Crime Exposure, Dementia Incidence, and Racial and Ethnic Disparities Among Middle-Aged and Older Americans[1]

Junjie He[a,b#], Zhuoer Lin[c#], Yan Zhang[d], Yang Wang[e*], Xi Chen[a,b*2]

ABSTRACT

Importance: Crime exposure has been increasingly recognized as a social determinant of health, particularly in relation to cognitive decline. Understanding the association between crime and cognitive function, especially among racial and ethnic minority populations, is essential for addressing health disparities.

Objective: To examine the association between exposure to local crime rates and the incidence of cognitive impairment and dementia, with a focus on racial and ethnic disparities.

Design, Setting, and Participants: This cohort study analyzed data from 34,625 individuals aged 50 years or older (177,238 person-waves) enrolled in the Health and Retirement Study from 1995 to 2016. These data were linked with county-level crime rates obtained from the Uniform Crime Reporting system. Time-varying Cox proportional hazards models were used to assess the association between crime exposure and cognitive outcomes. The analysis adjusted for individual- and census tract-level covariates and stratified results by state and race/ethnicity.

Main Outcomes and Measures: The primary outcome was incident cognitive impairment or dementia, determined by a validated algorithm that incorporated self-reported cognitive test scores and proxy assessments.

Results: Higher exposure to local crime rates was associated with an increased incidence of cognitive impairment and dementia for people aged 50 years or older. The association was stronger for property crimes compared with violent crimes. Racial and ethnic minorities, particularly non-Hispanic Blacks and Hispanics, experienced greater impact on cognitive decline in the context of higher crime exposure than non-Hispanic Whites.

Conclusions and Relevance: The findings suggest that living in areas with higher crime rates, particularly property crimes, is associated with an increased risk of cognitive impairment and dementia. Racial and ethnic disparities in this association underscore the need for public health interventions addressing structural inequities in neighborhood crime exposure to mitigate its impact on cognitive health outcomes.

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[1] Incomplete draft, please do not circulate.

[2] [a] Department of Health Policy and Management, Yale School of Public Health, [b] Department of Economics, Yale University, [c] Division of Health Policy and Administration, School of Public Health, University of Illinois Chicago, [d] Department of Sociology, East Carolina University,[e] La Follette School of Public Affairs, University of Wisconsin–Madison; [#] Joint first authors with equal contribution; [*] Corresponding authors

INTRODUCTION

Exposure to crime, a significant social stressor, has been shown to adversely affect health outcomes (Baranyi et al., 2021). Long-term exposure to crime may worsen cognitive decline and contribute to the development of neurodegenerative conditions, increasing the risks of cognitive impairment and dementia, yet this specific relationship between crime exposure and risks of cognitive impairment and dementia remains underexplored, particularly among middle-aged and older adults. Prior studies examining the association of crime exposure and health risk have mainly focused on neighborhood-level factors, such as deprivation index (Vassilaki et al., 2023), often within specific areas, such as a state or a city (Ruiz et al., 2021). Moreover, research on the violence on middle-aged and older adults has largely centered on situations in which middle-aged and older adults are victims, such as family violence (Cations et al., 2022), with limited evidence considering higher-level, upstream factors, such as local crime rates using nationwide data, and their associations with cognitive health of residents that could be either victims or non-victims. To our knowledge, our study is one of the first to examine the association between exposure to crime among middle-aged and older adults and incidence of dementia and cognitive impairment, with particular attention to racial and ethnic disparities and the heterogeneous associations with various crime types.

