how the “consequences” of police brutality affect health outcomes, particularly focusing on the impact of policed-related deaths on the residents’ health. As previously mentioned, the effect of police violence will manifest through different pathways, and the latent mechanism is to induce psychological distress within an individual. The restriction of police-related fatalities instead of other policing behaviors, such as stops or searches, ensures that the policing results can be reported in the news and spread through the audience. That is, these incidents typically generate significant media coverage and public discourse, potentially providing a more accurate representation of their impact across different communities. Policed-related fatalities have a more profound, prevalent, and explicit influence than other policing behaviors (Galovski et al. 2016).

The attributes of the Fatal Encounters and Mapping Police Violence, including the methodology and the cases recorded, facilitate our intention. All the recorded deaths are police-related and include the location and time information, so the measure can be calculated at the region level across time. Especially, the information on the incidents includes the type of force used and whether the victims were equipped with weapons. All the incidents were filtered by the criteria that (1) the suicide and undetermined cases would be dropped and (2) the allegedly armed incidents would be excluded. The cases with the uncertain status of possessing a weapon were included in the analysis since it suggests that the lethal use of force was implemented regardless of the weapon status. Although it could be reasonable for officers when facing potential threats, the overreaction is aligned with the definition of excessive use of force (Fagan

and Campbell 2020). To be noted, there are duplicate cases in these two datasets since Mapping Police Violence contains the cases existing in Fatal Encounters. A unique identifier is provided in Mapping Police Violence so that researchers can exclude the same cases.

The police brutality is quantified using the following formula:

$$PB_{ij} = \frac{Death_{ij}}{Population_{ij}} \times 100,000$$

In this equation, i denotes each county, and j represents each race/ethnic group. This measure is also called race-specific policed-related death rate, where the unit is per 100,000 people. It is aligned with the definition of a benchmark test (Neil and Winship 2019). As indicated by Schwartz and Jahn (2020), estimates in a small area could be unstable since police-related deaths are rare. Meanwhile, state-level estimates do not account for the variation within the state, so the present study uses county-level estimates for assessing police brutality. Also, the number of police-related deaths is averaged by five years, from 2011 to 2015, to address the instability since the incidents rarely happen in a small area within a year. The population data is obtained from the American Community Survey (ACS), which is the 5-year average estimates between 2011 and 2015. Regarding the race/ethnic group, the present study categorizes it into White people, Black people, and other race/ethnic groups. Notably, although this index does not directly measure policing inequality, including all the race-specific police brutality rates in a regression model could capture the inequality pattern. When controlling the influence of police brutality in other race/ethnic groups, the interpretation of the increased police violence in a certain race/ethnic group would be the relatively higher brutality. See APPENDIX D for the distribution.

County-Level Variables.

When modeling the relationship between police violence and health outcomes, the confounding variables should be carefully considered to make a causal inference. Many social and environmental factors have been recognized to be closely related to both police violence and health (Braveman, Egerter and Williams 2011, Zare et al. 2022). Specifically, based on the minority threat hypothesis (Roh and Robinson 2009), more formal social control (i.e. policing) would be executed in the areas that have a larger Black population and extreme racial/ethnic segregation (Helms and Costanza 2020, Johnson Jr et al. 2019, Mesic et al. 2018). Also, according to the social disorganization theory, the lack of informal social control could influence the perceptions of the police about the neighborhoods, and officers are more likely to intervene proactively through police stops or the use of force, where the social disorganization could be measured by higher poverty rates and higher violent crime rates (Johnson Jr et al. 2019). These regional characteristics are also viewed as social determinants of health (Dustmann and Fasani 2016, Robert 1999, Williams and Collins 2001), which indicates that we should incorporate them into our analysis as confounders.

Three county-level variables were derived from different sources. The violent crime counts were calculated from the 2011 Uniform Crime Reporting (UCR) Program from the Federal Bureau of Investigation (FBI). The types of violent crime include murder, rape, robbery, aggravated assault, burglary, larceny, auto theft, and arson. The number of violent crimes is divided by the population in each county, where the resulting values would be multiplied by one thousand to obtain the violent crime rate per thousand people. Next, the poverty rates in 2011 for all ages across the counties were obtained from Small Area Income and Poverty Estimates (SAIPE) provided by the U.S. Census Bureau. The last one, racial/ethnic segregation, was calculated by the following formula (Massey and Denton 1988):

$$Isolation_i = \sum_{j=1}^n \left[\left(\frac{x_j}{X} \right) \left(\frac{x_j}{t_j} \right) \right]$$

Where i denotes each county, n is the number of census tracts in county i , x_j is the black population in tract j , X is the total black population in the county, and t_j is the total population in tract j . This isolation index ranges from 0 to 1, where the higher value indicates that black people are fully isolated by other racial/ethnic groups in the area.

Individual-Level Variables.

To account for potential confounding factors, we incorporate various individual demographic characteristics into our analysis. Gender is operationalized as a binary variable, with males serving as the reference group. Educational attainment is quantified by years of formal education completed. Income is measured as weekly salary, whereas the income of older African American adults is assessed by household income. Cell-type composition is controlled in the models to ensure that aging is not related to epigenetic variation or individual differences in cell types (Horvath et al. 2016). The counts of different cell types, including CD8+ T cells, CD4+ T cells, natural killer cells, B cells, and monocytes, are estimated by the function “Estimate-CellCounts” in the “minfi” Bioconductor package (Houseman et al. 2012).

Analytic Strategy

First, it is essential to verify the main effect of police brutality on accelerated biological aging. To evaluate this effect, a series of ordinary least square (OLS) models with clustered-robust standard errors were estimated. Since the participants are unevenly distributed across 59 (for young adults) and 55 (for older adults) different counties, the clustered-robust standard error

could address the violation of independence of errors in the OLS. Alternative analysis using multilevel modeling frameworks provides similar results (See APPENDIX B). About 60% of the counties are singleton groups, that is, these counties only have one participant. Given that the intra-class coefficients are insignificant, the primary results are based on OLS with clustered-robust standard error to reduce the model complexity (Lei et al. 2019).

For the main effect, the present study investigated the influence of both overall police brutality and race-specific police brutality on epigenetic aging among African American young adults. It aimed to validate Hypotheses 1 and 2. Next, the moderation effect of gender was examined by adding interaction terms to the models, aligned with Hypothesis 3. It investigates if gender moderates race-specific police brutality. A simple slope analysis was applied to see if the interaction term represents a buffer or exacerbated effect. The sample is also separated by gender to execute a stratified analysis. The last analysis involved the sample of African American older adults, determining whether the main effect still manifests in this population.

To provide robust evidence for our hypotheses, all biological aging indices would undergo the aforementioned analyses. The analyses were conducted using R (version 4.3.2). The “estimatr” package was utilized to assess clustered-robust standard errors using the “lm_robust” function. The “lme4” package helps implement the multilevel framework for supplementary analysis. The simple slope test is implemented by using the “interactions” package.

CHAPTER 5

RESULTS

Table 1 shows the descriptive statistics of the sample of young adults and older adults. The average chronological age for the young adult sample was 29.15 years (SD = 0.75) in 2016, and the average age for older adults was 57.19 years (SD = 6.80) in 2019. In the young adult sample, about 62% of people are female, while 73.5% of people are female in the older adult sample. For the total police brutality, on average, there are 0.185 deaths per 100,000 people in the county that the young adults lived in between 2011 and 2015. The number in the older adult sample is 0.183 deaths per 100,000 people. It does not show a large difference between these two samples in total police brutality. Notably, the police brutality against Black people is almost three times higher than against White people, either in the young adult sample or older adult sample. This is consistent with the findings from Edwards et al. (2019), which suggest that the risk of being killed by police among Black people is 2.5 times more than White people.

– TABLE 1 HERE –

To investigate the influence of police brutality on epigenetic aging, the present study implemented the OLS regression model with clustered-robust standard error. Table 2 shows the effect of police brutality on epigenetic aging, in which Model 1 and Model 3 suggest that total police brutality has an effect on GrimAgeAccel ($\beta = 3.428, p < .001$) and DunedinPACE ($\beta = 0.152, p < .001$). It shows that a unit increase in the number of police-related deaths per 100,000 people was associated with a 3.428-year increase in GrimAgeAccel, which is aligned with

Hypothesis 1. On the other hand, Model 2 and Model 4 examine the influence of race-specific police brutality, showing an inconsistent result in different indexes. The police brutality against Black people ($\beta = 0.002, p < .001$) and other race/ethnic groups ($\beta = 0.026, p < .001$) exhibit a positive relationship with DunedinPACE, while the effect is not significant in GrimAgeAccel. Also, the effect size of police brutality against Black people is smaller than against White people, which means Hypothesis 2 is not satisfied.

– TABLE 2 HERE –

Model 5 to Model 10 in Table 3 further examines if gender moderates the influence of race-specific police brutality. For police brutality against White people, the result of Model 5 suggests a significant moderation in GrimAgeAccel ($\beta = 2.814, p < .05$). The positive coefficient states that the influence of police brutality against White people is higher among females. On the other hand, the result of Model 9 examines the moderation effect of gender in police brutality against Black people, which reveals the influence of brutality against Black people is higher among males ($\beta = -0.041, p < .001$). It indicates the higher risk of police brutality against Black people could lead to more stress among Black young males, resulting in accelerated aging. Furthermore, the moderation effect on police brutality against non-White people is also examined. Analyzing the effect of police brutality against non-White people could provide a binary comparison between the risk among White and non-White people, while the measure for non-White people could capture the overall discrimination against all minorities. Model 10 yields a similar result with the influence of brutality against Black people, indicating the effect is higher among males in DunedinPACE ($\beta = -0.058, p < .001$). Overall, the moderation effect of gender is only significant in one aging index, either for White or non-White

people, indicating that Hypothesis 3 is only partially supported. Notably, the moderation effect did not exist in the total police brutality (table not reported).

Additional analysis of the gender moderation effect on brutality against Black people is also made, which also shows a similar effect to Table 3. A simple slope analysis (Table 4 and Figure 1) was applied to illustrate the moderation effect further in Table 3. It indicates that for Black young males, a unit increase in the number of police-related non-White deaths per 100,000 people is positively correlated to DunedinPACE ($b = 0.07, p = .01$). However, the effect is not statistically significant for females ($b = 0.01, p = .14$). In Table 5, the young population sample was separated by males and females and implemented the OLS with clustered-robust standard error for DunedinPACE. The result of stratified analysis states that the influence of police brutality against Black or non-White people only manifests among Black young males ($\beta = 0.038, p < .001$ and $\beta = 0.071, p < .001$). Also, the influence of police brutality against White people is only significant among Black young females ($\beta = 0.139, p < .01$ and $\beta = 0.126, p < .01$).

