A structural vulnerability approach to older adult suicides: Trends and potential impacts of the COVID-19 pandemic in Clark County, NV (2017–2021)

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ABSTRACT

The ongoing SARS-CoV-2 (COVID-19) pandemic has affected all aspects of life in the United States and around the world. This is particularly true for marginalized and vulnerable groups who face disproportionate levels of violence and premature death within their communities. While general impacts of the pandemic have been well-studied overall, little has been done to examine the correlation between COVID-19 and the risk of suicide among older adults. Older adults are particularly at risk because they face challenges including ageism, inadequate support systems, unreliable transportation, and frequent social isolation. Medicolegal casework offers a unique vantage of these issues, as it aims to identify manner of death which may be influenced by underlying structural vulnerabilities. The current research draws upon data collected from the Clark County Office of the Coroner/Medical Examiner. A sample of 871 older adults (aged 50+), whose manner of death was deemed a suicide between the years 2017–2021, were included in this analysis. Statistical analyses investigated differences between adults aged 50–64, 65–84, and 85+ years. Results suggest statistically significant changes in mechanism of death between pre-pandemic and pandemic periods, indicating a shift in risk factors related to social isolation and the home environment. Understanding such changes in trends directly affects the interpretation of skeletal data in forensic anthropology and thus, should be taken into consideration when developing structural vulnerability profiles. Furthermore, the inclusion of a structural vulnerability approach in forensic case reports has the potential to provide additional context for deaths by suicide and may help develop policies and procedures for mitigating future risk.

1. Introduction

The concept of structural vulnerability is beginning to gain traction within the realm of forensic anthropology following a number of studies highlighting its applicability to medicolegal casework (e.g. this special issue). Recently, Winburn and colleagues [1] proposed the structural vulnerability profile (SVP), which would complement the biological profile by encouraging practitioners to consider skeletal biomarkers of inequity from the perspective of systemic marginalization. While opportunities for applying SVPs within forensic anthropological casework are apparent, the authors of this paper echo sentiments expressed by others in this special issue: contextual information is important when generating effective SVPs (see Ref. [2], this issue). Here, a regional example of suicide trends observed among older adults during the

SARS-CoV-2 (Coronavirus, COVID-19) pandemic is presented as an example of how such contextual information can provide guidance on the use of "early death" as a biomarker of inequality.

Winburn and colleague's [1] use of the term "early death" references both neglect of preventable or manageable conditions and premature mortality as the result of violence. While some might hesitate to consider the deaths discussed in this paper to be premature, we recommend consideration of the ageist undertones of such beliefs. Furthermore by definition, deaths by suicide occur earlier than would be considered natural and involve violence against oneself, and thus should be viewed as early or untimely deaths regardless of the age at which they occur. Arguments against such an interpretation (1) further support our assertion that older adults receive relatively little attention in both public health and forensic science research [3,4] and (2) raise questions

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as to who is counted or considered as a grievable life [5].

The latter point is viewed within the necropolitical conditions of a *state of acceptance* — a concept drawn from the *necropolitics* of Mbembe [6] and *slow violence* of Nixon [7] (see 8), — meaning that when weighing economics versus certain lives, older adult bodies are often considered as acceptable losses. In contrast, slow violence is less bound and focuses on the gradual layered deposits of everyday violence that occur out of sight [7,8]. During the COVID-19 pandemic, for example, a state of acceptance that certain (more) vulnerable peoples would die emerged through slow violence [8]. The addition of the cultural taboo of suicide further frames these individuals represented in this paper as less livable, and thus, less grievable [9].

When thinking of the necropolitical [6–8] conditions that inscribe which lives are more vulnerable, one can draw parallels with Judith Butler's conceptualization of precarious life. Butler's use of precarity as a universal category recognizes that while vulnerability to the other is a part of bodily life, there is differential exposure to violence and death. Thus, there is a disparate distribution of precariousness and grievability [9]. While the theoretical minutiae are beyond the scope of this paper [10], Butler's use of precarious life reflects an effort to develop an ethical response to contemporary forms of normative violence, a sentiment held by the present authors [9].

Many medicolegal practitioners already collect information in their existing reporting infrastructure that pertains to whether or not a decedent experienced structural vulnerability. A subsection of the full list of biomarkers relevant to assembling an SVP are already collected as vital data during routine examination of decedents. However, the process of integrating a structural vulnerability approach into forensic anthropological casework should be dialectical, informed by public health data that highlights structural inequalities experienced by particular groups in life and which subsequently influence their risk of early death [1]. In turn, forensic anthropological casework offers the potential to contribute to "the conversations" that concern the local iterative subject of vulnerable or precarious life [9]. It is important that applied anthropologists are careful with the use of concepts such as structural vulnerability. That is, we must be aware of the implications and make choices that do not label or stigmatize those who are entrusted in our care [11].

The goals of this study were to draw explicit attention to older adults as a vulnerable group and to highlight the utility of public health data in the formulation of developing an effective structural vulnerability approach in forensic science. The data collected explore the potential correlation between dramatic life changes (e.g. social isolation and fear) associated with the COVID-19 pandemic and older adult suicide deaths. It was hypothesized that stress and social isolation exacerbated by the pandemic would result in increased rates of death by suicide, and that mechanisms of death by suicide would differ among pre-pandemic and pandemic samples. Understanding such changes in trends directly affects the interpretation of skeletal data in forensic anthropology and thus, should be taken into consideration when developing structural vulnerability profiles.

1.1. Structural vulnerability

What is meant when *vulnerability* is used in academic discourse? Virokannas and colleagues [12] describe two predominant schools of thought in social science literature which align with prominent legal scholar and philosopher Jonathan Herring's [13] conceptualization of vulnerability. The first and most dominant partiality defines certain people or groups as vulnerable; whereas the second school emphasizes a concept of mutual or shared universal vulnerability [12,13]. The claim that everyone is vulnerable/precarious is different from the claim that everyone is *equally* vulnerable/precarious; meaning that the enhanced vulnerability of an individual or group is the result of state resource allocation, rather than some innate or inherent feature [14]. Essentially, a universal concept of vulnerability shifts the focus away from

attributing vulnerability to groups and individuals and toward understanding mechanisms that contribute to social inequality. In framing vulnerability in this manner, we may be better positioned to influence public policy to prevent such inequalities moving forward.

A structural vulnerability approach offers a means to consider underlying structural inequalities that leave individuals vulnerable to acts of violence or oppression. For instance, it considers factors such as financial security, environmental risks, social networks, and discrimination [14], all of which are concerns for the older adult population within the United States (U.S.). Older adults are a historically understudied population [3,4] experiencing health disparities due to structural vulnerabilities [15]. The effective application of a structural vulnerability approach requires extensive knowledge of how underlying vulnerabilities change over time in direct response to the environment and the effect that these changes may have on our interpretations of skeletal data. An interdisciplinary approach utilizing public health data presents opportunities to explore the underlying intricacies of structural violence that are necessary to inform forensic anthropological research. Consequently, older adults' experiences with COVID-19 are an avenue for forensic anthropologists to reveal important insights into the impact of global health crises on decidedly vulnerable groups [16].

