



# Incarceration And Its Disseminations: COVID-19 Pandemic Lessons From Chicago's Cook County Jail

## Citation

Reinhart, Eric, and Daniel Chen. "Incarceration And Its Disseminations: COVID-19 Pandemic Lessons From Chicago's Cook County Jail." Health Affairs (2020). <https://doi.org/10.1377/hlthaff.2020.00652>

## Permanent link

<http://nrs.harvard.edu/urn-3:HUL.InstRepos:42669496>

## Terms of Use

This article was downloaded from Harvard University's DASH repository, WARNING: No applicable access license found.

## Share Your Story

The Harvard community has made this article openly available.  
Please share how this access benefits you. [Submit a story](#).

[Accessibility](#)

## **Incarceration and Its Disseminations: Pandemic Lessons from Chicago's Cook County Jail**

### Abstract

Jails and prisons are major sites of SARS-CoV-2 infection. Many jurisdictions in the United States have therefore accelerated release of low-risk offenders. Early release, however, does not address how arrest and pre-trial detention practices may be contributing to disease spread. Using data from Cook County Jail, one of the largest known nodes of SARS-CoV-2, we analyze the relationship between jailing practices and community infections at the zip-code level. We find that jail cycling is a significant predictor of SARS-CoV-2 infection, accounting for 55 percent of the variance in case rates across zip codes in Chicago and 37 percent in Illinois. By comparison, jail cycling far exceeds race, poverty, public transit utilization, and population density as a predictor of variance. The data suggest that cycling through Cook County Jail alone is associated with 15.7 percent of all documented SARS-CoV-2 cases in Illinois and 15.9 percent in Chicago as of April 19, 2020. Our findings support arguments for reduced reliance on incarceration and for related justice reforms both as emergency measures during the present pandemic and as sustained structural changes vital for future pandemic preparedness and public health.

## INTRODUCTION

Relative to peer nations, the United States relies disproportionately on arrest and incarceration in its criminal justice administration. In 2018, there were more than 10 million arrests, five million arrests cycled through jails, and two million incarcerated persons in the United States, accounting for nearly a quarter of the total incarcerated population worldwide.<sup>1-3</sup> As a result, many of the country's jails and penitentiaries are severely overcrowded.<sup>4</sup> The current SARS-CoV-2 pandemic presents an urgent public health incentive for reconsidering the logic of punishment and reducing reliance on arrest and incarceration.<sup>5-9</sup> Such a shift would coincide with important political and ethical arguments for reforming policing and carceral policy.<sup>10-12</sup>

Existing conditions in jails and penitentiaries make infection control particularly difficult, putting inmates at unconscionable and perhaps unconstitutional risk.<sup>13</sup> The outbreak at Cook County Jail in Chicago, which was the largest known node of SARS-CoV-2 spread in the country until surpassed by a state prison in Ohio, makes this reality plain.<sup>14-16</sup> In light of the risk of epidemics in densely populated carceral facilities, many jurisdictions have begun releasing certain low-risk offenders in jails and prisons in order to mitigate the risks posed to

inmates with conditions that render them more vulnerable to severe SARS-CoV-2 disease.<sup>17</sup> It is estimated that for approximately 40 percent of incarcerated persons there is no public safety justification for their confinement.<sup>18,19</sup>

Early policy discussions around the infection risk posed by incarceration during the pandemic focused on prison epidemics and the need for associated changes in release policy, such as commutations and compassionate release.<sup>20</sup> These release-oriented approaches, which are necessary for ethical treatment of incarcerated persons, are not adequate to address the way in which ongoing arrest and pre-trial detention practices in jails may be contributing to disease spread in community contexts. This broader discussion goes beyond prison epidemics to consider the consequences of policing practices and jail cycling for SARS-CoV-2 spread. It has more recently begun to attract appropriate attention, including in a non-peer-reviewed modeling study produced by the American Civil Liberties Union in collaboration with several universities, which is based on extensive simulations but little evidence.<sup>21</sup>

Our research evaluates how, following arrest and subsequent cycling in and out of jails as individuals await hearings and trials, the infection risk to those processed through the jail

system may multiply into a generalized risk to the public. The data analysis of empirical evidence in our study offers a supplement to modeling studies, which, in the absence of strong available evidence, necessarily rely on various assumptions about SARS-CoV-2 infectivity in jails and prisons, spread in community contexts following inmate release, rates of symptomatic expression and detection among infected persons, mortality rates, and other estimated variables in order to simulate various scenarios.<sup>22</sup> Our analysis of jail cycling and community spread of SARS-CoV-2 presents preliminary evidence concerning Cook County Jail and the State of Illinois that should be followed by larger studies that can further strengthen the evidentiary basis for modeling and managing an ongoing public health crisis.