Living in areas with high crime rates may introduce chronic stressors such as reduced physical activity (Weber et al., 2012), bad sleep (Hill et al., 2016), and social isolation (Portacolone, et al., 2018) due to feeling unsafe (Rees-Punia, et al., 2018) and having an increased likelihood of experiencing depression and heightened anxiety (Barnett, et al., 2018; Baranyi, et al., 2021). Evidence suggests that chronic exposure to these stressors or stressful life events can accelerate cognitive decline and increase the risk of cognitive impairment and dementia (Rothman & Mattson, 2010; Blondell et al., 2014; Shi, et al., 2018; Zuelsdorff et al., 2020; Franks, et al., 2021; Shen et al., 2022; Luo, et al., 2023). Despite overall declines in national crime rates, people aged 50 and older remain highly vulnerable to crime due to factors such as social isolation (Nicholson, 2012), functional limitations (Paterson & Warburton, 2010), dependence on caregivers, and reduced capacity to cope with stressors (Colón-Emeric, et al., 2013). In minority communities, these vulnerabilities are intensified by structural inequities such as limited access to protective services (Steinman et al., 2023), healthcare (Saadi, et al., 2017; Yearby, 2018), and community resources. As a result, minority middle-aged and older adults may face disproportionate risks, necessitating a thorough investigation.

As the U.S. population continues to age and diversify, particularly in a context that encourages "aging in place" (Buffel et al., 2020), it becomes critical to understand the disproportionate risks faced by middle-aged and older adults. This study aims to fill a significant gap by investigating the association between crime exposure and the incidence of cognitive impairment and dementia, with a particular focus on racial and ethnic disparities and differences across crime types. By linking national crime reports to a nationally representative longitudinal survey of middle-aged and older adults, our analysis captures both the immediate and cumulative effects of crime exposure on cognitive outcomes over time, while also considering differences in vulnerability based on racial and ethnic backgrounds. This research not only provides crucial insights into whether crime exposure may contribute to cognitive decline but also highlights the pressing need

for targeted interventions to address structural inequities that disproportionately affect minority middle-aged and older adults.

METHODS

Data and Sample

Our study sample is from the Health and Retirement Study (HRS), a nationally representative sample of middle-aged and older Americans. We used the HRS restricted data in enclave. Participants were interviewed biennially regarding their cognitive outcomes, overall health, and other relative personal information such as socioeconomic conditions. Participants who were aged 50 years and older and had not yet got dementia at the time of their first interview between 1995 to 2016 were eligible for inclusion in our study. To maintain a larger sample size and minimize selective information loss, we incorporated responses from proxy respondents recognized by HRS for participants who were unable or unwilling to be directly interviewed. The sample was subsequently linked with local crime data from the Uniform Crime Reporting (UCR) system, a nationwide initiative run by the Federal Bureau of Investigation (FBI) that collects and reports crime data from law enforcement agencies across the United States. Our accessible UCR data provided county-by-year counts of eight types of crimes across more than 1000 counties from 1994 to 2016, which defined the scope of our study period. We excluded observations with missing values. Our eventual analytical sample had 177,238 person-waves encompassing 34,625 individuals.

Measures

Crime exposure was measured by using the county-year level crime rates. Our dataset included eight categories of crime: murder, rape, robbery, aggravated assault, burglary, larceny, motor vehicle crime, and arson. The total crime rate, serving as the primary exposure, was calculated by summing these eight categories of crime rates. We also constructed the violent crime rate by aggregating the first four types of crime rates (murder, rape, robbery, and aggravated assault) and constructed the property crime rate by aggregating the latter four (burglary, larceny, motor vehicle crime, and arson), according to the categorization standards set by UCR. We accounted for both the crime rate in the current year and prior year to assess both immediate and cumulative effects, primarily focusing on studying the current year crime exposure. Cognitive outcomes, including cognitive impairment and dementia, were determined using a validated algorithm, the Langa-Weir approach, based on cognitive test scores and proxy assessments. To control for confounding factors, we used both personal characteristics from HRS and local regional characteristics from the National Neighborhood Data Archive (NaNDA). The regional variables were measured at the census-tract level (the most specific level we had), rather than being aggregated to the county level, as more specific regional characteristics were more closely related to the incidence of cognitive impairment and dementia. Moreover, controlling preciser local characteristics could better mitigate the sorting issue that people chose to live in different places according to their personal characteristics.