While this paper is focused on a specific group often labeled as 'vulnerable', the present study operates under the condition of universal vulnerability within a specific historical, geographic, and sociocultural/political context and explores the way in which vulnerability is differentially experienced. While at first a universal-based approach to vulnerability might seem antithetical to this special issue's presumptive shared goal of exposing and mitigating "[A]n individual's or a population groups' condition of being at risk for negative health outcomes through their interface with socioeconomic, political and cultural/normative hierarchies" [[14] (chart 1)], conceptualizing the human condition as one of universal and continuous vulnerability may better satisfy our shared scientific and ethical goals of moving beyond biological determinist modes of explanation.

1.2. Forensic anthropology and structural vulnerability

First introduced by medical anthropologists [14, 15], structural vulnerability was later utilized by Beatrice and Soler [16] to explore how vulnerabilities of decedents believed to be unidentified migrants from Central America were reflected within their skeletal remains. Subsequently, this study inspired conference presentations highlighting structural vulnerability, publications including *The Marginalized in Death: A Forensic Anthropology of Intersectional Identity in the Modern Era* [17] and the article introducing the SVP [1]. Winburn and colleagues [1] advocate for employing the SVP in order to obtain a more holistic understanding of the individuals analyzed in forensic work. However, this has yet to be implemented into anthropological standard practice and remains a topic of ongoing discussion.

Several papers in this issue highlight the advantages of the SVP and advocate for the incorporation of structural vulnerability approaches to forensic anthropological assessments [18, 19]. However, the limitations and risks related to current anthropological methods for incorporating structural vulnerability [20, 21] are also made clear. We echo many of the concerns raised in these papers, as they outline limitations in applying this work to forensic anthropology casework and research.

Widespread use of the structural vulnerability profile enables anthropologists to challenge traditional biases and oversights in the field. Recent literature has critiqued the SVP as perpetuating marginalizing social categories. Reineke and colleagues [21] critique the SVP specifically, noting that the use of a "profile" as an inclusion/exclusion criteria for lived vulnerability risks unnecessary categorization and potential harm as a result of such categorization. With this, they discuss the importance of incorporating "contextual information—historical, sociopolitical, environmental, local, case-specific—with the biological expression of pathological conditions" [21].

Without considering context alongside skeletal evidence, we risk minimizing the impacts that forensic anthropological analyses have on medicolegal cases, cultural stigma, and legislation [21]. Gruenthal-Rankin and colleagues [2] voice similar concerns, noting that structural vulnerability approaches and assessments may further stigmatize deceased individuals who lived as members of vulnerable groups. While they continue to advocate for biocultural assessments in forensic anthropology casework and research, they do not advise doing so without 1) catering to an array of stakeholders; 2) evaluating the assessment for potential harm; and 3) integrating contextual data. We echo these sentiments, encouraging forensic anthropologists to incorporate contextual data based on public health research to supplement findings from skeletal remains.

The research presented here utilized data from the Clark County Office of the Coroner/Medical Examiner (CCOCME) in southern Nevada to identify death by suicide trends amongst older adults between the years 2017 and 2021 before and during the first year of the COVID-19 pandemic. In assessing these data, the application of a structural vulnerability approach enabled better understanding of older adults' susceptibility to death by suicide when compounded with additional risks introduced by the COVID-19 pandemic. Understanding suicide amongst vulnerable groups can help forensic anthropologists to better understand mortality trends, a key element in forensic anthropology praxis. Furthermore, public health data, such as the medicolegal/mortality data used in this study, has the potential to elucidate trends that may be missed when using anthropological datasets alone, bridging the gap between forensic and clinical approaches to death investigation. By considering population-level trends in suicide deaths as potential indicators of underlying vulnerability, knowledge of suicide is bettered and key insight is provided into the effects of global health crises on local mortality trends. Understanding suicide amongst vulnerable groups can help forensic anthropologists to better understand these mortality trends, a key element in forensic anthropology praxis.

1.3. The COVID-19 pandemic and suicidality

In many countries, suicide is a stigmatized global health issue with serious physical, emotional, and financial repercussions for society as a whole [22]. Determining suicide risk factors is a difficult task, especially during global crises such as the COVID-19 pandemic. Typically, risk factors for suicide include mental illness, unemployment, low income, single marital status, and a family history of suicide [23]. However, suicide rates are not evenly distributed across vulnerable groups [24]; they vary by age, assigned sex, gender, race, and other factors. While a multidisciplinary topic of research, the impact of COVID-19 on older adult suicides remains to be determined. At the time of this article's writing, the COVID-19 pandemic is an ongoing issue being researched across multiple disciplines (e.g., public health, epidemiology, and psychology) [25]. Although the relationship between COVID-19 and suicide risk has been a topic of interest since the beginning of the pandemic [26, 27, 28], few studies have specifically explored suicide risks specific to older adult populations during this time [29, 30, 31].

The COVID-19 pandemic exacerbated loneliness and social isolation experienced by older adults (i.e., individuals over 50 years old). Older adults tend to have additional comorbidities (e.g. arthritis, cancer, chronic obstructive pulmonary disease, heart disease, chronic pain, neurological disorders, functional disabilities, diabetes mellitus, etc.) that put them at greater risk during global health crises [4,32]. Protective measures, such as social isolation, were therefore critical among this age demographic during the COVID-19 pandemic [33]. However, this may have also exacerbated ageism and feelings of loneliness and anxiety already experienced by older adults [33–35], putting them at increased risk of death by suicide.

Social distancing and other measures to mitigate the spread of COVID-19 had collateral consequences, such as individuals facing higher levels of mental and physical health problems [14,15]. This was not randomly experienced during the peak of the pandemic [36]. As outlined by Solis and colleagues [37], the COVID-19 pandemic rippled through societal cracks, expanding these divides further by means of increased morbidity and mortality. Three structurally vulnerable groups were identified as being severely impacted by COVID-19: 1) those in nursing homes and long-term care facilities; 2) minority groups with underlying health conditions; and 3) those detained in correctional facilities [37,38]. Besides the short-term consequences, there are long-term ramifications in regards to pandemics and mental health [39]. This correlation between deteriorating mental health and pandemics in at-risk groups has been referred to as a "dual pandemic" wherein an increase in suicidality coincides with these events [40].

Research on suicidality during the COVID-19 pandemic is an ongoing process. Among those studies that have been published, Ehlman and colleagues [41] and the National Institute of Health [42] reported that overall suicide rates decreased between 2019 and 2020 following a dramatic increase between 2017 and 2018 [43]. Studies regarding subsequent changes in suicide trends during the COVID-19 pandemic provide variable results depending on region of focus. For example, a meta-analysis of 308,596 participants between 54 studies concluded that suicidal ideation, nonfatal suicidal acts, and self-harm increased overall during the COVID-19 pandemic [14]. However, a study examining temporal trends of suicide rates based on age groups during the pandemic in Taiwan found an initial decrease in the early months followed by an increase in suicide rates among older individuals [44]. Another study analyzing suicide mortality in Japan found a similar temporal trend in the general population [45], but they observed an increase in females and young-adult suicide mortality in the later parts of the pandemic as opposed to stable rates in males and older adults. Thus, having more regional-level data on suicide mortality is vital to understanding temporal trends of who are most vulnerable.

