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RESEARCH LETTER

Changes in renal failure mortality during the COVID-19 pandemic in the United States

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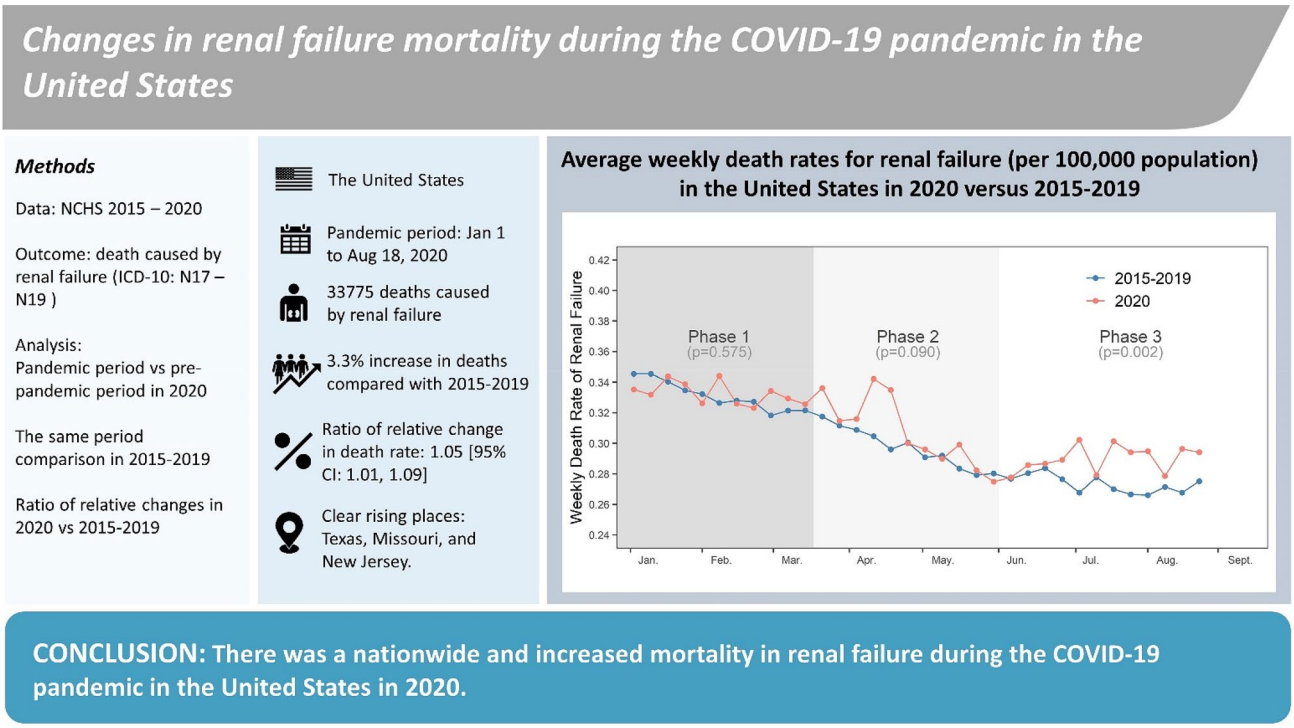
Graphic abstract



Emerging evidence has shown that the coronavirus disease 2019 (COVID-19) pandemic has brought substantial deaths not only among individuals with SARS-CoV-2 infections, but also among those free of infection but suffering from chronic conditions, such as cardiovascular disease [1] and diabetes [2]. The COVID-19 pandemic might challenge patients with renal failure to access routine dialysis services or kidney transplantation [3], resulting in an unexpected increase in renal failure deaths; however, to date, the excess deaths associated with the pandemic have not yet been examined. Accordingly, we aimed to investigate the changes in the mortality risk of renal failure during the COVID-19 pandemic across the US.