– TABLE 3 HERE –

– TABLE 4 HERE –

– FIGURE 1 HERE –

– TABLE 5 HERE –

Finally, the present study investigated the influence of police killings on epigenetic aging among Black older adults. Model 15 and Model 17 exhibit an insignificant result on GrimAgeAccel ($\beta = 1.726, p > .1$) and DunedinPACE ($\beta = 0.037, p > .1$). However, it does provide evidence for Hypothesis 4 that the effect size of police brutality on epigenetic aging is

smaller and insignificant among older adults than young adults. Interestingly, the effect is positive and significant in the brutality against other race/ethnic groups on GrimAgeAccel ($\beta = -0.679, p < .001$). Another interesting finding about the differences between young adults and older adults is related to the confounding variables. For Black young adults, the poverty rates in their neighborhoods are closely related to their epigenetic aging, in which the relationship can be observed from Model 1 to Model 4. On the other hand, for older adults, the violent crime rates in their neighborhoods are more essential and detrimental to their health outcomes.

– TABLE 6 HERE –

Sensitive Analysis

To receive robust results, additional analysis was made to ensure the results were consistent across different circumstances. The multilevel modeling framework is utilized to address the interdependence of errors within a county, and similar results are also shown (See APPENDIX B).

Table 1 Descriptive Statistics

Variables	Mean	SD	Min	Max
African American Young Adults				
Age (in 2016)	29.153	0.752	27.500	31.330
Police Brutality - Total	0.185	0.15	0	1.24
Police Brutality - White people	0.127	0.159	0	1.395
Police Brutality - Black people	0.466	3.448	0	72.727
Police Brutality - Other	0.102	0.473	0	6.609
Violent Crime Rate (per 1,000 people)	1.743	0.795	0.266	4.286
Segregation	0.354	0.21	0.018	0.802
Poverty Rate (%)	20.469	9.539	6.3	39.2
Female (%)	61.7			
Education by year (in 2011)	12.737	1.698	1	17
Weekly Income (per 1,000 dollars) (in 2011)	0.402	0.451	0	8
CD4+ T cells	0.179	0.065	0	0.375
CD8+ T cells	0.086	0.055	0	0.443
Natural killer cells	0.016	0.029	0	0.183
B cells	0.07	0.035	0	0.194
Monocytes	0.053	0.025	0	0.144
African American Older Adults				
Age (in 2019)	57.186	6.800	34	84.67
Police Brutality - Total	0.183	0.148	0	1.24
Police Brutality - White people	0.13	0.165	0	1.395
Police Brutality - Black people	0.371	0.537	0	1.711
Police Brutality - Other	0.062	0.423	0	6.609
Violent Crime Rate (per 1,000 people)	1.779	0.811	0.333	4.286
Segregation	0.34	0.192	0.056	0.802
Poverty Rate (%)	20.955	9.838	8.8	39.2
Female (%)	73.5			
Education by year (in 2011)	12.943	2.169	2	20
Weekly Household Income (per 1,000 dollars) (in 2011)	0.714	0.567	0.096	3.846
CD4+ T cells	0.179	0.073	0	0.392
CD8+ T cells	0.091	0.052	0	0.318
Natural killer cells	0.031	0.039	0	0.253
B cells	0.078	0.055	0.001	0.737
Monocytes	0.064	0.03	0	0.235

Table 2. OLS regression models with clustered-robust standard error predicting epigenetic aging for Black young adults (N=449)

Variables	GrimAgeAccel		DunedinPACE	
	Model 1	Model 2	Model 3	Model 4
Police Brutality - Total	3.428*** (0.966)		0.152*** (0.038)	
Police Brutality - White people		3.631*** (0.930)		0.107* (0.043)
Police Brutality - Black people		-0.004 (0.008)		0.002*** (0.000)
Police Brutality - Other		0.004 (0.336)		0.026*** (0.007)
Violent Crime Rate	0.136 (0.157)	0.077 (0.152)	0.008 (0.006)	0.008 (0.009)
Segregation	-0.046 (0.217)	0.170 (0.271)	-0.006 (0.005)	-0.001 (0.005)
Poverty Rate	0.567*** (0.102)	0.668*** (0.149)	0.011*** (0.003)	0.013* (0.005)
Gender (1 = female)	-2.090*** (0.291)	-2.097*** (0.289)	0.065*** (0.010)	0.067*** (0.010)
Education by year	-0.944*** (0.185)	-0.924*** (0.182)	-0.025*** (0.005)	-0.025*** (0.005)
Weekly Income	-1.131** (0.344)	-1.120** (0.339)	-0.018** (0.006)	-0.020** (0.006)
CD4+ T cells	-7.207+ (3.745)	-7.293+ (3.767)	-0.432*** (0.079)	-0.433*** (0.081)
CD8+ T cells	-12.292*** (2.252)	-12.055*** (2.262)	-0.610*** (0.092)	-0.607*** (0.096)
Natural killer cells	-19.765*** (4.104)	-19.114*** (4.100)	-0.484* (0.185)	-0.482* (0.188)
B cells	-7.498 (4.899)	-7.866 (4.927)	0.183 (0.206)	0.160 (0.211)
Monocytes	1.807 (6.621)	1.376 (6.782)	0.475+ (0.271)	0.480+ (0.273)
R ²	0.213	0.213	0.305	0.302
Adj. R ²	0.191	0.187	0.286	0.279
N	449	449	449	449

Notes: + p<0.1; * p<0.05; ** p<0.01; *** p<0.001

Table 3. OLS regression models with clustered-robust standard error predicting epigenetic aging for Black young adults, with interaction between race-specific police-related death rate and gender (N = 449)

Variables	GrimAgeAccel			DunedinPACE		
	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
Police Brutality - White people	1.570 (1.492)	3.614*** (0.910)	3.520*** (0.908)	0.042 (0.077)	0.100* (0.044)	0.092* (0.044)
Police Brutality - Black people	-0.007 (0.008)	0.104 (0.535)		0.001** (0.000)	0.043*** (0.010)	
Police Brutality - non-White			0.780 (0.786)			0.070*** (0.015)
Gender (1 = female)	-2.431*** (0.342)	-2.067*** (0.343)	-1.885*** (0.323)	0.054*** (0.013)	0.076*** (0.012)	0.079*** (0.013)
White people × Gender	2.814* (1.321)			0.088 (0.081)		
Black people × Gender		-0.108 (0.536)			-0.041*** (0.010)	
Non-White people × Gender			-0.863 (0.793)			-0.058** (0.017)
R ²	0.215	0.213	0.214	0.297	0.300	0.307
Adj. R ²	0.189	0.187	0.189	0.274	0.278	0.285
N	449	449	449	449	449	449

Notes: + p<0.1; * p<0.05; ** p<0.01; *** p<0.001, control variables are included in the model

Table 4. The Effect of police-related non-White death rate on DunedinPACE by Gender, Family and Community Health Study, Waves 2011–2016. Estimates calculated from Model 10 in Table 3.

Moderator Level	b	SE	t	p	95% CI
Gender = 0 (Male)	<i>0.07</i>	<i>0.03</i>	<i>2.71</i>	<i>0.01</i>	[0.02, 0.12]
Gender = 1 (Female)	<i>0.01</i>	<i>0.01</i>	<i>1.49</i>	<i>0.14</i>	[-0.0, 0.03]

Figure 1. The Effect of police-related non-White death rate on DunedinPACE by Gender, Family and Community Health Study, Waves 2011–2016. Estimates calculated from Model 10 in Table 3.

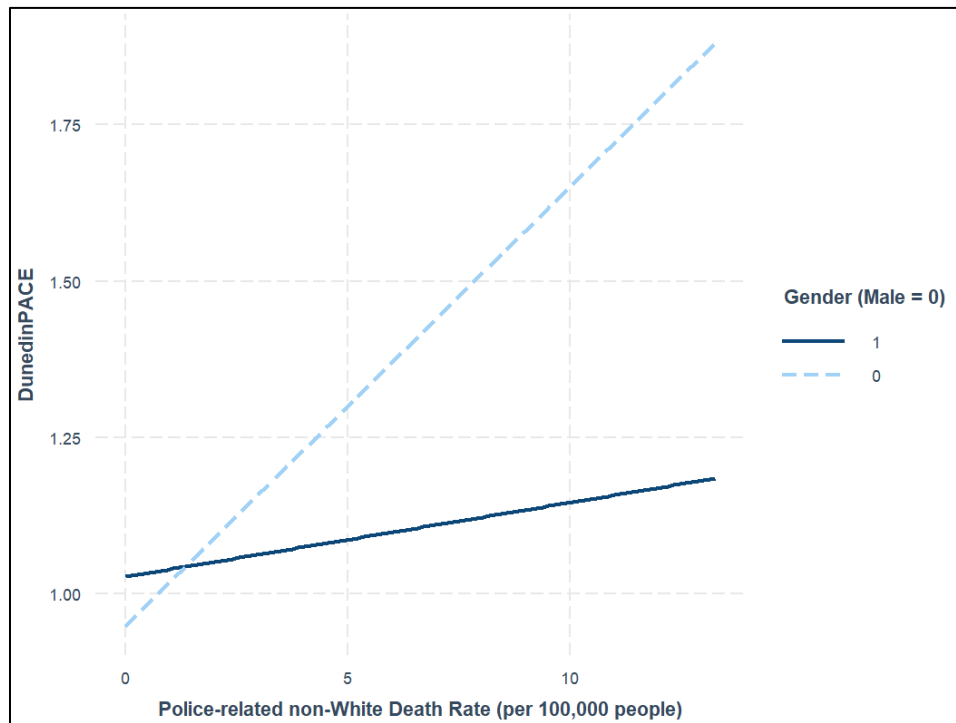


Table 5. OLS regression models with clustered-robust standard error predicting DunedinPACE for Black young adults, with separated sample by male (N = 172) and female (N = 277)