1.3.1. Older adults as a structurally vulnerable group

The quality of available data regarding suicide risk and mortality, in general, is relatively poor. This is true of most mortality data, but because suicide is a socially sensitive topic, it is particularly susceptible to misclassification bias and underreporting [46]. The application of a structural vulnerability approach has the potential to help identify those individuals who are most at risk of early death, including death by suicide. This is especially true for older adults, who may face discrimination, including ageism, or discrimination against an individual on the basis of their age [47,48]. Additionally, older adults who die by suicide may have experienced accelerated aging processes [49, 50] related to the intersection of poor mental and physiological health, potentially impacting skeletal age-at-death estimation [51].

Older adult suicides are an important demographic to consider as a population traditionally at higher risk. Suicidal ideation is detected less frequently and often later in its progression among older adults compared to younger individuals [52–54]. Older adults typically have lower rates of diagnosed depression than younger adults and tend to seek care from primary care physicians rather than mental health experts, potentially resulting in missed mental health diagnoses [55,56]. It has also been suggested that suicide amongst older adults is associated with less violent means of death and fewer warning signs of suicidal intent [57]. Adults over the age of 65 constitute one of the most at-risk groups for suicide, with an age-adjusted death rate of approximately 17.69 per 100,000 as of 2021 [58]. That same year (2021), suicide rates were higher among adults ages 75–84 years (19.56 per 100,000), with the highest rate among adults ages 85 years or older (22.39 per 100,000). Before the COVID-19 pandemic, this higher risk had been attributed to greater instances of multiple comorbidities, hopelessness, and social isolation [55,56].

Additionally, older adults are at an increased risk of suicide when suffering from chronic conditions. Some of these conditions, like osteoarthritis, leave visible skeletal markers that can be critically examined alongside material evidence (e.g. presence of pain management tools) to

contextualize the potential role of chronic pain in death of a decedent [59]. Older adults also experienced many lifestyle changes throughout the COVID-19 pandemic, as a result of quarantine and/or hospitalization, which led to a reduction in physical activity and dietary changes [60]. This form of isolation associated with the pandemic meant that many older adults suffered from muscle atrophy and decreased bone density, which can also be evidenced from the skeletal remains of these individuals [60]. One such example is osteoporosis, which can lead to differential preservation of the skeletal remains (i.e., fewer skeletal elements to analyze).

The initial dismissal of pandemic guidelines by younger individuals had ageist undertones [61]. Ageism, coupled with social stigma experienced by those affected by COVID-19, may have contributed to an added risk of suicide among older adults [26]. For example, younger individuals disregarding stay-at-home orders and mask mandates perpetuated the ageist perspective that older adults are burdens and largely to blame for societal problems [61]. Discriminatory healthcare practices were among the most concerning issues involving older adults during the COVID-19 pandemic [61]. The rationing of resources within the U.S. during the pandemic prioritized individuals perceived to have the most potential life-years to live, negatively impacting older adults in favor of younger, presumably less-susceptible, individuals [61,62].

The current research presents a regional analysis of suicides occurring between 2017 and 2021 among the older adult population in Clark County, Nevada. According to the U.S. Census Bureau [63], as of April 1, 2020, approximately 3,100,000 people resided in Nevada, between 2010 and 2020, of which approximately 16.5 % were over the age of 65 years. The majority of these older adults reside within Clark County in southern Nevada [64]. Importantly, as of 2020, approximately 41.8 % of adults aged 65 and older in Clark County lived alone [63,64]. As is seen in Table 1, according to the US Census Bureau, Clark County's older adult population primarily self-identified as White, with those self-identifying as Asian as the second most common racial category.

Suicide in older adults is significantly higher in Nevada, which ranks 8th in the US as the leading cause of death with an age-adjusted rate of 21.6 per 100,000 individuals versus 14.1 nationally in 2021 [65,66]. In 2020, the age-adjusted rate in Nevada was 30.7 deaths by suicide per 100,000 adults aged 65+ and in Clark County specifically the rate was 28.7, compared to 16.9 nationally for the same age cohort [67]. Lastly, older adults aged 85+ died by suicide 2.7 times more often than the same demographic nationally (56.6 versus 21.1 per 100,000), while in Clark County, the rate was higher at 60.9.

2. Methods

2.1. The study sample

While there is no agreed upon age range for "older adults" in the clinical literature, a range from 50+ years of age was chosen for this analysis [68,69]. This is largely due to age cutoffs utilized in standard osteological procedures (e.g., scoring of the pubic symphysis, cranial sutures, auricular surface) [68]. The sample was further divided into three age groups for analyses: 50–64 years, 65–84 years, and 85+ years. The 65- and 85-year age cutoffs were chosen as they are the age cutoffs

Table 1
Demographic breakdown of adults aged 65+ living in Clark County, NV as of 2021 [64].

Sex		Race	
Female	53.3 %	**White**	62.8 %
Male	46.7 %	**Asian**	13.0 %
		Black or African American	9.1 %
		Two or More Races	8.3 %
		Other	5.3 %
		American Indian or Alaska Native	1.0 %
		Native Hawaiian and Other Pacific Islander	0.5 %

for which most vital statistics related to "older adults" are reported by the Centers for Disease Control and Prevention [70]. Clinically, individuals over the age of 65 years are more likely to experience multiple chronic conditions and/or are beginning to experience age-related health conditions that may impact daily life (e.g., immobility, instability, incontinence, cognitive impairments) [59,60,71]. Those who are 85 and older experience similar health issues in addition to increased sensory changes (i.e., hearing and vision loss), osteoarthritis/osteoporosis, cognitive impairments, and depression [42]. While there are definite overlaps between individuals 65–84 and 85+, individuals over 85 years have additional difficulty performing daily activities (i.e., cooking, dressing, bathing, etc.), are more likely to be hospitalized, and suffer from increased chronic pain. The confluence of comorbidities can lead to more complex health problems, leading to declines in quality of life and increased risk of death. In making these age distinctions, this research has the potential to be applicable in both anthropological and clinical contexts.

The beginning of the COVID-19 pandemic is considered to be March 12, 2020, when Nevada's governor declared a state-of-emergency and issued the first stay-at-home order. The CCOCME database was used to conduct a search for all deaths that occurred among identified individuals aged 50 years and older within Clark County, NV between March 12, 2017 and March 11, 2021. Individuals for whom neither an autopsy nor investigation report could be obtained were excluded from the sample. Suicide data from the three years prior to the pandemic were analyzed in order to provide comparative annual and monthly means for older adult suicide rates. These were subsequently compared to the pandemic period annual and monthly rates.

