



Review article

Firearm-related research articles in health sciences by funding status and type: A scoping review

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ABSTRACT

Federal funding for firearm-related research in the health sciences has incurred Congressional restrictions and executive actions. Little is known about the funding landscape for published scholarship in this field. This study's aim was to characterize the number and sources of funding, including federal and non-federal sources, for firearm-related research articles published in health sciences journals. We performed a scoping review of original, empirical, peer-reviewed articles related to firearms published in health science journals and indexed in PubMed between January 2000 and December 2019, using the PRISMA extension for Scoping Review checklist. Four reviewers independently screened each article twice for inclusion. Included articles were reviewed again to identify funding sources. Articles were characterized as having explicitly declared funding, explicitly declared no funding, or no explicit funding declaration. Among articles with funding, we examined proportions by funding source. 812 articles met the inclusion criteria. 119 (14.7%) of the articles declared not having received any funding, and 240 (29.6%) had no funding declaration. 453 (55.8%) of the articles declared at least one source of funding. Of those, 221 (48.8%) reported at least one federal grant, and 232 (51.2%) reported at least one philanthropic grant. The number of published articles increased by 328.6% between 2000 and 2019. While the volume increased during the study period, the proportion of articles with funding was lower in 2019 (55.6%) than it was in 2000 (87.5%; proportion difference: 31.9%; 95% CI: 16.7%–47.2%). This study highlights the continued funding limitations in this field despite a growing volume of research.

1. Introduction

Partly in reaction to a study linking home gun ownership with the risk of homicide at home (Kellermann and Rivara, 2013), Congress passed an appropriations bill in 1996 which included a rider, known as the Dickey Amendment, restricting the Centers for Disease Control and Prevention (CDC) from using funds to “advocate or promote gun control” (United States House of Representatives, 1996). While this bill did

not strictly prohibit the CDC from funding firearm research and the interpretation of the amendment's restrictions were debated, its net effect was clear (Rostron, 2018). Starting in fiscal year 1997, the CDC's \$2.6 million budget for firearm-related research from the previous year was reallocated to traumatic brain injury research. In the years following, similar funding restrictions were extended to all Department of Health and Human Services agencies, including the National Institutes of Health (NIH) (Kellermann and Rivara, 2013). CDC spending

Abbreviations: CDC, Centers for Disease Control and Prevention; NIH, National Institutes of Health.

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on firearm-related research fell by 96% through 2012, potentially discouraging new investigators from joining a field with an already limited number of researchers and reducing their ability to produce scientific studies investigating the effect of different policies on the health risks of firearms and gun-violence for more than two decades (Alcorn, 2017; Mayors Against Illegal Guns, 2013).

More than two decades after the passing of the Dickey Amendment, a public health crisis of has grown. Firearm-related injuries is a leading cause of death among for all Americans (Centers for Disease Control and Prevention, 2021). Between 2000 and 2019, the crude mortality rate for firearm injury among all Americans grew from 10.16 per 100,000 to 12.10 per 100,000 (Centers for Disease Control and Prevention National Center for Injury Prevention and Control, 2005). The CDC reported nearly 40,000 firearm-related deaths in the United States in 2019, and data indicate that the number of firearm homicides increased in 2020. About 60% of those deaths were firearm suicides. Meanwhile, federal funding for firearm-related research pales in comparison to funding for other leading causes of death in the U.S (Stark and Shah, 2017). For instance, when looking at the mortality rates of leading causes of death in the United States, the firearm injuries research field received only 1.6% of its predicted federal funding compared to other conditions with a similar mortality rates. In the pediatric firearm injury research field this number is slightly higher at 3.3% of predicted federal funding, despite being the second-leading cause of death for children and adolescents in the United States (Cunningham et al., 2019). The volume of published peer-reviewed research likewise falls short of that for other leading causes of death. For example, based on a regression of dollars of funding per life lost for the 30 leading causes of death in the U.S., papers related to firearm injury prevention are only 4.5% of the predicted volume (Stark and Shah, 2017). A 2017 study found that the annual number of firearm-related research articles increased between 1985 and 1999, plateaued from 1999 through 2012, and then increased over the last two years of that study (2013 and 2014) (Alcorn, 2017). Other bibliographic trend analyses found similar trends (Chien et al., 2020). The impact of the Dickey Amendment's restrictions impacted more than the research field. The restriction of the empirical understanding of the public health impact of firearms has limited the ability to examine why people own guns and to have a conversation about security and protection in the United States, further polarizing the topic (Metzl, 2018).

In the last decade, several acts of violence involving firearms have captured the nation's attention and sparked a resurgence in mostly unsuccessful congressional efforts to remove barriers for federally funded research on firearms. In 2013, one month after the Sandy Hook shooting, President Obama issued 23 executive actions which included a memorandum directing the CDC to conduct or support firearm-related research (Presidential Memorandum, 2013; The President's plan to protect, 2013). The CDC remained hesitant, and no appropriation to allocate funds for this specific purpose was made by the Congress at that time (Rostron, 2018). The call for funding reemerged in 2016 through another set of executive actions and the insistence by some senators that the appropriations subcommittee remove the Dickey Amendment as a rider for the 2017 budget. This effort was coupled with a request to earmark \$10 million for CDC research on firearm injury and violence prevention; funding did not materialize (Lopez, 2016; Rubin, 2016). In 2018, Congress updated the language of the Dickey Amendment in the Omnibus spending bill to clarify that, "While appropriations language prohibits the CDC and other agencies from using appropriated funding to advocate or promote gun control, ...the CDC has the authority to conduct research on the causes of gun violence" (He and Sakran, 2019). No funding was earmarked alongside this clarification for research into the causes of firearm violence (United States Senate, 2018). Finally, a spending bill including \$25 million for studies of gun violence supported by the CDC and NIH was approved by the Congress in 2019 (Subbaraman, 2020).

While limited non-federal funding sources for firearm-related research in health sciences existed prior to the Dickey Amendment,

the political stalemate in Congress over the last two decades spurred some state and local governments, foundations, and universities to try to partially fill the research gap by pledging funds for firearm-related research. In 2011, the Joyce Foundation, along with several other foundations, established the Fund For A Safer Future to implement strategies and produce research that may help reduce gun injuries and deaths (Fund for a Safer Future). The Hope and Heal Fund, established in 2016 in the aftermath of the shooting in San Bernardino, California, invested more than \$1 million toward efforts to reduce gun violence in communities around the state (Hope and Heal Fund). In 2018, following the Parkland shooting, Arnold Ventures pledged \$20 million to fund firearm-related research through the National Collaborative on Gun Violence Research (Laura and John Arnold Foundation, 2018). Kaiser Permanente also promised \$2 million toward firearm injury research (Kaiser Permanente, 2018). Over the years, several other organizations (e.g., the American Foundation for Suicide Prevention) contributed to research on specific types of firearm-related injuries (e.g., suicide). Since 2017, the California, New Jersey, and Washington state legislatures have each allocated funds establishing their own firearm injury and violence research centers (Van Brocklin, 2019). While these investments represent a significant contribution to the firearm injury field, they do not come close in dollars to the funding that would typically be awarded each year by the federal government for a leading public health crisis.