#### DATA AND METHODS

The scale of jail-community cycling and its potential for infection seeding is significant: for example, in the month of March 2020, 1,855 individuals were booked into Cook County Jail in Chicago while 2,129 were released, 92 percent of whom had been booked into the jail after February 1, 2020. We examine this epidemiological connection between jail and community at the zip-code level, using booking, release, and SARS-CoV-2 data obtained from Cook County Jail, demographic data from the 2010

US Census and 2011 American Community Survey (the most recent years for which zip-code level data are available), and SARS-CoV-2 data reported by the Illinois Department of Public Health. To evaluate the relative strength of the correlation between Cook County Jail cycling and SARS-CoV-2 spread in the city of Chicago and the State of Illinois, we ran bivariate and multivariate regressions between the SARS-CoV-2 case rate and five variables by zip code: jail inmates released in March, proportion of black residents, poverty rate, public transit utilization rate, and population density.

#### LIMITATIONS

Our analysis necessarily relies on the assumption that arrests and releases are unrelated to omitted factors that may be associated with SARS-CoV-2 across zip codes. We therefore cannot rule out reverse causality. However, other likely causal factors of SARS-CoV-2 case rates are plausibly associated with the other demographic controls we have used, which we found did not account for the correlation we observe between jail cycling and SARS-CoV-2.

In terms of generalizability, we have used data only from Illinois and a single county jail—Cook County Jail, the nation's largest single-site jail and third largest jail system. Cook

County is the second most populous county in the US, which makes its activities relevant even if they are not representative of smaller counties. The association we document in Chicago and statewide in Illinois does not appear driven by outliers, which alleviates possible concerns that sampling factors are driving the correlations we report. As we have noted, these correlations persist in analysis of the raw data and in multiple regressions that include controls.

Minimal data concerning jail staff is another limitation. According to data we obtained from Cook County Sheriff's Office, there were more than 600 infections within the jail as of April 19; more than 100 of these were among jail staff. These infections among staff are accounted for within institutional reporting but not included in our community-level SARS-CoV-2 data. However, one might expect that jail staff who go in and out of the jail on a daily basis would have unusually high potential for seeding SARS-CoV-2 in their communities. Unfortunately, we do not have zip-code level data on the place of residence of jail staff that would enable us to account for their potential role in community spread. If we had been able to account for staff-associated community spread of SARS-CoV-2 in our analysis, we expect that the association between Cook County

Jail and community infection rates would be even greater than we have been able to demonstrate with available data.

## RESULTS

Exhibit 1 provides details on the above variables for zip codes in both Chicago and statewide in Illinois (limiting to zip codes with at least 5 cases of SARS-CoV-2 as of April 19), along with summary statistics. It shows that, in comparison with the rest of Illinois, Chicago zip codes are poorer, use public transit more, and have a higher proportion of black residents and higher population density.

Bivariate correlations between SARS-CoV-2 case rates and five variables are given in Exhibit 2. This shows that, restricting to the city of Chicago, released jail inmates, poverty, and black residents were significantly positively correlated with SARS-CoV-2 case rate, with R-sq values of 0.55, 0.26, and 0.41, respectively. Statewide in Illinois, all variables were significantly positively correlated with SARS-CoV-2, with R-sq values of 0.37 (released jail inmates), 0.09 (poverty), 0.26 (public transit utilization), 0.30 (black residents), and 0.21 (population density).



