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SARS-CoV-2 versus Other Duty-Related Deaths Among United States Law Enforcement Officers

Jessica Lizeth Alvitres
Walden University

Walden University

College of Health Sciences and Public Policy

This is to certify that the doctoral study by

Jessica Lizeth Alvitres

has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
the review committee have been made.

Review Committee
Dr. Twanda Wadlington, Committee Chairperson, Public Health Faculty
Dr. Harrison Ndetan, Committee Member, Public Health Faculty

Chief Academic Officer and Provost
Sue Subocz, Ph.D.

Walden University
2024

Abstract

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by

Jessica Lizeth Alvitres

MPH, Southern New Hampshire University, 2021

BA, New Jersey City University, 2019

CHES®, REHS, CPhT

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Public Health

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February 2024

Abstract

In 2020, more than half of United States law enforcement officer deaths were attributed to COVID-19, spurring the need for further investigation into the impact of the SARS-CoV-2 pandemic on this category of frontline essential workers. The purpose of this quantitative secondary data analysis study was to investigate the existence of associations between U.S. law enforcement officer deaths (SARS-CoV-2, non-SARS-CoV-2, or other duty-related) and the geographic region, as well as year of death while controlling for the officer rank, age, and sex. Based on the conceptual framework for evaluating mortality and morbidity following large-scale disasters from the National Academies of Sciences, Engineering, and Medicine, a public data set (collected through a cross-sectional design) on officer deaths from the National Law Enforcement Officers Memorial Fund was analyzed using multivariable logistic regression. Results showed statistically significant associations between US law enforcement deaths and geographic region, as well as years of death ($p < 0.001$). Compared to the West, there was greater likelihood of reporting SARS-CoV-2-related deaths in the South region (Adjusted Odd Ratio (AOR) = 0.49, 95% CI [.333, .731], $p < 0.001$) and a significant association between COVID-related law enforcement deaths in the years 2020 (AOR = 0.24, 95% CI [0.16,0.37], $p < 0.001$) and 2021 (AOR = 0.17, 95% CI [0.11,0.25], $p < 0.001$) compared to 2022. Implications for positive social change include the development of public health initiatives aimed at mitigating the impact of infectious disease disasters on law enforcement officers and the communities they serve.

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Dedication

I dedicate this effort to the members of the United States law enforcement. Their unwavering commitment to safeguarding communities in the face of any and all emerging challenges has served as an enduring source of inspiration. Their dedication to protect and serve, their sacrifices, and their ongoing commitment inspired my unending pursuit to contribute to their positive health outcomes through the scope of my public health knowledge and extensive research. To each and every officer, this work is offered with the utmost respect and profound gratitude for your service. Thank you.

Acknowledgments

I would like to sincerely thank my committee chair, Dr. Twanda Wadlington, and committee member, Dr. Harrison Ndetan, for their guidance, encouragement, and ongoing support throughout this process; this journey held its own unique challenges, and I could not have continued without their expertise and instruction. Thank you.

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Section 1: Foundation of the Study and Literature Review

Introduction

The SARS-CoV-2 pandemic was declared a public health emergency of international concern on January 30th, 2020 (World Health Organization, 2020). What began as a cluster of pneumonia cases in China led to declarations of national emergencies and country-wide shutdowns that later shaped global response to health emergencies. While the pandemic brought to light the crucial contributions of first responders and other frontline essential workers, the substantial role played by law enforcement personnel in combatting the virus was often overlooked, exposing this group to increased risks of contracting, spreading, and succumbing to SARS-CoV-2.

The COVID-19 pandemic has profoundly impacted public health worldwide, with significant consequences for various occupational groups, including law enforcement officers. Police officers, as frontline essential workers, are constantly exposed to unique risks due to the nature of their duties and frequent interactions with the public, and the SARS-CoV-2 pandemic was no exception. COVID-19 posed unprecedented challenges for law enforcement agencies, which led to growing concerns regarding the mortality rate among police officers resulting from this infectious disease.

The SARS-CoV-2 pandemic has highlighted several inconsistencies in public health emergency protocols across the essential workforce, with limited funding and communicable disease prevention interventions for law enforcement officials. The increased workload from evolving COVID-19 policies and statutes has strained law enforcement operational capacity, which has previously been linked to higher health

risks, work stress, and psychological distress (Godderis et al., 2020; Helfers & Nhan, 2021; Huang et al., 2021; Mathias et al., 2023; Jennings & Perez, 2020). The pandemic has also exposed the gap in recognizing the risks associated with policing efforts during public health emergencies, where governments enforce emergency measures with minimal acknowledgment or additional support for the necessary policing operations (Laufs & Waseem, 2020). This study analyzed the geographic region and year progression of law enforcement deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related) during the SARS-CoV-2 pandemic (March 2020 to December 2022) to provide valuable knowledge on the extent of the COVID-19 public health emergency's effect on this overlooked population of frontline essential workers.

Problem Statement

While SARS-CoV-2 accounted for 62% of law enforcement deaths in 2020 (Violanti et al., 2022), it remains unclear whether there is an association between U.S. law enforcement deaths (SARS-CoV-2 and other duty-related) and region, as well as year of deaths reported between March 2020 and December 2022.

The law enforcement workforce is underrecognized as a high-risk environment for infectious diseases, which results in a lack of prioritization and allocation of infectious disease prevention efforts. The SARS-CoV-2 pandemic has further highlighted the public health risks that law enforcement institutions face, as they have had to grapple with significant occupational demands (Vierlboeck et al., 2020), with little to no policy modifications, enforcement, or compliance for communicable disease prevention (Raciborski et al., 2020). Despite the existence of occupational safety protocols, there

needs to be more in establishing public health hazard protocols within law enforcement institutions, particularly in preventing communicable disease transmission.

Recent research highlights the elevated occupational risk of contracting SARS-CoV-2 among first responders and essential workers (Godderis et al., 2020). Studies in other countries indicate that law enforcement personnel have a higher prevalence of SARS-CoV-2 antibodies than the general population (Pasqualotto et al., 2021).

Purpose of the Study

The purpose of this quantitative study of secondary data analysis (of data collected from a cross-sectional design) was to investigate the association between U.S. law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related) and geographic region, as well as year of death while controlling for officer rank, age, and sex. For this purpose, the dependent variable was the types of law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related). The independent variables were the geographic region of death (Northeast, Midwest, South, and West) and year of death (2020, 2021, and 2022). The covariates or controlling variables included officer rank, age, and sex.

Research Questions and Hypotheses

This study was guided by the following research questions and corresponding hypotheses:

RQ1: Is there an association between the geographic region of death and United States law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-

related) reported between March 2020 and December 2022 while controlling for officer rank, age, and sex?

H_o1 –There is no association between the geographic region of death and United States law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related) reported between March 2020 and December 2022 while controlling for officer rank, age, and sex.

H_a1 –There is an association between the geographic region of death and United States law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related) reported between March 2020 and December 2022 while controlling for officer rank, age, and sex.

RQ2: Is there an association between the year of death and United States law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related) reported between March 2020 and December 2022 while controlling for officer rank, age, and sex?

H_o2 –There is no association between the year of death and United States law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related) reported between March 2020 and December 2022 while controlling for officer rank, age, and sex.

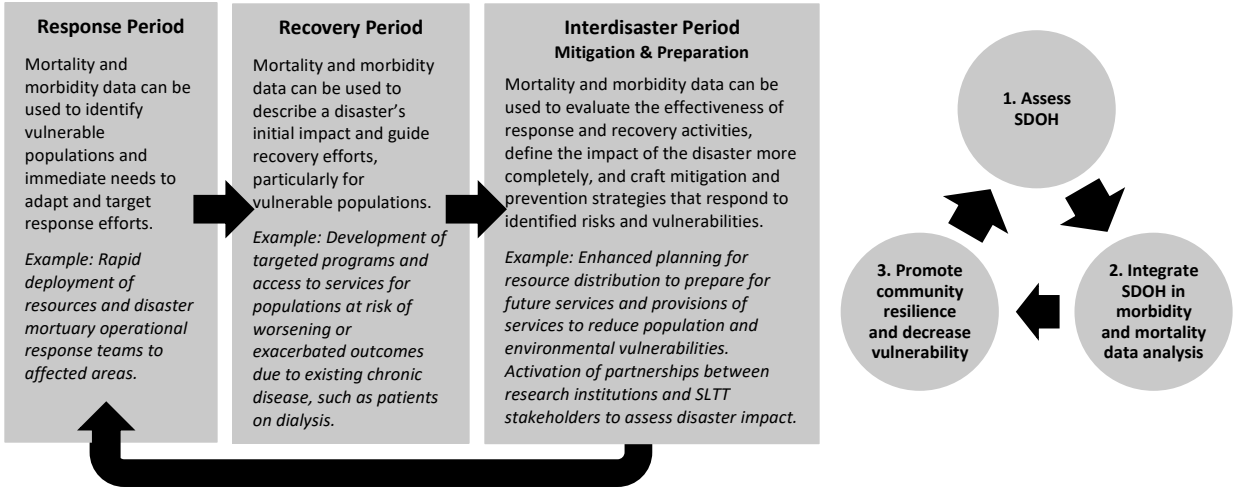
H_a2 –There is an association between the year of death and United States law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related) reported between March 2020 and December 2022 while controlling for officer rank, age, and sex.

Conceptual Framework

The National Academies of Sciences, Engineering, and Medicine's (2020) proposed conceptual framework emphasizes improving national data collection to assess mortality and morbidity following large-scale disasters. It highlights the need for uniformity and timeliness in data collection to enhance the accuracy of reporting disaster-related deaths, injuries, and illnesses, particularly in addressing pandemic-related health disparities. This framework supports using systems that provide precise estimates through complete counts of bodies and accurate attribution of mortality or morbidity to the disaster using consistent case definitions, as demonstrated by the National Law Enforcement Officers Memorial Fund's (NLEOMF) public database on United States law enforcement officer deaths.

Figure 1

Assessing Mortality and Morbidity After Large-Scale Disasters



Note. The concepts depicted are adapted from the "Assessing mortality and morbidity after large-scale disasters" conceptual framework by the National Academies of Sciences, Engineering, and Medicine, 2020.

The conceptual framework suggests that public health emergencies and other disasters affect populations inequitably (see Figure 1), with geographic dimensions heightening vulnerabilities and amplifying risk across all three stages of large-scale disasters (National Academies of Sciences, Engineering, and Medicine, 2020), which contributed to analysis of SARS-CoV-2 and non-SARS-CoV-2, other duty-related officer deaths across geographic regions. This framework also suggests that public health emergencies and other disasters affect populations inequitably over the chronological evolution of the disease, crisis, or other disasters (National Academies of Sciences, Engineering, and Medicine, 2020), which contributed to analysis of SARS-CoV-2 and non-SARS-CoV-2, other duty-related officer deaths reported between March 2020 and December 2022, which act as a surrogate of the evolution of the SARS-CoV-2 variant. This framework facilitates evidence-based public health actions, recommendations, and policies by prioritizing and improving public health surveillance and analyses from its interpretation (National Academies of Sciences, Engineering, and Medicine, 2020). This framework served as the foundation for approaching infectious disease disasters across levels of communities. It emphasized the need to prioritize surveillance and other research and public health initiatives that define and improve mortality data at the local, state, and national levels.

Nature of the Study

The nature of this study was to assess the measure of association between U.S. law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related) and the region as well as the year of deaths reported between March 2020 and December

2022 while controlling for officer rank, age, and sex. A public data set (collected through a cross-sectional design) on officer deaths from the NLEOMF was analyzed, applying multivariable logistic regression.

The NLEOMF provided a comprehensive public database on officer mortality, offering a credible and accurate data source for conducting this study. This database included critical demographic variables, such as sex, age, rank, location of death, cause of death, and full date of reported death, which are essential to address the research questions.

For RQ1, the independent variable was the geographic region where the United States law enforcement officer deaths occurred. According to the US Census Bureau (n.d.), four geographic regions were identified for which data was captured in this study: Northeast (which includes the following states: Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont), Midwest (which includes the following states: Illinois, Iowa, Indiana, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin), South (which includes Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Louisiana, Kentucky, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia) and West (which includes the following states: Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming). The geographic region of death was defined as a categorical variable with four levels (Northeast,

Midwest, South, and West) and was coded as Region 1, Region 2, Region 3, and Region 4 (or 1,2,3,4) respectively.