	Male		Female	
Variables	Model 11	Model 12	Model 13	Model 14
Police Brutality - White people	0.009 (0.074)	-0.007 (0.074)	0.139** (0.042)	0.126** (0.044)
Police Brutality - Black people	0.038*** (0.011)		0.002** (0.001)	
Police Brutality - Other	0.014 (0.011)		0.053*** (0.012)	
Police Brutality – non-White		0.071*** (0.017)		0.013+ (0.007)
Violent Crime Rate	0.018* (0.007)	0.019* (0.007)	-0.002 (0.012)	-0.005 (0.011)
Segregation	-0.010 (0.006)	-0.011+ (0.006)	0.001 (0.007)	0.006 (0.007)
Poverty Rate	0.009 (0.007)	0.006 (0.007)	0.013* (0.006)	0.010+ (0.006)
Education by year	-0.012+ (0.006)	-0.013* (0.006)	-0.041*** (0.007)	-0.038*** (0.008)
Weekly Income	-0.018** (0.006)	-0.018** (0.006)	-0.022 (0.027)	-0.020 (0.028)
CD4+ T cells	-0.422** (0.135)	-0.427** (0.133)	-0.383*** (0.099)	-0.354*** (0.097)
CD8+ T cells	-0.570*** (0.143)	-0.574*** (0.140)	-0.609*** (0.122)	-0.650*** (0.121)
Natural killer cells	-0.424* (0.181)	-0.421* (0.182)	-0.970** (0.328)	-0.915* (0.341)
B cells	0.472 (0.325)	0.465 (0.322)	0.029 (0.153)	0.031 (0.157)
Monocytes	0.244 (0.497)	0.210 (0.488)	0.994** (0.298)	0.942** (0.297)
R ²	0.233	0.246	0.323	0.312
Adj. R ²	0.169	0.190	0.290	0.281
N	172	172	277	277

Notes: + p<0.1; * p<0.05; ** p<0.01; *** p<0.001

Table 6. OLS regression models with clustered-robust standard error predicting epigenetic aging for Black older adults (N = 480)

Variables	GrimAgeAccel		DunedinPACE	
	Model 15	Model 16	Model 17	Model 18
Police Brutality - Total	1.726 (1.488)		0.037 (0.036)	
Police Brutality - White people		0.190 (1.629)		0.014 (0.045)
Police Brutality - Black people		0.565 (0.337)		0.004 (0.007)
Police Brutality - Other		-0.679*** (0.132)		0.000 (0.007)
Violent Crime Rate	0.739** (0.263)	0.567+ (0.299)	0.021*** (0.005)	0.020** (0.007)
Segregation	-1.716 (1.560)	-1.158 (1.594)	-0.054 (0.034)	-0.047 (0.038)
Poverty Rate	0.016 (0.016)	0.005 (0.019)	-0.001 (0.000)	-0.001 (0.001)
Gender (1 = female)	3.906*** (0.522)	3.927*** (0.520)	0.014 (0.011)	0.014 (0.012)
Education by year	-0.221** (0.077)	-0.226** (0.080)	-0.003+ (0.001)	-0.003+ (0.001)
Weekly Household Income	-1.659*** (0.317)	-1.588*** (0.299)	-0.041*** (0.008)	-0.040*** (0.008)
CD4+ T cells	-5.877*** (1.472)	-5.705*** (1.540)	-0.364*** (0.089)	-0.362*** (0.089)
CD8+ T cells	-13.136*** (3.485)	-13.245*** (3.457)	-0.613*** (0.124)	-0.610*** (0.124)
Natural killer cells	-13.423** (3.913)	-13.270** (4.015)	-0.049 (0.081)	-0.048 (0.079)
B cells	-11.024*** (2.459)	-10.878*** (2.465)	-0.199 (0.123)	-0.198 (0.124)
Monocytes	5.141 (7.127)	5.349 (7.028)	0.199 (0.230)	0.206 (0.231)
R ²	0.250	0.254	0.173	0.172
Adj. R ²	0.231	0.231	0.152	0.148
N	480	480	480	480

Notes: + p<0.1; * p<0.05; ** p<0.01; *** p<0.001

CHAPTER 6

DISCUSSION

In the present study, the relationship between exposure to police brutality and accelerated epigenetic aging among African American young adults and older adults was examined, with four hypotheses proposed. The first hypothesis assumes that every death due to police violence, regardless of race/ethnic group, would bring fear to the neighborhoods and lead to negative effects on biological aging. The finding provides support for the hypothesis. Specifically, a one-unit increase in police brutality is correlated with a 3.428-year increase in GrimAgeAccel and a 0.152-year increase in DunedinPACE. Take another point of view, including the total number of victims could also represent the extent of severe law enforcement in an area, which reveals that overall severe law enforcement would cause accelerated epigenetic aging among the residents.

For the second hypothesis examining the effect of race-specific police violence, the present study only uncovers partial support. To be noted, when controlling the police-related deaths in other race/ethnic groups, the value of a specific police brutality can be considered policing discrimination/inequality. The finding in the present study shows that the influence of non-White victims is only significant in DunedinPACE, not GrimAgeAccel. It suggests that the effect of policing inequality may not be prominent. It seems like the finding of Hypothesis 2 is contradictory to the previous findings from other studies, where they found the number of Black victims is associated with cardiovascular disease (Talbert 2023) and physiological distress (Browning et al. 2021). However, the difference could originate from the length of time to

calculate police violence. Previous studies focused on the short-term effect of police violence (i.e. within 30 days or one year), but the present study is interested in the long-term influences (i.e. five years) since the aging process is a gradual process. The average police-related killings over a long period could also provide a robust estimate of police brutality within a small area since the cases may rarely happen in some areas. Therefore, the finding in the present study indicates that the long-term policing inequality against non-White people could lead to an accelerated aging process, but the effect size is small and may disappear in some circumstances. On the other hand, the result indicates that the police inequality against White people is statistically significant and has the largest effect size on both epigenetic indexes compared to other race/ethnic groups. A possible explanation is that Black people may feel more anxious when they recognize that White people are experiencing a certain level of police brutality. From their perspective, police may adopt more lethal approaches to them or their peers. Additionally, the feeling of "schadenfreude" might arise when witnessing police violence against other groups, while "schadenfreude" could lead to neurodegeneration and poor health outcomes (Santamaría-García et al. 2017).

The third hypothesis examines the inconsistent findings from previous studies on the gender mechanism (McFarland et al. 2018, Sewell et al. 2021). The finding in the present study suggests that the relationship between policing inequality against non-White people and epigenetic aging only manifests in the Black male sample. Aligned with the findings from McFarland et al. (2018), Black young males are more vulnerable to policing inequality than females. However, it does not mean that the results from Sewell et al. (2021) should be dismissed. The "Health-Survival Paradox in Gender" has been confusing researchers for decades, where it describes a phenomenon that females typically have higher morbidity and lower

mortality, while males have lower morbidity and higher mortality (Rieker and Bird 2005). This phenomenon was surprisingly reproduced in the policing inequality study: McFarland et al. (2018) and the present study found that policing inequality is related to the index related to mortality among the male sample, while Sewell et al. (2021) found policing inequality is associated with higher morbidity in the female population. Ultimately, understanding the health-survival paradox may involve exploring the latent mechanisms that cause males and females to respond differently to the same social and environmental factors.

It takes a life course perspective for Hypothesis 4, indicating that early adulthood may be a sensitive period to police brutality. The results of the present study support the idea that the effect of police killings would manifest among young adults, not older adults. The observed small or no effect among the older adult sample could reflect three possible mechanisms. First, since older adults are not at a high risk of police killings, they may not experience the same amount of fear as young adults when witnessing or hearing these events. Second, older adults may have developed effective strategies over time to cope with these stressors, revealing a strong resilience (Ayalon and Gum 2011). The final possible explanation is that selection bias may exist. Individuals who are more susceptible to these social factors tend to have shorter longevity, making them less likely to survive into older adulthood. Another interesting aspect regarding the life course in the findings is that neighborhood characteristics have different influences on epigenetic aging among different aging groups. Among the regression models in young adults, the neighborhood poverty rates were consistently associated with accelerated epigenetic aging. It reveals that socioeconomic conditions in the neighborhoods are essential for young adult health, where fewer opportunities for social mobility could make young adults feel hopeless (Gugushvili et al. 2022). The relationship was not observed in older adults. On the other hand, violent crime

rates cause accelerated epigenetic aging among older adults, but the association is not significant in the young adult sample. The reason for this phenomenon may be that older adults typically live in a place for years, and safety and security concerns are more crucial for this group. Although the focus of the present study is not on these confounding neighborhood factors, the independent significance of police brutality and these variables suggests that they simultaneously influence the aging process.

Integrating the findings in the present study, the proposed mechanism for police brutality is that the overall degree of severe law enforcement that leads to fear among residents may be the major cause of negative health outcomes. On the other hand, objective policing discrimination/inequality only contributes little or no influence on accelerated epigenetic aging. The small influence can be explained by the gender difference, in which Black males are more vulnerable to policing inequality than females. Additionally, the life course perspective indicates that the effects of police violence are less pronounced among older Black adults. Overall, the present study suggests that even without direct police encounters, living in neighborhoods with higher police brutality is related to accelerated epigenetic aging.

Several limitations should be acknowledged in the present study. First, the location for calculating police brutality used in the present study is only based on a single time point, that is, the residential address of participants in 2011. It did not account for the possible mobility during these five years, so the measurement could be biased. Second, the measurement of police violence is based on county-level data, and the ecological fallacy could occur when we want to infer the influence of neighborhood factors on personal experiences. The present study does not make any argument based on personal experiences; instead, police brutality is considered an environmental factor. The relationship discovered in the present study could be spurious not only

because of the ecological fallacy but also due to other missing confounding variables, such as residential instability or economic inequality. Third, the data collection process of Fatal Encounters and Mapping Police Violence between 2011 and 2015 is unclear, so the data quality should be questioned. However, official records were considered more problematic during that period, making these crowdsourced datasets the better choice (Sharara et al. 2021). Fourth, the present study utilized the Last Observation Carried Forward method to deal with missing locations since some participants did not provide their residential information in 2011, which could cause biased estimates. Fifth, the present study only discusses the relationship at a single time point. Although the samples from young adults and older adults were utilized to assess the life course effect, longitudinal data for analysis is still needed to ensure the relationship discussed is not associated with the period and cohort effect. Finally, the present study only discussed the influence among African Americans, but there is still a need for the discussion among other racial/ethnic groups. White people account for the largest population of police-related victims, so we should still see the influence among this group. The relationship should also be seen in other racial groups, such as Asian and Latino people, since they are predominantly immigrants. These immigrants, no matter whether legal or illegal, would feel very anxious during police encounters since they have to worry about the possibility of deportation. Further study among these groups should be done for a thorough argument about this relationship.

