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Emotional and physical symptoms after gun victimization in the United States, 2009–2019

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ABSTRACT

Interpersonal firearm violence is a major public health problem in the United States. The objective of this study was to determine the effects of gun victimization on the likelihood of post emotional and physical symptoms as reported by victims. We focused on non-fatal violent crimes reported to the National Crime Victimization Surveys for 2009–2019 and ran a set of binary logistic regressions. For outcome measures, we used two dichotomous variables, whether the victim reported feeling at least one of the seven emotional symptoms included in the survey (i.e., anxious, angry, sad/depressed, vulnerable, violated, distrustful, unsafe) and whether they reported having at least one of the seven physical symptoms (i.e., headaches, sleep eating/drinking disorders, upset stomach, fatigue, high blood pressure, muscle tension). Our key independent variable was the type of weapons used by the offender: guns, other weapons, and no weapon. We controlled for demographics of the victim, as well as other aspects of the crime (e.g., age, race, sex of victim, multiple offenders, type of violent crime). Victims of crimes in which the offender used a gun were most likely to report both emotional and physical symptoms, followed by victims of crimes in which the offender used other weapons, and lastly by victims of unarmed offenders. Our findings suggest that the presence of a firearm during a violent crime results in an increased likelihood of subsequent emotional and physical repercussions.

1. Introduction

Estimates based on weighted data from the National Crime Victimization Surveys (NCVS) indicate that, on average, more than 5 million violent crimes occurred in the United States annually from 2015 through 2019 (Morgan and Truman, 2019). These violent crimes include sexual assaults, rapes, robberies, and assaults (both simple and aggravated).

In addition to the immediate impact, these crimes frequently have long term consequences. Prior studies show that violent crimes have a negative effect on the quality of life of victims, including an impact on parental skills, unemployment, occupational functions and intimate partner relations (Hanson et al., 2010). Research also shows that adolescents who witness a crime or are victims of a crime are more likely to suffer subsequent disorders such as substance abuse, PSTD, and major depressions (Kilpatrick et al., 2003). Similarly, studies have linked community violence to lower educational achievement among children (Schwartz and Gorman, 2003) and have shown a strong association between high levels of exposure to violence among young adults and higher levels of aggressive behavior, depressed mood, and interpersonal problems (Scarpa, 2003).

The negative long-term impact of violent crimes has also been addressed by government agencies. Using the NCVS, a 2014 report conducted by the Bureau of Justice Statistics (BJS) explored the socio-emotional impact of violent crimes on victims. They found that, from 2009 through 2012, over 2/3 of victims reported at least one of the following experiences after the occurrence of a violent crime: moderate to severe levels of distress; problems at school or work; or problems with friends or family members (Truman and Langton, 2014). Most victims who reported any of these experiences also reported emotional symptoms such as feelings of anxiety, anger, sadness or depression, vulnerability, distrustfulness, unsafety, or feeling violated. In a lesser proportion, these victims also reported physical symptoms such as headaches, lack of sleep, eating or drinking disorders, upset stomachs, fatigue, high blood pressure, and muscle tension. The BJS report did not include multivariable analyses nor disaggregate by the type of weapon (e.g., gun) used by offenders.

In this regard, gun-related crimes are common in the United States and can result in high levels of distress. Based on weighted data, it is

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estimated that in 2019 over 440,000 gun-related crimes occurred in the United States, more than 1200 per day (Morgan and Truman, 2019). Previous studies have concluded that the presence of a firearm during a violent crime can contribute to post traumatic emotions and have significant repercussions on health. A 2019 study reported that gun injuries among young Americans can lead to post traumatic stress and increase the likelihood of future gun injuries (Ranney et al., 2019). Another study concluded that exposure to gun violence among youth should be classified as an Adverse Childhood Experience (Rajan et al., 2019). These are defined as traumatic experience between the ages of 0 to 17 years of age that are linked to substance abuse, chronic health problems and mental illness (Centers for Disease Control, 2020). A 2019 analysis found that 58% of young Americans that had an indirect encounter with gun violence (seeing gun violence or hearing gun shots) reported feeling sad, afraid, or upset as a result of that exposure (Mitchell et al., 2019).