In total, a sample of 871 older adults whose manner of death was ruled a suicide were included. There were 469 individuals aged 50–64, 337 individuals aged 65–84, and 65 individuals aged 85+ years. Individual ages were determined based upon the year of life that an individual was in when they died (e.g. individuals aged 55 years, 6 months were recorded as being 55 years old at their time of death). Additional demographics (i.e., assigned sex and race) were included as they were reported within the CCOCME database. While use of the term "race" has been contested in recent anthropological literature (e.g. [72]), the term is used here due to its use in the CCOCME database. Additionally, as this research draws from public health data rather than anthropological assessments, the terms "ancestry" and "population affinity" are inappropriate in this context. Racial categories, as listed according to prevalence in the sample, included "Caucasian," "Hispanic," "Black American," "Asian," and "Other" (includes "Indian," "Multi-Cultured," Native American," and "Pacific Islander"). The "Other" racial category was used for groups with small sample sizes that would have made meaningful statistical comparisons impossible. Assigned sex was recorded as either "male" or "female" per the CCOCME database. While we recognize that these demographic categories may not fully reflect the lived identities of the individuals to whom they are assigned, they will be used for the purposes of this study as this was how available data were reported.

Mechanism of suicide was also originally recorded as it was presented in the CCOCME database and then combined into larger categories based on type of injury. Mechanisms of suicide deaths were coded as "firearm," "suffocation," "drug/alcohol intoxication," "blunt force trauma," "sharp force trauma," "non-drug poisoning," "drowning," "thermal injuries," and "other." For statistical analyses, non-drug poisonings, drowning, thermal injuries, and other injuries were combined into the larger "other" category.

2.2. Data analysis

Data was analyzed using both SPSS (Version 28) and Microsoft Excel to calculate descriptive statistics, chi-square, and Fisher's Exact test results.

3. Results

A total of 6286 older adult deaths (aged 50+) occurred between March 12, 2017 and March 11, 2021 in Clark County, NV (Table 2). Of these, approximately 13.87 % (n = 871) were deaths by suicide, representing the third most common manner of death for older adults behind natural (45.74 %) and accidental (36.76 %).

Of the 871 older adult suicide deaths analyzed in this study, the majority were assigned male at birth (77.0 %), between 50 and 64 years (55.0 %), and Caucasian (85.9 %). (Table 3). The average age-at-death for this sample was 65 years.

3.1. General trends

During the pre-pandemic period, 663 of the 4784 older adult deaths were by suicide (13.85 %) as compared to 208 of the 1503 older adult deaths by suicide (13.83 %) during the pandemic. Cases were mostly evenly distributed over the four years (Fig. 1). There was an increase in the annual frequency of age 85+ deaths between the pre-pandemic and pandemic periods from 12 % to 26 %, respectively (Fig. 1). This was a statistically significant difference based on a chi-square analysis ($\chi = 7.258$, df = 1, $p = 0.007$). No significant difference was detected using chi-square analyses with the 50–64 and 65–84 year old age groups for these time periods (p = 0.364 and 0.915, respectively).

Overall, rates of older adult (aged 50+) suicide deaths fluctuated following the beginning of the pandemic (Fig. 2). In sum, the months that displayed a decrease compared to the pre-pandemic means and standard deviations were March 12 to April 11, 2020; September 12 to October 11, 2020; and October 12 to November 11, 2020. The months with an increase compared to the pre-pandemic means and standard deviations were June 12 to August 11, 2020; November 12 to December 11, 2020; and January 12 to February 11, 2021. The months within one standard deviation of the mean for pre-pandemic months were April 12 to June 11, 2020; July 12 to September 11, 2020; December 12, 2020 to January 11, 2021; and February 12 to March 11, 2021.

3.2. Mechanisms of death

Firearms were the leading mechanism of death by suicide for all groups before and during the pandemic (Fig. 3 and Table 4). However, there was a significant ($p = 0.006$) overall increase in the number of firearm-related deaths between the pre-pandemic and pandemic time periods. Firearm deaths as related to the total number of deaths increased significantly ($p = 0.004$) in the pandemic period by about 11 % as compared to the pre-pandemic period (prior to March 2020).

Generally, older females were more likely to die by drug/alcohol intoxication than by firearm, whereas males were more likely to die by firearm or suffocation than by drug/alcohol intoxication (Table 5). Females became more likely to die by firearm following the beginning of the pandemic, although this was not a statistically significant change (p = 0.558). The number of drug/alcohol intoxication-related deaths among males decreased significantly ($p = 0.009$) following the beginning of the pandemic. Firearm deaths among males, by contrast, rose significantly ($p = 0.004$) following the beginning of the pandemic.

4. Discussion

To reiterate, the goals of this study were to draw attention to older adults as a vulnerable group and to highlight the utility of public health data in the formulation of an effective structural vulnerability approach in forensic anthropology. This included an analysis of deaths by suicide that occurred among older adults in Clark County, NV during the COVID-19 pandemic. According to the CDC, 14.0 suicide deaths per 100,000 occurred in the U.S. in 2020. By contrast, the death rate for suicides in Nevada was 19.21 per 100,000 individuals that same year [66]. The results of the present study suggest that the rates of older

Table 2
All older adult deaths by manner of death within the CCOCME sample (%), reported by age-at-death, manner of death, and date of death. Frequencies were calculated by age group and date of death.

| | Pre-Pandemic | | | | | | Pandemic | | | | | | |
| | 3/12/2017–3/11/2018 | | | 3/12/2018–3/11/2019 | | | 3/12/2019–3/11/2020 | | | 3/12/2020–3/11/2021 | | | Totals |
	50–64 Years	65–84 Years	85+ Years	50–64 Years	65–84 Years	85+ Years	50–64 Years	65–84 Years	85+ Years	50–64 Years	65–84 Years	85+ Years	
Natural	335	402	75	314	396	42	260	309	42	262	389	49	2875
% Natural	37.14 %	54.03 %	58.59 %	37.43 %	57.73 %	42.86 %	37.52 %	50.57 %	50.00 %	35.36 %	59.21 %	47.57 %	45.74 %
Accident	386	243	37	362	196	42	283	203	28	334	171	26	2311
% Accident	42.79 %	32.66 %	28.91 %	43.15 %	28.57 %	42.86 %	40.84 %	33.22 %	33.33 %	45.07 %	26.03 %	25.24 %	36.76 %
Suicide	129	83	15	128	84	9	119	83	13	103	79	26	871
% Suicide	14.30 %	11.16 %	11.72 %	15.26 %	12.24 %	9.18 %	17.17 %	13.58 %	15.48 %	13.90 %	12.02 %	25.24 %	13.86 %
Homicide	37	12	1	25	9	2	18	11	1	34	10	2	162
% Homicide	4.10 %	1.61 %	0.78 %	2.98 %	1.31 %	2.04 %	2.60 %	1.80 %	1.19 %	4.59 %	1.52 %	1.94 %	2.58 %
Undetermined	15	4	0	10	1	3	13	5	0	8	8	0	67
% Undetermined	1.66 %	0.54 %	0.00 %	1.19 %	0.15 %	3.06 %	1.88 %	0.82 %	0.00 %	1.08 %	1.22 %	0.00 %	1.07 %
Totals	902	744	128	839	686	98	693	611	84	741	657	103	6286

Table 3

Demographic breakdown by assigned sex, age-at-death, and race as recorded in the CCOCME records for 871 individuals aged 50+ years who died by suicide between March 12, 2017 and March 11, 2021.