Typical approaches to solving national health problems involve scientific studies aimed at collecting data, providing an unbiased scientific analysis to examine causality, testing new and existing interventions and implementing and evaluating them (Rajan et al., 2018). Without the substantial support from federal funding, this approach is difficult to pursue. Yet, firearm-related research persisted over the last two decades, and while studies have quantified the volume of published research in the firearm injury and violence field and modeled how it compares to other leading causes of death, little is known about the quantity of published firearm injury research that received funding during this period and where funding came from. We do not judge the quality of the publications, but we systematically characterize the status and type of funding for firearm-related research articles published in health sciences journals. In beginning to quantify the number of published firearm-related research articles over time and describing the status and type of funding during the Dickey Amendment era, we seek to better understand how researchers in health sciences continued their work with little financial support from the federal government and to identify key contributors to sustaining firearm-injury research. We anticipated seeing an initial decrease in volume of published articles followed by an increase of both volume and funding declarations in the second decade of our study period.

2. Methods

We followed the PRISMA-ScR (Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Review) checklist for this review. A formal review protocol was developed to guide reviewers (Link: http://www.prisma-statement.org/documents/PRISMA-ScR-Fillable-Checklist_11Sept2019.pdf) (Appendix A).

2.1. Data source and searches

Using a search query developed by the authors and a University of Washington Health Sciences Librarian, we searched through health sciences journals indexed in PubMed to identify English-language, peer-reviewed research articles related to firearm injury or violence published (either in print or e-published) any time from January 1, 2000 through December 31, 2019 (Appendix A). We restricted our search to health sciences journals indexed in PubMed for two reasons. First, the PubMed database consists of more than 32 million citations of literature in the biomedical and health fields, including the life sciences and behavioral among other fields (hereafter referenced as health sciences

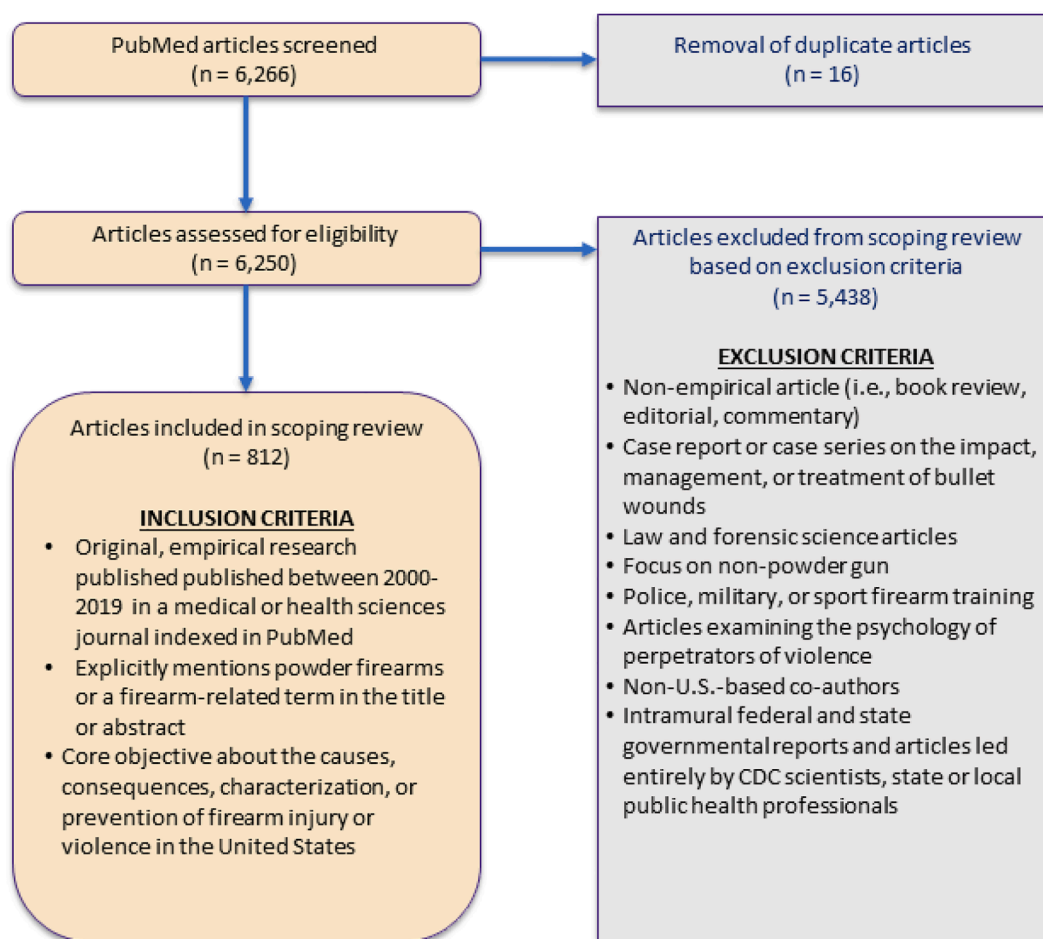


Fig. 1. PRISMA extension for Scoping Review Flow Chart.

literature) ([National Library of Medicine](#)). This comprehensive database would help identify a majority of the relevant literature. Second, the Dickey Amendment restricted funding opportunities from firearm-injury researchers based primarily in the health sciences. Funding available through the Department of Justice (DOJ) and National Institute of Justice (NIJ) were not impacted. We introduced a three-year time-lag for our study period so we could reduce the likelihood of including published research that was funded prior to 1997. Full text of the articles were uploaded to Rayyan, a web-based systematic review program, and reviewed for duplicates ([Ouzzani et al., 2016](#)). The University of Washington Institutional Review Board determined that PubMed data do not involve “human subjects” and does not require Institutional Review Board (IRB) approval or a determination of exempt status.

2.2. Study selection

Each research article was reviewed independently by two of the reviewers (S.G., H.M., M.B., P.P.) ([PRISMA Extension for Scoping Reviews \(PRISMA-ScR\), 2018](#)). Decisions were not blinded. The authors met weekly to discuss the inclusion criteria and to ensure consistency of decisions. Articles with conflicting decisions among the authors were shared with a senior author (A.R.R.) who helped make the final decision.