Like the BJS report, a 2018 study analyzed data from the NCVS and reported that the threats of death posed by firearms contributed to victims reporting higher levels of distress (Kagawa et al., 2018). Similarly, a 2019 study concluded that in addition to experiencing higher levels of distress, victims of gun related crimes were more likely to report subsequent daily functioning problems (Kagawa et al., 2020). These included problems at work or school, with family members or peers. The results were consistent across different sociodemographic groups.

While these previous studies addressed the likelihood of reporting distress levels or daily functioning problems after gun victimization, they did not explore the role of gun victimization on the likelihood of reporting emotional and physical symptoms.

Our objective is to add to this literature by analyzing the likelihood of reporting emotional or physical symptoms after the occurrence of a crime if offenders used guns. We complement the 2014 BJS report by controlling for other variables and analyzing gun victimization. Our study contributes to understanding the impact of gun violence beyond immediate physical injuries.

2. Methods

Data come from the U.S. National Crime Victimization Survey (NCVS). The NCVS is a self-reported survey that asks about crime victimization of individuals ages 12 or older in more than 90,000 households (BJS, 2020). Each household is interviewed twice per year and remains in the sample for 3 years. This means that eligible persons within each household are interviewed up to seven times. While the first interviews are in-person, the subsequent interviews are often conducted by phone. Respondents provide information about themselves (household information, age, sex, ethnicity, and race) and whether they experienced a victimization in the form of threatened, attempted or completed crime during the previous six months (BJS, 2020). Specifically, respondents are asked multiple times such questions as "Was something belonging to you stolen, such as…" "Did anyone attempt to steal anything belonging to you" "Were you attacked or threatened" "Has anyone attacked or threatened you in any of these ways…" If one or multiple instances of victimization are reported, the NCVS then asks respondents to provide detailed information about all criminal incidents. Inquiries about criminal incidents include information on type of crime, location, whether victims were present, characteristics of offenders, whether perpetrators were armed, and about weapon types. Specifically, respondents are asked "Did the offender have a weapon such as a gun or knife" and "What was the weapon?" Additionally, respondents provide information on whether crimes were reported to the police, and reasons for not reporting crimes to the police. Overall, incidents are grouped into three specific categories: violent crimes (excluding homicides), personal theft, and property crimes. Weighted data from the NCVS is nationally representative.

While weighted data derived from the NCVS are useful for estimating national victimization rates, unweighted data are often preferable when conducting regressions (Sharon and Joanna, 1994; Avery et al., 2019). For this study, we used unweighted data and focused on violent crimes as categorized by the Bureau of Justice Statistics (Truman, 2010; Morgan and Oudekerk, 2018) These include rapes, sexual assaults, robberies, and assaults (both simple and aggravated). We analyzed data from 2009 to 2019 because questions about the victim's emotional and physical symptoms after a crime were first fully incorporated in 2009, and 2019 is the latest year with available data.

Within the NCVS, respondents are asked about levels of distress experienced after the occurrence of a violent crime. Answers to this question are grouped into four categories: no distress, mild distress, moderate distress or severe levels of distress. Specifically, respondents are asked "did being a victim of this crime lead you to have significant problems with your job or schoolwork, or trouble with your boss, coworkers, or peers?" and "Did being a victims of this crime lead you to have significant problems with family members or friends, including getting into more arguments or fights than you did before, not feeling you could trust them as much, or not feeling as close to them as you did before?" Consistent with the 2014 BJS report, we considered victims to have socio-emotional problems if they reported one of the following experiences: mild to severe distress; problems at work or school; or problems with friends and family members (Truman and Langton, 2014).

The NCVS asks victims with socio-emotional problems whether they experienced emotional or physical symptoms "for a month or more" after the occurrence of the crime. Inquiries about emotional symptoms asked specifically whether victims felt "worried or anxious; angry; sad or depressed; vulnerable; violated; like you couldn't trust people; and unsafe." Inquiries about physical symptoms asked whether victims experienced "headaches; trouble sleeping; changes in your eating or drinking habits; upset stomach; fatigue; high blood pressure; muscle tension or back pain."