Sex		Age-at-Death		Race	
Male	671 (77.0 %)	**50–64 Years**	479 (55.0 %)	**Caucasian**	748 (85.9 %)
Female	200 (23.0 %)	**65–84 Years**	329 (37.8 %)	**Hispanic**	38 (4.4 %)
		85+ Years	63 (7.2 %)	**Black American**	36 (4.1 %)
				Asian	30 (3.4 %)
				Other	19 (2.2 %)

adults who died by suicide each year did not significantly change during the pandemic.

The exception to these observations in deaths by suicide were older adults ages 85 and older. This may reflect the fact that this demographic typically experiences increased social isolation and loneliness during non-pandemic times and thus, were at a particularly high risk of suicide as a result of this compounded issue. Another potential reason for the changes observed among the 85+ demographic involves differential access to mental health care. Due to increased demand during the pandemic, access to psychiatric services may have been limited. Additionally, increasing need for preventative drugs (e.g., antidepressants) and logistical issues which essentially halted the supply chain of these medications, resulting in reduced supply and increased prices [73]. Surging costs related to a dramatic increase in prescriptions of antidepressants, such as those seen in England, may have restricted access to these medications as well [74].

The demographic results of this study appear to be similar to pre-pandemic trends regarding those most at risk of death by suicide [75]; that is, older adult Caucasian males were the most prevalent cases reported in the CCOCME sample. These results are also representative of overall demographic trends in Nevada. However, the age-adjusted suicide rates for older Caucasian adults in Nevada between 2019 and 2021 were 2.0 times that of the same demographic nationally (40.8 versus 20.3 per 100,000) [67], although in Clark County the rate was slightly lower at 34.0 per 100,000 individuals. Older males died by suicide 1.7 times that of the same demographic nationally (53.9 versus 31.5 per 100,000), while in Clark County the rate was slightly higher at 54.6 per

100,000 [67].

According to literature on suicide demographics, gender is an important predictor of suicide in older adults. Canetto [76] suggested that gendered differences in coping mechanisms may be an underlying risk factor of why White older adult males' suicide rates are the highest. Specifically, socialization and developmental experiences over the life course create gendered differences in how flexible their adaptability is in later life stages. This is of interest, as White adult males are typically presented as the most privileged identity in Western society. Therefore, it is probable that White males' privilege erodes as they age, and their previously privileged status now counteractively works against them by not developing coping skills and resilience earlier in life due to traditional gender roles [77]. Development of resilience primarily involves social networks or relationships with others as well as the emotional responsibility of maintaining these experiences, which in Western society are considered female-oriented roles. Additionally, Canetto [78] examined how even though White older men's privileged status meant less exposure to adversity in later life stages, due to their rigidity of coping coinciding with hegemonic-masculinity suicide scripts, this demographic may be more dramatically impacted by these challenges.

