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PLSC 504
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Homework 2

"Risk Factors for COVID-19 in a Retired FDNY WTC-Exposed Cohort" by Krystal L. Cleven and colleagues

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https://github.com/olyamorozova/covid_wtc_2020

Introduction

The article "Risk Factors for COVID-19 in a Retired FDNY WTC-Exposed Cohort" by Krystal L. Cleven and colleagues investigates the determinants of SARS-CoV-2 infection among retired Fire Department of New York (FDNY) responders who were previously exposed to the World Trade Center (WTC) disaster. The authors analyze demographic characteristics, pre-existing health conditions, lifestyle factors, and biomarkers of exposure to better understand why certain individuals in this high-risk occupational cohort were more likely to contract COVID-19. The study is based on clinical surveillance data collected between January and August 2020 during the first wave of the pandemic in New York City.

Research Methods

The original article used a prospective cohort design based on longitudinal data from the FDNY WTC Health Program. The authors calculated the cumulative incidence and incidence of COVID-19 based on the observed number of cases between March 2020 and August 2021. A multivariable regression model, yielding adjusted risk ratios (aRRs), was used to identify risk factors for COVID-19. The analysis adjusted for demographics, WTC exposure, smoking, obesity, respiratory disease, and other clinical variables.

Data and Variables

Data were obtained from the FDNY WTC Health Program's long-term database and included annual physical examinations, laboratory test results, spirometry, radiography, electronic medical records, and questionnaires. Key variables included age, gender, race/ethnicity, previous service type (firefighter vs. EMS), WTC exposure level (time to scene), smoking status, body mass index, obesity, hypertension, diabetes, obstructive airway disease (OAD), and interstitial lung disease (ILD). Outcome was defined as COVID-19 status (self-report, hospitalization, or death).

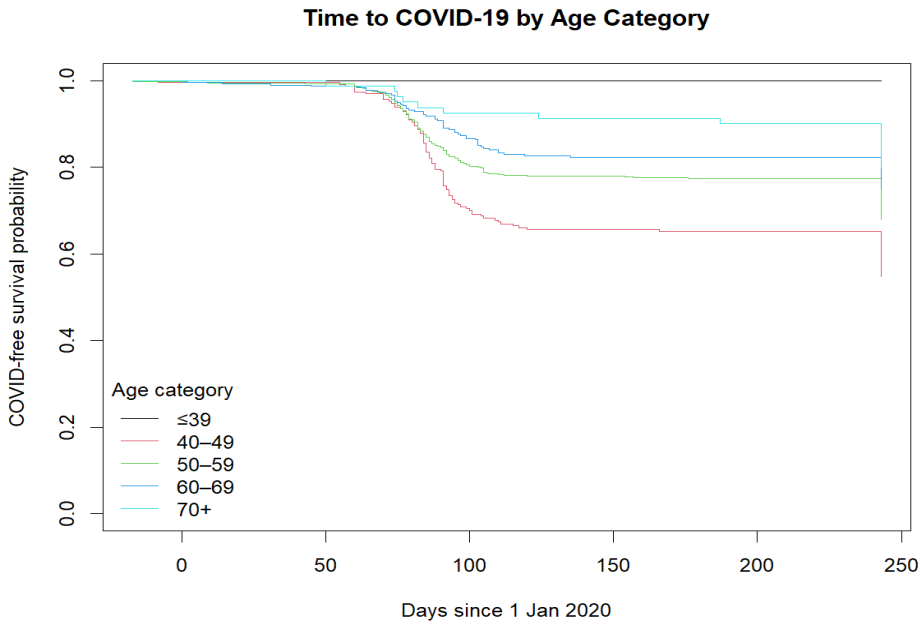
Rationale for Using Kaplan-Meier and Cox Regression

Unlike the original article, which used a simple binary outcome (infected/not infected), I applied survival methods because they allow analysis of when infection occurs, not just whether it occurs. This provides richer insight into infection dynamics and correctly handles censoring for participants who never became infected during follow-up.

The Kaplan-Meier method estimates COVID-free survival over time and visually compares infection risk across groups, such as age categories. The Cox proportional hazards model evaluates the independent effect of multiple factors on the rate of infection while accounting for differences in observation time.

Using Kaplan–Meier and Cox regression is a meaningful extension of the original study, adding a time-to-event perspective that helps identify factors influencing the timing and likelihood of COVID-19 infection.

Result Kaplan-Meier curve



The Kaplan-Meier curve shows how the probability of remaining COVID-19-free changed over time across the five age categories in the retired FDNY WTC-exposed cohort. COVID-free survival remained close to 100% early in 2020, with curves diverging around March-April (days 60-80), corresponding to the first major COVID-19 wave. The 40–49 age group experienced the earliest and steepest decline, suggesting higher exposure or susceptibility in this segment, while participants aged 50-59 and 60-69 showed moderate declines.

In contrast, the ≥70 age group maintained the highest COVID-free survival throughout follow-up, likely reflecting reduced exposure and more cautious behaviors among older retirees. The youngest group (≤39) also showed relatively high survival, although the sample size was

small. Overall, the Kaplan-Meier results indicate meaningful age-related differences in infection timing, with middle-aged participants experiencing earlier infections and older participants showing slower decline in survival. These patterns highlight the value of survival analysis for capturing not only infection status but also the timing of infection.

Cox model

Variable	Hazard Ratio (HR)	95% CI	p-value
Age (midpoint)	**0.98**	0.96–1.00	**0.021**
Sex (male)	1.23	0.82–1.85	0.316
Race group 1	1.37	0.88–2.15	0.167
Race group 2	1.55	0.97–2.48	0.065
Race group 3	1.33	0.59–3.00	0.498
Employment status (category 1)	**0.57**	0.43–0.76	**<0.001**
Morbid obesity	1.21	0.90–1.63	0.203

The Cox proportional hazards model was used to identify independent predictors of time to COVID-19 infection in the retired FDNY WTC-exposed cohort. The model included midpoint age, sex, race, employment status, and morbid obesity. Hazard ratios indicate the relative rate of infection over time while adjusting for other factors.

Age showed a small but statistically significant protective effect (HR = 0.98, p = 0.021), likely reflecting reduced exposure and more cautious behavior among older retirees. Sex and most race groups were not significant predictors, although Race group 2 showed a borderline increase in hazard (HR = 1.55, p = 0.065). Employment status (category 1) was the strongest predictor: individuals in this category had a substantially lower hazard of infection (HR = 0.57, p < 0.001), suggesting lower community or occupational exposure. Morbid obesity did not significantly affect infection risk (HR = 1.21, p = 0.203).

Overall, the Cox results indicate that exposure-related and behavioral factors, particularly employment status, played a more important role in determining infection timing than biological characteristics. These findings underscore the value of survival analysis for understanding not only who became infected but also when infection occurred.

Survival analysis allowed us to assess not only who became infected but also when infections occurred in the FDNY WTC cohort. Kaplan-Meier curves showed earlier infection among middle-aged participants compared with older retirees. The Cox model identified employment status as the strongest predictor, while age showed a modest protective effect. Overall, behavioral and exposure-related factors played a key role in shaping infection patterns during the early COVID-19 wave.