In conclusion, police brutality has a profound influence on health outcomes among African Americans. Although the effects vary by age and gender, they provide several significant implications for public health, policy, and the criminal justice system. First, as a neighborhood-level determinant of health, police brutality contributes to biological aging processes even without direct encounters. These indirect contacts with lethal events are very common so

reducing the number of police killings would enhance the well-being among the Black communities. Second, there would be a need for mental health services that address the impact of structural violence, particularly for Black young males. This type of service could reduce the life-threatening stress among Black young males and potentially prevent them from negative physical health outcomes. Finally, the significant influence of total police brutality could imply that the negative relationship between officers and residents should be addressed. The worse the relationship is, the greater the fear is. A possible solution could be to encourage officers to participate in community activities by attending school visits, neighborhood patrols, or local events.

REFERENCE

- Alang, Sirry, Donna McAlpine, Ellen McCreedy and Rachel Hardeman. 2017. "Police Brutality and Black Health: Setting the Agenda for Public Health Scholars." *American journal of public health* 107(5):662-65.
- Alang, Sirry, Donna McAlpine and Malcolm McClain. 2021. "Police Encounters as Stressors: Associations with Depression and Anxiety across Race." *Socius* 7:2378023121998128.
- Alang, Sirry, Rahwa Haile, Rachel Hardeman and J   Judson. 2023. "Mechanisms Connecting Police Brutality, Intersectionality, and Women's Health over the Life Course." *American journal of public health* 113(S1):S29-S36.
- Arnett, Jeffrey Jensen. 2000. "Emerging Adulthood: A Theory of Development from the Late Teens through the Twenties." *American psychologist* 55(5):469.
- Ayalon, Liat and Amber M Gum. 2011. "The Relationships between Major Lifetime Discrimination, Everyday Discrimination, and Mental Health in Three Racial and Ethnic Groups of Older Adults." *Aging & mental health* 15(5):587-94.
- Aymer, Samuel R. 2016. "'I Can't Breathe': A Case Study—Helping Black Men Cope with Race-Related Trauma Stemming from Police Killing and Brutality." *Journal of Human Behavior in the Social Environment* 26(3-4):367-76.
- Bailey, Zinzi D, Nancy Krieger, Madina Ag  nor, Jasmine Graves, Natalia Linos and Mary T Bassett. 2017. "Structural Racism and Health Inequities in the USA: Evidence and Interventions." *The Lancet* 389(10077):1453-63.
- Bailey, Zinzi D, Justin M Feldman and Mary T Bassett. 2021. "How Structural Racism Works—Racist Policies as a Root Cause of Us Racial Health Inequities." Pp. 768-73, Vol. 384: Mass Medical Soc.
- Bandes, Susan A, Marie Pryor, Erin M Kerrison and Phillip Atiba Goff. 2019. "The Mismeasure of Terry Stops: Assessing the Psychological and Emotional Harms of Stop and Frisk to Individuals and Communities." *Behavioral sciences & the law* 37(2):176-94.
- Beach, Steven RH, Frederick X Gibbons, Sierra E Carter, Mei Ling Ong, Justin A Lavner, Man-Kit Lei, Ronald L Simons, Meg Gerrard and Robert A Philibert. 2022a. "Childhood Adversity Predicts Black Young Adults' DNA Methylation-Based Accelerated Aging: A Dual Pathway Model." *Development and psychopathology* 34(2):689-703.
- Beach, Steven RH, Eric T Klopach, Sierra E Carter, Robert A Philibert, Ronald L Simons, Frederick X Gibbons, Mei Ling Ong, Meg Gerrard and Man-Kit Lei. 2022b. "Do Loneliness and Per Capita Income Combine to Increase the Pace of Biological Aging for Black Adults across Late Middle Age?". *International journal of environmental research and public health* 19(20):13421.

- Belsky, Daniel W, Avshalom Caspi, David L Corcoran, Karen Sugden, Richie Poulton, Louise Arseneault, Andrea Baccarelli, Kartik Chamarti, Xu Gao and Eilis Hannon. 2022. "Dunedinpace, a DNA Methylation Biomarker of the Pace of Aging." *Elife* 11:e73420.
- Berg, Mark T, Ethan M Rogers, Kendall Riley, Man-Kit Lei and Ronald L Simons. 2022. "Incarceration Exposure and Epigenetic Aging in Neighborhood Context." *Social Science & Medicine* 310:115273.
- Blackburn, Elizabeth H. 2000. "Telomere States and Cell Fates." *Nature* 408(6808):53-56.
- Bor, Jacob, Atheendar S Venkataramani, David R Williams and Alexander C Tsai. 2018. "Police Killings and Their Spillover Effects on the Mental Health of Black Americans: A Population-Based, Quasi-Experimental Study." *The Lancet* 392(10144):302-10.
- Braveman, Paula, Susan Egerter and David R Williams. 2011. "The Social Determinants of Health: Coming of Age." *Annual review of public health* 32(1):381-98.
- Brayne, Sarah. 2014. "Surveillance and System Avoidance: Criminal Justice Contact and Institutional Attachment." *American sociological review* 79(3):367-91.
- Browning, Christopher R, Jake Tarrence, Eric LaPlant, Bethany Boettner, Kammi K Schmeer, Catherine A Calder, Baldwin M Way and Jodi L Ford. 2021. "Exposure to Police-Related Deaths and Physiological Stress among Urban Black Youth." *Psychoneuroendocrinology* 125:104884.
- Brunson, Rod K. 2007. "'Police Don't Like Black People': African-American Young Men's Accumulated Police Experiences." *Criminology & public policy* 6(1):71-101.
- Brunson, Rod K and Ronald Weitzer. 2009. "Police Relations with Black and White Youths in Different Urban Neighborhoods." *Urban Affairs Review* 44(6):858-85.
- Bryant-Davis, Thema, Tyonna Adams, Adriana Alejandre and Anthea A Gray. 2017. "The Trauma Lens of Police Violence against Racial and Ethnic Minorities." *Journal of Social Issues* 73(4):852-71.
- Carbonaro, Richard. 2022. "System Avoidance and Social Isolation: Mechanisms Connecting Police Contact and Deleterious Health Outcomes." *Social Science & Medicine* 301:114883.
- Carter, Sierra E, Mei Ling Ong, Ronald L Simons, Frederick X Gibbons, Man Kit Lei and Steven RH Beach. 2019. "The Effect of Early Discrimination on Accelerated Aging among African Americans." *Health Psychology* 38(11):1010.
- Das, Abhery, Parvati Singh, Anju K Kulkarni and Tim A Bruckner. 2021. "Emergency Department Visits for Depression Following Police Killings of Unarmed African Americans." *Social Science & Medicine* 269:113561.
- Das, Aniruddha. 2022. "Childhood Police Encounters, Social Isolation and Epigenetic Age Acceleration among Older Us Adults." *Social Science & Medicine* 301:114967.
- De Nadal, Eulàlia, Gustav Ammerer and Francesc Posas. 2011. "Controlling Gene Expression in Response to Stress." *Nature Reviews Genetics* 12(12):833-45.
- Dustmann, Christian and Francesco Fasani. 2016. "The Effect of Local Area Crime on Mental Health." *The economic journal* 126(593):978-1017.
- Edwards, Frank, Hedwig Lee and Michael Esposito. 2019. "Risk of Being Killed by Police Use of Force in the United States by Age, Race–Ethnicity, and Sex." *Proceedings of the National Academy of Sciences* 116(34):16793-98.

- Fagan, Jeffrey and Alexis D Campbell. 2020. "Race and Reasonableness in Police Killings." *BUL Rev.* 100:951.
- Finch, Brian Karl, Audrey Beck, D Brian Burghart, Richard Johnson, David Klinger and Kyla Thomas. 2019. "Using Crowd-Sourced Data to Explore Police-Related-Deaths in the United States (2000–2017): The Case of Fatal Encounters." *Open health data* 6:1.
- Fitz-James, Maximilian H and Giacomo Cavalli. 2022. "Molecular Mechanisms of Transgenerational Epigenetic Inheritance." *Nature Reviews Genetics* 23(6):325-41.
- Franks, Peter, Marthe R Gold and Kevin Fiscella. 2003. "Sociodemographics, Self-Rated Health, and Mortality in the Us." *Social Science & Medicine* 56(12):2505-14.
- Galovski, Tara E, Zoë D Peterson, Marin C Beagley, David R Strasshofer, Philip Held and Thomas D Fletcher. 2016. "Exposure to Violence during Ferguson Protests: Mental Health Effects for Law Enforcement and Community Members." *Journal of traumatic stress* 29(4):283-92.
- Gaston, Shytierra, April D Fernandes and Rashaan A DeShay. 2021. "A Macrolevel Study of Police Killings at the Intersection of Race, Ethnicity, and Gender." *Crime & Delinquency* 67(8):1075-102.
- Geier, Timothy J, Sydney C Timmer-Murillo, Amber M Brandolino, Isela Piña, Farah Harb and Terri A deRoos-Cassini. 2024. "History of Racial Discrimination by Police Contributes to Worse Physical and Emotional Quality of Life in Black Americans after Traumatic Injury." *Journal of racial and ethnic health disparities* 11(3):1774-82.
- Geller, Amanda, Jeffrey Fagan, Tom Tyler and Bruce G Link. 2014. "Aggressive Policing and the Mental Health of Young Urban Men." *American journal of public health* 104(12):2321-27.
- Geronimus, Arline T, Margaret Hicken, Danya Keene and John Bound. 2006. "'Weathering' and Age Patterns of Allostatic Load Scores among Blacks and Whites in the United States." *American journal of public health* 96(5):826-33.
- Gross, Neil and Marcus Mann. 2017. "Is There a 'Ferguson Effect?'" Google Searches, Concern About Police Violence, and Crime in Us Cities, 2014–2016." *Socius* 3:2378023117703122.
- Gugushvili, Alexi, Olga Zelinska, Patrick Präg and Grzegorz Bulczak. 2022. "Does Perceived Social Mobility Affect Health? Evidence from a Fixed Effects Approach." *Social Science & Medicine* 294:114705.
- Hadden, Bernadette R, Willie Tolliver, Fabienne Snowden and Robyn Brown-Manning. 2018. "An Authentic Discourse: Recentering Race and Racism as Factors That Contribute to Police Violence against Unarmed Black or African American Men." Pp. 140-53 in *Police and the Unarmed Black Male Crisis*: Routledge.
- Hägg, Sara and Juulia Jylhävä. 2021. "Sex Differences in Biological Aging with a Focus on Human Studies." *Elife* 10:e63425.
- Haile, Rahwa, Tawandra Rowell-Cunsolo, Marie-Fatima Hyacinthe and Sirry Alang. 2023. "'We (Still) Charge Genocide': A Systematic Review and Synthesis of the Direct and Indirect Health Consequences of Police Violence." *Social Science & Medicine*:115784.
- Hannum, Gregory, Justin Guinney, Ling Zhao, Li Zhang, Guy Hughes, Srinivas Sadda, Brandy Klotzle, Marina Bibikova, Jian-Bing Fan and Yuan Gao. 2013. "Genome-Wide