Results of the chi-square test suggest statistically significant changes in mechanism of death between pre-pandemic and pandemic periods generally. Overall, the most common mechanism of death was by firearm, followed by drug and/or alcohol intoxication, suffocation and, lastly, blunt force trauma (Fig. 3). The mechanisms that changed significantly between the pre-pandemic and pandemic periods for all older adults were firearms (increased, *p=0.006*) and drug/alcohol intoxication (decreased, *p=0.007*) (Fig. 3). Suicide deaths by firearm increased by 10.8 % between the two reported time periods (Fig. 3). Disaggregating data by age-at-death showed that adults aged 50–64 years displayed a significant difference in their chosen mechanism of death between the two time periods for drug/alcohol intoxication (decreased); there were no other significant differences for this age group (Table 4). No significant differences in chosen mechanism were detected for the 65–84 age group. For the 85+ age group, firearms as a mechanism significantly increased during the pandemic period (p = 0.021), and suffocation was approaching a significant difference with a decrease during the pandemic (p = 0.051). Pre-pandemic, firearms were already a widely utilized mechanism for suicide amongst older adults (Table 4 and Fig. 3). In a population already vulnerable to suicide death
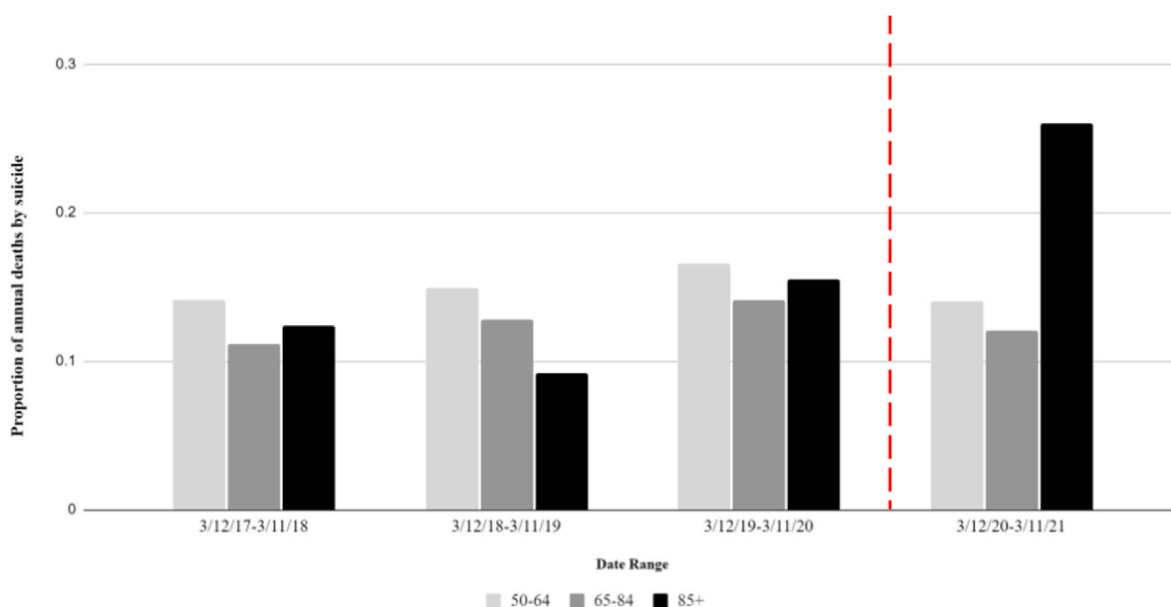
Fig. 1. Annual proportions of death by suicide for all older adults (50+ years) within the CCOCME sample, reported by age group. The vertical red dashed line represents the beginning of the pandemic.
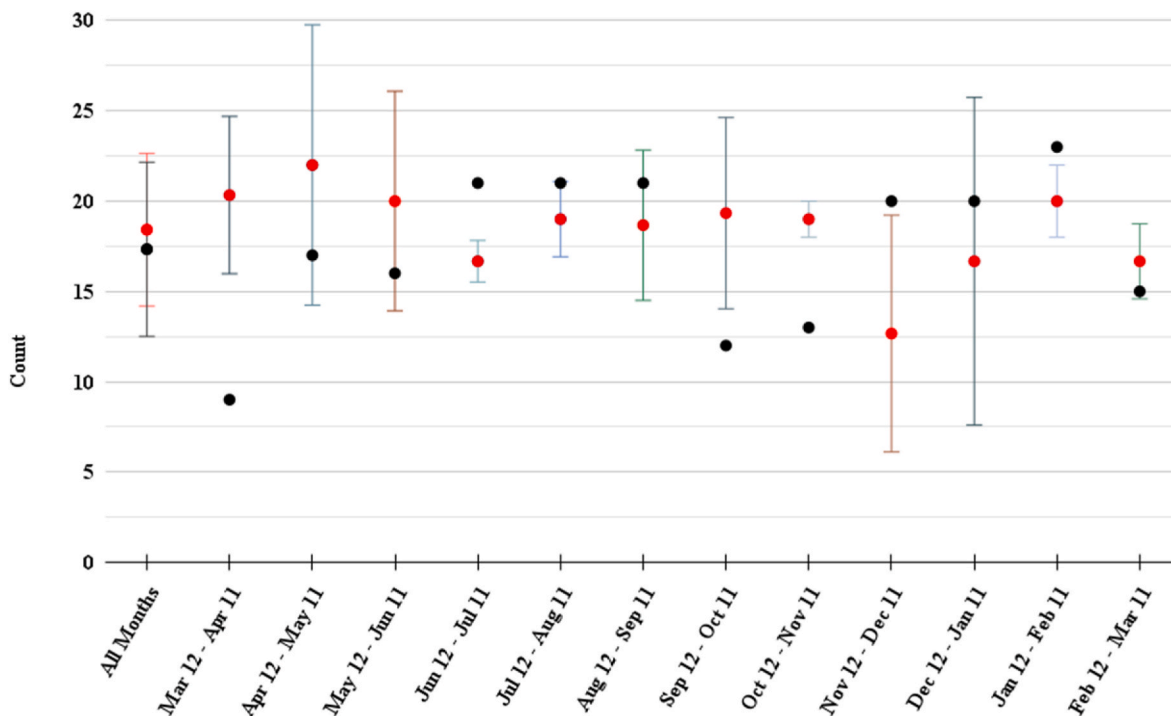
Fig. 2. Suicide deaths by time period with monthly counts or means, as well as standard deviations (error bars). Red series represents the pre-pandemic period monthly means, averaged 3-year monthly counts. Black series represents the pandemic period counts by month, as well as the monthly average for the 12-month period. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)
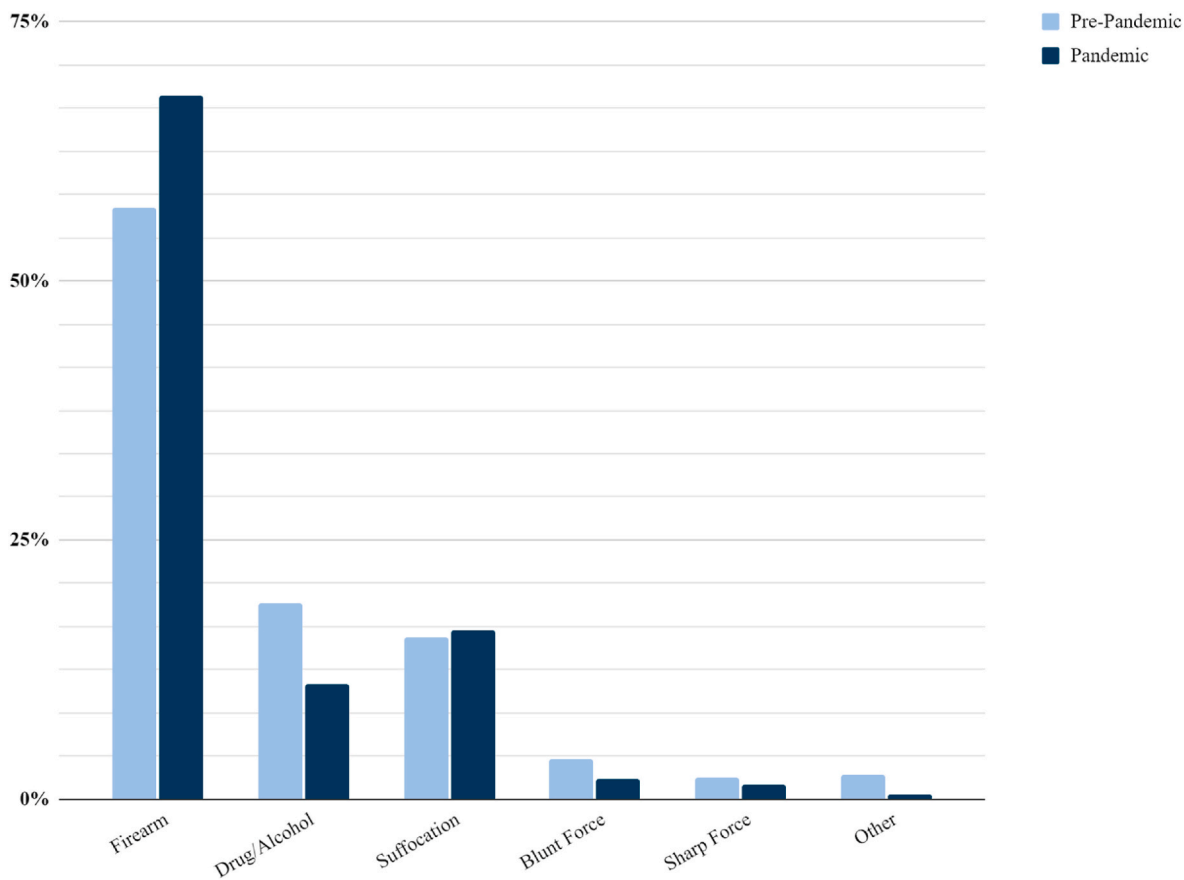

Fig. 3. Mechanism of death frequencies of all older adults who died by suicide by time period.

Table 4

Suicide deaths by age-at-death and mechanism. Chi-square and Fisher's Exact results are reported comparing time period (e.g., pre-pandemic versus pandemic) and mechanism (e.g., firearm versus non-firearm death). Cells are bolded to highlight the most prevalent mechanism by time period and age.