In multivariate linear regression restricted to Chicago, the significant positive associations with race and poverty disappear while released inmates remains significant at the 1 percent level (Exhibit 3). See Exhibit 4 for a scatter plot of this relationship and Appendix Exhibit 1 for scatter plots of all the other relationships.<sup>23</sup> In multivariate regression for Illinois, positive associations with released inmates, race, and population density remain significant at the 1 percent level. Exhibit 3 provides the regression coefficients. Rendered in absolute population terms (as in the lower half of Exhibit 3), multivariate regressions suggest that the cycling of 2,129 individuals through Cook County Jail in March was associated with 4,575 additional known community infections in Illinois as of April 19. We have arrived at this number by multiplying the number of released inmates by the regression coefficient (2.149). In Chicago zip codes, the number of released inmates (1,252) multiplied by the regression coefficient (1.548) suggests 1,938 additional Chicago cases were associated with the jail.

These numbers would represent 15.7 percent of all documented cases in Illinois and 15.9 percent in Chicago as of April 19, suggesting that a much higher number of cases is linked to the jail than limited contact tracing has established.<sup>7</sup> Our results

are robust to the inclusion of all Illinois zip codes with fewer than 5 reported SARS-CoV-2 community infections (the limited number required by Illinois Department of Public Health in order for them to report cases by zip code) by assigning them a value of zero infections. See Appendix Exhibit 2 for this analysis and Appendix Exhibits 3 and 4 for additional models and specifications.<sup>23</sup>

## CONCLUSIONS AND DISCUSSION

This analysis shows that, as of April 19, SARS-CoV-2 case rates were significantly higher in zip codes with higher rates of arrest and released jail inmates. We find that jail cycling is a significant predictor of SARS-CoV-2 infection, accounting for 55 percent of the variance in case rates across zip codes in Chicago and 37 percent in Illinois. By comparison, jail cycling far exceeds race, poverty, public transit utilization, and population density as predictor of variance.

Although currently available data are inadequate to establish a clear causal relation, these provisional findings are consistent with the hypothesis that arrest and jailing practices are augmenting infection rates in highly policed neighborhoods. Although we cannot infer causality, it is possible that, as arrested individuals are exposed to high-risk spaces for

infection in jails and then later released to their communities, the criminal justice system is turning them into potential disease vectors for their families, neighbors, and, ultimately, the general public. In light of the well-documented, disproportionate intensity of policing and incarceration in black neighborhoods in the United States, the carceral-community spread of disease may bear partial responsibility for the striking racial disparities noted in SARS-CoV-2 cases.<sup>12</sup> In Chicago, although black residents comprise only 30 percent of the population, they represent 75 percent of the Cook County Jail population and 72 percent of the city's SARS-CoV-2-related deaths.<sup>24</sup>

Our findings reinforce arguments that efforts to shift criminal justice administration away from arrest and incarceration may be vital for protecting the public health during this pandemic and reducing vulnerability to future epidemics.<sup>5-9,19</sup> Waiting until epidemic outbreaks become apparent to implement changes in the criminal justice system, as in the present case, is not sufficient and will not protect against a reprise of the current situation. The SARS-CoV-2 pandemic is making clear that alternative mechanisms of criminal deterrence such as citations, public service requirements, and supervised release are not simply ethical demands but also sound public health policy in a

globalized era of vulnerability to rapid spread of infectious diseases.<sup>25</sup>

The criminal justice system in the United States is just one among many existing social structures that are being subjected to renewed scrutiny during the SARS-CoV-2 pandemic because of the public health hazards they pose. Pandemic reality has brought us to an unprecedented collective realization of national and global interconnectedness in which the risks of vulnerability to disease for America's incarcerated and the world's poor, for example, threaten all of us, although clearly not equally.<sup>26-29</sup>

## References

- 1 Wagner P, Sawyer W. States of Incarceration: The Global Context 2018. Prison Policy Initiative. Jun 2018.  
<https://www.prisonpolicy.org/global/2018.html> (accessed April 19, 2020)
- 2 Heard, C. Towards A Health-Informed Approach to Penal Reform: Evidence from Ten Countries. Institute for Criminal Policy Research. Jun 2018.  
[https://www.prisonstudies.org/sites/default/files/resources/downloads/icpr\\_prison\\_health\\_report.pdf](https://www.prisonstudies.org/sites/default/files/resources/downloads/icpr_prison_health_report.pdf) (accessed on April 19, 2020)
- 3 Crime in the United States, 2018. Federal Bureau of Investigation. <https://ucr.fbi.gov/crime-in-the-u.s/2018/crime-in-the-u.s.-2018> (accessed on April 19, 2020)
- 4 Overcrowding and Overuse of Imprisonment in the United States. American Civil Liberties Union Submission to the Office of the High Commissioner for Human Rights. May 2015.  
<https://www.ohchr.org/Documents/Issues/RuleOfLaw/OverIncarceration/ACLU.pdf> (accessed on April 19, 2020)
- 5 Wurcel AG, et al. Spotlight on Jails: COVID-19 Mitigation Policies Needed Now. Clinical Infectious Diseases. Published online March 28, 2020. <https://doi.org/10.1093/cid/ciaa346> (accessed on May 8, 2020)