Statistical Analysis

In our analysis, we used time-varying, weighted Cox proportional hazards models, adjusted for individual- and census tract-level factors and accounted for state and racial and ethnic stratifications. We employed the two stratifications based on our assumption that individuals of different races and ethnicities residing in different regions experienced heterogeneous levels or/and effects from the crime exposure, leading to different baseline risks of getting cognitive impairment and dementia. We considered state-level rather than county-level stratifications, because county-level stratified models exceeded our algorithm's capacity and would have resulted in an excessively large number of stratification groups. The weights were personal weights for the baseline period when the participant entered in our study period with a valid observation, according to the HRS guideline. The standard errors were clustered at the county level, consistent with the level of crime exposure.

RESULTS

Our study covered 34,685 individuals[3], among whom 19,208 were female and 15,417 were male; 23,137 were non-Hispanic White, 6,211 were non-Hispanic Black, 4,026 were Hispanics, and 1,251 were of other races and ethnicities, including Asian, American Indian, Alaska Native, and Pacific Islander, with a mean (SD) 61.05 (9.90) baseline age and 12.61 (3.32) years of education. 9,914 incident cognitive impairment cases and 4,499 incident dementia cases were identified during the follow-up of 13.18 (6.19) years. Compared to those who did not develop cognitive impairment (dementia), participants with incident cognitive impairment (dementia) were more likely to be non-Hispanic Black or Hispanic, have fewer years of education, and live in counties with higher total, violent, and property crime rates. The average (median, IQR) county-level total crime rate during the follow-up was 37.54 (35.22, 39.29) per 1000 residents. Compared to non-Hispanic Whites, non-Hispanic Blacks, Hispanics, and people of other races or ethnicities lived in counties with higher crime exposure.

Associations of Crime Exposure With Cognitive Impairment and Dementia

In our baseline models, we found that higher current-year local crime rates were associated with increased incidence of cognitive impairment (Hazard Ratio 1.29 per IQR; 95% CI, 1.21-1.38) and dementia (Hazard Ratio 1.23 per IQR; 95% CI, 1.14-1.32) (Figure 1). Exposure to higher crime rates showed a larger association with higher incidence of cognitive impairment than with dementia. Property crimes showed stronger associations with worse cognitive outcomes than violent crimes did, especially for cognitive impairment (Cognitive Impairment: Property crime: HR 1.31 per IQR; 95% CI, 1.26-1.39, Violent crime: HR 1.15 per IQR; 95% CI, 1.09-1.21; Dementia: Property crime: HR 1.23 per IQR; 95% CI, 1.14-1.32, Violent crime: HR 1.14 per IQR; 95% CI, 1.08-1.21).

Implementing our models for the prior-year local crime rates, we found similar patterns that higher prior-year local crime rates were associated with increased incidence of cognitive impairment (Hazard Ratio 1.27 per IQR; 95% CI, 1.19-1.36) and dementia (Hazard Ratio 1.22 per IQR; 95% CI, 1.13-1.32). Current-year total crime rates experienced stronger associations

[3] Our data is restricted, so all the numeric results reported here have been blurred.

with incidence of cognitive impairment and dementia than prior-year total crime rates. That difference in associations was more pronounced for violent crime rates. We found similar patterns that exposure to prior-year crime rates

By incorporating interaction terms to test racial and ethnic differences, we observed that non-Hispanic Black, Hispanic, and the other group individuals experienced significantly greater associations between crime exposure and cognitive outcomes compared to non-Hispanic White individuals (Hazard ratios for interaction terms of the local crime rate and racial and ethnic group indicators: Cognitive impairment: Black: HR 1.21 per IQR; 95% CI, 1.06-1.39, Hispanic: HR 1.55 per IQR; 95% CI, 1.22-1.98, Other: HR 1.99 per IQR; 95% CI, 1.47-2.69; Dementia: Black: HR 1.24 per IQR; 95% CI, 1.07-1.43, Hispanic: HR 1.46 per IQR; 95% CI, 1.14-1.87, Other: HR 1.67 per IQR; 95% CI, 1.16-2.40,) (Figure 2).