- Methylation Profiles Reveal Quantitative Views of Human Aging Rates." *Molecular cell* 49(2):359-67.
- Harris, Kathleen Mullan and Kristen M Schorpp. 2018. "Integrating Biomarkers in Social Stratification and Health Research." *Annual review of sociology* 44(1):361-86.
- Helms, Ronald and Stephan E Costanza. 2020. "Contextualizing Race: A Conceptual and Empirical Study of Fatal Interactions with Police across Us Counties." *Journal of Ethnicity in Criminal Justice* 18(1):43-71.
- Hillary, Robert F, Anna J Stevenson, Simon R Cox, Daniel L McCartney, Sarah E Harris, Anne Seeboth, Jon Higham, Duncan Sproul, Adele M Taylor and Paul Redmond. 2021. "An Epigenetic Predictor of Death Captures Multi-Modal Measures of Brain Health." *Molecular psychiatry* 26(8):3806-16.
- Himmelstein, Mary S, Danielle M Young, Diana T Sanchez and James S Jackson. 2015. "Vigilance in the Discrimination-Stress Model for Black Americans." *Psychology & health* 30(3):253-67.
- Hirschberger, Gilad, Victor Florian, Mario Mikulincer, Jamie L Goldenberg and Tom Pyszczynski. 2002. "Gender Differences in the Willingness to Engage in Risky Behavior: A Terror Management Perspective." *Death studies* 26(2):117-41.
- Horvath, Steve. 2013. "DNA Methylation Age of Human Tissues and Cell Types." *Genome biology* 14:1-20.
- Horvath, Steve, Michael Gurven, Morgan E Levine, Benjamin C Trumble, Hillard Kaplan, Hooman Allayee, Beate R Ritz, Brian Chen, Ake T Lu and Tammy M Rickabaugh. 2016. "An Epigenetic Clock Analysis of Race/Ethnicity, Sex, and Coronary Heart Disease." *Genome biology* 17:1-23.
- Houseman, Eugene Andres, William P Accomando, Devin C Koestler, Brock C Christensen, Carmen J Marsit, Heather H Nelson, John K Wiencke and Karl T Kelsey. 2012. "DNA Methylation Arrays as Surrogate Measures of Cell Mixture Distribution." *BMC bioinformatics* 13:1-16.
- Idler, Ellen and Kate Cartwright. 2018. "What Do We Rate When We Rate Our Health? Decomposing Age-Related Contributions to Self-Rated Health." *Journal of Health and Social Behavior* 59(1):74-93.
- Jackson, Dylan B, Chantal Fahmy, Michael G Vaughn and Alexander Testa. 2019. "Police Stops among at-Risk Youth: Repercussions for Mental Health." *Journal of Adolescent Health* 65(5):627-32.
- Jackson, Dylan B, Alexander Testa and Cashen M Boccio. 2022. "Police Stops and Adolescent Substance Use: Findings from the United Kingdom Millennium Cohort Study." *Journal of Adolescent Health* 70(2):305-12.
- Jackson, Dylan B, Rebecca L Fix, Alexander Testa, Lindsey Webb, Juan Del Toro and Sirry Alang. 2024. "Cumulative Police Exposures, Police Violence Stress, and Depressive Symptoms: A Focus on Black Lgbq Youth in Baltimore City, Maryland." *Journal of Urban Health* 101(3):544-56.
- Jaenisch, Rudolf and Adrian Bird. 2003. "Epigenetic Regulation of Gene Expression: How the Genome Integrates Intrinsic and Environmental Signals." *Nature genetics* 33(3):245-54.

- Jee-Lyn García, Jennifer and Mienah Zulfacar Sharif. 2015. "Black Lives Matter: A Commentary on Racism and Public Health." *American journal of public health* 105(8):e27-e30.
- Johnson Jr, Odis, Christopher St Vil, Keon L Gilbert, Melody Goodman and Cassandra Arroyo Johnson. 2019. "How Neighborhoods Matter in Fatal Interactions between Police and Men of Color." *Social Science & Medicine* 220:226-35.
- Knox, Dean, Will Lowe and Jonathan Mummolo. 2020. "Administrative Records Mask Racially Biased Policing." *American Political Science Review* 114(3):619-37.
- Koch, Carmen M and Wolfgang Wagner. 2011. "Epigenetic-Aging-Signature to Determine Age in Different Tissues." *Aging (albany NY)* 3(10):1018.
- Kramer, Rory and Brianna Remster. 2018. "Stop, Frisk, and Assault? Racial Disparities in Police Use of Force during Investigatory Stops." *Law & Society Review* 52(4):960-93.
- Krieger, Nancy. 2014. "Discrimination and Health Inequities." *International journal of health services* 44(4):643-710.
- Lei, Man-Kit, Ronald L Simons, Steven RH Beach and Robert A Philibert. 2019. "Neighborhood Disadvantage and Biological Aging: Using Marginal Structural Models to Assess the Link between Neighborhood Census Variables and Epigenetic Aging." *The Journals of Gerontology: Series B* 74(7):e50-e59.
- Lei, Man-Kit, Mark T Berg, Ronald L Simons and Steven RH Beach. 2022. "Neighborhood Structural Disadvantage and Biological Aging in a Sample of Black Middle Age and Young Adults." *Social Science & Medicine* 293:114654.
- Li, Xia, Alexander Ploner, Yunzhang Wang, Patrik KE Magnusson, Chandra Reynolds, Deborah Finkel, Nancy L Pedersen, Juulia Jylhävä and Sara Hägg. 2020. "Longitudinal Trajectories, Correlations and Mortality Associations of Nine Biological Ages across 20-Years Follow-Up." *Elife* 9:e51507.
- Liang, Wenchi, Mona C Shediak-Rizkallah, David D Celentano and Charles Rohde. 1999. "A Population-Based Study of Age and Gender Differences in Patterns of Health-Related Behaviors." *American journal of preventive medicine* 17(1):8-17.
- Lim, Sungju, Dumebi Nzegwu and Michelle L Wright. 2022. "The Impact of Psychosocial Stress from Life Trauma and Racial Discrimination on Epigenetic Aging—a Systematic Review." *Biological Research for Nursing* 24(2):202-15.
- Lopes, Claudia S, Claudia L Moraes, Washington L Junger, Guilherme L Werneck, Antonio C Ponce de Leon and Eduardo Faerstein. 2015. "Direct and Indirect Exposure to Violence and Psychological Distress among Civil Servants in Rio De Janeiro, Brazil: A Prospective Cohort Study." *BMC psychiatry* 15:1-9.
- Lu, Ake T, Austin Quach, James G Wilson, Alex P Reiner, Abraham Aviv, Kenneth Raj, Lifang Hou, Andrea A Baccarelli, Yun Li and James D Stewart. 2019. "DNA Methylation Grimace Strongly Predicts Lifespan and Healthspan." *Aging (albany NY)* 11(2):303.
- Martz, Connor D, Aprile D Benner, Bridget J Goosby, Colter Mitchell and Lauren Gaydosh. 2024. "Structural Racism in Primary Schools and Changes in Epigenetic Age Acceleration among Black and White Youth." *Social Science & Medicine* 347:116724.
- Massey, Douglas S and Nancy A Denton. 1988. "The Dimensions of Residential Segregation." *Social forces* 67(2):281-315.

- McCrory, Cathal, Giovanni Fiorito, Belinda Hernandez, Silvia Polidoro, Aisling M O'Halloran, Ann Hever, Cliona Ni Cheallaigh, Ake T Lu, Steve Horvath and Paolo Vineis. 2021. "Grimage Outperforms Other Epigenetic Clocks in the Prediction of Age-Related Clinical Phenotypes and All-Cause Mortality." *The Journals of Gerontology: Series A* 76(5):741-49.
- McEwen, Bruce S and Eliot Stellar. 1993. "Stress and the Individual: Mechanisms Leading to Disease." *Archives of internal medicine* 153(18):2093-101.
- McFarland, Michael J, John Taylor and Cheryl AS McFarland. 2018. "Weighed down by Discriminatory Policing: Perceived Unfair Treatment and Black-White Disparities in Waist Circumference." *SSM-population health* 5:210-17.
- McFarland, Michael J, John Taylor, Cheryl AS McFarland and Katherine L Friedman. 2018. "Perceived Unfair Treatment by Police, Race, and Telomere Length: A Nashville Community-Based Sample of Black and White Men." *Journal of Health and Social Behavior* 59(4):585-600.
- McFarland, Michael J, Amanda Geller and Cheryl McFarland. 2019. "Police Contact and Health among Urban Adolescents: The Role of Perceived Injustice." *Social Science & Medicine* 238:112487.
- Mesic, Aldina, Lydia Franklin, Alev Cansever, Fiona Potter, Anika Sharma, Anita Knopov and Michael Siegel. 2018. "The Relationship between Structural Racism and Black-White Disparities in Fatal Police Shootings at the State Level." *Journal of the National Medical Association* 110(2):106-16.
- Motley Jr, Robert O, Yu-Chih Chen and Jamie D Motley. 2023. "Prevalence and Correlates of Adverse Mental Health Outcomes among Male and Female Black Emerging Adults with a History of Exposure (Direct Versus Indirect) to Police Use of Force." *Social work research* 47(2):125-34.
- Motley, Robert, Eric Williamson and Camille Quinn. 2024. "Prevalence and Correlates of Exposure (Direct and Indirect) to Perceived Racism-Based Police Violence among Black Emerging Adult College Students." *Social work in public health*:1-12.
- Nakamura, Eitaro and Kenji Miyao. 2008. "Sex Differences in Human Biological Aging." *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences* 63(9):936-44.
- Neil, Roland and Christopher Winship. 2019. "Methodological Challenges and Opportunities in Testing for Racial Discrimination in Policing." *Annual Review of Criminology* 2(1):73-98.
- Paradies, Yin, Jehonathan Ben, Nida Denson, Amanuel Elias, Naomi Priest, Alex Pieterse, Arpana Gupta, Margaret Kelaher and Gilbert Gee. 2015. "Racism as a Determinant of Health: A Systematic Review and Meta-Analysis." *PloS one* 10(9):e0138511.
- Rieker, Patricia P and Chloe E Bird. 2005. "Rethinking Gender Differences in Health: Why We Need to Integrate Social and Biological Perspectives." *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences* 60(Special_Issue_2):S40-S47.
- Robert, Stephanie A. 1999. "Socioeconomic Position and Health: The Independent Contribution of Community Socioeconomic Context." *Annual review of sociology* 25(1):489-516.