- 6     Hawks L, Woolhandler S, and McCormick D. COVID-19 in Prisons and Jails in the United States JAMA Intern Med. Published online April 28, 2020.  
doi:10.1001/jamainternmed.2020.1856 (accessed on April 29, 2020)
- 7     Akiyama MJ, Spaulding AC, Rich JD. Flattening the Curve for Incarcerated Populations – Covid-19 in Jails and Prisons. Published online April 2, 2020  
DOI: 10.1056/NEJMp2005687 (accessed on April 29, 2020)
- 8     Nowotny K, Zinzi B, Omori M, Brinkley-Rubinstein L. COVID-19 Exposes Need for Progressive Criminal Justice Reform. American Journal of Public Health. Published online April 30, 2020. <https://doi.org/10.2105/AJPH.2020.305707> (accessed on May 8, 2020)
- 9     Barnert E, Ahalt C, Williams B. Prisons: Amplifiers of the COVID-19 Pandemic Hiding in Plain Sight. American Journal of Public Health. Published online May 14, 2020. <https://doi.org/10.2105/AJPH.2020.305713> (accessed on May 21, 2020)
- 10    Roberts DE. Foreword: Abolition Constitutionalism. Harvard Law Rev. 2019 Nov;133(1):3-122. [https://harvardlawreview.org/wp-content/uploads/2019/11/1-122\\_Online.pdf](https://harvardlawreview.org/wp-content/uploads/2019/11/1-122_Online.pdf) (accessed on April 19, 2020)

11 Gilmore, RW. *Golden Gulag: Prisons, Surplus, Crisis, and Opposition in Globalizing California*. Berkeley: University of California Press, 2007.

12 Western B, et al. On Mass Incarceration. *Daedalus* Summer 2010.

[https://www.amacad.org/sites/default/files/daedalus/downloads/10\\_summer\\_western.pdf](https://www.amacad.org/sites/default/files/daedalus/downloads/10_summer_western.pdf) (accessed on April 19, 2020)

13 Wallace M, Hagan L, Curran KG, et al. COVID-19 in Correctional and Detention Facilities – United States, February–April 2020. *Morb Mortal Wkly Rep*. Published online May 6, 2020. DOI: <http://dx.doi.org/10.15585/mmwr.mm6919e1> (accessed on May 9, 2020)

14 Cook County Sheriff Press Release April 19, 2020. COVID-19 Cases at CCDOC. <https://www.cookcountysheriff.org/covid-19-cases-at-ccdocr/> (accessed on April 19, 2020)

15 Ohio Department of Rehabilitation & Correction. COVID-19 Inmates Testing. April 20, 2020. Available from: [https://www.drc.ohio.gov/Portals/0/DRC%20COVID-19%20Information%2004-20-2020%20%201304\\_1.pdf](https://www.drc.ohio.gov/Portals/0/DRC%20COVID-19%20Information%2004-20-2020%20%201304_1.pdf) (accessed on April 21, 2020)

16 Rojas R, Cooper M. Georgia, Tennessee and South Carolina Say Businesses Can Reopen Soon. *The New York Times*. April 20, 2020 [updated April 21, 2020].

<https://www.nytimes.com/2020/04/20/us/coronavirus-us-hot-spots->

[reopening.html?searchResultPosition=1](#) (accessed on April 21, 2020)

17 Williams T, Weisel B, Rashbaum WK. 'Jails Are Petri Dishes': Inmates Freed as the Virus Spreads Behind Bars. *The New York Times*. March 30, 2020 [updated March 31, 2020].