Our methodology was informed by the one used in the Harvard Injury Control Research Center’s Firearm Researcher Survey ([Hemenway and Nolan, 2017](#)). Included articles were original, empirical research articles that explicitly mentioned firearms or a firearm-related term in the title or abstract (i.e., *gun, handgun, firearm, rifle, long gun, shotgun, shooting, semi-automatic*). To avoid the inclusion of articles that mentioned a firearm without centrally focusing on it, the article’s core

objective had to address the causes, consequences, prevention, or characterization of firearm injury or violence in the United States or compare the United States’ firearm injury or violence with other countries. This included articles on diverse types of firearm violence, such as suicide, homicide, mass shootings, and domestic violence. The articles had to be co-authored by at least one U.S.-based researcher for inclusion.

We excluded non-empirical articles, such as book reviews, editorials, commentaries, historical articles; case reports or case series articles on the impact, management, or treatment of bullet wounds; law and forensic science articles; articles focused on non-powder guns (i.e., nail, air, mole, or electron guns); police, military, or sport firearm training; and articles examining the psychology of perpetrators of violence. Intramural federal and state governmental reports and articles led entirely by CDC scientists, state or local public health professionals, usually published as a Morbidity and Mortality Weekly Report, were excluded for two reasons. First, these articles were mainly part of routine public health surveillance programs, and second, extramural researchers did not typically receive funding for this work.

2.3. Data extraction and quality assessment

Four reviewers (S.G., H.M., M.B., P.P.) developed a data charting spreadsheet and piloted it on 10 articles. Each included article was again independently reviewed by two of the reviewers for explicit mention of funding and for data charting. The reviewers examined the full text of the published articles for a funding declaration section or for wording that explicitly mentioned funding or financial support in the Acknowledgements, Conflict of Interest, Disclosure sections, or the main text. Journals varied with the presentation and wording of this information.

Table 1
Funding status and type among firearm-related research articles published in health sciences journals from 2000 through 2019.

	2000-2001		2002-2003		2004-2005		2006-2007		2008-2009		2010-2011		2012-2013		2014-2015		2016-2017		2018-2019		Total	
	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)
Funded	36	78.3	38	69.1	32	61.5	23	65.7	19	76.0	24	61.5	24	46.2	39	43.8	77	49.4	141	53.6	453	55.8
<i>Federal*</i>	22	61.1	16	42.1	13	40.6	9	39.1	11	57.9	10	41.7	7	29.2	20	51.3	44	57.1	69	48.9	221	48.8
<i>Foundations/philanthropy*</i>	22	61.1	24	63.2	19	59.4	16	69.6	10	52.6	13	54.2	12	50.0	22	56.4	31	40.3	63	44.7	232	51.2
<i>Non-federal Government Funding*</i>	2	5.6	2	5.3	1	3.1	2	8.7	1	5.3	2	8.3	3	12.5	3	7.7	5	6.5	12	8.5	33	7.3
<i>Academic*</i>	2	5.6	5	13.2	2	6.3	2	8.7	0	0.0	4	16.7	4	16.7	7	17.9	15	19.5	35	24.8	76	16.8
<i>Other*</i>	2	5.6	2	5.3	5	15.6	1	4.3	0	0.0	3	12.5	0	0.0	5	12.8	4	5.2	12	8.5	34	7.5
No funding	0	0.0	0	0.0	2	3.8	2	5.7	0	0.0	2	5.1	9	17.3	19	21.3	32	20.5	53	20.2	119	14.7
No declaration	10	21.7	17	30.9	18	34.6	10	28.6	6	24.0	13	33.3	19	36.5	31	34.8	47	30.1	69	26.2	240	29.6

Table 1 shows the total counts and percentages of articles with funding, no funding, and with no funding declaration. Among the articles reporting funding, this table also shows the count and percentage of articles reporting at least one grant within each funding source category. Since many articles reported more than one funding source, the funding source category count and percentage will add up to more than the total number of articles funded.

The lack of consistency around the use of the Conflict of Interest, Acknowledgements, and Disclosure sections across journals prompted the reviewers to rely only on explicit mentions of a funding source. Acknowledgements of “support” from foundations or academic institutions were interpreted as having funding. Articles were marked as having “no funding” when there was explicit language stating such (i.e., “*These authors have no support or funding to report*”) (O’Brien et al., 2013; Ruggles and Rajan, 2014).

Research articles without an explicit declaration of funding source were documented as having “no explicit declaration”. Secondary analyses reporting funding were reviewed to differentiate between funding for the original data collection and analysis and funding for the secondary analysis. Supplementary information not directly within the full text was not reviewed.

Included research articles were subsequently categorized by funding source type defined as: federal, non-federal government, philanthropic, academic, and other. Funding from a federal research branch or department was categorized as a federal funding source. Non-federal government funding included funding from state and local municipalities. Philanthropic funding sources included funding from foundations and not-for-profit organizations. Academic funding was defined as coming from a college or university-based funding source awarded to a group or an individual (i.e., research center, university-wide grant, or fellowship, etc.). Other funding included self-funded research, grants from outside of the U.S., for-profit companies, professional associations, and hospitals (Khubchandani et al., 2011; Thompson et al., 2012; Fallucco et al., 2020; Vriniotis et al., 2015; Prickett and Crosnoe, 2014; Castillo-Carniglia et al., 2018; Bandyaly et al., 2020). Other variables extracted for data charting were the year of print publication or electronic publications (whichever came first), journal name, funding source name, grant ID, and sponsored individual or group, if mentioned. The evidence presented in the included articles were not critically appraised or used for data analysis.

2.4. Data synthesis

We tallied the number of included research articles that had funding, no funding, or no explicit declaration. Among research articles with funding, we examined proportions by the funding source and the counts of top mentioned funding sources. Data analyses were conducted using R v3.6.0 software.

3. Results

A total of 6,266 articles were screened from our PubMed search query. After removing duplicates, 6,250 articles were assessed for eligibility based on the defined inclusion criteria. We excluded 5,438 articles leaving 812 firearm-related research articles in this scoping review (Fig. 1). The number of articles published annually ranged from a low of 11 in 2008 to a high of 162 in 2019.