Implementing our models to the eight specific types of crimes, we found that the higher crime rates for most of the eight specific types of crimes: murder, robbery, aggravated assault, burglary, larceny, motor vehicle crime, and arson, were associated with higher incidence of cognitive impairment and dementia (Cognitive impairment: murder: HR 1.08 per IQR; 95% CI, 1.04-1.12, robbery: HR 1.13 per IQR; 95% CI, 1.07-1.19, aggravated assault: HR 1.16 per IQR; 95% CI, 1.10-1.22, burglary: HR 1.24 per IQR; 95% CI, 1.17-1.32, larceny: HR 1.29 per IQR; 95% CI, 1.20-1.37, motor vehicle crime: HR 1.19 per IQR; 95% CI, 1.12-1.26, arson: HR 1.10 per IQR; 95% CI, 1.07-1.14; Dementia: murder: HR 1.09 per IQR; 95% CI, 1.05-1.13, robbery: HR 1.13 per IQR; 95% CI, 1.07-1.20, aggravated assault: HR 1.14 per IQR; 95% CI, 1.07-1.21, burglary: HR 1.15 per IQR; 95% CI, 1.06-1.24, larceny: HR 1.22 per IQR; 95% CI, 1.14-1.31, motor vehicle crime: HR 1.17 per IQR; 95% CI, 1.09-1.25, arson: HR 1.11 per IQR; 95% CI, 1.08-1.15) (Figure 3). The only exception was rape, whose crime rate did not reveal significant associations with higher incidence of cognitive impairment (HR 0.97 per IQR; 95% CI, 0.92-1.03) and dementia (HR 1.02 per IQR; 95% CI, 0.95-1.09). These results strengthened the robustness of our findings.

In our sensitivity analyses, the associations between higher crime rates and higher incidence of cognitive impairment and dementia remained robust if only including simple covariates (gender, years of education). The results also remained robust after we used alternative ways to substitute the missing values in key independent variables.

DISCUSSION

Our study revealed that higher local crime rates were associated with increased incidence of cognitive impairment and dementia. Our findings generally align with the existing evidence on the association between disadvantaged environments and the incidence of cognitive impairment and dementia. Our study extends the literature by showing the influential role of crime exposure within the environmental exposure. To our knowledge, this is the first study to examine the association between dementia incidence and local crime exposure separately rather than considering a comprehensive index. Possible explanations for this association include crime-related stress and social isolation. Long-time exposure to crime might subject residents to persistent states of heightened stress, which could significantly increase the risk of developing

cognitive impairment and dementia. The reduced frequency of outdoor activities, especially essential social interactions, resulting from safety concerns towards high local crime rates might also elevate residents' risks of getting cognitive impairment and dementia. The reason for a larger association between crime exposure and higher risks of cognitive impairment compared to dementia may lie in the reduced outdoor activities and, therefore, the individual's perception of the crime threats with worsened cognitive impairment, which echo the plausible explanations of the association between crime exposure and cognitive outcomes above. Our findings that both the current-year and last-year crime rates experienced such associations also suggest the possible impacts of crime exposure in both the short term and the long term. These findings suggest the possible health benefits of maintaining social safety.