We used the responses to these fourteen questions to construct our two main outcome variables. For the first dependent variable, observations equaled "1" if victims reported suffering at least one emotional symptom for a month or more after the crime and "0" otherwise. For our second dependent variable, observations equaled "1" if victims reported suffering at least one physical symptom for a month or more after the crime and "0" otherwise. We assumed that victims who were initially determined not to have socio-emotional problems, and thus not asked subsequent questions, did not suffer any emotional or physical symptoms. These were victims who reported no distress or mild distress and reported no problems at school or work as well as no problems with friends or family members. For these cases, both dependent variables equaled "0." We imputed observations for both dependent variables if respondents did not answer the questions concerning whether they had socio-emotional problems and therefore were not asked about emotional and physical symptoms ($n = 2545$). We further imputed observations for our first outcome variable when victims were asked about all emotional symptoms but did not respond to any of those inquires ($n = 27$). Similarly, we imputed observations for our second outcome variable where victims were asked about all physical symptoms but did not respond to those inquiries ($n = 54$).

Following BJS methodology used to categorize gun-related crimes (Truman and Langton, 2015), our main independent variable equaled "1" if offenders used long guns, handguns or the type of weapon was labeled as an undetermined firearm, regardless of whether they also used other weapons. We constructed another variable that equaled "1" if offenders were unarmed and "0" if they were armed with any weapon. The comparison group was crimes that involved weapons other than a gun, such as blunt or sharp objects (and no guns). A small number of observations ($n = 293$) where type of weapons was undetermined were categorized as other weapons. This latter group excludes observations were respondents specified that the weapon was an undetermined firearm ($n = 11$).

On all regressions, we incorporated variables for the different types

of violent crimes as categorized by the BJS (Morgan and Oudekerk, 2018). One variable was for sexual assaults and rapes and another was for robberies. The comparison group for this category was assaults (both simple and aggravated). As victims may suffer multiple crimes in a short period, we generated a variable that equaled "1" if a particular crime was the first to be reported by the victim in that NCVS survey and "0" if this was not the case.

Following BJS methodology, we generated three variables based on the relationship between victims and offenders: crimes perpetrated by intimate partners, by other relatives, and by acquaintances (including friends, roommates, costumers, neighbors, schoolmate, employee, co-worker, teacher, patient, supervisor, and other non-relatives). The comparison group was crimes perpetrated by strangers. We further controlled for whether any injuries occurred during the crime, whether the crime occurred at or near the victim's home, whether the perpetrators were under the influence of drugs and/or alcohol, and whether there were multiple aggressors. In the few cases where respondents were unsure about the number of offenders, we categorized them as being perpetrated by multiple aggressors. As there were a small number of cases where respondents did not answer the question about the number of offenders, we generated a missing category. Results for this category are not reported.

We controlled for characteristics of the victims: sex (M/F), age and household income. We created age and income categories as well as comparison groups used in prior studies (Kagawa et al., 2020). For age groups, we made victims between the ages of 12 and 18 the comparison group. For household income, we made victims living in households with an annual income higher than 75,000 dollars the comparison group. As many respondents did not report income levels, we generated a missing income category. Results for this category are not reported. We also controlled for race of the victim. Due to the limited number of observations, we generated two variables, whether victim's race was non-Hispanic White and whether victim's race was non-Hispanic Black. For the comparison group, we included all other victims, including Hispanic, Native American, and Asian.

From 2009 to 2019, 18,275 non-fatal violent crimes were reported to the NCVS (unweighted data). Of these, 8% were perpetrated with a gun ($n = 1483$), 14% (2582) were perpetrated with other weapons, and 78% ($n = 14{,}210$) were perpetrated by unarmed offenders. Roughly 82% of crimes were reported as assaults ($n = 15{,}065$), 11% as robberies ($n = 1971$), and 7% as sexual crimes ($n = 1239$).