Of the 812 research articles, 119 (14.7%) articles explicitly declared not having received any funding for the study, 240 (29.6%) articles did not have any explicit mention of funding, and 453 (55.8%) explicitly declared funding (Table 1). Among the articles with funding, 212 (46.8%) had one funding source, 112 (24.7%) had two funding sources; and 129 (28.5%) had three or more funding sources (Mean = 2.1; Median = 2; Mode = 1; IQR = 1–3). One research article had ten funding sources (Ladapo et al., 2016). Among the research articles with funding, 221 (48.8%) articles reported having at least one federal grant, 232 (51.2%) had at least one grant from a philanthropic organization, 33 (7.3%) reported at least one grant from a non-federal government entity, 76 (16.8%) reported at least one grant from an academic institution or research group, and 34 (7.5%) reported at least one grant from another source.

The count of firearm-related research articles with funding increased over time, especially since 2017 (Fig. 2). From 2000 to 2019, the number

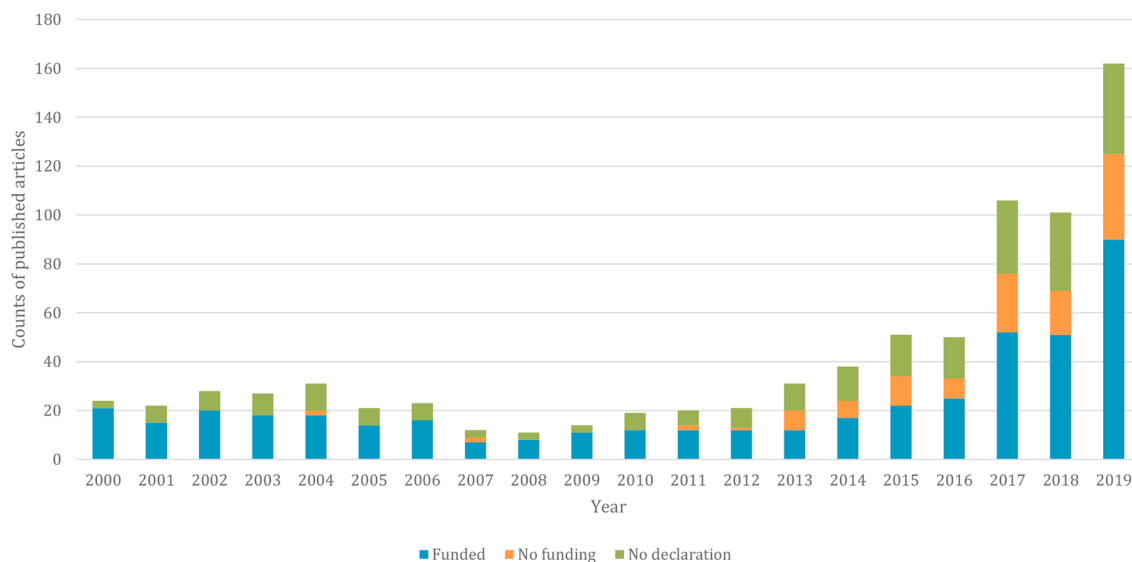


Fig. 2. Counts of firearm injury and violence research articles published in health sciences journals by funding status from 2000 through 2019.

of articles with funding increased by 328.6%, with its largest increase of 224.0% between 2016 and 2019. However, the proportion of articles with funding was lower in 2019 (55.6%) than it was in 2000 (87.5%; proportion difference: 31.9%; 95% CI: 16.7%–47.2%).

During the 20-year study period, 127 (57.5%) of the 221 articles with at least one federal funding source declared having a least one grant from the National Institutes of Health (Table 2). Among those articles with NIH funding, the National Institutes on Mental Health ($n = 45$), Drug Abuse ($n = 37$), Child Health and Human Development ($n = 35$), and Alcohol Abuse and Alcoholism ($n = 25$) were the most frequently mentioned sources of funding. The CDC and the DOJ represented 22.6% (50) and 20.4% (45) of the articles with federal funding. Other federal sources of funding included the National Institute of Justice, Department of Veterans Affairs, and Maternal and Child Health Bureau under the Department of Health and Human Services.

Among the 232 articles citing at least one philanthropic funding source, the Joyce Foundation was cited in 125 (53.9%) articles and accounted for 27.5% of the 453 research articles that declared funding (Table 2). Nearly a third of those articles were published between 2016 and 2019. The Robert Wood Johnson Foundation was the second most common philanthropic funding source mentioned in 50 (22.0%) research articles. Other frequently mentioned foundations included the California Wellness Foundation, the David and Lucile Packard Foundation, the Fund for a Safer Future, and the Open Society Institute.

State funding came from California (Kravitz-Wirtz et al., 2020; Schleimer et al., 2020; Pallin et al., 2019), Illinois (Walker et al., 2016), Massachusetts (Kacanek and Hemenway, 2006), Michigan (Meyer et al., 2003), Minnesota (Roesler and Ostercamp, 1998), New Hampshire (Demico, 2015), New York (Hardiman et al., 2019); (Matthew, 2019), Oregon (Wolsko et al., 2020), Ohio (Slovak and Singer, 2001), Pennsylvania (Beardslee et al., 2021; Beardslee et al., 2019; Docherty et al., 2019), and Washington (Walton and Stuber, 2020). Cities such as those of Seattle (Lyons et al., 2019) and Baltimore (Webster et al., 2013) provided funding for published firearm injury and prevention research. We identified academic funding sources from institutions across the U.S. One study received funding from the University of Groningen in the Netherlands (Stroebe et al., 2017). Among research articles categorized as having other sources of funding, we identified three self-funded articles authored by the same four researchers (Khubchandani et al., 2011; Thompson et al., 2012; Price et al., 2014), and several articles declaring funding from non-academic Canadian research groups (Martin-Storey et al., 2020; Prickett et al., 2014; Martin-Storey et al., 2015; Riddell et al., 2018).

4. Discussion

This study makes a contribution toward identifying and describing the limitations of firearm injury and prevention research conducted in the two decades since the Dickey Amendment by characterizing published scholarship for firearm-related research in the health sciences by funding status and type through a scoping review. While the volume of original, empiric research (funded and unfunded) more than tripled from 2000 through 2019, the number of articles reporting funding was about 30% lower in 2019 than in 2000. These 812 empirical articles included in our study represented 0.006% of total published research indexed in PubMed between 2000 and 2019 (National Library of Medicine, 2021).

The overall increase of articles, especially since 2016, may be partially due to an increased interest in firearm-related research by journal editors who actively looked for papers and created edited volumes focused on firearms. If so, this might be a response to a culmination of many factors, such as President Obama's executive actions and calls by members of Congress to remove the Dickey Amendment in 2016. During the same period, we also saw an increase in unfunded articles. This may be the result of an increased interest among researchers in firearm-related research following public mass shooting events. These researchers may have leveraged new sources of public data, minimizing the cost of research, where possible. It is possible that the number of research articles reporting funding in 2000 were buoyed by pre-Dickey Amendment funding from the CDC.