- Roh, Sunghoon and Matthew Robinson. 2009. "A Geographic Approach to Racial Profiling: The Microanalysis and Macroanalysis of Racial Disparity in Traffic Stops." *Police quarterly* 12(2):137-69.
- Santamaría-García, Hernando, Sandra Baez, Pablo Reyes, José A Santamaría-García, José M Santacruz-Escudero, Diana Matallana, Analía Arévalo, Mariano Sigman, Adolfo M García and Agustín Ibáñez. 2017. "A Lesion Model of Envy and Schadenfreude: Legal, Deservingness and Moral Dimensions as Revealed by Neurodegeneration." *Brain* 140(12):3357-77.
- Savin, Micah J, Haoyang Wang, Heming Pei, Allison E Aiello, Stephanie Assuras, Avshalom Caspi, Terrie E Moffitt, Peter A Muenning, Calen P Ryan and Baoyi Shi. 2024. "Association of a Pace of Aging Epigenetic Clock with Rate of Cognitive Decline in the Framingham Heart Study Offspring Cohort." *Alzheimer's & Dementia: Diagnosis, Assessment & Disease Monitoring* 16(4):e70038.
- Schwartz, Gabriel L and Jaquelyn L Jahn. 2020. "Mapping Fatal Police Violence across Us Metropolitan Areas: Overall Rates and Racial/Ethnic Inequities, 2013-2017." *PloS one* 15(6):e0229686.
- Sewell, Abigail A and Kevin A Jefferson. 2016. "Collateral Damage: The Health Effects of Invasive Police Encounters in New York City." *Journal of Urban Health* 93(Suppl 1):42-67.
- Sewell, Abigail A. 2017. "The Illness Associations of Police Violence: Differential Relationships by Ethnoracial Composition." Pp. 975-97 in *Sociological Forum*, Vol. 32: Wiley Online Library.
- Sewell, Alyasah Ali, Kevin A Jefferson and Hedwig Lee. 2016. "Living under Surveillance: Gender, Psychological Distress, and Stop-Question-and-Frisk Policing in New York City." *Social Science & Medicine* 159:1-13.
- Sewell, Alyasah Ali, Justin M Feldman, Rashawn Ray, Keon L Gilbert, Kevin A Jefferson and Hedwig Lee. 2021. "Illness Spillovers of Lethal Police Violence: The Significance of Gendered Marginalization." *Ethnic and Racial Studies* 44(7):1089-114.
- Sharara, Fablina, Eve E Wool, Gregory J Bertolacci, Nicole Davis Weaver, Shelley Balassyano and Ismaeel Yunusa Ph D. 2021. "Fatal Police Violence by Race and State in the USA, 1980–2019: A Network Meta-Regression." *The Lancet* 398(10307):P1239.
- Simckes, Maayan, Dale Willits, Michael McFarland, Cheryl McFarland, Ali Rowhani-Rahbar and Anjum Hajat. 2021. "The Adverse Effects of Policing on Population Health: A Conceptual Model." *Social Science & Medicine* 281:114103.
- Simons, Ronald L, Man-Kit Lei, Eric Klopach, Mark Berg, Yue Zhang and Steven SR Beach. 2021a. "(Re) Setting Epigenetic Clocks: An Important Avenue Whereby Social Conditions Become Biologically Embedded across the Life Course." *Journal of Health and Social Behavior* 62(3):436-53.
- Simons, Ronald L, Man-Kit Lei, Eric Klopach, Steven RH Beach, Frederick X Gibbons and Robert A Philibert. 2021b. "The Effects of Social Adversity, Discrimination, and Health Risk Behaviors on the Accelerated Aging of African Americans: Further Support for the Weathering Hypothesis." *Social Science & Medicine* 282:113169.
- Sinyangwe, Samuel, D McKesson and J Elzie. 2021. "Mapping Police Violence Database." *Mapping Police Violence*. Available at <https://mappingpoliceviolence.us>.

- Sosoo, Effua E, Jennifer K MacCormack and Enrique W Neblett Jr. 2022. "Psychophysiological and Affective Reactivity to Vicarious Police Violence." *Psychophysiology* 59(10):e14065.
- Staggers-Hakim, Raja. 2018. "The Nation's Unprotected Children and the Ghost of Mike Brown, or the Impact of National Police Killings on the Health and Social Development of African American Boys." Pp. 67-76 in *Police and the Unarmed Black Male Crisis*: Routledge.
- Talbert, Ryan D. 2023. "Lethal Police Encounters and Cardiovascular Health among Black Americans." *Journal of racial and ethnic health disparities* 10(4):1756-67.
- Triche Jr, Timothy J, Daniel J Weisenberger, David Van Den Berg, Peter W Laird and Kimberly D Siegmund. 2013. "Low-Level Processing of Illumina Infinium DNA Methylation Beadarrays." *Nucleic acids research* 41(7):e90-e90.
- Vitale, Alex S. 2021. *The End of Policing*: Verso Books.
- Williams, David R and Chiquita Collins. 2001. "Racial Residential Segregation: A Fundamental Cause of Racial Disparities in Health." *Public health reports*.
- Williams, David R, Hector M Gonzalez, Harold Neighbors, Randolph Nesse, Jamie M Abelson, Julie Sweetman and James S Jackson. 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." *Archives of general psychiatry* 64(3):305-15.
- Williams, David R and Selina A Mohammed. 2013. "Racism and Health I: Pathways and Scientific Evidence." *American behavioral scientist* 57(8):1152-73.
- Zare, Hossein, Nicholas S Meyerson, Paul Delgado, Michelle Spencer, Darrell J Gaskin and Roland J Thorpe Jr. 2022. "Association between Neighborhood and Racial Composition of Victims on Fatal Police Shooting and Police Violence: An Integrated Review (2000–2022)." *Social Sciences* 11(4):153.
- Zare, Hossein. 2024. "Disparities in Policing from Theory to Practice." Pp. 384-86, Vol. 114: American Public Health Association.
- Zimmerman, Gregory M and Chad Posick. 2016. "Risk Factors for and Behavioral Consequences of Direct Versus Indirect Exposure to Violence." *American journal of public health* 106(1):178-88.

APPENDIX

APPENDIX A. R scripts for calculating neighborhood police brutality

A1. Assign FIPS for each death

```
library(data.table)
library(tidyverse)
library(geosphere)
library(progress)

#Functions
latlong2fips <- function(latitude, longitude) {
  url
  "https://geo.fcc.gov/api/census/block/find?format=json&latitude=%f&longitude=%f&censusYear=2010"
  url <- sprintf(url, latitude, longitude)
  json <- RJSONIO::fromJSON(url)
  as.character(json$Block['FIPS'])
}

#Police Violence
fe <- fread("FATAL ENCOUNTERS.csv", colClasses="character")
fe$`Race with imputations` <- tolower(fe$`Race with imputations`)
fe$`Imputation probability` <- as.numeric(fe$`Imputation probability`)
fe$`Race with imputations` <- ifelse(grepl("black", fe$`Race with imputations`), "Black",
  ifelse(grepl("white", fe$`Race with imputations`), "White",
    ifelse(grepl("islander", fe$`Race with imputations`), "Islander",
      ifelse(grepl("latino", fe$`Race with imputations`), "Latino",
        ifelse(grepl("native", fe$`Race with imputations`), "Native",
```

```

        ifelse(grepl("middle eastern", fe$`Race with
imputations`), "Middle Eastern", NA))))))
fe$`Race with imputations` <- ifelse(!is.na(fe$`Imputation probability`) & (fe$`Imputation
probability` < 0.8), NA, fe$`Race with imputations`)
fe <- fe[!(fe$`Intended use of force (Developing)` %in% c("No", "Suicide", "", "Undetermined")), ]
fe$date <- as.Date(fe$`Date of injury resulting in death (month/day/year)`, format =
"%m/%d/%Y")
fe <- fe[fe$date >= as.Date("2011-01-01") & fe$date < as.Date("2016-01-01"), ]
fe <- fe[(fe$`Armed/Unarmed` %in% c("Unarmed", "Uncertain", "None")), ] # Exclude this line
for calculating all cases
# names(fe)
fe <- fe[, c(1:4, 6, 37, 13, 17, 16)]
fe$Longitude <- as.numeric(fe$Longitude)
fe$Latitude <- as.numeric(fe$Latitude)
fe <- fe[(!is.na(fe$Longitude)) & (!is.na(fe$Latitude)), ]
names(fe) <- c("UniqueID", "name", "age", "gender", "race", "date", "zipcode", "longitude",
"latitude")
####Mapping police violence
mp <- fread("Mapping Police Violence.csv", colClasses="character")
mp$date <- as.Date(mp$date, format = "%m/%d/%Y")
mp <- mp[mp$date >= as.Date("2011-01-01") & mp$date < as.Date("2016-01-01"), ]
mp <- mp[mp$allegedly_armed != "Allegedly Armed", ]
mp <- mp[!(mp$fe_id %in% fe$UniqueID), ] # make sure unique cases
mp <- mp[, c(26, 1:4, 6, 10, 38, 37)]
names(mp) <- c("UniqueID", "name", "age", "gender", "race", "date", "zipcode", "longitude",
"latitude")
mp$longitude <- as.numeric(mp$longitude)
mp$latitude <- as.numeric(mp$latitude)
mp <- mp[(!is.na(mp$longitude)) & (!is.na(mp$latitude)), ]
####Merge
fe <- rbind(fe, mp)
##Decide FIPS