For RQ2, the independent variable was the year of death. Data were captured for the date of death of each fatality. For the purpose of this study, only deaths that occurred between March 2020 and December 2022 were considered. Thus, year of death was defined as a nominal categorical variable with three levels (2020, 2021, and 2022).

For both research questions, the dependent variable was United States law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related). The NLEOMF captures all officer deaths and categorizes them as the following: AIRC (aircraft crash), AUTO (automobile crash), BEAT (main cause of death was a beating), CRUSH (officer killed by falling object/s), DROW (officer drowned), FLOOD (floodwater-related incident), KNIFE (officers whose primary cause of death was a stabbing), MOTO (motorcycle crash), PHYS (physical-related incident, i.e., heart attack, TB, heat stroke, COVID-19 infectious disease), SHOT (officer who was shot, regardless of call answering), and STRU (officer struck and killed by a vehicle). These were operationalized into a binary categorical variable coded as 1 for SARS-CoV-2-related deaths (PHYS deaths that had COVID-19 as a specific circumstance of death) and 0 otherwise (i.e., non-SARS-CoV-2-related deaths, including PHYS deaths that do not have COVID-19 as a specific circumstance of death). The covariates or controlling variables included officer rank, age, and sex, all of which were outlined within the same database.

Literature Search Strategy

An exhaustive review of the existing, credible, and scholarly literature was undertaken to provide a foundation for this study and contribute to the current (and limited) understanding of SARS-CoV-2's progression (from 2020 to 2022) and law enforcement fatalities (with the United States being of the highest level of interest). The literature review was an extensive investigation, focusing on identifying and including all relevant studies while striving to meet the predetermined criteria for study inclusion, considering factors such as study relevance, methodology, and sample size. It comprised of multiple electronic databases, including Emerald Insight, Directory of Open Access Journals, EBSCOhost, Google Scholar, and PubMed. The keywords that were used to obtain relevant information include the following: *law enforcement officer mortality, law enforcement officer fatality, police officer mortality, police officer fatality, LEOs mortality, LEOs fatality, SARS-CoV-2 deaths, COVID-19 deaths, COVID-19 prevalence, COVID-19 among first responders, COVID-19 among law enforcement,* and *law enforcement as first responders/essential workers*, *COVID-19 impact on law enforcement officers,* and *COVID-19 impact on United States first responders*. The literature mentioned remains timely and relevant as the COVID-19 pandemic was only recently declared. The literature review also incorporated a seminal article pertinent to this study's theoretical framework. The entirety of the literature review focused on the impact of the pandemic on law enforcement, the role of law enforcement as first responders, the importance of public health processes in mitigating the spread of the SARS-CoV-2 virus,

and the relevance of mortality and fatality data in understanding the impact of the COVID-19 pandemic on law enforcement officers.

Literature Review Related to Key Variables

SARS-CoV-2 Impact on Law Enforcement Duties

The outbreak of the SARS-CoV-2 virus and the subsequent COVID-19 pandemic posed unprecedented challenges to various sectors of society, including law enforcement agencies. As first responders, law enforcement officers play a crucial role in maintaining public safety and ensuring the well-being of communities. However, the pandemic significantly impacted their duties and working conditions. Understanding the specific impact of SARS-CoV-2 on law enforcement duties is essential for assessing the risks officers face and devising strategies to mitigate those risks. This portion of the literature review examined various aspects of this impact, including the correlation between the public's perception of law enforcement and compliance with personal protective equipment (PPE), the occupational health risks and mental health implications for police officers, and the challenges faced during violation response and compliance enforcement.

One area of concern was the compliance of civilians with COVID-19-related mandates. Yang et al. (2021) found that civilian non-compliance led to incidents of intentional contamination of law enforcement officers. The study emphasized the direct threat to officer health by deliberate contamination through droplet and airborne transmission. Compliance with public health measures is crucial in protecting law enforcement personnel from infectious diseases. Maskály et al. (2021) reported a rise in the use of PPE by law enforcement officers, driven by the severity of the pandemic and

the limited global availability of protective gear. These findings suggest that law enforcement duties have been influenced by the need to prevent infectious disease transmission and promote officer safety.

Another concern was the association between the public's perception of law enforcement and compliance with PPE during public health crises. Simpson and Sandrin (2021) conducted a study on the use of PPE by law enforcement officers and its impact on public perception. Their qualitative analysis revealed that maintaining infection prevention equipment, including PPE, created positive perceptions of safety among the public and law enforcement personnel. The study highlighted the importance of visible changes to the first responder system, such as compliance with PPE protocols, during public health crises. Moreover, the study raised the possibility that the analysis of COVID-related deaths among law enforcement officers can be influenced by the public's perception of officer compliance with PPE usage. Lee et al. (2021) conducted a systematic review and meta-analysis that further assessed the effectiveness of personal protective measures in reducing transmission of pandemic influenza, including face masks as PPE, hand hygiene, and social distancing. Understanding the effectiveness of these measures can inform the analysis of PPE usage and its impact on COVID-19 transmission among law enforcement officers.

Crane and Richardson (2021) studied law enforcement officer experiences as frontline essential workers during the COVID-19 pandemic. They provided insights into the unique challenges of interacting directly with the public. The study acknowledged the pivotal role of these frontline essential workers in maintaining public safety and how the

increase in working hours and shifts in work practices highlighted the disparities in adequate training, resources, and psychological support.

These studies underscored the impact of the SARS-CoV-2 pandemic on law enforcement duties. The non-compliance of civilians, intentional contamination incidents, and the need for strict adherence to infection prevention protocols and more internal resources have emphasized the challenges law enforcement officers face in maintaining their safety while conducting the line-of-duty. Adapting standard operating procedures (SOPs) and ensuring compliance with infection prevention measures is crucial for safeguarding the well-being of law enforcement personnel during public health crises.

Law Enforcement Officers as First Responders

Law enforcement officers are often among the first at a scene, addressing emergencies, maintaining public order, and ensuring the safety of communities. This literature review examined law enforcement officer experiences and challenges as frontline responders and how it justified this current study and its scientific and medical importance.

A notable study by Chiu et al. (2019) evaluated a health hazard after a multi-agency law enforcement operation. The study found that many law enforcement agents exhibited symptoms indicative of influenza-like illness, highlighting the potential exposure to communicable diseases officers face during operations. This finding emphasized the need for effective protocols and protective measures to safeguard the health and well-being of law enforcement officers who are frequently exposed to various risks in the line-of-duty.

Godderis et al. (2020) examined the association between COVID-19 and exposure among essential workers, including law enforcement, as first responders. Their study revealed that frontline essential workers, including law enforcement officers, faced a higher occupational risk of COVID-19 compared to other workforce personnel. This highlighted the increased vulnerability of law enforcement officers in the face of infectious diseases and emphasized the importance of providing adequate resources, training, and PPE to mitigate the risk of exposure. These findings also offered a critical baseline for understanding the role of COVID-19 in the context of frontline essential workers, potentially enabling the assessment of SARS-CoV-2's contribution to U.S. law enforcement officer deaths through rigorous surveillance and analysis.

Pasqualotto et al. (2021) conducted a study on the seroprevalence of COVID-19 among military police forces in southern Brazil. They reported that the seroprevalence of SARS-CoV-2 was significantly higher among police officers enforcing COVID-19 quarantine guidelines compared to the general population in the same areas. The study underscored the heightened risk of exposure faced by law enforcement officers due to their frontline role in enforcing public health measures and the need to implement comprehensive strategies to protect their health and well-being.

Eisenman et al. (2021) conducted a study on reducing SARS-CoV-2 transmission during civil protests. The study acknowledged law enforcement officers as crucial stakeholders in managing civil protests and highlighted their role in preventing the spread of SARS-CoV-2 during such events. It recognized the need for officers to be equipped with the knowledge and resources to mitigate transmission risks effectively. The study

also addressed the challenges law enforcement officers faced in managing protests while considering the risk of COVID-19 transmission, which can inform law enforcement agencies on adopting appropriate measures to ensure the safety of both officers and protesters. While the study does not directly focus on mortality rates among law enforcement officers, its emphasis on reducing transmission during civil protests indirectly contributes to minimizing the risk of SARS-CoV-2-related deaths among U.S. law enforcement officers.

Standard Operating Procedures for Law Enforcement

SOPs play a crucial role in guiding the actions and behaviors of law enforcement officers. During public health crises like the COVID-19 pandemic, SOPs are particularly essential in ensuring the safety of officers and the communities they serve. This portion of the literature review explored the impact of the pandemic on the development and implementation of SOPs for law enforcement agencies and how it may provide insight into the association between U.S. law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related) and the region as well as the year of deaths reported between March 2020 and December 2022, which further acts as a proxy to the biological evolution of the global pandemic.

Mustamu and Bakarbessy (2020) qualitatively analyzed Indonesia's COVID-19 policy modifications and compliance and the provisions made in regional health protocols and regulations. The study revealed various levels of public health compliance despite active law enforcement interventions, which bore relevance to the present study, as it offered plausible explanations for the potentially observed patterns of mortality

resulting from SARS-CoV-2 infection among law enforcement officers relative to the trends of non-SARS-CoV-2, other duty-related deaths among the same population.

Yang et al. (2021) conducted a spatial analysis study in New York City, examining civilian compliance with COVID-19-related mandates and their impact on law enforcement. The study found incidents of intentional civilian-to-officer contamination via droplet and airborne transmission, which highlighted the risks law enforcement officers face in COVID-19-dense communities. These findings emphasized the need for robust SOPs that address the unique challenges of enforcing compliance and protecting officer health in high-risk areas.

Byrd et al. (2022) conducted a study examining the impact of COVID-19 on police officer injury and illness reporting in the United States. The study revealed significant changes in the patterns of injury and illness reports among law enforcement officers during the pandemic, which indicated the disparities in guidance to address emerging health risks. The findings underscored the importance of proactive monitoring, reporting, and preventive measures within law enforcement agencies to safeguard officer health and well-being, which set the stage for identifying potential vulnerabilities to infectious diseases.

Collectively, these studies highlighted the significance of SOPs in guiding the actions and responses of law enforcement officers during public health crises. They emphasized the need for continuous adaptation, communication, and enforcement of SOPs to address emerging challenges and ensure the safety of both officers and the communities they serve. By integrating evidence-based practices, effective

communication strategies, and proactive monitoring into SOPs, law enforcement agencies can enhance their capacity to respond to public health emergencies and mitigate the risks associated with infectious diseases.

SARS-CoV-2 Impact on Law Enforcement Mortality

The impact of SARS-CoV-2 on mortality rates among law enforcement officers is a significant concern, but limited studies endeavor to contribute to awareness of the statistical implications. This portion of the literature review expanded on the disproportionate impact of COVID-19 on law enforcement mortality.

Violanti et al. (2022) found that COVID-19 accounted for more than half of duty-related law enforcement officer deaths in 2020. Pasqualotto et al. (2021) reported a significantly higher seroprevalence of SARS-CoV-2 among law enforcement officers enforcing COVID-19 quarantine guidelines compared to the general population. These findings suggested that law enforcement officers face a higher risk of infection and subsequent mortality from COVID-19 than other duty-related causes.

Thompson (2022) examined the relationship between COVID-19 infection rates and mortality among law enforcement officers across different regions. The findings highlighted a positive correlation between higher infection rates and increased mortality risk among law enforcement officers. The study drew attention to the importance of understanding the impact of COVID-19 infection rates on the mortality of law enforcement officers. It provided valuable insights into the risk factors associated with duty-related deaths.

Similarly, Wilson and Anderson (2022) explored the influence of COVID-19 on duty-related deaths among law enforcement officers in the United States. Their research investigated the relationship between COVID-19 exposure and mortality, considering numerous factors such as age, pre-existing health conditions, and workplace safety measures. The findings revealed that higher levels of COVID-19 exposure were associated with an elevated risk of duty-related deaths among law enforcement officers. The study contributed to the understanding of the specific impact of COVID-19 on law enforcement mortality and provided valuable insights into the risk factors that contributed to these deaths.