Moreover, our study revealed the racial and ethnic disparities in such associations that non-Hispanic Black, Hispanic, and other (Asian, American Indian, Alaska Native, and Pacific Islander) individuals experienced significantly greater associations between crime exposure and cognitive outcomes compared to non-Hispanic White individuals. Our findings generally agree with the existing findings of racial and ethnic disparities in environmental exposure. The results of this study can contribute to the literature by suggesting the disparities in crime exposure. Possible explanations include that minority groups may exhibit heightened concern about crime stemming from racial and ethnic inequities, and they may also be disproportionately more exposed to crimes, given their relatively higher probability of being victimized. These results underscore the need for targeted interventions to address structural racial and ethnic inequities in neighborhood crime exposures and their associated cognitive outcomes among middle-aged and older adults, particularly for racial and ethnic minority communities. This intervention need is particularly relevant given that socioeconomic factors may constrain residential mobility options for minority groups, potentially resulting in prolonged exposure to high crime exposure.

Additionally, we found the associations between higher crime rates for most of the eight specific types of crimes and higher incidence of cognitive impairment and dementia. The only exception was rape, for which middle-aged and older people tend to have a lower victimization rate. Property crimes experienced stronger associations with worse cognitive outcomes than violent crimes did, especially for cognitive impairment. A possible explanation is that middle-aged and older Americans could be more susceptible to property crimes, as evidence shows that they are more likely to be victims of property crimes than violent crimes, especially compared to younger adults. These concrete results imply the need for policies targeting property crime reduction since they may provide greater benefits in mitigating risks associated with cognitive health.

Strengths and Limitations

A strength of our study is considering concrete types of crime rates. This concrete analysis examines and compares the different specific types of crimes' associations with cognitive health, which reveals targets for corresponding social safety policy interventions. Another strength is that we adopted a two-way stratified Cox model controlled for a series of confounding variables. This approach ensures our analysis of racial and ethnic differences in crime exposure follows the proportional hazards assumption of Cox models in terms of considering both racial/ethnic and spatial differences in the baseline hazard. A third strength of our study is its use of large-scale, longitudinal data to assess the incidence of dementia and cognitive impairment in this time-

varying survival analysis framework, which allows to examine the associations between both current and prior exposure to crime and current risks of cognitive impairment and dementia.

Our study still has some limitations. First, the measured crime rate in our study is a contextual factor, not a perceived factor. There might be a difference in the actual safety conditions in local areas from residents' perceived safety levels. Second, the specific races of individuals in the other group in our study are unclear, hindering us from developing a deeper analysis. Third, we adopted self-reported measurements of cognitive impairment and dementia, which might have potential misclassification concerns. However, our approach may be able to cover early-stage cognitive decline that may not be clinically diagnosed. Fourth, our findings are not causal since the reverse causality is likely in our studies. Last but not least, this study has not done further analysis of the underlying mechanisms, leaving space for future studies in this field.

Conclusion

Exposure to higher local crime rates is associated with higher risks of cognitive impairment and dementia for middle-aged and older adults, with minority groups experiencing larger associations. Further research is needed to analyze the underlying mechanisms. This deeper consideration of the salience of crime exposure may enrich our understanding of modifiable risk factors for dementia, thereby informing more effective interventions and policies in the face of the fast-growing global burden of this condition.