```

```

##Open data
nom_geo <- fe
#remove missing values of lat and lon
nom_geo_miss <- nom_geo[complete.cases(nom_geo[, c('latitude', 'longitude')]), ]
census_block <- list()
num_catch <- rep(NA, nrow(nom_geo_miss))
pb <- progress_bar$new(
  format = 'Processing [:bar] :percent estimation: :eta',
  total = nrow(nom_geo_miss), clear = FALSE, width = 80
)
for (i in 1:nrow(nom_geo_miss)) {
  census_block[[i]] <- latlong2fips(nom_geo_miss$latitude[i], nom_geo_miss$longitude[i])
  pb$tick()
}
datout=data.frame(census_block)
tdatout=data.frame(FIPS=t(datout))
#combined data with FIPS
Data_FIPS = cbind(nom_geo_miss, tdatout)
#Save as spss. file
# write.csv(Data_FIPS, "Results/PV_FIPS_20240821.csv")
fwrite(Data_FIPS, "Results/PV_FIPS.csv", row.names = FALSE, encoding = "UTF-8")

```

A2. Assign

```

library(data.table)
library(tidyverse)
rena <- function(x, y){
  ifelse(is.na(x), y, x)
}
#Read ACS data

```

```

pop <- fread("ACS Population/ACSDP5Y2015.DP05-Data.csv", skip = 1)
pop$countyID <- substr(pop$Geography, regexpr("US", pop$Geography) + 2, regexpr("US",
pop$Geography) + 6)
sum(nchar(pop$countyID) != 5)
dt <- pop[, c("Estimate!!RACE!!Total population",
"Estimate!!RACE!!One race!!White",
"Estimate!!RACE!!One race!!Black or African American",
"countyID")]
names(dt)[1:3] <- c("TotalPop", "Pop_W", "Pop_B")
dt_c <- dt %>% mutate(Pop_WB = Pop_W + Pop_B)
# Read Police violence data - Unarmed
pv <- fread("Results/PV_FIPS.csv", colClasses = "character")
pv$FIPS <- substr(pv$FIPS, 1, 11)
pv$FIPS_c <- substr(pv$FIPS, 1, 5)
pv$race <- ifelse(pv$race %in% c("White", "Black"), pv$race, "Other")
pvd <- pv %>% dplyr::select(countyID = FIPS_c, race) %>% group_by(countyID, race) %>%
summarise(n = n()) %>% pivot_wider(names_from = race, values_from = n, values_fill = 0)
pvd$TotalDeath <- rowSums(pvd[, c(2:4)], na.rm = T)
pvd$TotalDeathWB <- rowSums(pvd[, c(2:3)], na.rm = T)
# Read Police violence data - All Cases
pv <- fread("Results/PV_FIPS_AllCases.csv", colClasses = "character")
pv$FIPS <- substr(pv$FIPS, 1, 11)
pv$FIPS_c <- substr(pv$FIPS, 1, 5)
pv$race <- ifelse(pv$race %in% c("White", "Black"), pv$race, "Other")
pvdA <- pv %>% dplyr::select(countyID = FIPS_c, race) %>% group_by(countyID, race) %>%
summarise(n = n()) %>% pivot_wider(names_from = race, values_from = n, values_fill = 0)
names(pvdA)[2:4] <- paste0(names(pvdA)[2:4], "_AllCases")
pvdA$TotalDeath_AllCases <- rowSums(pvdA[, c(2:4)], na.rm = T)
pvdA$TotalDeathWB_AllCases <- rowSums(pvdA[, c(2:3)], na.rm = T)
# Merge
dt_c <- left_join(dt_c, pvd, by = "countyID")

```

```

dt_c <- left_join(dt_c, pvdA, by = "countyID")

dt_c[, c(6:15)] <- as.data.frame(sapply(dt_c[, c(6:15)], FUN = function(x) rena(x, 0))) # recode
NA to zero

# Create Variables

dt_c <- dt_c %>% mutate(Rate_Black = Black/Pop_B,
                        Rate_White = White/Pop_W,
                        Rate_Other = Other/(TotalPop - Pop_WB),
                        Rate_NW = (Other + Black)/(TotalPop - Pop_W),
                        Rate_Black_AllCases = Black_AllCases/Pop_B,
                        Rate_White_AllCases = White_AllCases/Pop_W,
                        Rate_Other_AllCases = Other_AllCases/(TotalPop - Pop_WB),
                        Rate_NW_AllCases = (Other_AllCases + Black_AllCases)/(TotalPop - Pop_W),
                        Rate_TotalWBO = TotalDeath/TotalPop,
                        Rate_TotalWBO_AllCases = TotalDeath_AllCases/TotalPop)

setDF(dt_c)

fwrite(dt_c, "Results/inequalityIndex_county_sample.csv", row.names = F)

```

APPENDIX B. Alternative Analysis Using Multilevel Linear Regression Model

Table S 1. Multilevel Linear Regression models predicting epigenetic aging for Black young adults (N=449)

Variables	GrimAgeAccel		DunedinPACE	
	Model 1	Model 2	Model 3	Model 4
Police Brutality - Total	3.325* (1.520)		0.154*** (0.043)	
Police Brutality - White people		3.332* (1.609)		0.112* (0.050)
Police Brutality - Black people		-0.009 (0.049)		0.002 (0.001)
Police Brutality - Other		0.245 (0.444)		0.021 (0.013)
Violent Crime Rate	0.106 (0.242)	0.078 (0.245)	0.008 (0.007)	0.007 (0.008)
Segregation	0.068 (0.283)	0.237 (0.280)	-0.009 (0.008)	-0.000 (0.009)
Poverty Rate	0.610* (0.288)	0.670* (0.300)	0.012 (0.008)	0.012 (0.011)
Gender (1 = female)	-1.076*** (0.196)	-1.061*** (0.197)	-0.021*** (0.006)	-0.021*** (0.006)
Education by year	-0.815+ (0.426)	-0.804+ (0.429)	-0.028* (0.012)	-0.029* (0.012)
Weekly Income	-8.996* (3.528)	-9.064* (3.538)	-0.379*** (0.100)	-0.379*** (0.100)
CD4+ T cells	-9.774** (3.769)	-9.586* (3.782)	-0.690*** (0.106)	-0.696*** (0.107)
CD8+ T cells	-12.842+ (6.796)	-12.348+ (6.838)	-0.689*** (0.192)	-0.676*** (0.193)
Natural killer cells	-4.176 (6.047)	-4.685 (6.082)	0.083 (0.171)	0.078 (0.172)
B cells	8.616 (8.390)	8.326 (8.415)	0.253 (0.237)	0.249 (0.237)
Monocytes	0.106 (0.242)	0.078 (0.245)	0.008 (0.007)	0.007 (0.008)
SD (between-group)	0.418	0.426	0.013	0.023
SD (within-group)	4.026	4.035	0.114	0.113
AIC	2522.0	2530.0	-596.2	-572.7
BIC	2579.5	2595.7	-538.7	-507.0
RMSE	3.96	3.96	0.11	0.11
ICC	0.009	0.009	0.010	0.029
N	449	449	449	449

Notes: + p<0.1; * p<0.05; ** p<0.01; *** p<0.001

Table S 2. Multilevel Linear Regression models predicting epigenetic aging for Black young adults, with interaction between race-specific police-related death rate and gender (N = 449)

Variables	GrimAgeAccel			DunedinPACE		
	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
Police Brutality - White people	1.083 (2.576)	3.246* (1.595)	3.062+ (1.618)	0.044 (0.074)	0.100* (0.042)	0.092* (0.042)
Police Brutality - Black people	-0.002 (0.048)	0.156 (0.812)		0.001 (0.001)	0.043+ (0.022)	
Police Brutality - non-White			0.937 (0.961)			0.070** (0.026)
Gender (1 = female)	-2.459*** (0.530)	-2.066*** (0.477)	-1.876*** (0.484)	0.052*** (0.015)	0.076*** (0.013)	0.079*** (0.014)
White people × Gender	2.948 (2.733)			0.092 (0.077)		
Black people × Gender		-0.155 (0.812)			-0.041+ (0.022)	
Non-White people × Gender			-0.958 (0.984)			-0.058* (0.027)
SD (between-group)	0.479	0.477	0.512	0.018	0.000	0.000
SD (within-group)	3.920	3.926	3.919	0.110	0.111	0.110
AIC	2502.8	2506.3	2501.5	-593.9	-592.6	-600.9
BIC	2572.6	2576.2	2571.3	-524.1	-522.7	-531.1
RMSE	3.84	3.85	3.84	0.11	0.11	0.11
ICC	0.012	0.012	0.013	0.018	0.0	0.0
N	449	449	449	449	449	449

Notes: + p<0.1; * p<0.05; ** p<0.01; *** p<0.001

Table S 3. Multilevel Linear Regression models predicting DunedinPACE for Black young adults, with separated sample by male (N = 172) and female (N = 277)

	Male		Female	
Variables	Model 11	Model 12	Model 13	Model 14
Police Brutality - White people	0.009 (0.075)	-0.007 (0.075)	0.150** (0.056)	0.135* (0.056)
Police Brutality - Black people	0.038+ (0.022)		0.001 (0.001)	
Police Brutality - Other	0.014 (0.014)		0.054* (0.024)	
Police Brutality – non-White		0.071** (0.025)		0.009 (0.009)
Violent Crime Rate	0.018+ (0.010)	0.019+ (0.010)	-0.003 (0.010)	-0.007 (0.010)
Segregation	-0.010 (0.010)	-0.011 (0.010)	-0.003 (0.012)	0.004 (0.012)
Poverty Rate	0.009 (0.011)	0.006 (0.011)	0.014 (0.013)	0.012 (0.013)
Education by year	-0.012 (0.007)	-0.013+ (0.007)	-0.041*** (0.008)	-0.038*** (0.008)
Weekly Income	-0.018 (0.012)	-0.018 (0.012)	-0.014 (0.033)	-0.012 (0.033)
CD4+ T cells	-0.422** (0.145)	-0.427** (0.142)	-0.391** (0.136)	-0.369** (0.136)
CD8+ T cells	-0.570*** (0.140)	-0.574*** (0.138)	-0.612*** (0.163)	-0.645*** (0.164)
Natural killer cells	-0.424* (0.214)	-0.421* (0.212)	-0.993* (0.389)	-0.930* (0.391)
B cells	0.472+ (0.248)	0.465+ (0.244)	0.046 (0.222)	0.043 (0.224)
Monocytes	0.244 (0.349)	0.210 (0.344)	0.971** (0.320)	0.915** (0.322)
SD (between-group)	0.000	0.000	0.025	0.025
SD (within-group)	0.105	0.104	0.110	0.111
AIC	-200.6	-212.5	-337.6	-344.2
BIC	-150.2	-165.3	-279.6	-289.8
RMSE	0.10	0.10	0.11	0.11
ICC	0.0	0.0	0.034	0.034
N	172	172	277	277