	50–64 Years			65–84 Years			85+ Years		
	Pre-Pandemic	Pandemic	*p-value*	Pre-Pandemic	Pandemic	*p-value*	Pre-Pandemic	Pandemic	*p-value*
Firearm	**187 (49.7 %)**	**61 (59.2 %)**	0.088	**168 (67.2 %)**	**57 (72.2 %)**	0.409	**23 (62.2 %)**	**23 (88.5 %)**	0.021[b,c]
Suffocation	80 (21.3 %)	24 (23.3 %)	0.659	19 (7.6 %)	10 (12.7 %)	0.167	5 (13.5 %)	0 (0.0 %)	0.051[b]
Drug/Alcohol	76 (20.2 %)	10 (9.7 %)	0.014[c]	42 (16.8 %)	10 (12.7 %)	0.379	7 (18.9 %)	3 (11.5 %)	0.430[b]
Blunt Force Trauma	15 (4.0 %)	4 (0.9 %)	0.961[b]	10 (4.0 %)	0 (0.0 %)	0.071[b]	1 (2.7 %)	0 (0.0 %)	0.398[b]
Sharp Force Trauma	9 (2.4 %)	2 (1.9 %)	0.786[b]	4 (1.6 %)	1 (1.3 %)	0.832[b]	1 (2.7 %)	0 (0.0 %)	0.398[b]
Other[a]	9 (2.4 %)	1 (1.0 %)	0.371[b]	7 (2.8 %)	0 (0.0 %)	0.133[b]	0 (0.0 %)	0 (0.0 %)	–
Total	376	103		250	79		37	26	

[a] Other mechanisms of suicide include non-drug poisonings, thermal injuries, drownings, and multiple mechanisms.
[b] Fisher's Exact Test.
[c] Significant *p-value* (<0.05).

Table 5

Suicide deaths by assigned sex and mechanism. Chi-square and Fisher's Exact results are reported comparing time period (e.g., pre-pandemic versus pandemic) and mechanism(e.g., firearm versus non-firearm death). Cells are bolded to highlight the most prevalent mechanism by time period and sex.

	Female			Male		
	Pre-Pandemic	Pandemic	*p-value*	Pre-Pandemic	Pandemic	*p-value*
Firearm	53 (34.4 %)	**18 (39.1 %)**	*0.558*	**325 (63.9 %)**	**123 (75.9 %)**	*0.004*[c]
Suffocation	26 (16.9 %)	9 (19.6 %)	*0.674*	78 (15.3 %)	25 (15.4 %)	*0.974*
Drug/Alcohol	**68 (44.2 %)**	16 (34.8 %)	*0.258*	57 (11.2 %)	7 (4.3 %)	*0.009*[c]
Blunt Force Trauma	3 (1.9 %)	0 (0.0 %)	*0.340*[b]	23 (4.5 %)	4 (2.5 %)	*0.248*[b]
Sharp Force Trauma	2 (1.3 %)	1 (2.2 %)	*0.668*[b]	12 (2.4 %)	2 (1.2 %)	*0.384*[b]
Other[a]	2 (1.3 %)	2 (4.3 %)	*0.195*[b]	14 (2.5 %)	1 (0.6 %)	*0.110*[b]
Total	154	46		509	162	

[a] Other mechanisms of suicide include non-drug poisonings, thermal injuries, drownings, and multiple mechanisms.
[b] Fisher's Exact Test.
[c] Significant *p-value* (<0.05).

by firearm, exacerbated social isolation and delayed medical care could have contributed to this rise in firearm-related deaths [79].

The most notable temporal differences by assigned sex was the change in the most prevalent mechanism of death for females from drug/alcohol intoxication in the pre-pandemic period (44.2 %) to firearms during the pandemic (39.1 %) (Table 5). While these mechanisms of death for females were not statistically significant, this may be due to the smaller sample size for the pandemic period females (i.e., 46). Males displayed significant differences temporally for both drug/alcohol intoxication and firearms as the mechanism of suicide, in which drug/alcohol-induced deaths decreased significantly (*p=0.009*) and firearm deaths increased significantly (*p=0.004*).

In the U.S., nearly 70 % of older adult suicide deaths involve the use of a firearm, with the majority of these decedents being Caucasian males [32]. Data from the National Violent Death Reporting System (NVDRS) found that older adult males who died by suicide with the use of a firearm were typically Caucasian, married, veterans, and had physical health problems [80–82]. There is a prevailing theory according to Canetto [77,83] that suicide is culturally scripted; meaning, a specific person in a unique situation using a specific method elicits different social responses. This suicide script can illuminate culturally acceptable and unacceptable intersectional identities (e.g., White older males versus Indigenous young females), mechanisms (e.g., hanging versus poisoning), and situations (e.g., loss of income due to COVID-19 pandemic) in which death by suicide may be expected, unsurprising, or allowable in that cultural setting. Linking this back to older White males' preference for firearms may not necessarily be due to accessibility of a lethal mechanism, but instead a suicide script coded with ideals of masculinity (i.e., choosing more violent methods of death because of masculinity, power, etc.). Due to the COVID-19 pandemic, many older adults experienced the loss of friends, loss of relationships with family members, loss of a spouse, and/or loss of jobs/belonging within their communities [32,84,85].

Caucasian males who died by suicide during the COVID-19 pandemic were typically also under additional stress due to unemployment and lack of financial resources which, ultimately, results in greater instances of social isolation and loneliness amongst this demographic [85]. As of 2018, approximately 62 % of adults aged 55–64, 23 % of adults aged 65–74, and 7 % of adults aged 75+ living in Nevada were still in the labor force [64]. According to the Bureau of Labor Statistics [86], in Nevada in 2019, the unemployment rate was 4.2 % with a total of 65 thousand unemployed individuals and 22 thousand unemployment insurance claims. Within the span of one year, the unemployment rate in 2020 increased to 9.7 % with 147 thousand people unemployed and 86 thousand filing for unemployment insurance. This drastic change in lifestyle was likely a major contributor to the number of suicides throughout the U.S., in conjunction with social isolation and loneliness.

Access to lethal means is among the leading risk factors for suicide among older adults [55]. Notably, as of 2021, more than 45 % of households in Clark County owned a firearm [87]. There was a surge in firearm purchases during the pandemic, with approximately 2.9 % of U. S. adults becoming first-time gun owners [88]. One study calculated that gun violence rose nationally by about 30 % during the pandemic [89]. This surge in gun violence is likely related to increased stress that resulted from the COVID-19 pandemic [90], which is also a risk factor for suicide. The firearm suicide rate in the U.S. was higher than homicides involving firearms both before and during the pandemic [91,92]. This same report also noted that not all groups were impacted equally by the increase in suicide deaths by firearms throughout the pandemic; rather, other aspects of identity (i.e., age and race) compounded with the social isolation and stress of the pandemic more drastically affected already marginalized groups. Pre-pandemic gun ownership trends in the United States have been shown to be primarily those who were White, males, and over 50 years of age [93].