<https://www.nytimes.com/2020/03/30/us/coronavirus-prisons-jails.html?searchResultPosition=2> (accessed on April 21, 2020)

18 Austin J and Eisen L-B. How Many Americans Are Unnecessarily Incarcerated? Brennan Center for Justice. 2016.

[https://www.brennancenter.org/sites/default/files/2019-08/Report\\_Unnecessarily\\_Incarcerated\\_0.pdf](https://www.brennancenter.org/sites/default/files/2019-08/Report_Unnecessarily_Incarcerated_0.pdf) (accessed on April 23, 2020)

19 Margulies J. Let the People Go. *Boston Review*. April 20, 2020. <http://bostonreview.net/law-justice/joseph-margulies-prisons-and-pandemics> (accessed April 24, 2020)

20 Editorial Board. No One Deserves to Die of Covid-19 in Jail. *The New York Times*. April 23, 2020.

<https://www.nytimes.com/2020/04/23/opinion/coronavirus-prisons.html> (accessed on April 23, 2020)

21 ACLU. COVID-19 Model Finds Nearly 100,000 More Deaths Than Current Estimates, Due to Failures to Reduce Jails. April 22, 2020.

[https://www.aclu.org/sites/default/files/field\\_document/aclu\\_covid19-jail-report\\_2020-8\\_1.pdf](https://www.aclu.org/sites/default/files/field_document/aclu_covid19-jail-report_2020-8_1.pdf) (accessed on April 20, 2020)



22 Fuller J. Models v. Evidence. *Boston Review*. May 5, 2020.  
<http://bostonreview.net/science-nature/jonathan-fuller-models-v-evidence> (accessed on May 6, 2020)

23 To access the Appendix, click on the Appendix link in the box to the right of the article online.

24 Foody K. Rate of Deaths, Illness Among Black Residents Alarms Cities. Associated Press News. April 6, 2020.  
<https://apnews.com/1862bf401d6aad1d182e0bd967488c90> (accessed on April 19, 2020)

25 Kahan DM. What Do Alternative Sanctions Mean? *Univ of Chicago Law Rev* 1996;63:591-653. [last revised April 16, 2013].  
[https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=1286855](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1286855) (accessed on April 19, 2020)

26 Stafford K, Hoyer M, Morrison, A. Outcry Over Racial Data Grows as Virus Slams Black Americans. Associated Press News. April 8, 2020.  
<https://apnews.com/71d952faad4a2a5d14441534f7230c7c> (accessed on April 19, 2020)

27 Yancy CW. COVID-19 and African Americans. *JAMA* 2020;232(19):1891-1892.

28 Gordon C, Johnson W, Purnell JQ, Rogers J. COVID-19 and the Color Line. *The Boston Review*. May 1, 2020.  
<http://bostonreview.net/race/colin-gordon-walter-johnson-jason->

[q-purnell-jamala-rogers-covid-19-and-color-line](#) (accessed on May 2, 2020)

29 Gross CP, Essien UR, Pasha S, Gross JR, Wang S, Nunez-Smith M. Racial and Ethnic Disparities in Population Level Covid-19 Mortality. Published online at medRxiv on May 7, 2020.

<https://doi.org/10.1101/2020.05.07.20094250> (accessed on May 21, 2020)

## Exhibit List:

### Exhibit 1 (table)

Caption: Summary Statistics

Source/Notes: SOURCE Authors' analysis of data from Cook County Jail, Illinois Department of Public Health, 2010 US Census, and 2011 American Community Survey. NOTES Sample is restricted to zip codes with 5 or more SARS-CoV-2 cases as of April 19, 2020 (the minimum requirement set by the Illinois Department of Public Health for reporting by zip code).

### Exhibit 2 (table)

Caption: Estimated relationships between SARS-CoV-2 cases per capita, number of inmates released, and other variables from bivariate regression analysis

Source/Notes: SOURCE Authors' analysis of data from Cook County Jail, Illinois Department of Public Health, 2010 US Census, and 2011 American Community Survey. NOTES Sample is restricted to zip codes with 5 or more SARS-CoV-2 cases as of April 19, 2020 (the minimum requirement set by the Illinois Department of Public Health for reporting by zip code).