Notes: + p<0.1; * p<0.05; ** p<0.01; *** p<0.001

Table S 4. Multilevel Linear Regression models predicting epigenetic aging for Black older adults (N = 480)

Variables	GrimAgeAccel		DunedinPACE	
	Model 15	Model 16	Model 17	Model 18
Police Brutality - Total	1.019 (1.678)		0.037 (0.045)	
Police Brutality - White people		-0.428 (1.691)		0.003 (0.048)
Police Brutality - Black people		0.693 (0.602)		0.006 (0.016)
Police Brutality - Other		-0.665 (0.483)		0.001 (0.015)
Violent Crime Rate	0.701* (0.340)	0.506 (0.376)	0.021* (0.009)	0.018+ (0.010)
Segregation	-1.006 (1.695)	-0.279 (1.711)	-0.054 (0.042)	-0.035 (0.047)
Poverty Rate	0.014 (0.036)	0.002 (0.039)	-0.001 (0.001)	-0.001 (0.001)
Gender (1 = female)	3.928*** (0.463)	3.959*** (0.464)	0.014 (0.014)	0.015 (0.014)
Education by year	-0.230* (0.103)	-0.244* (0.104)	-0.003 (0.003)	-0.003 (0.003)
Weekly Household Income	-1.672*** (0.395)	-1.638*** (0.395)	-0.041*** (0.012)	-0.041*** (0.012)
CD4+ T cells	-5.899+ (3.038)	-5.794+ (3.038)	-0.364*** (0.093)	-0.362*** (0.093)
CD8+ T cells	-12.893** (4.100)	-12.914** (4.095)	-0.613*** (0.125)	-0.605*** (0.126)
Natural killer cells	-14.066* (5.450)	-14.256** (5.463)	-0.049 (0.166)	-0.061 (0.168)
B cells	-10.629** (3.708)	-10.498** (3.708)	-0.199+ (0.113)	-0.192+ (0.114)
Monocytes	5.144 (7.438)	5.117 (7.430)	0.199 (0.227)	0.202 (0.228)
SD (between-group)	0.562	0.631	0.000	0.013
SD (within-group)	4.251	4.244	0.130	0.130
AIC	2754.2	2754.5	-503.6	-485.9
BIC	2816.8	2825.5	-441.0	-415.0
RMSE	4.18	4.16	0.13	0.13
ICC	0.013	0.016	0.0	0.008
N	480	480	480	480

Notes: + p<0.1; * p<0.05; ** p<0.01; *** p<0.001

APPENDIX C. Alternative Analysis Using Multilevel Linear Regression Model

Table S 5 T-test for those excluded for missing data and those remaining for analyses (young adult sample)

	Cases used for analysis (n = 449)	With missing values (n = 107)		
	Mean	Mean	<i>t</i>	<i>p</i> -value
Total police brutality	0.177	0.232	0.199	.072
Females	0.617	0.607	0.199	.842
Weekly income	0.357	0.368	-.288	.774
Education by year	12.737	13.673	-5.151	.000
Poverty rate	20.469	17.574	1.610	.108
Segregation	0.350	0.284	1.556	.120
Violent crime rate	1.707	1.823	-.749	.454

Note: Clustered-robust standard errors were used (R “sandwich”: vcovCL and coeftest).

Table S 6 T-test for those excluded for missing data and those remaining for analyses (older adult sample)

	Cases used for analysis (n = 480)	With missing values (n = 18)		
	Mean	Mean	<i>t</i>	<i>p</i> -value
Total police brutality	0.176	0.179	-0.156	0.876
Females	0.735	0.667	0.631	0.529
Household income	0.714	1.095	-1.920	0.055
Education by year	12.943	13.222	-0.429	0.668
Poverty rate	20.955	21.250	-0.153	0.879
Segregation	0.340	0.316	0.948	0.344
Violent crime rate	1.779	1.502	1.247	0.213

Note: Clustered-robust standard errors were used (R “sandwich”: vcovCL and coeftest).

APPENDIX D. Distribution of Police Brutality

Figure S 1 The histogram of overall police brutality in the young adult sample (N=449)

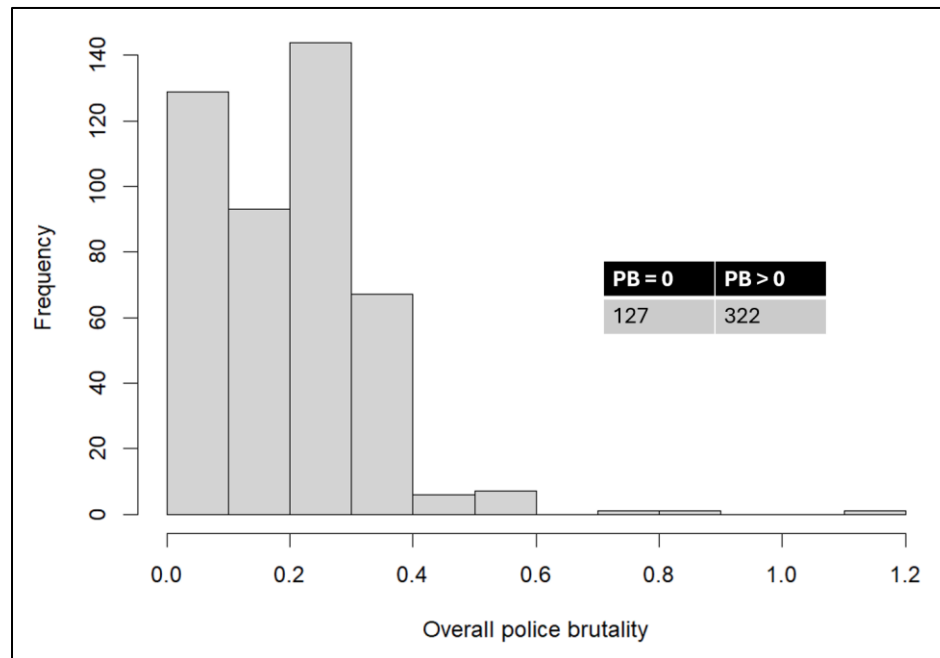


Figure S 2 The histogram of police brutality against Black people in the young adult sample (N=448, an observation was deleted to ease the plotting since it is greater than 80)

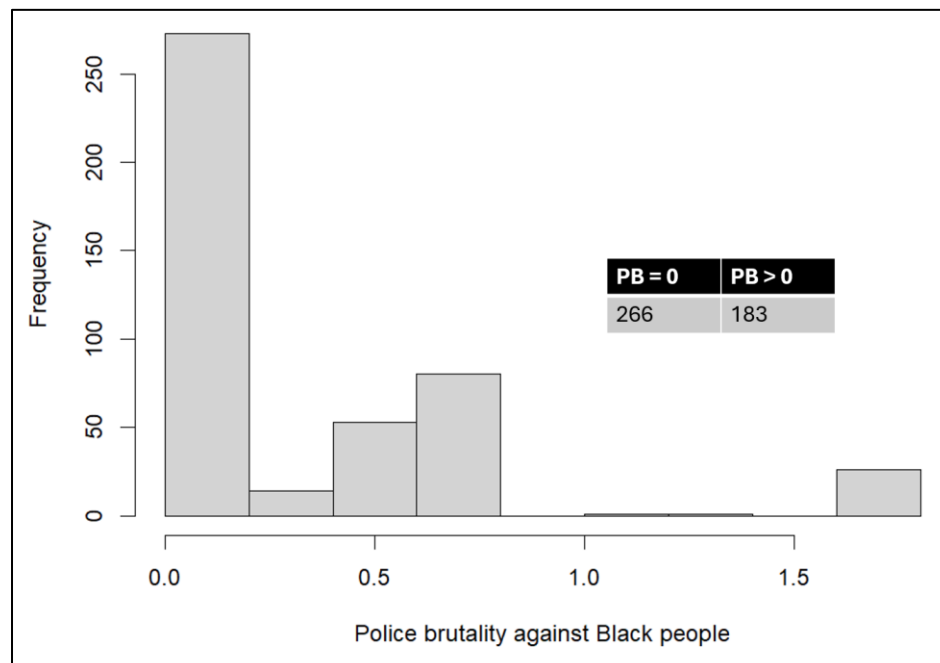


Figure S 3 The histogram of overall police brutality in the older adult sample (N=480)

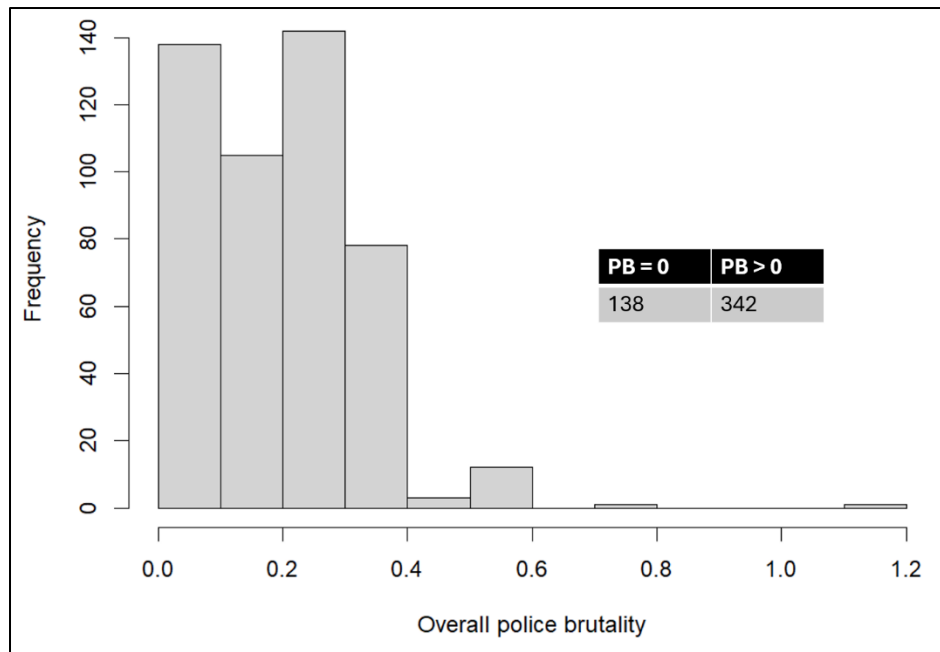


Figure S 4 The histogram of police brutality against Black people in the older adult sample (N=480)