Shrestha et al. (2021) performed a qualitative study to identify and legitimize occupational safety concerns among law enforcement officials involved in COVID-19-related death investigations. Through interviews with experts in the field, the study revealed that medico-legal death investigations commence with law enforcement personnel visiting the scene, thereby increasing the risk of exposure to a range of infectious agents. These findings reinforced the heightened risk of communicable diseases among the law enforcement population during routine procedures, which was pertinent to understanding the SARS-CoV-2-related mortality trends among this population.

These studies demonstrated the significance of the relationship between COVID-19 infection rates and mortality among law enforcement officers. The findings laid emphasis on the importance of considering factors such as infection rates, exposure levels, and individual risk factors when examining the impact of SARS-CoV-2 on law

enforcement officer deaths and stressed the need for preventive measures and workplace safety protocols to reduce the risk of infection and mortality.

Conceptual Framework for the Study

The National Academies of Sciences, Engineering, and Medicine's report from 2020 informed this study's conceptual framework. In their report, the National Academies examined the data-related challenges hindering the management of the SARS-CoV-2 pandemic. They presented recommendations (as a conceptual framework) to improve the accuracy of quantifiable reporting of pandemic-related mortality (National Academies of Sciences, Engineering, and Medicine, 2020). This conceptual framework drew attention to the importance of enhancing public health data reporting and surveillance to respond to the pandemic effectively. It can aid in formulating community recommendations for responding to these challenges.

Within this framework, several research journals contributed to the understanding of the impact of SARS-CoV-2 on law enforcement officers. The preceding studies, including those by Thompson (2022), Wilson and Anderson (2022), and Violanti et al. (2022) shed light on the relationship between COVID-19 infection rates, mortality rates, and duty-related deaths among law enforcement officers. By examining the specific impact of the virus on this at-risk population, these studies helped formulate community recommendations for responding to the challenges posed by the pandemic.

The National Academies of Sciences, Engineering, and Medicine's (2020) conceptual framework offered valuable insights into managing the SARS-CoV-2 pandemic, emphasizing the importance of accurate data reporting and surveillance. The

preceding studies align with this framework by providing empirical evidence and analysis to inform public health actions and policies concerning law enforcement officers. Their findings contributed to the understanding of the pandemic's impact on this specific population, facilitating the development of targeted interventions and strategies to mitigate risks and ensure the well-being of law enforcement personnel.

Overview of the Works

The literature review highlighted the association between infectious disease exposure and the health outcomes of law enforcement personnel. The SARS-CoV-2 pandemic has profoundly impacted law enforcement duties, with officers serving as first responders and facing increased risks of infectious disease exposure.

Definitions

The NLEOMF's (2023) inclusion criteria are used for this study's operational descriptions.

Additional exclusions: The NLEOMF (2023) defined other exclusions from the public database as law enforcement officer deaths ascribed to voluntary substance use (including alcohol), intentional misconduct, officer's intention to cause death and/or grossly negligent behavior at the time of death.

Additional inclusions: The NLEOMF (2023) defined other inclusions from the public database as law enforcement officer deaths that have been reported by their respective department, with the department affirming that the law enforcement officer died in the line-of-duty, and upon the NLEOMF's research staff exhausting all verification means, no information contradicts eligibility.

Death by natural causes: The NLEOMF (2023) defined deaths by natural cause as law enforcement officers who died from a condition not related to the line-of-duty. Exceptions to this criterion (or law enforcement officers recognized within the database) were as follows: officers with deaths attributed to natural causes resulting from physical exertion while on duty. Scenarios for these exceptions include the following: training program exercises, fitness test administrations, manual material handling, and stressful response/s to a law violation or emergency.

Law enforcement officer: The NLEOMF (2023) defined the population in their memorial and database as full-time individuals involved in crime control or reduction on a municipal, county, state, or federal level within the United States or its territories. This individual has been sworn into service and has full arresting powers. Less than full-time law enforcement officers are also considered after thorough, case-by-case review by the NLEOMF's research staff. Correctional employees can also be included in the database if they are acknowledged as possessing law enforcement status by their employing jurisdiction, which varies across regions.

Line-of-duty: The NLEOMF (2023) defined line-of-duty as any action that an officer is legally required or authorized to perform or for which the officer is remunerated by the public agency they serve.

Line-of-duty deaths: The NLEOMF (2023) defined fatalities that met the inclusion criteria as those where the law enforcement officer died as a direct and proximate outcome of job responsibilities. This term denoted that the law enforcement officer was engaged in an action or activity they are legally required or authorized to

perform, which directly and significantly contributed to their fatal injury. Line-of-duty deaths included deaths of victim law enforcement officers and active or on-duty law enforcement officers. For the purpose of this study, line-of-duty deaths were grouped as SARS-CoV-2 and non-SARS-CoV-2, other duty-related deaths.

Stressful response: The NLEOMF (2023) defined stressful response as specific actions relating to the line-of-duty, which included (but were not limited to) any and all of the following: physical struggles, physical exertion needed for search and rescue missions, performing or assisting with emergency medical treatment, responding to law violation or emergencies, and a high-speed response or pursuit, whether on foot, with vehicle, or both.

Victim law enforcement officers: The NLEOMF (2023) defined victim law enforcement officers as officers who met one or more of the following criteria before or during the time of death: officers in an off-duty capacity who acted in response to a law violation, officers in an off-duty capacity who were en-route to or from responding to the agency's request for assistance, officers driving employer vehicles to or from work, officers driving personal vehicles at work and killed while en-route to or from work. Victim law enforcement officers not included in the NLEOMF's law enforcement fatality database include those with deaths attributed to natural causes.

Assumptions

The successful culmination of this study was attributed to carefully considering a set of explicit assumptions. For this study, it is assumed that the NLEOMF's data set for law enforcement deaths reported between March 2020 and December 2022 was

complete, accurate, reliable, and reflective or representative of all possible law enforcement officer deaths across the United States during the specific time period. Within the prior statement, this study assumed that the data collected on geographic region and year of death, as well as additional demographic variables (officer rank, age, and sex), was sufficiently captured, accurately recoded, and guaranteed as reliable by the fallen officer's department's reporting and the NLEOMF's research staff's law enforcement officer death reporting verification process. This study also assumed that the NLEOMF database was comprehensive and representative of the law enforcement officer population, notably due to their inclusion and exclusion criteria and every U.S. law enforcement department's commitment to reporting law enforcement officer deaths both accurately and extensively. Another assumption that was made was that a law enforcement officer's death did not influence another law enforcement officer's death to retain independence. The final assumption was that the covariates (the demographic variables of officer rank, age, and sex) adequately controlled for potential confounding factors within this study. The culmination of these assumptions dramatically aided in the data's validity, reliability, and generalizability, allowing this study to be eligible to inform and advocate for practical public health interventions and education and support policy changes.

Scope and Delimitations

The scope of this study focused on examining the association between US law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related) and the region as well as the year of deaths reported between March 2020 and December

2022. The analysis considered the potential influence of demographic variables, namely officer rank, age, and sex. However, it was essential to note that this study was limited to available data from the NLEOMF's public law enforcement officer deaths database, as well as the willingness and accuracy of law enforcement departments in reporting officer deaths. This study did not explore individual-level factors or provide an all-encompassing analysis of all potential variables influencing law enforcement officer deaths. Additionally, the findings and conclusions drawn from this study may only be generalized to other time periods within the specified study period and geographical context.

Geographic Scope

On a geographic scale, this study analyzed the association between geographic regions and United States law enforcement officer deaths (COVID-19 and non-COVID-19 or other duty-related). While the NLEOMF's public database on law enforcement officer deaths encompassed information provided by law enforcement departments across the entire country, this study acknowledged that its findings and conclusions may not apply to law enforcement agencies outside the United States. This study specifically considered the independent variable of geographic regions to explore potential variations in SARS-CoV-2 and non-SARS-CoV-2, other duty-related United States law enforcement officer deaths.

Temporal Scope

On a temporal scale, this study analyzed the association between the year of death and United States law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2,

other duty-related). This study outlined the impact of the year of death on United States law enforcement officer deaths, where the years acted as a proxy for the temporal proximity to SARS-CoV-2's progression (infection rates, public health measures, vaccination efforts, and variant emergence). Findings were interpreted within the context of the available data. This study acknowledged the inherent limitations of using dates of law enforcement officer deaths as a proxy for SARS-CoV-2 variant emergence and the potential influence of these variants on law enforcement officer mortality.

Demographic Considerations

In this study, the demographic variables of officer rank, age, and sex were controlling factors. By accounting for these factors in the data analysis, this study explored the potential influence of the covariates on United States law enforcement officer deaths in conjunction with geographic and temporal factors. However, it was essential to note that this study did not investigate additional individual-level characteristics or external factors beyond the specified variables. This study interpreted the findings within the context of the available data and the limitations imposed by the scope and nature of this study.

Limitations

Limitation of Data Availability

One of this study's limitations is the reliance on available data from the NLEOMF's database. The accuracy and completeness of the reported law enforcement officer deaths may vary across different jurisdictions and departments. Inaccurate or

incomplete reporting of deaths could have affected this study's findings and generalizability.

Generalizability

The findings from this study have limited generalizability beyond the United States law enforcement population. This study focused specifically on law enforcement officer deaths in the United States, and the unique characteristics and circumstances of law enforcement work in different jurisdictions may affect the results and restrict their applicability to broader populations.

Causality and Confounding Variables

While this study examined the association between U.S. law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related) and the geographic region as well as the year of deaths, this study design did not establish whole causality. Other unmeasured factors or confounding variables could have influenced the observed associations. Despite the efforts that were made to control for variables such as officer rank, age, and sex, there may have still been residual confounding or unaccounted factors that could have impacted this study's findings.

Variability in COVID-19 Transmission and Reporting

This study focused on United States law enforcement officer deaths during the COVID-19 pandemic. This public health emergency was characterized by evolving transmission patterns (with the emergence of variants and variations in vaccination and intervention efforts) and reporting practices. The availability and accuracy of COVID-19-related data may vary across different geographic regions and years within the pandemic

period. Variations in testing, reporting standards, and awareness of COVID-19 among law enforcement agencies may have introduced potential biases or limitations in the analysis.

Proxy Measures and Data Limitations

This study used the proxy measures of year of death to approximate SARS-CoV-2 progression (variant emergence and implementation of public health prevention and treatment measures). While this proxy measure provided valuable insights, it may have yet to capture the complete picture of the global pandemic and its progression across the globe and throughout the United States. Additionally, this study relied on the accuracy and completeness of the NLEOMF's database, which may have inherent limitations, including potential errors or inaccurate omissions in the recording and reporting of U.S. law enforcement officer deaths.

Significance

Significance of the Study

Research on proportionate SARS-CoV-2-related deaths among law enforcement officers remains limited, particularly concerning the progression of COVID-19 in the United States and when US law enforcement officer deaths are compared to non-SARS-CoV-2, other duty-related causes of death among law enforcement. This study addressed the gap in knowledge of this topic by having this study's findings contribute to a better understanding of the prevalence of this infectious disease among law enforcement officers and the associated mortality risk, both within the initial year of the SARS-CoV-2 pandemic (2020) and during the biological evolution of COVID-19 up to the end of 2022.

This study has significant implications for public health, as it contributes to understanding of infectious diseases as an occupational health risk for law enforcement officers.

Research in the realm of law enforcement has primarily focused on the risk of contracting acquired immunodeficiency syndrome (AIDS), human immunodeficiency virus (HIV), and hepatitis (Helfers & Nhan, 2021). However, the perception of communicable diseases that this population is susceptible to has remained limited to these three diseases (Laufs & Waseem, 2020), highlighting the importance of COVID-19 as a crucial element in enhancing health literacy within this demographic and subsequently reforming law enforcement protocols and support during public health emergencies. Given the persistent nature of this public health issue, more significant efforts must be made to highlight the severity of the problem to bring about positive social change. This study's outcome served to emphasize SARS-CoV-2, as well as other infectious diseases, as occupational health risks among law enforcement officers. Such knowledge aid in prioritizing law enforcement institutions as first responders with risks analogous to those in the clinical field (Garbarino, 2021). It can reshape first responder considerations during government decision-making, especially in emerging global epidemics and other public health issues.