### Exhibit 3 (table)

Caption: Estimated relationships between SARS-CoV-2 cases per capita, number of inmates released, and other variables from multivariate regression analysis

Source/Notes: SOURCE Authors' analysis of data from Cook County Jail, Illinois Department of Public Health, 2010 US Census, and 2011 American Community Survey. NOTES Sample is restricted to zip codes with 5 or more SARS-CoV-2 cases as of April 19, 2020 (the minimum requirement set by the Illinois Department of Public Health for reporting by zip code).

\*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ , \*\*\*\*  $p < 0.001$

### Exhibit 4 (figure)

Caption: Scatterplot Analysis of SARS-CoV-2 Cases in Chicago

Source/Notes: SOURCE Authors' analysis of data from Cook County Jail, Illinois Department of Public Health, 2010 US Census, and 2011 American Community Survey. NOTES This scatter represents a relationship between SARS-CoV-2 cases per capita and Inmates released in March per capita after residualizing on poverty rate, public transit utilization rate, percent black population, and population density. Sample is restricted to zip codes with 5 or more SARS-CoV-2 cases as of April 19, 2020 (the reporting

requirement by the Illinois Department of Public Health for reporting by zip code).

**Exhibit 1:** Summary Statistics

	Chicago (n = 50)		Illinois (n = 355)	
	Mean	Standard Deviation	Mean	Standard Deviation
SARS-CoV-2 cases per capita	0.005	0.002	0.003	0.002
Inmates released in March per capita	0.001	0.001	0.0001	0.0003
Poverty rate	0.242	0.159	0.117	0.116
Public transit utilization rate	0.251	0.098	0.079	0.090
% Black population	0.360	0.357	0.145	0.243
Population density	15433	8016	4276	5895
Population	52545	24304	27815	18818

Source: Authors' analysis of data from Cook County Jail, Illinois Department of Public Health, 2010 US Census, and 2011 American Community Survey.

Notes: Sample is restricted to zip codes with 5 or more SARS-CoV-2 cases as of April 19, 2020 (the minimum requirement set by the Illinois Department of Public Health for reporting by zip code).

**Exhibit 2:** Estimated relationships between SARS-CoV-2 cases per capita, number of inmates released, and other variables from bivariate regression analysis

Sample: Chicago

Independent variable	Parameter estimate	p value	R-sq
Inmates released in March per capita	2.207	<0.001	0.551
Poverty rate	0.00551	<0.001	0.261
Public transit utilization rate	0.00139	>0.1	0.006
% Black population	0.00307	<0.001	0.406
Population density	0.0000000403	>0.1	0.035

Sample: Illinois

Inmates released in March per capita	4.065	<0.001	0.367
Poverty rate	0.00518	<0.001	0.094
Public transit utilization rate	0.0110	<0.001	0.256
% Black population	0.00442	<0.001	0.301
Population density	0.000000152	<0.001	0.209

Source: Authors' analysis of data from Cook County Jail, Illinois Department of Public Health, 2010 US Census, and 2011 American Community Survey.

Notes: Sample is restricted to zip codes with 5 or more SARS-CoV-2 cases as of April 19, 2020 (the minimum requirement set by the Illinois Department of Public Health for reporting by zip code).

**Exhibit 3:** Estimated relationships between SARS-CoV-2 cases per capita, number of inmates released, and other variables from multivariate regression analysis

Independent variables	Chicago	Illinois
	Coefficients for SARS-CoV-2 cases/population	
Inmates released in March per capita	1.874****	2.398****
Poverty rate	0.000153	-0.00561****
Public transit utilization rate	-0.00527	-0.00191
% Black population	0.00131	0.00398****
Population density	0.000000027	0.000000122****
R-sq	0.601	0.508
	Coefficients for SARS-CoV-2 cases	
Inmates released in March	1.548**	2.149****
Poverty population	-0.000596	-0.000536
Public transit utilization population	-0.00648***	-0.00168
Black population	0.00179**	0.00195****
Population density	0.00223	0.00395****
Population	0.00452****	0.00263****
R-sq	0.847	0.791

Source: Authors' analysis of data from Cook County Jail, Illinois Department of Public Health, 2010 US Census, and 2011 American Community Survey.

Notes: Sample is restricted to zip codes with 5 or more SARS-CoV-2 cases as of April 19, 2020 (the minimum requirement set by

the Illinois Department of Public Health for reporting by zip code).

\*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ , \*\*\*\*  $p < 0.001$