Sexual related crimes have large underreporting problems, even in victimization surveys (Kruttschnitt et al., 2014). These crimes are linked to higher emotional symptoms and are rarely perpetrated with a gun (only 28 gun-related sexual crimes are included in our analysis). As a sensitivity analysis, we ran a second set of binary logistic regressions that excluded sexual related crimes. Finally, we conducted an additional sensitivity analysis where we removed imputed observations for both outcome variables. Results of these analyses are included in the appendix.

3. Results

Over half (55%) of victims reported emotional symptoms, and more than one-third (35%) reported physical symptoms (Table 1). Roughly two-thirds (67%) of victims where the perpetrator used a gun reported suffering emotional symptoms compared to 59% of victims where the perpetrator used other weapons, and 52% were the perpetrator was unarmed.

Similarly, 42% of victims of crimes where the perpetrator used a gun reported at least one physical problem, compared to 39% of victims where the perpetrator used other weapons, and 34% were the perpetrator was unarmed.

Victims of sexual crime victims were the most likely to report at least one emotional symptom (80%) or physical symptom (64%). For robbery victims the respective percentages were 68% and 48% and for assault victims the respective percentages were 51% and 31%.

Table 1
Percentage of victims reporting at least one symptom by type of weapons and type of crime.

	Reported at least one emotional symptom	Reported at least one physical symptom
Overall	55%	35%
Type of weapons		
Firearms	67%	42%
Other weapons	59%	39%
Unarmed	52%	34%
Type of crime		
Sexual assaults/ rape	80%	64%
Robberies	68%	48%
Assaults	51%	31%

The multiple regressions gave similar results. After controlling for the independent variables, victims of gun-involved crimes were significantly more likely to report at least one emotional symptom (Table 2) compared to victims of crimes where the perpetrator used other weapons and victims of crimes perpetrated by unarmed offenders were significantly less likely to report at least one emotional symptom compared to victims of where the perpetrator used a weapon other than a gun.

After controlling for the independent variables, victims of gun-involved crimes were significantly more likely to report at least one physical symptom than victims of crimes perpetrated with other weapons and victims of crimes perpetrated by unarmed offenders were significantly the least likely to report a physical symptom (Table 2).

Victims of sexual-related crimes were significantly more likely than victims of robberies to report both emotional and physical symptoms and victims of robberies were more likely to report such symptoms compared to victims of assault. When compared to crimes perpetrated by strangers, victims were significantly more likely to report emotional and physical symptoms if the perpetrator was an intimate partner,

Table 2
Emotional & physical symptoms after gun victimization (odds ratio).

	Reporting at least one emotional symptom			Reporting at least one physical symptom		
	Odds ratio	Confidence interval		Odds ratio	Confidence interval	
Firearms	1.744	1.504	2.024	1.376	1.187	1.595
Unarmed	0.709	0.644	0.780	0.729	0.661	0.805
Sexual assault/rape	2.930	2.508	3.422	2.846	2.483	3.262
Robberies	1.768	1.578	1.982	1.892	1.694	2.112
First crime	0.908	0.849	0.970	0.778	0.725	0.834
Intimate partner	3.111	2.741	3.530	3.440	3.053	3.876
Other relatives	2.776	2.416	3.191	2.389	2.090	2.731
Acquaintance	1.558	1.439	1.688	1.697	1.555	1.852
Injuries	2.020	1.858	2.196	2.270	2.092	2.462
Crime at or near victim's home	1.584	1.470	1.707	1.401	1.297	1.513
Multiple offenders	1.619	1.477	1.776	1.714	1.556	1.888
Drugs or alcohol	1.064	0.990	1.144	1.267	1.175	1.366
Female victim	2.381	2.223	2.549	2.463	2.287	2.652
Victims age 19 to 39	0.969	0.873	1.075	1.119	0.995	1.259
Victims age 40 to 59	1.640	1.472	1.827	2.141	1.900	2.413
Victims age over 60	2.109	1.838	2.419	2.300	1.987	2.662
Victim race white	0.870	0.802	0.944	0.922	0.846	1.006
Victim race black	0.883	0.786	0.992	0.940	0.834	1.061
Household income <20,000	1.467	1.329	1.621	1.683	1.513	1.872
Household income 20,000 to 39,999	1.374	1.242	1.521	1.468	1.315	1.638
Household income 40,000 to 74,999	1.285	1.165	1.418	1.225	1.097	1.369
Observations	**18,275**			**18,275**		
Pseudo R2	**0.156**			**0.178**		