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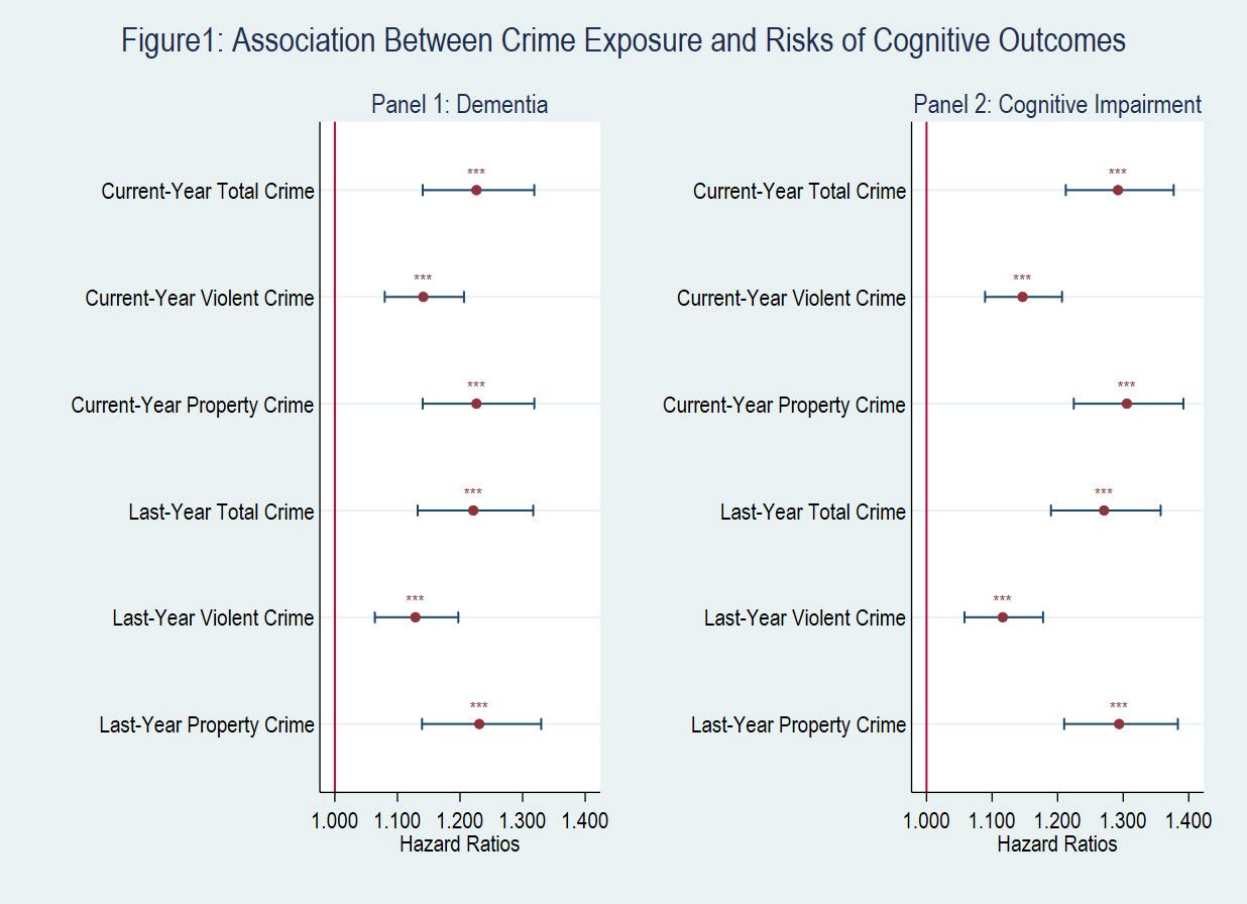
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