NIH funding was the most common funding source overall and one that consistently provided funding during the study period. This suggests that researchers often secured funding by drawing upon intersections between firearms issues and other causes of injuries or health problems that were better funded, (e.g., suicide, adolescent health, substance abuse, and injuries more generally) across different populations, to secure funding.

During the twenty-year period, articles with philanthropic funding accounted for slightly more articles than those with federal grants. It is noteworthy that the Joyce Foundation, a Chicago-based foundation focused on grantmaking in the Great Lakes region, supported nearly one-third of the 453 funded articles, and, moreover, has consistently provided a lion's share of funding for firearm research throughout these last two decades, buoying many long-time academic researchers in the firearm injury and prevention field. A recent report released from the foundation echoed these findings (The Joyce Foundation, 2019). Since 1993, the Joyce Foundation has committed \$32 million in research

Table 2

Summary of federal and philanthropic funding sources among firearm-related research articles published in health sciences journals from 2000 through 2019.

Number of articles	2000–2001		2002–2003		2004–2005		2006–2007		2008–2009		2010–2011		2012–2013		2014–2015		2016–2017		2018–2019		Total	
	(N = 22)		(N = 16)		(N = 13)		(N = 9)		(N = 11)		(N = 10)		(N = 7)		(N = 20)		(N = 44)		(N = 69)		(N = 221)	
Federal Funding	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)
National Institutes of Health	4	18.2	6	37.5	6	46.2	6	66.7	7	63.6	5	50.0	3	42.9	14	70.0	32	72.7	44	63.8	127	57.5
Centers for Disease Control and Prevention	13	59.1	7	43.8	7	53.8	1	11.1	2	18.2	2	20.0	4	57.1	3	15.0	7	15.9	4	5.8	50	22.6
Department of Health and Human Services	2	9.1	2	12.5	3	23.1	2	22.2	0	0.0	0	0.0	2	28.6	3	15.0	2	4.5	2	2.9	18	8.1
Department of Justice	8	36.4	3	18.8	2	15.4	3	33.3	2	18.2	3	30.0	0	0.0	2	10.0	6	13.6	16	23.2	45	20.4
Department of Veterans Affairs	0	0.0	0	0.0	1	7.7	0	0.0	1	9.1	1	10.0	1	14.3	1	5.0	2	4.5	6	8.7	13	5.9
National Science Foundation	0	0.0	0	0.0	0	0.0	0	0.0	1	9.1	0	0.0	0	0.0	2	10.0	2	4.5	2	2.9	7	3.2
Other federal source	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	14.3	0	0.0	1	2.3	1	1.4	3	1.4
Number of articles	2000–2001		2002–2003		2004–2005		2006–2007		2008–2009		2010–2011		2012–2013		2014–2015		2016–2017		2018–2019		Total	
Foundations and Philanthropies	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)
Joyce Foundation	9	40.9	15	62.5	13	68.4	13	81.3	9	90.0	10	76.9	7	58.3	12	54.5	13	41.9	24	38.1	125	53.9
Robert Wood Johnson Foundation	12	54.5	9	37.5	3	15.8	3	18.8	1	10.0	1	7.7	3	25.0	5	22.7	7	22.6	7	11.1	51	22.0
California Wellness Foundation	1	4.5	6	25.0	2	10.5	0	0.0	0	0.0	5	38.5	3	25.0	2	9.1	3	9.7	8	12.7	30	12.9
David and Lucile Packard Foundation	2	9.1	4	16.7	6	31.6	1	6.3	2	20.0	3	23.1	0	0.0	0	0.0	0	0.0	0	0.0	18	7.8
Fund for a Safer Future	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	4	12.9	11	17.5	15	6.5
Open Society Institute	9	40.9	9	37.5	1	5.3	2	12.5	0	0.0	1	7.7	0	0.0	0	0.0	0	0.0	0	0.0	22	9.5
John D. and Catherine T. MacArthur Foundation	3	13.6	2	8.3	1	5.3	3	18.8	1	10.0	1	7.7	0	0.0	1	4.5	1	3.2	0	0.0	13	5.6
William T. Grant Foundation	2	9.1	4	16.7	6	31.6	1	6.3	2	20.0	3	23.1	0	0.0	1	4.5	0	0.0	0	0.0	19	8.2
Other Foundation or philanthropy	5	22.7	5	20.8	1	5.3	0	0.0	0	0.0	3	23.1	1	8.3	4	18.2	7	22.6	23	36.5	49	21.1

Table 2 describes in further detail the articles reporting at least one federal and philanthropic funding source between 2000 and 2019. This table shows the counts and proportion of articles that reported at least one grant from a specific federal and philanthropic entity. Since many articles reported more than one funding source, the funding source category count and percentages will add up to more than the total number of articles reporting federal and philanthropic funding.

grants resulting in 240 peer-reviewed research publications.

At a less consistent cadence over our study period, but still noteworthy, the Robert Wood Johnson Foundation was the second most common philanthropic source identified in our study. This study found that a variety of its programs over the years supported new and seasoned firearm injury and prevention researchers alike through programs like its Clinical Scholars Fellowships and the Evidence for Action Program (Riley et al., 2017; Knopov et al., 2019).

Increased public and media attention to firearm-related issues mixed with the recent increase in academic scholarship and newly available funding hints at a new momentum for the field. As the CDC and NIH have now awarded the fiscal year 2020 earmarked funds for firearm research and with new research from private organizations, we anticipate that this positive trend will continue (Office of Behavioral and Social Sciences Research, 2021). Still, compared to other leading causes of death, the field still has a gap in scholarship and funding and greater strides could be made to address them, such as training junior scholars and improving the availability and accessibility to firearm-related data (Rowhani-Rahbar et al., 2019; Galea et al., 2018).

This study had some limitations. First, the number of articles with funding do not represent the number of grants or the dollar amount issued between 2000 and 2019. It is likely that funding from a single source (e.g., one grant) was often used to produce several articles, but without grant ID numbers from every funding source identified it is difficult to know. Second, while we examined all disclosure statements included in the articles, without consistent guidelines and requirements from journals around funding disclosures, there are limitations to our ascertainment of funding and funding sources for the articles reviewed. Third, in limiting our scoping review to biomedical literature and life sciences, we did not include funded firearm-related articles that were not indexed in PubMed. We thus may have excluded some articles from other fields such as sociology and criminology. We focused on the biomedical literature because federal agencies, such as the National Institute of Justice, were not restricted by the Dickey Amendment and played a role in firearm injury and prevention research over the years despite wide variations in their available funding for firearms research. Still, 45 articles funded by the National Institute of Justice were picked up by our PubMed search. This study is only representative of the funding landscape within the health sciences, a field most directly impacted by restrictions in CDC and NIH funding.