another relative, or an acquaintance. Victims were significantly more likely to report emotional and physical symptoms if the victim was injured, the crime occurred near the victims' home, the crime involved multiple offenders, the victim was female, and the victim reported low household income.

For the first sensitivity analysis, excluding sexual assault crimes, the results for the effect of gun crimes vs other weapons crimes and other weapons crimes vs unarmed crimes were similar (see Table A1 in the appendix). In the second sensitivity analysis, removing imputed cases, the results were again like those presented on Table 2 (see Table A2 in the appendix).

4. Discussion

Victims of crimes in which the perpetrator used a gun were significantly more likely to report at least one emotional and to report at least one physical symptom compared to victims where the perpetrator used another type of weapon (e.g, knife). Victims of unarmed offenders were the least likely to report either type of symptom. These results indicate that victimization with a firearm can lead to increased likelihood of negative emotional and physical impacts on victims, days and even months after the occurrence of a crime.

Our findings complement and are consistent with previous research done by the Bureau of Justice Statistics as well as those studies analyzing the impact of gun victimization on levels of distress and daily functions. The higher likelihood of showing emotional and physical symptoms offers a potential explanation as to why victims of gun-related crimes experience more problems at school or work as well as with family and peers.

Many studies have found that exposure to violence—as a victim, bystander, or even just a part of the community–is associated with subsequent higher rates of lifetime mental and physical health problems, and that exposure to gun violence can be particularly detrimental to long term health (Rajan et al., 2019; Centers for Disease Control, 2020; Wright et al., 2017) Our findings, focusing on victimization of adults, fit into this broad literature that shows the health costs of gun violence are far larger than deaths and immediate injuries.

Our study has limitations. The NCVS are self-reported surveys and thus may be subject to the common problems of such surveys such as faulty recall, unreliable coding, (Junger-Tas and Marshall, 1999) and socially desirable responses (Lynch, 2006). Nevertheless, the NCVS is an important national data source that provides information about crime not available from police reports. NCVS surveys are widely used by academics analyzing gun violence in the United States (Cook, 2018; Hemenway and Solnick, 2015) Another limitation of our study is that while respondents report on whether they have had these subsequent emotional and physical problems, we cannot say for sure that these symptoms were caused by the victimization. On the other hand, we have no information about the longer run effects of the victimization; our data only include a maximum of 6 months post-victimization. It is possible that some emotional and physical problems may not develop until many months or years after the crime, leading to an underestimation of the emotional and physical symptoms related to the incident.

Other limitations include a lack of information about the severity of the problems and about many potential confounders. Many factors affect the likelihood of the outcome variables, so there may be omitted variable bias since we have data on only about a dozen of these potential independent variables. There are many other variables about which it would be useful to have data. For example, studies show that the caliber of a firearm affects the likelihood of death during assaults (Braga and Cook, 2018), it is possible that emotional and physical symptoms reported by victims also differ depending on the firearm type and caliber.

Our results show a strong association between victimization with a gun and the likelihood the victim will exhibit many emotional and physical problems over the ensuing months. The likely increased negative impact of gun victimization on these emotional and physical symptoms should be considered when medical and mental health professionals attend to victims of non-fatal gun violence.

Our study adds to the literature indicating that violence, and firearm violence in particular, is an important risk factor for subsequent emotional and physical problems. These subsequent emotional and physical effects should be considered when measuring the overall costs of firearm violence and in addressing and determining victim compensation after the occurrence of a crime.