Significance of RQ1

With the first research question, this study contributed to the existing literature by investigating the association between United States law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related) and geographic region of

death. This research question provided valuable insights into the spatial distribution patterns and variations of mortality rates within this population. By controlling for demographic variables (officer rank, age, and sex), this study accounted for potential confounding factors. This study gained a nuanced understanding of the independent association between regions and law enforcement officer deaths and not only contributed to the existing literature on spatial aspects of United States law enforcement deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related) but also shed light on the potential influence of contextual factors, such as regional differences in COVID-19 prevalence, law enforcement practices, and healthcare infrastructure, on United States law enforcement mortality risk.

Significance of RQ2

With the second research question, this study contributed to the existing literature by investigating the association between United States law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related) and the year of death. By examining temporal dynamics, this study provided valuable insights into the potential influence of contextual factors, such as the emergence of COVID-19 variants, on United States law enforcement deaths. By controlling for demographic variables (officer rank, age, and sex), this study accounted for potential confounding factors and provided a more accurate understanding of the association between the variables. This study contributed to the existing literature on temporal aspects of U.S. law enforcement deaths, but also shed light on the potential influence of contextual factors, such as the emergence of COVID-

19 variants, law enforcement practices, and healthcare infrastructure, on United States law enforcement mortality risk.

Summary and Conclusions

COVID-19 has factually posed significant challenges for frontline essential workers and has empirically presented a greater risk of exposure to this population. Law enforcement is one of the many agencies of frontline essential workers that have a higher risk of contracting the virus during their line-of-duty because of direct and frequent public interactions. Given the unprecedented global pandemic caused by SARS-CoV-2, examining this infectious disease's impact on United States law enforcement personnel at the forefront of ensuring public safety is crucial. Through detailed data analyses of deaths reported between March 2020 and December 2022, and controlling for demographic variables, this study outlined the association between U.S. law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, or other duty-related) and the region as well as the year of death.

This study provided valuable insights into the potential disparities and variations in geographic region of the two recoded causes of U.S. law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related). SARS-CoV-2 had not only presented immediate health risks but had also evolved with the emergence of new variants. Secondly, this study provided valuable insights into the variations in U.S. law enforcement officer deaths between March 2020 and December 2022. This study had year of death serve as a proxy for variant emergence. The findings of this study have substantial implications for targeted interventions, resource allocation strategies, and

policy decisions aimed at mitigating the impact of the pandemic on law enforcement officer mortality and ensuring the well-being of this critical workforce. Ultimately, this study's findings shed light on the complex interplay between geographic region and year of death factors on US law enforcement deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related), enabling evidence-based approaches to enhance the safety and health outcomes of this critical population.

Section 2: Research Design and Data Collection

Introduction

The primary objective of this study was to examine the association between United States law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related) and the geographic region and year of death, while controlling for the demographic variables of officer rank, age, and sex. To achieve this research objective, this study quantitatively analyzed secondary data from a public dataset (collected through a cross-sectional design). This design encompassed the pandemic period between March 2020 (declaration of COVID-19 as a global pandemic) to December 2022 (continuation of the global pandemic and the emergence of its variants), making it suitable for this study.

Data for this study were obtained from the NLEOMF's public database, which included information on official law enforcement officer deaths reported by corresponding departments. This database contained the following vital details: cause of death, date of death, geographic region of death, and demographic characteristics of the fallen officers. Data on controlling variables such as officer rank, age, and sex were also collected from the same database. The chosen research design thoroughly examined the association between the dependent variable of U.S. law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related) and the two independent variables of geographic region and year of death. By considering controlling variables, this study provided valuable insights into the factors influencing law enforcement officer deaths and contributed to the existing knowledge of law enforcement and public health.

This section provides additional rationale for the research design, introduces this study's methodology, operationalizes the constructs, discusses the data analysis plan, and acknowledges and addresses threats to validity.

Research Design and Rationale

This study employed a cross-sectional approach of a public dataset to quantitatively examine the association between geographic region of death, year of death, and United States law enforcement officer deaths, divided into SARS-CoV-2 and non-SARS-CoV-2 or other duty-related deaths. The source for the secondary data examined was the NLEOMF's public database on officer mortality. This source is a single database that contained all the variables needed to conduct this study, which included the following demographic variables: sex, age, rank, region, cause of death, and date of each reported death.

This research design allowed for the analysis of data collected over multiple years (2020-2022, the span of the pandemic period) to explore the potential impact of US law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related) and geographic region as well as the year of death while controlling for officer rank, age, and sex. This research design was the most suitable approach for this study as the secondary data taken from the NLEOMF's public database on officer mortality is quantitative, making qualitative research designs inapplicable or inappropriate for analyses.

The collection of data through a cross-sectional design of the NLEOMF public dataset enabled the assessment of US law enforcement officer deaths across different geographic regions between March 2020 and December 2022. This allowed for

comparisons and the identification of potential regional disparities in mortality rates and enabled year of death to serve as a proxy for the chronological evolution of SARS-CoV-2 in the United States. By leveraging this research design, this study explored the complex relationships between, and provided a holistic analysis of, U.S. law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related) while accounting for the influence of officer rank, age, and sex as demographic covariates.

This study's independent variables are geographic region of death, coded as four categorical levels (Northeast, Midwest, South, and West), and year of death, coded as three nominal levels (2020, 2021, and 2022). The dependent variable was the occurrence of United States law enforcement officer deaths, further divided into two categories of deaths: SARS-CoV-2 and non-SARS-CoV-2, other duty-related deaths. The three demographic variables of officer rank, age, and sex were operationalized as covariates. Sex was a binary categorical variable representing the two genders noted in the NLEOMF database: male and female. Age was a continuous variable, indicating the numerical age of the officers at the time of death. Officer ranking was an ordinal categorical variable, indicating the hierarchical position of the officers within their respective departments before death.

Methodology

Overview

This quantitative secondary data analysis (of data collected from a cross-sectional design) relied exclusively on the NLEOMF's public database on officer mortality. The NLEOMF, established in 1984, is a non-profit organization dedicated to commemorating

the sacrifices of fallen law enforcement officers. In fulfilling its mission, the NLEOMF is responsible for maintaining the nation's monument to law enforcement officers, organizing the annual National Police Week observance each May, hosting a Candlelight Vigil every May 13th, and maintaining the most extensive, complete database of line-of-duty officer deaths. The NLEOMF also researches officer fatality trends and provides a clearinghouse on law enforcement officer mortality matters. Their public database on United States law enforcement officer deaths met requirements for empirical data due to their strict inclusion and exclusion criteria and investigative efforts made by their research staff to confirm the validity, reliability, ethicality, and quality of the law enforcement officer death reporting. Given their countless contributions to the field, the public database is an invaluable resource for scholars and practitioners seeking to advance knowledge on law enforcement officer mortality in the United States.

Population

The population examined in this study was sourced from the NLEOMF's public database on law enforcement officer deaths. The NLEOMF is the only organization that tracks and maintains a comprehensive, public database on fallen officers across the United States, making it the leading authority on United States line-of-duty deaths. This was an ideal tool to approach the research questions and other inquiries on law enforcement fatalities. Each person honored in this memorial and within the database met the inclusion criteria of being a law enforcement officer who died in the line-of-duty (NLEOMF, 2023).

The NLEOMF's database comprised of a diverse population of law enforcement officers across the United States, including federal, state, local, special jurisdiction, and corrections officers. By including officers from various branches of law enforcement, the NLEOMF's database offered a comprehensive representation of law enforcement officer mortality in the United States. This diverse sample is of critical importance for scholars and practitioners seeking to better understand trends and patterns in law enforcement officer mortality and for informing policy decisions that improve the safety and well-being of law enforcement officers across all branches of law enforcement.

Sampling and Sampling Procedures Used by the Original Creators of the Data Set

As a secondary data analysis, this study operationalized the sampling and sampling procedures exercised by the NLEOMF's public database on law enforcement officer deaths. NLEOMF's database inclusion eligibility states that an official department representative must complete a comprehensive data form for the fallen officer, signed by the head of the agency. This report form contains crucial demographic information about the deceased officer, including the cause of death, date of death, and the circumstances surrounding the officer's death (NLEOMF, 2023). In addition, supporting documentation such as death certificates and autopsy reports are also required (NLEOMF, 2023). The Memorial Fund's Research Department meticulously reviews Officer Data Forms and supporting documents for accuracy and completeness, after which they are submitted to a committee of the Memorial Fund Board of Directors for a thorough review. Each case is carefully assessed to determine whether the circumstances of the death meet the criteria for inclusion on the National Memorial, and ultimately approved or denied based on this

assessment. The Armed Forces Institute of Pathology and other skilled medical personnel conduct in-depth investigations to determine the category of the law enforcement officer's cause of death. Medical investigators also work a thorough review of police reports, medical history, medical records, and interviews with coworkers and family to certify the cause of death and proceed with categorizing death for publication in the database. Once the death is approved by the NLEOMF, it is published in their public database. While this information is public, for the purpose of this study, data between March 2020 and December 2022 was taken with permission from the executive director. To use the data (based on this discussion), this study acknowledged that the exact database cannot be published nor duplicated (whole or in part) publicly, nor shared with any institution or individual. The NLEOMF, as the leading authority on United States line-of-duty deaths, is the sole originator of the available data. Most importantly, anything drawn from this data (conclusions, hypothesis, correlations, etc.) is not attributed to the NLEOMF and was articulated as my ideas. While the data can support the finding, it is not necessarily an organization-supported view.

Power Analysis

A priori power analysis involves calculating the required sample size to detect an effect of a specific magnitude with the desired power. This necessitates the establishment of appropriate Type I and Type II error rates, which are then used to calculate the required sample size, ensuring that this study has sufficient power to detect the desired effect. The conventional statistical significance level is when $\alpha = 0.05$; this translates to the willingness to accept a 5% chance of incorrectly rejecting the null hypothesis or

making a Type I error. In hypothesis testing, if the p-value (or the probability of observing the data given the null hypothesis) is less than or equal to the significance level (α), the results are considered statistically significant. This leads to rejecting the null hypothesis in favor of the alternative hypothesis.

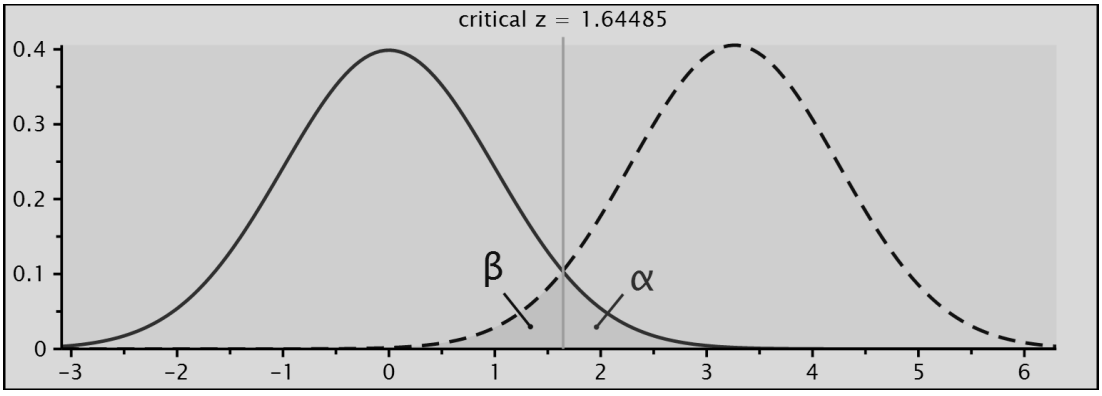
Multivariable logistic regression is the primary statistical method of testing this study's research hypotheses, so power analysis was performed considering odds ratio as the effect size statistic. For logistic regression, as defined in similar studies, a small effect size constitutes around 1.2 to 1.5, a medium effect size is around 2.0, and a large effect size is 3.0 and higher (Parish et al., 2021). This study utilized a small effect size of 1.3 to account for variation (Parish et al., 2021) in the quantity of U.S. law enforcement deaths per year and geographic region between March 2020 and December 2022. Having power (β) conventionally equal to 0.80 also assisted in refraining from Type II error, as the value is not too high nor too low to detect a significant effect. A power of 80% implies that this study had an 80% chance of correctly identifying a considerable influence or relationship, given that it genuinely exists in the population. The 95% confidence interval (CI) reflects the level of uncertainty around the estimated impact, allowing for a margin of error. Conventional quantitative studies generally accept a sample size that ensures a minimum of 80% power at a 95% CI with a significance level of $p = 0.05$.