Future analyses can add to these findings by examining the study design and quality of the articles included in this study. Additional studies could examine federal funding “clusters” using the award’s grant ID information (where available) to determine if the number of funded projects and their dollar amount during the same time could be estimated. Building on previous research from Alcorn et al., (Alcorn, 2017) a comparison of the results from this review with scholarship from other leading causes of death during this same time period may provide another comparison group to demonstrate the field’s relative level of funding.

5. Conclusions

The field of firearm-related research in the health sciences has proven resilient against more than twenty years of politics and limited federal funding. This study’s findings illustrate how limited funding for firearm researchers in the U.S. affected the publication volume and the proportion of studies declaring funding over the past two decades. As new challenges will present themselves in this next decade, coalitions of funders coupled with federal and state funding can help build a cohesive evidence-base for solving America’s gun problem.

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Authors contribution

S.G., A.R.R., M.F., D.H., F.P.R., M.M., D.A. contributed to the conception and design of the scoping review. S.G., P.P., H.M., and M.B. contributed to the acquisition and analysis of the data. S.G. led interpretation of the data and the writing of the manuscript. All authors read and contributed to the intellectual content of the manuscript and revised it accordingly, and all approved the final manuscript.

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.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.pmedr.2021.101604>.

References

- Alcorn, T., 2017. Trends in research publications about gun violence in the United States 1960 to 2014. *JAMA Intern. Med.* 177 (1), 124–126. <https://doi.org/10.1001/jamainternmed.2016.7076>. Accessed October 3, 2020.
- Bandealy, A., Herrera, N., Weissman, M., Scheidt, P., 2020. Use of lethal means restriction counseling for suicide prevention in pediatric primary care. *Prev. Med. (Baltim.)* 130. <https://doi.org/10.1016/j.pymed.2019.105855>. Accessed November 11, 2020.
- Beardslee, J., Docherty, M., Yang, V.J.H., Pardini, D., 2019. Parental disengagement in childhood and adolescent male gun carrying. *Pediatrics* 143 (4), 2020. <https://doi.org/10.1542/peds.2018-1552>. Accessed November 17, 2020.
- Beardslee, Jordan, Docherty, Meagan, Mulvey, Edward, Pardini, Dustin, 2021. The direct and indirect associations between childhood socioeconomic disadvantage and adolescent gun violence. *J Clin Child Adolesc Psychol.* August 2019:1–11. 50 (3), 326–336.
- Castillo-Carniglia, A., Kagawa, R.M.C., Webster, D.W., Vernick, J.S., Cerdá, M., Wintemute, G.J., 2018. Comprehensive background check policy and firearm background checks in three US states. *Inj. Prev.* 24 (6), 431–436. <https://doi.org/10.1136/injuryprev-2017-042475>. Accessed November 11, 2020.
- Centers for Disease Control and Prevention National Center for Injury Prevention and Control, 2005. Web-based Injury Statistics Query and Reporting System (WISQARS) [online]. www.cdc.gov/injury/wisqars. Published 2005. Accessed August 8, 2021.
- Centers for Disease Control and Prevention, 2021. Firearm Violence Prevention - Fast Facts. <https://www.cdc.gov/violenceprevention/firearms/fastfact.html>. Accessed August 8, 2021.
- Chien, L.-C., Gakh, M., Coughenour, C., Lin, R.-T., 2020. Temporal trend of research related to gun violence from 1981 to 2018 in the United States: a bibliometric analysis. *Inj. Epidemiol.* 7 (1), 9. <https://doi.org/10.1186/s40621-020-0235-6>. Accessed October 3, 2020.
- Cunningham, R.M., Ranney, M.L., Goldstick, J.E., Kamat, S.V., Roche, J.S., Carter, P.M., 2019. Federal funding for research on the leading causes of death among children and adolescents. *Health Aff.* 38 (10), 1653–1661. <https://doi.org/10.1377/hlthaff.2019.00476>. Accessed August 8, 2020.
- Docherty M, Beardslee J, Grimm KJ, Pardini D. Distinguishing between-individual from within-individual predictors of gun carrying among Black and White males across adolescence. *Law Hum Behav.* 2019;43(2):144-155. doi:10.1037/lhb0000320. Accessed November 17, 2020.
- Fallucco, E.M., Joseph, M.M., Leung, K., Smotherman, C., Robertson, Blackmore E., 2020. Post-Parkland shooting: Development and assessment of experiential training in adolescent depression and post-traumatic stress disorder for primary care providers. *Acad. Pediatr.* 20 (3), 430–432. <https://doi.org/10.1016/j.acap.2019.10.013>. Accessed November 11, 2020.
- Fund for a Safer Future. Who we are. [fundforasaferfuture.org/who-we-are/](https://www.fundforasaferfuture.org/who-we-are/). Accessed October 3, 2020.
- Galea S, Branas CC, Flescher A, et al. Priorities in recovering from a lost generation of firearms research. *Am. J. Public Health.* 2018;108(7):858-860. doi:10.2105/AJPH.2018.304436. Accessed November 17, 2020.
- Hardiman ER, Jones L V, Cestone LM. Neighborhood perceptions of gun violence and safety: Findings from a public health-social work intervention. *Soc Work Public Health.* 2019;34(6):492-504. doi:10.1080/19371918.2019.1629144. Accessed November 17, 2020.
- He, Katherine, Sakran, Joseph, 2019. Elimination of the moratorium on gun research is not enough: The need for the CDC to set a budgetary agenda. *JAMA Surg.* 154 (3), 195–196. <https://doi.org/10.1001/jamasurg.2018.4211>. Accessed October 3, 2020.
- Hemenway, D., Nolan, E.P., 2017. The scientific agreement on firearm issues. *Inj. Prev.* 23 (4), 221–225. <https://doi.org/10.1136/injuryprev-2016-042146>. Accessed October 3, 2020.