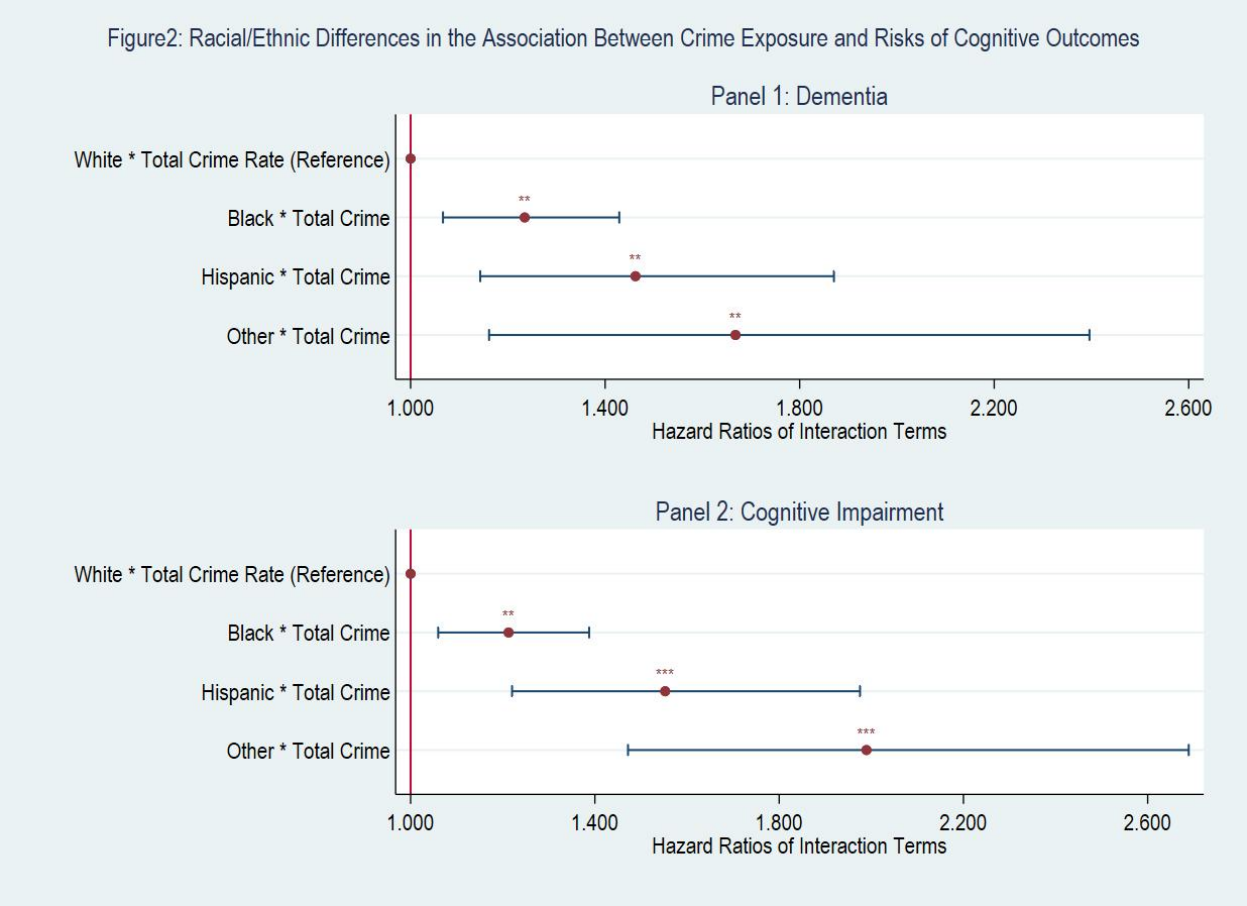
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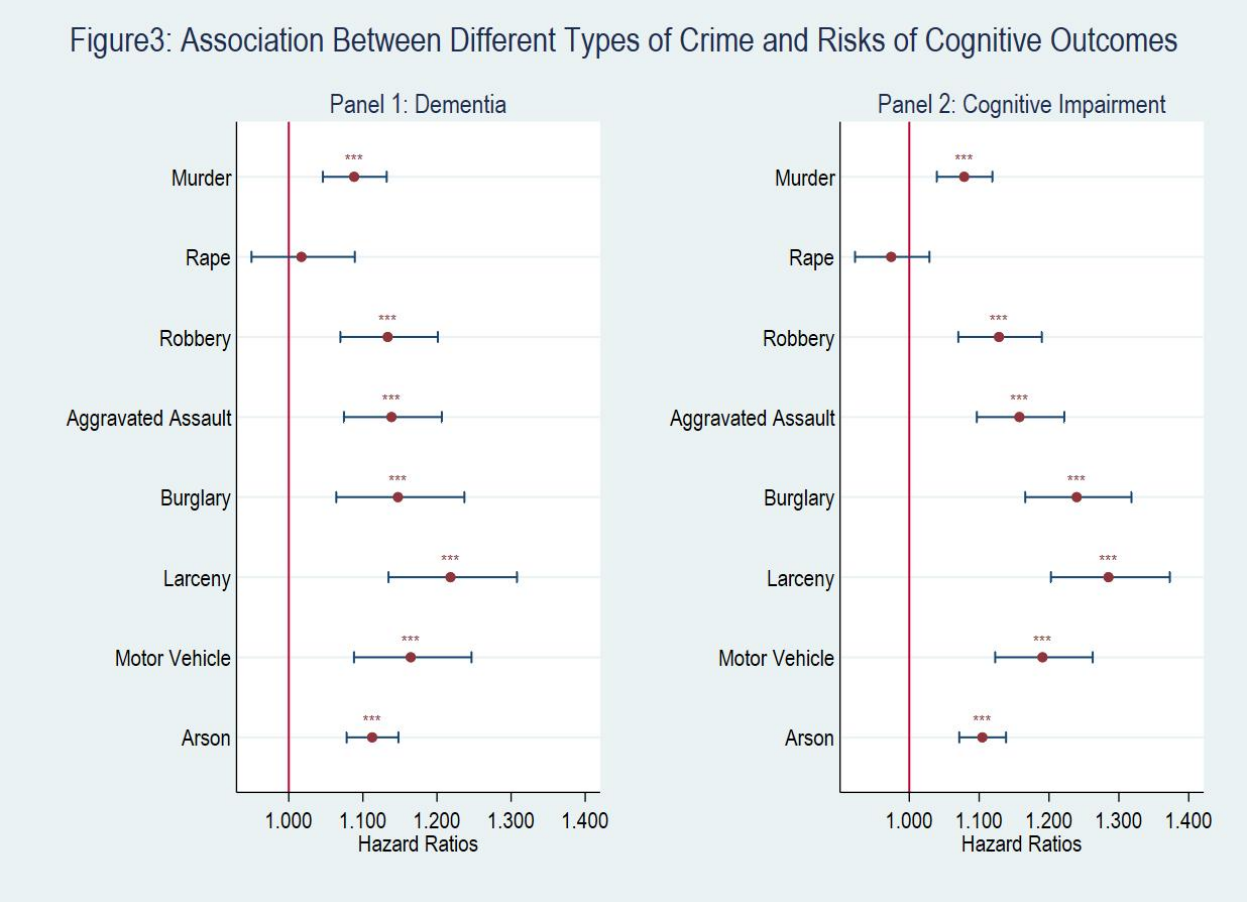
Figures