A lack of access to other lethal mechanisms, such as substances, could explain the reduction in drug/alcohol intoxication-related deaths

between the pre-pandemic and pandemic time periods. For example, there may have been greater difficulties in older adults acquiring drugs and/or alcohol following the initiation of Nevada's emergency stay-at-home orders. Additionally, panic-buying (i.e., buying an unusually large amount of items in anticipation of the COVID-19 pandemic) in the early weeks of the pandemic restricted access to many over-the-counter medications, which are commonly utilized in suicide-related overdose deaths [94,95].

Suicide is a multifaceted issue, and research regarding the impact of the pandemic on suicide trends is ongoing. Studying suicidality amongst older adult populations presents additional challenges, as we must consider the intersection of multiple lived identities (e.g. race, gender, socioeconomic status) alongside advancing age. The purpose of this research is not to identify specific causes of change in suicidality among the older adult population in southern Nevada, but rather to emphasize the need for forensic anthropologists to engage with public health datasets when developing new methods for interpreting skeletal bio-markers of inequality. Through this approach, a greater degree of transparency can be generated within our forensic anthropological reports.

4.1. Forensic anthropology

If we are to develop effective means of interpreting structural vulnerabilities in forensic science research, it is essential that we consider their underlying mechanisms. This should involve the analysis of both morbidity and mortality patterns observed among different groups across time and space. This research represents a necessary step in this process. Forensic anthropologists have both the means and potential to contribute to public health analyses and, in turn, influence public policy. Public health and forensic anthropology are intrinsically intertwined; both are concerned with the circumstances surrounding differential risk of mortality among at-risk groups. The development of the SVP introduces an opportunity for forensic anthropology to become increasingly interdisciplinary and applied, making positive change in modern society. However, in order to make this possibility a reality, forensic anthropologists must engage with public health data.

The Osteological Paradox [96] reminds us that individuals vary in their susceptibility to stress, posing challenges to the interpretation of skeletal biomarkers. Through the lens of structural vulnerability, forensic anthropologists stand to better interpret the underlying mechanisms of inequality that contribute to heterogeneity in frailty. It is therefore imperative that forensic anthropologists draw upon public health datasets when developing new methods and theories that will influence the interpretation of skeletal biomarkers of stress. While the analysis of public autopsy records and investigation reports lie outside of the forensic anthropologist's typical role, the data obtained from these records provide key insights into population-level mortality trends that should be taken into consideration when conducting skeletal analyses. Effective interpretation of skeletal biomarkers requires an intricate understanding of the underlying mechanisms of social inequality which lead to differential exposure to stressors.

Forensic anthropologists have had a longstanding commitment to evidencing overt forms of violence, which may include suicide, in both antemortem and perimortem trauma analyses. Winburn and colleagues [1] argue that within a structural vulnerability approach, premature death can be viewed as a biomarker with implications for the culmination of a lack of social, economic, and/or familial care. However, in order to use this as an effective biomarker of structural vulnerability, we must first identify contributing factors and patterns of differential risk that are grounded in epidemiological realities.

The COVID-19 pandemic is an excellent example of a period of widespread challenges affecting the human lived experience. Closely related disciplines, like social epidemiology and medical anthropology, have focused on the role that society plays in the development of negative health outcomes, especially during global health crises such as

the COVID-19 pandemic [97]. The continuum of violence, originally proposed by Scheper-Hughes and Bourgois [98], can provide a starting framework for forensic anthropologists to follow the path of our sister disciplines and expand our understanding of structural violence and vulnerability [97]. The development of the SVA represents an ideal opportunity for forensic anthropologists to begin engaging with public health datasets. In light of less detailed individual-level context, throughout this paper we have offered thoughts regarding areas of possible intersecting vulnerabilities. We do so in the hope that those interested in further exploring the social and structural determinants of vulnerable death can do so with more detailed contextual information.

Forensic anthropologists often function as "last responders" who seek to restore the identity of decedents; however, caution is advised when simplifying quantifiable variables so as to not inadvertently reproduce stereotyping in our casework [see 21, this issue] or promoting public misconceptions of violence within certain communities [99]. Regardless of specific context, forensic anthropologists operate in, and are subject to, larger systems of state identification practices and politics [21]. We must continuously be aware of how our skeletal assessments might be interpreted by non-medicolegal professionals and the general public. In its current form, the U.S. medicolegal system has little need for interpretations of non-overt forms of physical violence that forensic anthropologists may be able to provide (i.e., structural vulnerability, structural violence). Kim and Friedlander [18] discuss some of the current workflow and ethical limitations of expanding the forensic anthropologist's role to include a social or structural vulnerability component, as well as exploring its potential/beneficial uses to state identification practices. Despite the developmental ambiguity of this burgeoning approach, we support Moore and Kim's [100] argument that "if not for the courts, then for the historical record, both for policy makers and service providers."

The applicability of a SVA to forensic anthropology cases of older adult suicides is difficult. This may be due largely in part to focusing on a limited data stream, echoing recent critiques [2] that have targeted the lack of contextualization when interpreting potential vulnerability through skeletal data (or in this case, mortality data). While biological and forensic anthropologists are well suited to interpret structural vulnerability, our field must reflect on our history and praxis before moving forward and fully operationalizing this concept. In doing so, we can shift the understanding of structural vulnerability approaches from one of solely anthropological consideration to one that relies on interdisciplinary and community collaboration in order to enact the greatest change.

5. Conclusion

The number of older adult suicides did not increase significantly following the beginning of the COVID-19 pandemic, except among those aged 85 years and older. The most interesting changes were in relation to the mechanism of deaths observed. Firearm-related deaths increased significantly, possibly related to increased access to firearms kept in the home, while drug and/or alcohol related deaths decreased significantly. Females became more likely to die by firearm following the beginning of the pandemic, although this was not a statistically significant change. By contrast, firearm deaths among males increased significantly following the beginning of the pandemic.

The future of this research involves an intersectional exploration of the impact of socioeconomic identities on suicide risk among older adults more generally. Through the exploration of intersectional identities we are better able to understand the effects of structural violence on marginalized individuals.

The structural vulnerabilities that older adults face are not unique to, but were exacerbated by, the COVID-19 pandemic. Forensic science, and forensic anthropologists more specifically, are uniquely situated to contextualize the intricacies of structural violence and to expose societal challenges that older adults and otherwise at-risk groups face on a daily

basis. This might be best accomplished by engaging intentionally with public health datasets. In doing so, forensic anthropologists might contribute to policy decisions that impact the daily lived experiences of vulnerable groups.

Funding

CRediT authorship contribution statement

Katherine Gaddis: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Supervision, Writing – original draft, Writing – review & editing. **Katharine C. Woollen:** Writing – original draft, Writing – review & editing. **Liam J. Johnson:** Writing – original draft, Writing – review & editing. **Taylor Flaherty:** Writing – original draft, Writing – review & editing. **Jennifer F. Byrnes:** Supervision, Writing – original draft, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

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