Given these definitions, *a priori* statistical power analysis for this study was conducted using G*Power 3.1.9.7 (Faul et al., 2019) to calculate the minimum sample size with the following parameters: β or a power of 0.80, an effect size of 0.3, or small effect size, and a statistical significance level or $\alpha = 0.05$. Considering both Type I and II

errors and time constraints, the sample size of 988 was the most appropriate for this study (see Figure 2).

Figure 2

Power Analysis



Note. The figure results from an *a priori* statistical power analysis conducted using G*Power 3.1.9.7 software tool (Faul et al., 2019). The minimum sample size was determined using a power of 0.80, a small effect size of 0.3, and a CI 0.05. The sample size 988 is above the threshold value of 80% for this study.

Instrumentation and Operationalization of Constructs

This section summarizes the operationalization of the dependent and independent variables and the additional demographic variables accounted for within this study to address the research questions.

Dependent Variable

This study had one dependent variable: the types of United States law enforcement officer deaths. This dependent variable was operationalized into a binary,

categorical variable coded as 1 for SARS-CoV-2-related deaths and 0 otherwise (i.e., non-SARS-CoV-2, other duty-related deaths).

The NLEOMF's public database on law enforcement officer deaths does not directly group deaths into the two binary variables of SARS-CoV-2 and non-SARS-CoV-2, other duty-related deaths. The following list defines the eleven primary reasons for death that are utilized within NLEOMF's database, where circumstances of death are briefly described, and where COVID-19-related deaths are outlined.

Table 1

The National Law Enforcement Officers Memorial Fund's (NLEOMF) Causes of Law Enforcement Officer Deaths

Cause of death	Definition
AIRC	Aircraft crash
AUTO	Automobile crash
BEAT	Leading cause of death was a beating
CRUSH	Officers killed by falling object(s)
DROW	Officer drowned
FLOOD	Floodwater-related incident
KNIFE	Officers whose primary cause of death was a stabbing
MOTO	Motorcycle crash
PHYS	Physical-related incident (i.e., heart attack, TB, heat stroke, COVID-19 infectious disease, etc.)
SHOT	Officers who were shot, regardless of call answering
STRU	Officers killed when they were struck by a vehicle

Note. The table summarizes causes of death and their definitions, as published by the NLEOMF (2023).

The primary reason/circumstance of death listed in the database was operationalized where deaths grouped in the PHYS category, with circumstance of death

being COVID-19, were coded as 1 for the SARS-CoV-2 related death category. Any primary reason/circumstance unrelated to SARS-CoV-2 (including deaths in the PHYS category that did not have COVID-19 as circumstance) was coded as 0.

Independent Variables

Regions. For RQ1, the independent variable was the geographic region of the United States law enforcement officer's death. This independent variable was operationalized as a categorical variable with four levels (the four geographic regions outlined by the US Census Bureau) and coded as 1, 2, 3, and 4, respectively.

The NLEOMF's public database captured the geographic region of death as US states; the US Census Bureau (n.d.) categorizes states into four regions, as outlined below:

Table 2

US Census Bureau's Geographic Regions and Corresponding States

Region	States
Northeast	Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont
Midwest	Illinois, Iowa, Indiana, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin
South	Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Louisiana, Kentucky, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia
West	Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming

Note. The table summarizes states belonging to each of the four regions created by the US Census Bureau (n.d.).

The independent variable, region, was operationalized as a categorical variable with four levels (Northeast, Midwest, South, and West) and coded as 1 for Northeast, 2 for Midwest, 3 for South, and 4 for West.

Years. For RQ2, the independent variable was the year of the United States law enforcement officer's death. This independent variable was operationalized as a nominal, categorical variable with three levels (2020, 2021, and 2022). The NLEOMF's public database captured date of death as month, day, and year (mm/dd/yyyy). This study broke down the dates as seen in the following table.

Table 3

Breakdown of Dates of Death Included in This Study

Year	Months
2020	March, April, May, June, July, August, September, October, November, December
2021	January, February, March, April, May, June, July, August, September, October, November, December
2022	January, February, March, April, May, June, July, August, September, October, November, December

Note. The table summarizes years of death included in this study and their corresponding dates.

For the purpose of this study, only deaths that occurred between March 2020 and December 2022 were considered. This is because March 2020 marked when the World Health Organization (WHO) officially declared COVID-19 a pandemic (World Health Organization, 2020).

Covariates

Variables operationalized as covariates in this study due to the potential influence on the association between the independent and dependent variables included officer rank, age, and sex.

Sex was captured by the NLEOMF's public database as males and females. Age was captured as an integer and then segmented into seven distinct age groups (20-29, 30-

39, 40-49, 50-59, 60-69, 70-79, 80-89). Officer ranking was captured as seven distinct rank groups (correctional officers, court and detention officers, investigators and detectives, leadership and management, patrol and general officers, specialized roles, supervisors, and sergeants).

Data Analysis Plan

Software

The following software was utilized to perform data analysis: IBM SPSS Statistics Version 28.0.0.0 (IBM Corporation, 2023), Microsoft® Excel® for Microsoft 365 MSO Version 2302, Build 16.0.16130.20754 (Microsoft Corporation, 2023), and Tableau Desktop Version 2023.2 (Tableau Software, 2023). Microsoft Excel 2302 was the software that housed the US law enforcement officer deaths reported between March 2020 and December 2022. IBM SPSS 28.0.0.0 was utilized to perform multivariable logistic regression analysis and primary characteristic summaries. Tableau 2023.2 was used to create data visualization tools.

Data Cleaning & Management

The quantitative, secondary data required for this study was collected from the NLEOMF's public database on United States law enforcement officer deaths. The applicable inclusion and exclusion criteria and database variable composition information were taken directly from the NLEOMF's web page. I analyzed a subset of the public database's data, only including United States law enforcement officer deaths that occurred between March 2020 and December 2022. This dataset was kept in Excel format, and the independent and dependent variables were recoded for statistical analysis.

The dependent variable of law enforcement deaths was operationalized as a binary, categorical variable coded as 1 for SARS-CoV-2 related deaths and 0 otherwise. The independent variable of geographic region of death was operationalized as a categorical variable with four levels (Northeast, Midwest, South, and West), coded as 1,2,3 and 4, respectively. The independent variable of year of death was operationalized as a nominal, categorical variable with three levels (2020, 2021, and 2022).

Research Questions

The following research questions were analyzed in this study:

RQ1: Is there an association between the geographic region of death and United States law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related) reported between March 2020 and December 2022 while controlling for officer rank, age, and sex?

H_o1 –There is no association between the geographic region of death and United States law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related) reported between March 2020 and December 2022 while controlling for officer rank, age, and sex.

H_a1 –There is an association between the geographic region of death and United States law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related) reported between March 2020 and December 2022 while controlling for officer rank, age, and sex.

RQ2: Is there an association between the year of death and United States law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related)

reported between March 2020 and December 2022 while controlling for officer rank, age, and sex?

H_o2 –There is no association between the year of death and United States law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related) reported between March 2020 and December 2022 while controlling for officer rank, age, and sex.

H_a2 –There is an association between the year of death and United States law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related) reported between March 2020 and December 2022 while controlling for officer rank, age, and sex.

Statistical Tests. This study utilized multivariable logistic regression as the primary statistical analysis method to examine the association between the independent variable of United States law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related) and the independent variables of geographic region and year of death.

Analysis of RQ1. A multivariable logistic regression analysis addressed RQ1, which examined the association between United States law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2) and geographic region of death. The independent variable was operationalized as four levels (Northeast, Midwest, South, and West), and the demographic covariates (officer rank, age, and sex) were accounted for.

Analysis of RQ2. A multivariable logistic regression analysis addressed RQ2, which examined the association between United States law enforcement officer deaths

(SARS-CoV-2 and non-SARS-CoV-2) and year of death. The independent variable was operationalized as three levels (2020, 2021, and 2022), and the demographic covariates (officer rank, age, and sex) were accounted for.

Assumption Assessment. In the analysis of both RQ1 and RQ2, several assumptions were assessed to ensure the validity and reliability of the statistical analyses. These assumptions included linearity of relationships, where correlation coefficients were examined. The independence of observations was also met by having each reported United States law enforcement officer death treated as a separate or independent event. Multicollinearity was also evaluated to verify no significant correlations among the independent variables using SPSS collinearity diagnostics.

Violation Actions. If significant multicollinearity were detected, the variable/s responsible would be efficiently detected. Specific actions that could be taken included the removal of the correlated variable/s or the retainment of the variable/s while acknowledging the potential multicollinearity in the interpretation of the results.

Covariate Inclusion Rationale. The rationale for including the three covariates of officer rank, age, and sex in the analysis is grounded in each of their potential to confound the relationships between the independent variables in each research question (geographic region and year of death) and the dependent variables (SARS-CoV-2 and non-SARS-CoV-2, other duty-related deaths). Including sex as a covariate was essential as it accounted for potential biological differences and susceptibilities. The inclusion of age as a covariate was also necessary as it accounted for age-related factors and variations, including, but not limited to, physical health, experience, and training, which

could contribute to officer fatalities. The inclusion of officer ranking as a covariate addressed the potential influence of specific roles and responsibilities and the exposures and risks that may come with each within the United States law enforcement agencies on fatality rates. The inclusion of these covariates also promotes workplace equity in the form of improving the design and implementation of effective interventions.

Interpretation of Results. Results were interpreted through the examination of adjusted odds ratio, CIs, p-values, and other relevant statistical measures in the descriptive statistical summaries. These interpretations provided insights into the relationships between the independent and dependent variables, allowing for the broad assessment of the research questions and hypotheses.

Threats to Validity

By addressing the following three threats to validity, the findings from this study were enhanced in credibility, robustness, and overall quality, allowing for a more accurate assessment of the association between the independent and dependent variables.

Quality of Primary Research

This study required addressing the reliance on secondary data. This reliance on secondary data subjects the results to potential limitations stemming from the quality of the primary research, including the methodology (inclusion and exclusion criteria and death reporting verification) used by the NLEOMF's research staff. Since the data used in this study was derived from secondary sources, it was crucial to acknowledge the inherent limitations associated with the initial data collection process. Additionally,

caution was exercised in interpreting the findings, recognizing the potential limitations associated with the secondary data.

Death Reporting

Accurate and complete reporting of law enforcement officer deaths from the corresponding departments was essential for the validity of the findings. This study acknowledged the potential threat to validity arising from inconsistencies or inaccuracies in death reporting across various sources or jurisdictions that could not be addressed by the NLEOMF's research staff. This study documented any limitations or discrepancies encountered during the data collection process to provide transparency and acknowledge potential sources of bias.

SARS-CoV-2 Progression

It was essential to recognize that the management, mitigation, and prevention efforts for COVID-19 may have varied across jurisdictions, leading to potential differences in the reported cases and outcomes. Moreover, variations in education, awareness, and available resources within law enforcement departments could have impacted the response to COVID-19. To mitigate this threat, this study utilized the years of deaths reported as a proxy for COVID-19 progression and variant emergence. This study also captured any potential associations between the timing of deaths and the evolving nature of the pandemic. Additionally, the researcher remained current with the latest research and public health information available between March 2020 and December 2022 to contextualize this study's findings and provide a comprehensive understanding of the impact on law enforcement officer deaths.