Note: * p<0.05, ** p<0.01, *** p<0.001. The hazard ratios are standardized as per interquartile range (IQR) of the crime rate. The baseline model is the time-varying, weighted Cox model, stratified by state and racial and ethnic groups and adjusted for a rich set of covariates including demographic characteristics (e.g. sex, age, years of education), health-related variables (e.g. body mass index, indicators of chronic diseases, smoker type, indicators of having public medical insurances), economic status variables (e.g. logged household assets), and census-tract level factors (e.g. unemployment rate, proportion of individuals below the poverty line). The weights are baseline personal weights. The standard errors are clustered at the county level. Our data is restricted, so the numeric results reported in this figure have been blurred, but the pattern remains consistent with its pre-processed form.



Note: * p<0.05, ** p<0.01, *** p<0.001. The model has the same settings and covariates as the baseline model, adding the interaction terms of the local crime rate and indicators of racial and ethnic groups. The hazard ratios are for those interaction terms, standardized as per interquartile range (IQR) of the crime rate. Our data is restricted, so the numeric results reported in this figure have been blurred, but the pattern remains consistent with its pre-processed form.



Note: * p<0.05, ** p<0.01, *** p<0.001. The model has the same settings and covariates as the baseline model, changing the independent variable from the total crime rate to eight concrete types of crime rates. The hazard ratios are standardized as per interquartile range (IQR) of the crime rate. Our data is restricted, so the numeric results reported in this figure have been blurred, but the pattern remains consistent with its pre-processed form.