



## **Association between EMS workforce density and population health outcomes in the U.S.**

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**Background:** Emergency medical services (EMS) personnel are an integral part of the U.S. emergency care system. However, in 40 states, EMS is not considered an essential public service, and studies examining community-level health outcomes in relation to the density of EMS personnel are lacking. Our objective was to quantify the association between EMS workforce density in the U.S. and health outcomes. We hypothesized that higher density of EMS personnel per county population is associated with lower mortality.

**Methods:** We used the U.S. Census Bureau's American Community Survey 5-year Public Use Microdata Sample dataset from 2015-2019 to estimate density of EMS personnel per county of employment ( $n=2,855/3,142$ ; 91% with complete data). Health resources and outcomes were obtained from the National Emergency Department Inventory, Area Health Resources Files, CDC WONDER Database, and Robert Wood Johnson County Health Rankings. Age-adjusted health outcomes included life expectancy at birth; years of potential life lost (YPLL); all-cause mortality rate; and cardiac arrest mortality rate. We fit multivariable linear regression models with robust standard errors for each, adjusting for area health resources, urbanicity, population density and demographics, and tested for an interaction between EMS density and urbanicity.

**Results:** The mean EMS density was 87 per 100,000 population (95%CI 84-89), with a significant difference in urban (81, 95%CI 77-85) versus rural (90, 95%CI 87-94,  $p<0.001$ ) counties. In fully adjusted models, there was no significant association between EMS density and life expectancy or all-cause mortality rate. A 10-person increase in EMS density was associated with an increase of 9.8 YPLL (95%CI 1.6-17.9,  $p=0.02$ ). There was a statistically significant interaction between EMS density and urbanicity ( $p=0.002$ ). In urban counties, a 10-person increase in EMS density was associated with an increase of 3.8 cardiac arrest deaths per 1 million population (95%CI -0.2-7.7,  $p=0.06$ ) compared to a decrease of 4.7 in rural counties (95%CI -8.5 to -0.9,  $p=0.02$ ).

**Conclusion:** EMS workforce density was significantly associated with cardiac arrest mortality rates in rural, but not urban areas, even after adjusting for other healthcare and community factors. Further work is needed to quantify the value of EMS care and robust EMS systems.