We obtained the weekly death counts by jurisdictions from the US National Center for Health Statistics between January 1, 2015 and August 18, 2020 [4]. Deaths from renal

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Table 1 Change in death rates in renal failure associated with the COVID-19 pandemic in the United States over the pandemic period

Jurisdiction	Relative change in death rate in 2015-2019[a] (03/19–08/19 vs. 01/01–03/18) (95% CI)	Relative change in death rate in 2020[b] (03/18–08/18 vs. 01/01–03/17) (95% CI)	Ratio of relative changes in death rates in 2020 vs. 2015-2019[c] (95% CI)
United States	0.86 (0.84, 0.87)	0.90 (0.87, 0.93)	1.05 (1.01, 1.09)
Alabama	0.81 (0.76, 0.87)	0.90 (0.79, 1.03)	1.11 (0.96, 1.29)
Arizona	0.92 (0.84, 1.01)	0.94 (0.79, 1.11)	1.01 (0.83, 1.23)
Arkansas	0.85 (0.80, 0.91)	0.93 (0.76, 1.12)	1.09 (0.89, 1.33)
California	0.83 (0.80, 0.86)	0.84 (0.76, 0.92)	1.02 (0.92, 1.13)
Colorado	0.93 (0.86, 1.00)	0.91 (0.76, 1.09)	0.98 (0.81, 1.20)
Connecticut	0.99 (0.91, 1.08)	1.11 (0.87, 1.40)	1.11 (0.87, 1.43)
Florida	0.84 (0.80, 0.88)	0.83 (0.77, 0.91)	0.99 (0.90, 1.09)
Georgia	0.88 (0.83, 0.93)	1.00 (0.88, 1.14)	1.14 (0.99, 1.31)
Illinois	0.89 (0.85, 0.94)	0.87 (0.77, 0.98)	0.97 (0.85, 1.10)
Indiana	0.84 (0.78, 0.89)	0.82 (0.72, 0.93)	0.98 (0.85, 1.13)
Kentucky	0.87 (0.81, 0.93)	0.88 (0.75, 1.03)	1.02 (0.86, 1.21)
Louisiana	0.88 (0.81, 0.94)	0.95 (0.80, 1.13)	1.09 (0.90, 1.31)
Maryland	0.90 (0.84, 0.96)	0.96 (0.82, 1.12)	1.07 (0.91, 1.27)
Massachusetts	0.84 (0.79, 0.91)	0.75 (0.65, 0.86)	0.89 (0.76, 1.04)
Michigan	0.84 (0.80, 0.89)	0.83 (0.74, 0.92)	0.99 (0.88, 1.11)
Minnesota	0.92 (0.85, 1.01)	0.93 (0.77, 1.13)	1.01 (0.81, 1.24)
Mississippi	0.95 (0.89, 1.02)	0.95 (0.82, 1.11)	1.00 (0.85, 1.18)
Missouri	0.80 (0.75, 0.86)	0.95 (0.82, 1.10)	1.18 (1.00, 1.38)
New Jersey	0.82 (0.78, 0.87)	1.00 (0.83, 1.19)	1.21 (1.00, 1.46)
New York	0.97 (0.90, 1.04)	1.20 (0.87, 1.65)	1.23 (0.89, 1.71)
New York City	0.84 (0.80, 0.89)	0.86 (0.75, 0.97)	1.01 (0.88, 1.17)
North Carolina	0.90 (0.85, 0.95)	0.94 (0.83, 1.07)	1.05 (0.91, 1.20)
Ohio	0.87 (0.82, 0.92)	0.94 (0.86, 1.03)	1.08 (0.97, 1.20)
Oklahoma	0.99 (0.91, 1.09)	0.95 (0.87, 1.03)	0.95 (0.84, 1.08)
Pennsylvania	0.86 (0.82, 0.90)	0.92 (0.83, 1.01)	1.07 (0.95, 1.20)
South Carolina	0.89 (0.83, 0.96)	0.81 (0.69, 0.95)	0.91 (0.76, 1.08)
Tennessee	0.84 (0.78, 0.91)	0.91 (0.78, 1.06)	1.09 (0.92, 1.29)
Texas	0.87 (0.84, 0.90)	0.98 (0.90, 1.08)	1.13 (1.03, 1.24)
Utah	1.02 (0.91, 1.13)	0.96 (0.82, 1.11)	0.94 (0.78, 1.13)
Virginia	0.87 (0.82, 0.94)	0.81 (0.71, 0.94)	0.93 (0.80, 1.09)
Washington	1.01 (0.91, 1.12)	0.93 (0.76, 1.14)	0.92 (0.73, 1.15)
West Virginia	0.92 (0.84, 1.01)	0.92 (0.78, 1.08)	1.00 (0.83, 1.21)
Wisconsin	0.90 (0.83, 0.97)	0.90 (0.79, 1.03)	1.00 (0.86, 1.17)