- Hope and Heal Fund. Who we are. <https://hopeandhealfund.org/who-we-are/#our-story>. Accessed October 3, 2020.
- Kacanek, Deborah, Hemenway, David, 2006. Gun carrying and drug selling among young incarcerated men and women. *J. Urban Health* 83 (2), 266–274. <https://doi.org/10.1007/s11524-005-9022-5>. Accessed November 17, 2020.
- Kellermann, A.L., Rivara, F.P., 2013. Silencing the science on gun research. *JAMA* 309 (6), 549–550. <https://doi.org/10.1001/jama.2012.208207>. Accessed October 3, 2020.
- Khubchandani, J., Wiblehauser, M., Price, J.H., Thompson, A., 2011. Graduate psychiatric nurse's training on firearm injury prevention. *Arch. Psychiatr. Nurs.* 25 (4), 245–252. <https://doi.org/10.1016/j.apnu.2010.07.010>. Accessed November 11, 2020.
- Kaiser Permanente. Kaiser Permanente commits \$2 million to gun injury prevention research. 2018. <https://about.kaiserpermanente.org/community-health/news/kaiser-permanente-commits-2-million-to-gun-injury-prevention-res>. Accessed October 3, 2020.
- Knopov A, Siegel M, Xuan Z, Rothman EF, Cronin SW, Hemenway D. The impact of state firearm laws on homicide rates among Black and white populations in the United States, 1991–2016. *Health Soc Work.* 2019;44(4):232–240. doi:10.1093/hsw/hlz024. Accessed November 17, 2020.
- Kravitz-Wirtz, Nicole, Pallin, Rocco, Miller, Matthew, Azrael, Deborah, Wintemute, Garen J., 2020. Firearm ownership and acquisition in California: Findings from the 2018 California Safety and Well-being Survey. *Inj. Prev.* 26 (6), 516–523.
- Ladapo, J.A., Elliott, M.N., Kanouse, D.E., et al., 2016. Firearm ownership and acquisition among parents with risk factors for self-harm or other violence. *Acad. Pediatr.* 16 (8), 742–749. <https://doi.org/10.1016/j.acap.2016.05.145>. Accessed November 17, 2020.
- Laura and John Arnold Foundation. Research collaborative formed to study gun violence. 2018. <https://www.prnewswire.com/news-releases/research-collaborative-formed-to-study-gun-violence-300657452.html>. Accessed October 2, 2020.
- Lyons VH, Rivara FP, Yan AN-X, et al. Firearm-related behaviors following firearm injury: changes in ownership, carrying and storage. *J Behav Med.* 2019;42(4):658–673. doi:10.1007/s10865-019-00052-1. Accessed November 17, 2020.
- Martin-Storey A, Prickett KC, Crosnoe R. Family process correlates of firearm ownership and firearm storage among families with young children. *Matern Child Health J.* 2015;19(1):17–24. doi:10.1007/s10995-014-1490-3. Accessed November 17, 2020.
- Lopez, G., 2016. President Obama's boldest action on guns yet, explained. *Vox*. <https://www.vox.com/2016/1/4/10708324/obama-gun-control-executive-order>. (Accessed 17 November 2020).
- Martin-Storey, A., Prickett, K.C., Crosnoe, R., 2020. Alcohol use and change over time in firearm safety among families with young children. *Drug Alcohol Depend.* 2018 (186), 187–192. <https://doi.org/10.1016/j.drugalcdep.2018.01.032>. Accessed November 17, 2020.
- Matoba N, Reina M, Prachand N, Davis MM, Collins JW. Neighborhood gun violence and birth outcomes in Chicago. *Matern Child Health J.* 2019;23(9):1251–1259. doi:10.1007/s10995-019-02765-w. Accessed November 17, 2020.
- Mayors Against Illegal Guns, 2013. Access denied: How the gun lobby is depriving police, policymakers, and the public of the data we need to prevent gun violence. http://libcloud.s3.amazonaws.com/9/c1/6/1017/3/access_denied.pdf. Accessed October 3, 2020.
- Metzl, Jonathan, 2018. Repeat the Dickey Amendment to address polarization surrounding firearms in the United States. *Am. J. Public Health* 108 (7), 864–865. <https://doi.org/10.2105/AJPH.2018.304461>. Accessed August 8, 2021.
- Meyer, G., Roberto, A.J., Atkin, C.K., 2003. A radio-based approach to promoting gun safety: process and outcome evaluation implications and insights. *Health Commun.* 15 (3), 299–318. https://doi.org/10.1207/S15327027HC1503_3. Accessed November 17, 2020.
- National Library of Medicine. PubMed Overview. <https://pubmed.ncbi.nlm.nih.gov/about/>. Accessed August 8, 2021.
- National Library of Medicine. MEDLINE® Citation Counts by Year of Publication (as of January 2021)*. https://www.nlm.nih.gov/bsd/medline_cit_counts_yr_pub.html. Accessed August 8, 2021.
- O'Brien, K., Forrest, W., Lynott, D., Daly, M., 2013. Racism, gun ownership and gun control: biased attitudes in US whites may influence policy decisions. *PLoS One.* 8 (10) <https://doi.org/10.1371/journal.pone.0077552>. Accessed November 11, 2020.
- Office of Behavioral and Social Sciences Research. Notice of intent to publish funding opportunity announcements for research on firearm injury and mortality prevention. <https://grants.nih.gov/grants/guide/notice-files/NOT-OD-21-059.html>. Published 2021. Accessed February 15, 2021.
- Ouzzani, M., Hammady, H., Fedorowicz, Z., et al., 2016. Rayyan: A web and mobile app for systematic reviews. *Syst. Rev.* 5 (1), 210. <https://doi.org/10.1186/s13643-016-0384-4>. Accessed November 11, 2020.
- Pallin, R., Charbonneau, A., Wintemute, G.J., Kravitz-Wirtz, N., 2019. California public opinion on health professionals talking with patients about firearms. *Health Aff. (Millwood)* 38 (10), 1744–1751. <https://doi.org/10.1377/hlthaff.2019.00602>. Accessed November 17, 2020.
- Presidential Memorandum: Engaging in public health research on the causes and prevention of gun violence. obamawhitehouse.archives.gov/the-press-office/2013/01/16/presidential-memorandum-engaging-public-health-research-causes-and-preve. Accessed November 11, 2020.
- Price JH, Thompson AJ, Khubchandani J, Wiblehauser M. Psychiatric residency directors' perceptions of firearm access by the mentally ill in the United States. *J Community Health.* 2014;39(2):322–326. doi:10.1007/s10900-013-9764-z. Accessed November 17, 2020.
- Prickett, K.C., Martin-Storey, A., Crosnoe, R., 2014. State firearm laws, firearm ownership, and safety practices among families of preschool-aged children. *Am. J. Public Health* 104 (6), 1080–1086. <https://doi.org/10.2105/AJPH.2014.301928>. Accessed November 11, 2020.
- PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. *Ann. Intern. Med.* 2018;169(7):467–473. doi:10.7326/m18-0850 %m 30178033. Accessed November 11, 2020.
- Rajan, S., Branas, C.C., Hargarten, S., Allegrante, J.P., 2018. Funding for gun violence research is key to the health and safety of the nation. *Am. J. Public Health* 108 (2), 194–195. <https://doi.org/10.2105/AJPH.2017.304235>. Accessed August 8, 2021.
- Riddell CA, Harper S, Cerdá M, Kaufman JS. Comparison of rates of firearm and nonfirearm homicide and suicide in Black and white non-Hispanic men, by U.S. State. *Ann Intern Med.* 2018;168(10):712–720. doi:10.7326/M17-2976. Accessed November 17, 2020.
- Riley C, Roy B, Harari N, et al. Preparing for disaster: A cross-sectional study of social connection and gun violence. *J Urban Health.* 2017;94(5):619–628. doi:10.1007/s11524-016-0121-2. Accessed November 17, 2020.
- Roesler, J., Ostercamp, M., 2000. Pediatric firearm injury in Minnesota, 1998. *Fatal and nonfatal firearm injuries among Minnesota youth.* *Minn. Med.* 83 (9), 57–60. Accessed November 17, 2020.
- Rostron, A., 2018. The Dickey Amendment on Federal Funding for Research on Gun Violence: A Legal Dissection. *Am. J. Public Health* 108 (7), 865–867. <https://doi.org/10.2105/AJPH.2018.304450>. Accessed August 8, 2021.
- Rowhani-Rahbar, Ali, Bellenger, Morgan A., Rivara, Frederick P., 2019. Firearm violence research: Improving availability, accessibility, and content of firearm-related data systems. *JAMA* 322 (19), 1857. <https://doi.org/10.1001/jama.2019.16286>.
- Rubin, Rita, 2016. Senators urge appropriation of funds for gun violence research at the CDC. *JAMA* 315 (18), 1938. <https://doi.org/10.1001/jama.2016.5311>.
- Ruggles, K.V., Rajan, S., 2014. Gun possession among American youth: a discovery-based approach to understand gun violence. *PLoS One* 9 (11). <https://doi.org/10.1371/journal.pone.0111893>. Accessed November 11, 2020.
- Schleimer, J.P., Kravitz-Wirtz, N., Pallin, R., Charbonneau, A.K., Buggs, S.A., Wintemute, G.J., 2020. Firearm ownership in California: A latent class analysis. *Inj. Prev.* 26 (5), 456–462. <https://doi.org/10.1136/injuryprev-2019-043412>. Accessed November 17, 2020.
- Slovak K, Singer M. Gun violence exposure and trauma among rural youth. *Violence Vict.* 2001;16(4):389–400. Accessed November 17, 2020.
- Stark, D.E., Shah, N.H., 2017. Funding and publication of research on gun violence and other leading causes of death. *JAMA* 317 (1), 84–85. <https://doi.org/10.1001/jama.2016.16215>. Accessed October 3, 2020.
- Stroebe W, Leander NP, Kruglanski AW. The impact of the Orlando mass shooting on fear of victimization and gun-purchasing intentions: Not what one might expect. *PLoS One.* 2017;12(8):e0182408. doi:10.1371/journal.pone.0182408. Accessed November 17, 2020.
- Subbaraman N. United States to fund gun-violence research after 20-year freeze. *Nature.* 2020 Jan;577(7788):12. doi:10.1038/d41586-019-03882-w. PMID: 31871323.
- The Joyce Foundation. 25 Years of Impactful Grant Making: Gun Violence Prevention Research Supported by the Joyce Foundation. 2019. http://www.joycefdn.org/assets/images/Joyce_Report_v5.pdf. Accessed November 17, 2020.
- The President's plan to protect our children and our communities by reducing gun violence. obamawhitehouse.archives.gov/sites/default/files/docs/wh_now_is_the_time_full.pdf. Accessed November 11, 2020.
- Thompson, A., Price, J.H., Khubchandani, J., Bryant, M., Reindl, D., Hogue, P., 2012. Physician assistants training on firearm injury prevention. *Patient Educ. Couns.* 86 (3), 348–353. <https://doi.org/10.1016/j.pec.2011.06.009>. Accessed November 11, 2020.
- United States House of Representatives. Omnibus Consolidated Appropriations Bill. HR 3610, Pub L No. 104-208 1996. <http://www.gpo.gov/fdsys/pkg/PLAW-104publ208/pdf/PLAW-104publ208.pdf>. Accessed October 3, 2020.
- United States Senate. Departments of Labor, Health and Human Services, and Education, and related agencies appropriations for fiscal year 2018: Hearings before a subcommittee of the Committee on Appropriations, United States Senate, One Hundred Fifteenth Congress, First Session, on H.R. 3358/S. 2018. https://docs.house.gov/billssthisweek/20180319/DIV_H_LABORHHS_SOM_FY18_OMNI.OCR.pdf. Accessed October 3, 2020.
- Van Brocklin, E., 2019. States are funding the gun violence research the feds won't. [TheTrace.org https://www.thetrace.org/2019/01/state-gun-violence-research-california-new-jersey/](https://www.thetrace.org/2019/01/state-gun-violence-research-california-new-jersey/). Accessed November 11, 2020.
- Vriniotis, M., Barber, C., Frank, E., Demicco, R., 2015. A suicide prevention campaign for firearm dealers in New Hampshire. *Suicide Life Threat Behav.* 45 (2), 157–163. <https://doi.org/10.1111/sltb.12123>. Accessed November 11, 2020.
- Walker, G.N., McLone, S., Mason, M., Sheehan, K., 2016. Rates of firearm homicide by Chicago region, age, sex, and race/ethnicity, 2005–2010. *J. Trauma Acute Care Surg.* 81 (4 Suppl 1), S48–53. <https://doi.org/10.1097/TA.0000000000001176>. Accessed November 17, 2020.
- Walton T, Stuber J. Firearm retailers and suicide: Results from a survey assessing willingness to engage in prevention efforts. *Suicide Life Threat Behav.* 2020;50(1):83–94. doi:10.1111/sltb.12574. Accessed November 17, 2020.
- Webster DW, Whitehill JM, Vernick JS, Curriero FC. Effects of Baltimore's Safe Streets Program on gun violence: a replication of Chicago's CeaseFire Program. *J Urban Health.* 2013;90(1):27–40. doi:10.1007/s11524-012-9731-5. Accessed November 17, 2020.
- Wolso K, Marino E, Keys S. Affirming cultural values for health: The case of firearm restriction in suicide prevention. *Soc Sci Med.* 2020;248:112706. doi:10.1016/j.socscimed.2019.112706. Accessed November 17, 2020.