Ethical Procedures

To ensure the protection of law enforcement officer confidentiality and maintain the integrity of the data, identifying information (legal first and last name, as well as suffix) was removed from the dataset, allowing the dataset to be anonymized. The dataset was also stored securely in a password-protected electronic format; no physical copies were ever stored. As requested by the executive director of the NLEOMF, confidentiality of the data was strictly adhered to, where access to the dataset was limited solely to the researcher and was not shared with any other individual or institution. Use of the data was only allowed for the purpose of this study. Following the completion of this study, the dataset was permanently and irretrievably removed from researcher access.

Summary

A cross-sectional, quantitative data analysis of a secondary dataset was conducted to understand the association between United States law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related) and the geographic region as well as the year of death. This study's dataset was obtained from the NLEOMF's public database, which provided empirically supported data on United States law enforcement officer deaths. Inclusion of demographic variables (officer rank, age, and sex) ensured consideration of potential confounding factors. This study's methodology, including the sampling and sampling procedures employed by the NLEOMF's research staff, also contributed to the dataset's validity and reliability. The constructs of interest (geographic region of death, year of death, and types of United States law enforcement officer deaths) were recoded for data analyses. The findings of this study contribute to the existing

knowledge in the field of law enforcement and public health, potentially leading to the understanding of the impact of SARS-CoV-2 and its evolution throughout the pandemic timeline on United States law enforcement, which can, in turn, create further discussion on public health actions and resources needed for this population to address infectious diseases.

Section 3: Presentation of the Results and Findings

Introduction

The purpose of this study was to examine the association between United States law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related) and geographic region as well as year of death, while controlling for the demographic variables of officer rank, age, and sex. As confirmed by the literature review, law enforcement officers serve as frontline essentials workers, proven to be statistically more at risk of contracting SARS-CoV-2 (Crane and Richardson, 2021; Chiu et al., 2019; Godderis et al., 2020; Pasqualotto et al., 2021; Shrestha et al., 2021; Thompson, 2022; Violanti et al., 2022; Wilson & Anderson, 2022; Yang et al., 2021). This quantitative, secondary data analysis of a public data set (collected through a cross-sectional design) utilized multivariable logistic regression as the primary statistical analysis tool to answer both research questions. This section provides an overview of this study's data collection process, statistical analyses, and graphic depictions to illustrate findings and summarize this study.

Pre-Data Analysis Process

Data Collection and Cleaning of Secondary Data Set

The NLEOMF provided a public database of United States fallen officers that is annually reviewed, approved, and published on the website as well as in the physical memorial; the specific data set of fallen law enforcement officers taken between March 2020 and December 2022 was also accessible via the public database but was directly provided by the executive director of the NLEOMF. This data set was a protected Excel

sheet that contained all the needed variables for this study (rank, sex, age, state, date of death, and primary reason/circumstance of death). The data set also included full/legal name of the fallen officers (last name, first name, and suffix), which was immediately removed to protect officer anonymity. Before addressing the research questions, the dataset had to be coded based on the dependent and independent variables. SARS-CoV-2-related deaths were coded as 1, and other non-SARS-CoV-2-related deaths were coded as 0. The independent variable of geographic region of death was coded as 1,2,3,4 based on the four levels (Northeast, Midwest, South, and West) and the independent variable of year had three levels (2020, 2021, and 2022) and was operationalized as a nominal categorical variable. The dataset only included reported deaths marked as of March 2020, when the World Health Organization (WHO) officially declared COVID-19 a pandemic (World Health Organization, 2020). The data set also defined December 2022 as the ending timeline for reported deaths.

Data Analysis

Overview of Statistical Analyses

Descriptive statistics were conducted for all the variables involved in the study. Frequency distribution [n (%)] of all the U.S. law enforcement officer deaths (SARS-CoV-2 vs. non-SARS-CoV-2 duty-related deaths) that occurred between March 2020 and December 2022 were generated based on the geographic region, year of death, officer rank, age, and sex using cross-tabs reporting the resulting Chi-square statistics, the degrees of freedom and p-value. Further inferential statistics using the multivariable logistics regression were performed to answer the specific research questions as follows:

RQ1: Is there an association between the geographic region of death and United States law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related) reported between March 2020 and December 2022 while controlling for officer rank, age, and sex?

H_o1 –There is no association between the geographic region of death and United States law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related) reported between March 2020 and December 2022 while controlling for officer rank, age, and sex.

H_a1 –There is an association between the geographic region of death and United States law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related) reported between March 2020 and December 2022 while controlling for officer rank, age, and sex.

RQ2: Is there an association between the year of death and United States law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related) reported between March 2020 and December 2022 while controlling for officer rank, age, and sex?

H_o2 –There is no association between the year of death and United States law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related) reported between March 2020 and December 2022 while controlling for officer rank, age, and sex.

H_a2 –There is an association between the year of death and United States law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-

related) reported between March 2020 and December 2022 while controlling for officer rank, age, and sex.

Descriptive Statistics

Table 4 and Figures 3-8 provided an overview of both causes of U.S. law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related).

All United States Fallen Officers (March 2020 to December 2022)

Demographics. During the pandemic period, there were 1,128 reported U.S. law enforcement officer deaths (see Table 4). The mean age of the total reported fallen officers was 48 (*SD* = 12), with ages ranging from 20 to 82. The majority (~ 92%) of registered fallen officers were male. The majority (>27%) of reported deaths served within the patrol and general officer ranks (see Table 4). Of the total reported fallen officers, 61% of the population served in the South region (see Table 4). The highest number of reported deaths (51%) were made in 2021 (see Table 4 and Figure 7).

Population 1 (SARS-CoV-2-Related Deaths)

Demographics. Out of the total 1,128 U.S. fallen officers, SARS-CoV-2-related deaths made up over 61%, with 693 total reported officers (see Table 4). The largest age group of this population was 50-59, composing over 42% of the total (see Table 4 and Figure 3). The majority (92%) of reported fallen officers were male (see Figure 4). The majority (>25%) of reported deaths served within the leadership and management rank (see Table 4 and Figure 5). Of the total reported fallen officers, over 61% of the population served in the South region (see Table 4 and Figures 6 and 8). The highest number (51%) of reported deaths occurred in 2021 (see Table 4 and Figure 7).

Population 2 (Non-SARS-CoV-2-Related Deaths)

Demographics. Out of the total 1,128 fallen officers, non-SARS-CoV-2-related deaths made up less than 39%, with 435 total reported officers (see Table 4). The largest age group of this population was the 30-39 age group, composing over 25% of the total (see Figure 3). The majority (~92%) of reported fallen officers were male (see Figure 4). The majority (>41%) of reported deaths served within the patrol and general officer ranks (see Table 4 and Figure 5). Of the total reported fallen officers, over 51% of the population served in the South region (see Table 4 and Figures 6 and 8). The highest number (~40%) of reported deaths were made in 2021 (see Table 4 and Figure 7).

Table 4

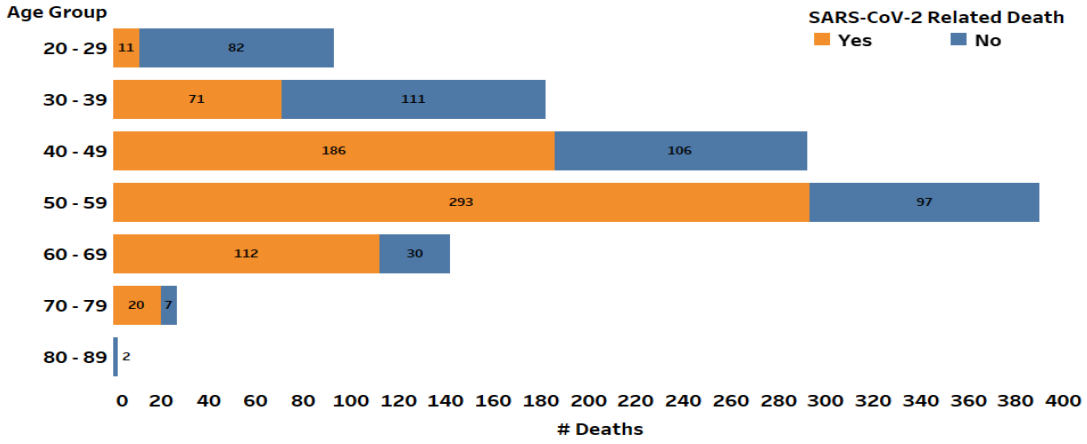
A Summary of U.S. Fallen Officers Reported Between March 2020 and December 2022

Characteristics	All fallen officers (n = 1128)		SARS-CoV-2 deaths (n = 693)		Non-SARS-CoV-2 deaths (n = 435)		x^2	df	p-value
	n	%	n	%	n	%			
Sex									
Male	1036	91.8	634	91.5	402	92.4	0.16	1	0.307
Female	92	8.2	59	8.5	33	7.6			
Age Group									
20 – 29	93	8.2	11	1.6	82	18.9	78.29	6	< .001
30 – 39	182	16.1	71	10.2	111	25.5			
40 – 49	292	25.9	186	26.8	106	24.4			
50 – 59	390	34.6	293	42.3	97	22.3			
60 – 69	142	12.6	112	16.2	30	6.9			
70 – 79	27	2.4	20	2.9	7	1.6			
80 – 89	2	0.2	0	0	2	0.4			
Rank Groups									
Correctional officers	116	10.3	107	15.4	9	2.1	65.71	6	< .001
Court and detention officers	46	4.1	34	4.9	12	2.8			
Investigators and detectives	78	6.9	43	6.2	35	8.1			
Leadership and management	289	25.6	179	25.8	110	25.3			
Patrol and general officers	314	27.8	134	19.3	180	41.4			
Specialized roles	139	12.3	105	15.2	34	7.8			
Supervisors and sergeants	146	12.9	91	13.1	55	12.6			
Region									
Midwest	140	12.4	74	10.7	66	15.2	72.98	3	< .001
Northeast	157	13.9	83	12	74	17			
South	686	60.8	462	66.7	224	51.5			
West	145	12.9	74	10.7	71	16.3			
Year of death									
2020	365	32.4	240	34.6	125	28.7	109.87	2	< .001
2021	575	51	403	58.2	172	39.5			
2022	188	16.7	50	7.2	138	31.7			

Note. Degrees of freedom (df) were calculated based on the number of categories within each characteristic (minus 1), and p-values indicate significance level, where statistical significance was set at a p-value of 0.05.

Figure 3

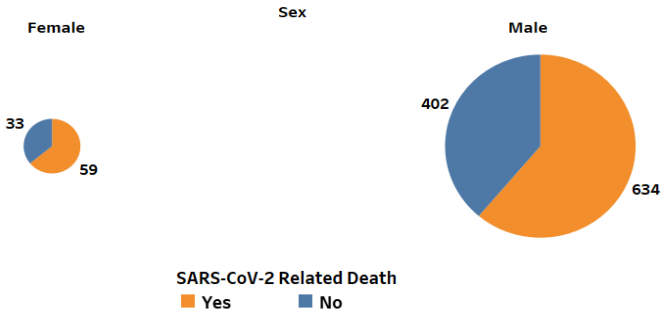
A Summary of Age Distribution Among United States Fallen Officers



Note. The graph depicts that the highest count of United States fallen officers with SARS-CoV-2-related deaths were within the 50-59 age group, with a total of 293 reported deaths. Non-SARS-CoV-2, other duty-related deaths had the highest count within the 30-39 age group, with 111 reported deaths.

Figure 4

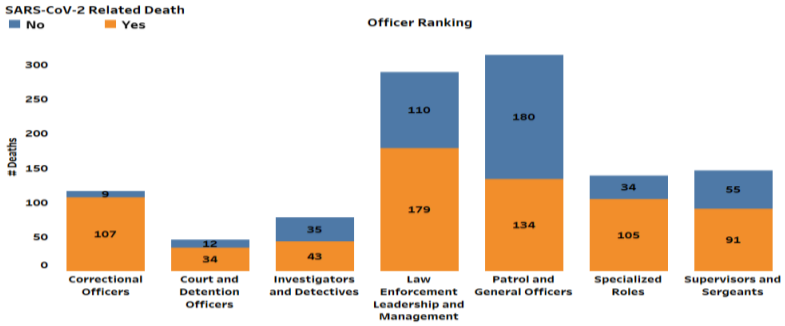
A Summary of Sex Distribution Amongst United States Fallen Officers



Note. The pie charts demonstrate that SARS-CoV-2-related deaths composed the majority of the reported deaths (61%), and within the dataset, males were the majority sex in both SARS-CoV-2 and non-SARS-CoV-2, other duty-related deaths.