[a]Ratio of weekly death rate (per 100,000 population) from March 19 to August 19 versus January 1 to March 18 from 2015 to 2019

[b]Ratio of weekly death rate (per 100,000 population) from March 18 to August 18 versus January 1 to March 17 in 2020

[c]Ratio of the relative change in death rates in 2020 (March 18 to August 18 versus January 1 to March 17) versus the relative change in death rates from 2015 to 2019 (March 19 to August 19 versus January 1 to March 18). This ratio indicates the relative change in death rates of patients with renal failure attributable to the pandemic compared with this historical level

failure were identified based on the International Statistical Classification of Diseases Tenth Revision and were coded from N17 to N19. To evaluate the indirect impacts on renal failure mortality, we excluded deaths from COVID-19.

We divided 2020 into the pre-pandemic phase (January 1 to March 17), early pandemic phase (March 18 to June 2), and later pandemic phase (June 3 to August 18). We defined the start date (March 18, 2020) of the pandemic according to the rapid increase in COVID-19 cases and the implementation of the 'stay-at-home' order in the US [1]. A total of 33 jurisdictions were included after excluding jurisdictions with missing data.

We used an analogue of the 'difference-in-difference' comparison approach to examine the changing rates in renal failure deaths during the pandemic [1]. We used the Poisson regression model separately for each jurisdiction to compare

the relative change in the death rates during the pandemic phase versus the pre-pandemic phase in 2020. We also used the same approach to compare the death rates in the analogous period in 2015–2019. We then calculated the ratio of the relative change in death rates in 2020 versus the relative change in death rates in 2015–2019. This approach allows us to estimate the increase in renal failure deaths associated with the pandemic while controlling for long-term trends and seasonal variations in renal failure deaths and variables that do not change markedly with time, such as age, sex, and race. All analyses were conducted by R 3.6.1.

From January 1 to August 18, 2020, there were 33,775 renal failure deaths in the US, approximately a 3.3% increase compared to the historical level. Texas (9.8%), California (9.2%), and Florida (6.9%) were the three most affected jurisdictions. Compared with the baseline death rate in 2015−2019, we observed two increases in renal failure death rates in 2020: one in April and the other one from July to August (Supplementary Figure).

Nationally, the pandemic period was associated with an increased mortality rate of renal failure (Table 1). Texas, Missouri, and New Jersey showed marginal rises in the ratio of the relative change in renal failure deaths. Compared with the early pandemic phase, the ratio of relative change in death rates was slightly increased in the later pandemic phase (Supplementary Table). Only Texas and New Jersey showed apparent mortality increases in both early and later pandemic phases.

Several reasons might explain the increased death rates in renal failure during the pandemic. First, given the rising concerns on the nosocomial transmission of COVID-19, some patients may have avoided visiting hospitals for necessary treatments, and some healthcare providers might have decided to postpone scheduled services. This delayed treatment of renal failure could have resulted in excess deaths. Second, part of nephrology care had to be delivered by telehealth services during the pandemic. Patients may have failed to receive quality care if they had difficulty accessing telemedical services, especially older people or those from rural areas. Third, nephrology healthcare providers encountered a dramatic challenge in balancing their routine workload and their surging workload with COVID-19 patients with kidney involvement during hospitalization, telemedical nephrology services and self-protection for COVID-19. The challenges were likely also shared with specialties of other diseases, such as cardiovascular disease and diabetes [1, 2]. Finally, overwhelming medical sources possibly occurred because of insufficient medical replenishment and excess consumption for COVID-19 patients with kidney function exacerbation, which might also have led to increased renal failure mortality [5].

Limitations of this study include the possibility of incomplete reporting of deaths and inability to generalize study findings to jurisdictions with missing data.

In conclusion, we identified increased mortality rates of renal failure during the COVID-19 pandemic in the US. Our findings highlight the importance of timely management and quality care for patients with chronic renal illness during the COVID-19 period.

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Declarations

Conflict of interest None declared.

Ethical approval The study adhered to the Declaration of Helsinki. As the data were publicly available and data were aggregated and de-identifiable, institutional review board approval and informed consent were not needed.

Consent to participate Not applicable.

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