Figure 5

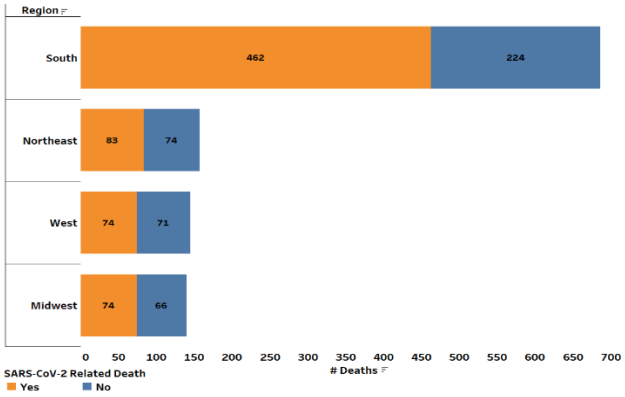
A Summary of Rank Distribution Among United States Fallen Officers



Note. The stacked bar charts demonstrate that SARS-CoV-2-related deaths composed the majority of the reported deaths (61%). Among the SARS-CoV-2-related deaths, the majority (179 total officers) were from the law enforcement leadership and management rank, while the majority of non-SARS-CoV-2-related deaths (180 total officers) were from the patrol and general officer rank.

Figure 6

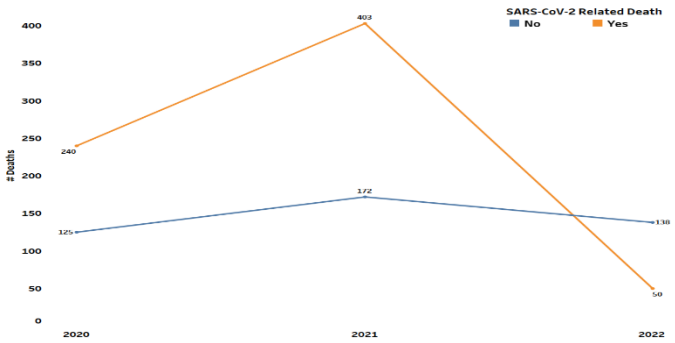
A Summary of Geographic Distribution Among United States Fallen Officers



Note. The stacked charts represent the geographic distribution of U.S. fallen officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related). This summary indicates that the majority (61%) of reported deaths occurred in the South region of the United States.

Figure 7

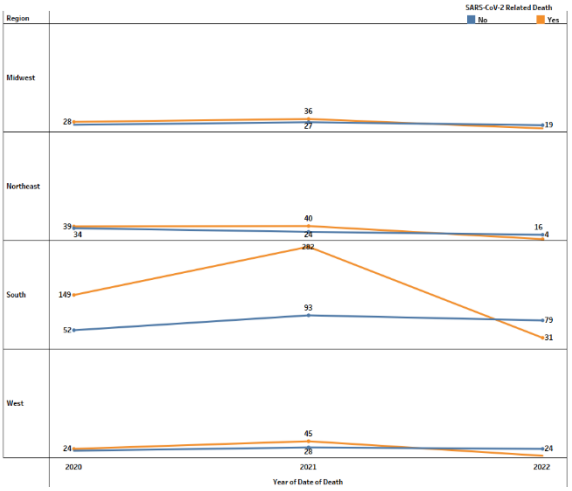
A Summary of United States Fallen Officer Deaths Reported Between March 2020 and December 2022



Note. The line graphs represent the yearly distribution of reported US law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related). This summary indicates that most (51%) reported deaths occurred in 2021.

Figure 8

Year and Geographic Region Distribution of U.S. Law Enforcement Officer Deaths



Note. The line charts represent the year and region distribution of reported US law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related). This summary confirms that the majority (61%) of reported deaths occurred in the South region and during 2021 (51%).

Assumption Check

In the analysis of both RQ1 and RQ2, several assumptions were assessed to ensure the validity and reliability of the statistical analyses. These assumptions included verifying the linearity of relationships, where the independence of observations was met by having each reported United States law enforcement officer death treated as a separate or independent event. Multicollinearity was assessed to confirm the absence of significant correlations among the independent variables. The resulting collinearity statistics verified that there is no strong evidence of multicollinearity for the predictor variables in the model, as indicated by high tolerances (geographic region of death: 0.991, year of death: 0.991) and low Variance Inflation Factors or VIF (geographic region of death: 1.009,

year of death: 1.009), where the variables provide unique information in the model without substantial redundancy due to multicollinearity (see Table 5). These findings affirmed the reliability of the multivariable logistic regression model, suggesting that the included variables are not highly correlated, and each provides valuable, independent information in the analysis.

Table 5

Collinearity Statistics

Predictors	Tolerance	VIF
Geographic Region of Death	.991	1.009
Year of Death	.991	1.009

Dependent Variable: US law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related)

Note. The SPSS output indicates that the variables of geographic region of death and year of death have low levels of multicollinearity.

Model Fit

Incorporating model fit information was crucial to assess the performance and suitability of the multivariable logistic regression model. The SPSS analyses (see Table 6) revealed a significant improvement in model performance, as evidenced by the reduction in the -2 Log Likelihood from 668.314 (intercept only) to 468.583 (final model). The Likelihood Ratio tests further corroborate this improvement, with a significant chi-square value of 199.732 (*df=6, p<.001*). The goodness-of-fit tests uncovered some inadequacy in model fit, as evidence by significant Pearson chi-square (*309.266, df=167, p<0.001*) and deviance chi-square (*280.381, df=167, p<0.001*). Higher Pseudo R-Square values indicate better model fit and greater explanatory power.

The analyses suggested that the model provides some degree of explanation for the outcomes, while still highlighting opportunities for improvement (*Cox and Snell: 0.162, Nagelkerke: 0.220, McFadden: 0.133*).

Table 6

Model Fit Information, Goodness-of-Fit, and Pseudo R-Squares

Model fitting information

Model	Model fitting criteria	Likelihood ratio tests		
	-2 Log Likelihood	Chi-Square	Df	Sig.
Intercept only	668.314			
Final	468.583	199.732	6	<.001

Goodness-of-fit			
	Chi-Square	Df	Sig.
Pearson	309.266	167	<.001
Deviance	280.381	167	<.001

Pseudo R-Square	
Cox and Snell	.162
Nagelkerke	.220
McFadden	.133

Note. The SPSS model fit statistics suggested that the model holds room for improvement.

Multivariable Logistic Regression

Multivariable logistic regression was conducted as the primary statistical analysis to investigate the association between the dependent variable of U.S. law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related) and the independent variables of geographic region of death as well as the year of death, while controlling for the demographic covariates of sex, age, and officer rank. An evaluation of the analyses was provided below:

Research Question 1: Geographic Region of Death

Multivariable Logistic Regression. The first research question is as follows: Is there an association between the geographic region of death and United States law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related) reported between March 2020 and December 2022 while controlling for officer rank, age, and sex? Upon running multivariable logistic regression analysis (see Table 7) with SARS-CoV-2-related deaths as the reference categories, the South region had a statistically significant association (*Adjusted OR-0.49, 95% CI [.333, .731], p<0.001),* suggesting lower odds of non-SARS-CoV-2-related deaths in that U.S. region compared to the West region. This rejects the null hypothesis, confirming association between the geographic region of death and United States' law enforcement officers' deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related) while controlling for officer rank, age, and sex.

Table 7

Multivariable Logistic Regression of Geographic Region of Death and U.S. Fallen Officer Deaths Reported Between March 2020 and December 2022

			95% C.I.	
SARS-CoV-2[a]	p-value	AOR	Lower bound	Upper bound
No				
Sex	.256	.752	.460	1.229
Rank	.016	.921	.861	.985
Age	< .001	.475	.420	.537
Region				
Midwest	.188	1.302	.800	2.118
Northeast	.907	.970	.584	1.611
South	**<.001**	.493	.333	.731
West	.	.	.	.

a. The reference category is Yes.
b. This parameter is set to zero because it is redundant.

Note. The SPSS output summarizes the analysis of the geographic region of death and US law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related) reported between March 2020 and December 2022 while controlling for officer rank, age, and sex.

Research Question 2: Year of Death

Multivariable Logistic Regression. The second research question is as follows: Is there an association between the year of death and United States law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related) reported between March 2020 and December 2022 while controlling for officer rank, age, and sex? Upon running multivariable logistic regression analysis (see Table 8) with SARS-CoV-2-related deaths as the reference categories, there was a significant association between COVID-related law enforcement deaths in the years 2020 (*AOR=0.24, 95% CI [0.16,0.37], p<0.001*) and 2021 (*AOR=0.17, 95% CI [0.11,0.25], p<0.001*) compared to

2022. This suggested the likelihood of SARS-CoV-2-related law enforcement officer deaths during the beginning of the pandemic period (2020 and 2021) when compared to 2022. This rejects the null hypothesis, confirming association between the year of death and United States' law enforcement officers' deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related) while controlling for officer rank, age, and sex.

Table 8

Multivariable Logistic Regression of Year of Death and U.S. Fallen Officer Deaths Reported Between March 2020 and December 2022

			95% C.I.	
SARS-CoV-2[a]	p-value	AOR	Lower bound	Upper bound
No				
Sex	.217	.756	.437	1.206
Rank	.038	.930	.868	.996
Age	< .001	.506	.447	.573
Year of death				
2020	**<.001**	.244	.161	.370
2021	**<.001**	.166	.112	.246
2022	.	.	.	.

a. The reference category is Yes.
b. This parameter is set to zero because it is redundant.

Note. The SPSS output summarizes the analysis of the year of death and US law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related) reported between March 2020 and December 2022 while controlling for officer rank, age, and sex.

Conclusion

Characteristic summary statistics revealed that the majority (61%) of deaths were SARS-CoV-2-related. Demographically, the South region and the year 2021 held the majority of deaths (61% and 51%, respectively). Multivariable logistic regression analyses revealed that the South region (*Adjusted OR-0.49, 95% CI [.333, .731], p<0.001)* and the years 2020 (*AOR=0.24, 95% CI [0.16,0.37], p<0.001*) and 2021 (*AOR=0.17, 95% CI [0.11,0.25], p<0.001*) held the highest statistical significance to SARS-CoV-2-related deaths. Analyses findings call for the rejection of the null hypotheses and acceptance of alternate hypotheses, indicating associations between US law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2) and the geographic region as well as the year of death while controlling for officer rank, age, and sex.

Section 4: Application to Professional Practice and Implications for Social Change

Introduction

This study was a quantitative approach to secondary data analysis of a public dataset (collected through a cross-sectional design) on officers' deaths from the NLEOMF and used multivariable logistic regression to investigate the association between U.S. law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related) and geographic region as well as the year of deaths reported between March 2020 and December 2022 while controlling for the demographic variables of officer rank, age, and sex. As underscored in the literature review, before and during the pandemic, law enforcement officers played a vital role as frontline, essential workers and have been proven to face elevated risks, especially in the context of SARS-CoV-2 as a communicable disease (Crane & Richardson, 2021; Chiu et al., 2019; Godderis et al., 2020; Pasqualotto et al., 2021; Shrestha et al., 2021; Thompson, 2022; Violanti et al., 2022; Wilson & Anderson, 2022; Yang et al., 2021). To delve deeper into understanding the complexities of the role of this infectious disease on reported fallen officer deaths, multivariable logistic regression analyses were conducted to address both research questions. While the characteristic summary highlighted SARS-CoV-2 deaths composing the majority (61%) of reported deaths between March 2020 and December 2022, multivariable logistic regression concluded that the South region (*Adjusted OR-0.49, 95% CI [.333, .731], p<0.001)* and the years 2020 (*AOR=0.24, 95% CI [0.16,0.37], p<0.001*) and 2021 (*AOR=0.17, 95% CI [0.11,0.25], p<0.001*) held the highest statistical significance to SARS-CoV-2-related deaths, when compared to their counterparts

(specifically reference categories of West region and 2022, respectively) thus allowing for both research null hypotheses to be rejected. This section further interprets the findings in the context of the research questions and practical implications in law enforcement and broader social change. In all, the results of the analyses shed light on the critical factors that have affected United States law enforcement officer deaths during the SARS-CoV-2 pandemic and contribute to key recommendations for this at-risk population and the communities they serve.

Interpretation of the Findings

Results were interpreted through the examination of descriptive statistics and multivariable logistic regression. These interpretations provided insights into the relationships between the independent and dependent variables, allowing for the rejection of both null hypotheses.

Demographic Considerations

On a demographic level, analyses revealed that sex did not play a statistically significant role in officer fatalities. This finding suggests that both male and female officers face a relatively similar risk of succumbing to SARS-CoV-2, which aligns with the shared workplace exposure that both genders encounter (Byrd et al., 2022). Officer rank emerged as a significant factor impacting fatalities, indicating that lower-ranking officers were notably less vulnerable than their higher-ranking counterparts. While existing literature underscored challenges in training and resource disparities affecting officers across all ranks during the pandemic (Crane & Richardson, 2021), studies that gauge infectious disease exposure risk among the different law enforcement officer

rankings are needed. The age of officers also held statistical significance, revealing that older officers were at a higher risk of COVID-19-related deaths. This highlighted the significant role age played in officer vulnerability to the virus, consistent with the Centers for Disease Control and Prevention's confirmation that older adults, specifically those aged 50 or older, faced a greater risk of infection and mortality from SARS-CoV-2 (Centers for Disease Control and Prevention, 2023).

Geographic Considerations

On a geographic level, demographic statistics and multivariable logistic regression analyses confirmed the presence of notable geographic disparities. Officers in the South region faced significantly higher odds of SARS-CoV-2-related deaths than non-SARS-CoV-2-related deaths (*Adjusted OR-0.49, 95% CI [.333, .731], p<0.001)* when compared to the West region. This pattern corresponds with the Centers for Disease Control and Prevention's (2023) yearly COVID-19 mortality mapping, which identified states in the South region as having the highest age-adjusted death rates in the country, while only a few states in the Northeast and Midwest regions experienced elevated death rates. These findings allowed for the rejection of the null hypothesis and drew attention to the regional disparities of the SARS-CoV-2 pandemic and its impact on law enforcement officers.

Temporal Considerations

Descriptive statistics and multivariable logistic regression confirmed a significant association between SARS-CoV-2-related law enforcement deaths in the years 2020 (*AOR=0.24, 95% CI [0.16,0.37], p<0.001*) and 2021 (*AOR=0.17, 95% CI [0.11,0.25],*

p<0.001) compared to 2022. These findings gain context when considering the Centers for Disease Control and Prevention's (2023) timeline of COVID-19-related events for those two years alone. In May 2020, only 2 months after the World Health Organization declared COVID-19 a pandemic, the United States still grappled with understanding the virus, implementing social distancing measures, and witnessing varying state responses (Centers for Disease Control and Prevention, 2023). September 2020 marked a period of international vaccine discussions and an increase in COVID-19-related deaths, coinciding with the start of flu season (Centers for Disease Control and Prevention, 2023). October to November 2020 saw updated guidelines recognizing airborne transmission, which may have impacted law enforcement practices and training (Centers for Disease Control and Prevention, 2023). September 2021 followed the Delta variant surge and increased public health measures, making it statistically significant, and March to April of 2022 followed the emphasis of Omicron BA.2 (as opposed to BA.1) variant among the population, with May of 2022 marking the month when the number of recorded United States SARS-CoV-2 deaths reached 1 million (Centers for Disease Control and Prevention, 2023). These findings allowed for the rejection of the null hypothesis and drew attention to the evolving nature of the pandemic and its impact on law enforcement officers.

Limitations of the Study

It is critical to consider that this study solely relied on the available dataset from the NLEOMF's database. The accuracy, completeness, and timeliness of the reported law enforcement officer deaths within the database and the analyzed dataset can vary across jurisdictions and departments. While the NLEOMF's research team has an intricate

verification and extensive researching process to validate the reported deaths, inaccurate and incomplete reporting risks remain and could have affected the findings. There is also a matter of limited generalizability, where the dataset analyzed is limited to the United States law enforcement population. Law enforcement work and procedures may also vary slightly across jurisdictions and departments, which may affect and restrict the applicability of the results to broader populations. While this study examined the association between United States law enforcement officer deaths (SARS-CoV-2 and non-SARS-CoV-2, other duty-related) and geographic region as well as year of death, this study's design did not entirely establish causality. Even though the collinearity statistics did not reveal compelling evidence of multicollinearity, it is essential to exercise caution in interpreting the results, other unmeasured factors or confounding variables could have influenced the observed associations. Despite controlling for the demographic variables of officer rank, age, and sex, there may still be residual confounding or unaccounted factors that could have impacted this study's findings (and could enhance the model's predictive power to better capture the complexity of the predictive variables), such as compliance with public health measures (Raciborski et al., 2020; Vierlboeck et al., 2020), PPE availability (Maskály et al., 2021; Simpson and Sandrin, 2021), variations in protocols and training (Crane & Richardson, 2021, Godderis et al., 2020), and an increase in workplace demands, as well as its complementary increase in levels of stress and workplace burnout (Vierlboeck et al., 2020). Socioeconomic factors, such as poverty rates, could have also affected these results, as regions with higher poverty rates may have increased exposure risk, especially when paralleled with the Centers for Disease

Control and Prevention's (2023) national surveillance reporting. Lastly, the fallen officers' underlying health conditions, vaccination rates, and their jurisdictions and departments could have also accounted for SARS-CoV-2 exposure. Even so, they were not captured in the NLEOMF's database and were not considered during this study.

Recommendations

Because of SARS-CoV-2's continued presence in society today, this study holds importance, and continued research can be regarded as highly significant and advantageous to the surveillance, prevention, and treatment of this communicable disease. Based on the findings and the noted limitations, future research in the field of law enforcement fatality and within the context of the SARS-CoV-2 pandemic should include continuing analyses post-2022, which can help to identify the existence of long-term trends, where geographic region and year of death may or may not hold the same significance once reassessed. Comparative studies can also be conducted to compare this particular population of frontline, essential workers with other frontline, essential workers, such as healthcare professionals and other first responders within the same variable constraints; this can aid in providing insight into whether region and year of death still hold significance, as well as open the research up to provide better insight into relative risks and protective measures. This study can even be expanded to law enforcement on an international basis with the same variables. It can also be compared with frontline, essential workers of international borders to further solidify trends and significance. Another set of studies that can be considered include the same dataset being analyzed but alongside vaccination information. While the NLEOMF does not verify nor

provide this information; collaborations with state departments of health could assist in providing the missing COVID-19 vaccination data, which can help to assess whether vaccination rates could have impacted the odds of SARS-CoV-2-related deaths among U.S. law enforcement officers. Similarly, the geographic scope can be expanded to explore geographic disparities of each region and the smaller divisions defined by the US Census Bureau (n.d.); future data can focus on the specific departments that the fallen officers served from and can help to investigate whether particular regions are more vulnerable than others. These future research recommendations aim to build upon the existing, and now slightly less limited, knowledge base and address critical gaps in understanding the factors influencing law enforcement officer mortality during the SARS-CoV-2 pandemic. By conducting further research in these areas, policymakers and stakeholders can develop evidence-based strategies to protect the health and safety of law enforcement personnel in the continued evolution of this communicable disease and future public health crises.

Implications for Professional Practice and Social Change

In alignment with the conceptual framework proposed by the National Academies of Sciences, Engineering, and Medicine (2020) as well as the literature review, implications for professional practice and social change include enhancement of law enforcement officer training protocols that include public health-related education, communicable disease awareness, and public health emergency preparedness and response. This would entail equipping officers with the necessary knowledge and skills to understand and prevent the spread of communicable diseases and effectively and safely

respond to public health emergencies by adequately using PPE and adherence to infection control measures. Simultaneously, advocating for standardized public health-based training in law enforcement academies can ensure that officers are well-prepared to protect themselves and the communities they serve during health crises. This implication highlights the second positive social change measure, where a long-overdue and much-needed collaboration between law enforcement agencies and public health departments and agencies is solidified to address health disparities among officers. This includes ensuring equitable access to healthcare resources, such as vaccinations and medical evaluations, with advocacy for health equity initiatives within the law enforcement community playing a pivotal role in reducing health disparities. Public health policies and procedures within law enforcement agencies must be evidence-based, especially amid public health crises; decisions related to resource allocation and distribution (such as PPE and vaccination) must be rooted in scientific research and best practices. Advocating for the development of more robust policies that prioritize United States law enforcement officer safety and health based on empirical data is essential. Continuous adaptation of SOPs in response to emerging health challenges can prove to be lifesaving, aligning with the conceptual framework proposed by the National Academies of Sciences, Engineering, and Medicine (2020). An example of tailored interventions and resource recommendations emphasizes implementing programs for older officers, especially during critical seasons and in high-risk regions. Interventions and the continued surveillance and research of this population can also consider the start of flu season and other respiratory disease trends (Centers for Disease Control and Prevention, 2023),

where actively supporting further studies can deepen the understanding of the challenges this at-risk population may face, which can inform future health-based strategies. Active community engagement can also be a critical aspect of positive social change, where fostering trust and cooperation with the communities served can enhance public compliance with health guidelines and emergency-based mandates and recommendations, contributing to better infectious disease prevention outcomes. Community education efforts can also lead to increased trust, cooperation, and support for the at-risk population, where civilians can stay informed on the challenges law enforcement officers face during public health crises and the importance of transparency and communication, as evidenced in the literature review (Maskály et al., 2021; Simpson & Sandrin, 2021; Yang et al., 2021).

Conclusion

When interpreted in the context of the literature review, conceptual framework, and noted scope and limitations, the findings provide valuable insights into the complex factors influencing United States law enforcement officer deaths reported between March 2020 and December 2022. These findings revealed significant disparities in the dimensions of geographic region and year of death of U.S. law enforcement officer mortality rates, with notable implications for practice and policy. Geographic disparities underlined the importance of tailored interventions and resource allocation to address regional variations in health outcomes; future impacts of health interventions must consider the unique challenges faced by law enforcement agencies in different regions, especially when addressing the threat of this and future communicable diseases. This

study reinforced the significance of empirical data-driven decision-making and the importance of transparent, complete, and accurate data reporting, as well as advocated for a comprehensive approach to protecting officer health and safety. To protect law enforcement officers effectively, agencies must prioritize research, specifically data collection, analysis, and dissemination, adhering to consistent case definitions and reporting standards, as advocated by the conceptual framework of the National Academies of Sciences, Engineering, and Medicine (2020), and as meticulously carried out by the NLEOMF's public database on United States law enforcement officer deaths. Future research should continue to explore the multifaceted factors influencing United States law enforcement officer deaths during the SARS-CoV-2 pandemic, including individual-level characteristics (vaccination and health conditions), organizational practices (SOPs, training, and assignments), and external influences (socioeconomic disparities and community compliance to public health measures). Research efforts should also focus on identifying innovative strategies to enhance officer safety and well-being during public health emergencies, including interdisciplinary collaboration between law enforcement and public health experts, as well as active community engagement and evidence-based policies within law enforcement agencies that prioritize officer safety and health based on evidence-based statistics and scientific research. Most importantly, this study reaffirmed the indispensable role that law enforcement officers, specifically United States officers, play in safeguarding communities, especially during public health emergencies. Their commitment to public safety is evident in their continued service amid heightened public health and other categories of risks, and this service deserves the

utmost recognition and support in the form of tailored public health measures and interventions that prioritize law enforcement officer health. There is a critical need for a multifaceted approach to protect and support frontline, essential workers. In doing so, law enforcement officers are protected, and communities' safety and well-being are enhanced. The findings and recommendations put forth in this study contribute to a growing body of knowledge that can inform policies, practices, and public health initiatives aimed at mitigating the impact of infectious disease disasters on law enforcement officers and the communities they protect.

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