CRediT authorship contribution statement

Eugenio Weigend Vargas: Conceptualization, Formal analysis, Data curation, Writing - original draft, Writing - review & editing. **David Hemenway**: Formal analysis, Data curation, Writing - original draft, Writing - review & editing.

Declaration of Competing Interest

None.

Appendix A. Supplementary data

Table A1
Emotional & physical symptoms after gun victimization (odds ratio) Excluding sexual-related crimes.

	Reporting at least one emotional symptom			Reporting at least one physical symptom		
	Odds ratio	Confidence interval		Odds ratio	Confidence interval	
Firearms	1.745	1.502	2.026	1.379	1.187	1.602
Unarmed	0.715	0.649	0.788	0.744	0.672	0.822
Robberies	1.765	1.575	1.978	1.885	1.688	2.105
First crime	0.900	0.841	0.964	0.766	0.712	0.824
Intimate partner	3.306	2.901	3.768	3.596	3.176	4.071
Other relatives	2.763	2.400	3.180	2.361	2.061	2.706
Acquaintance	1.544	1.422	1.677	1.654	1.508	1.813
Injuries	1.975	1.812	2.154	2.217	2.035	2.415
Crime at or near victim's home	1.597	1.479	1.724	1.402	1.294	1.519
Multiple offenders	1.628	1.483	1.787	1.739	1.577	1.919
Drugs or alcohol	1.058	0.982	1.140	1.260	1.165	1.363
Female victim	2.326	2.170	2.493	2.406	2.231	2.595
Victims age 19 to 39	0.965	0.867	1.073	1.133	1.000	1.283

(continued on next page)

Table A1 (*continued*)

	Reporting at least one emotional symptom			Reporting at least one physical symptom		
	Odds ratio	Confidence interval		Odds ratio	Confidence interval	
Victims age 40 to 59	1.657	1.485	1.850	2.184	1.928	2.474
Victims age over 60	2.143	1.864	2.464	2.377	2.044	2.764
Victim race white	0.862	0.793	0.937	0.919	0.840	1.005
Victim race black	0.907	0.805	1.021	0.969	0.857	1.097
Household income <20,000	1.451	1.310	1.608	1.674	1.498	1.870
Household income 20,000 to 39,999	1.377	1.241	1.527	1.482	1.323	1.661
Household income 40,000 to 74,999	1.303	1.179	1.441	1.224	1.091	1.374
Observations	**17,036**			**17,036**		
Pseudo R2	**0.146**			**0.164**		

Table A2. Emotional & physical symptoms after gun victimization (odds ratio) Excluding imputed observations.

	Reporting at least one emotional symptom			Reporting at least one physical symptom		
	Odds ratio	Confidence interval		Odds ratio	Confidence interval	
Firearms	1.700	1.441	2.005	1.432	1.215	1.689
Unarmed	0.705	0.636	0.782	0.734	0.660	0.817
Sexual assault/rape	2.892	2.454	3.408	2.812	2.432	3.252
Robberies	1.764	1.559	1.996	1.880	1.668	2.119
First crime	0.906	0.843	0.973	0.765	0.710	0.826
Intimate partner	3.085	2.696	3.530	3.452	3.038	3.923
Other relatives	2.728	2.355	3.161	2.404	2.083	2.775
Acquaintance	1.560	1.432	1.699	1.727	1.573	1.897
Injuries	2.077	1.905	2.265	2.301	2.114	2.505
Crime at or near victim's home	1.571	1.448	1.704	1.419	1.305	1.544
Multiple offenders	1.605	1.452	1.773	1.794	1.616	1.992
Drugs or alcohol	1.083	1.003	1.168	1.286	1.188	1.392
Female victim	2.390	2.220	2.574	2.453	2.264	2.658
Victims age 19 to 39	0.995	0.888	1.115	1.140	1.002	1.296
Victims age 40 to 59	1.673	1.486	1.883	2.103	1.845	2.396
Victims age over 60	2.166	1.865	2.515	2.286	1.948	2.681
Victim race white	0.870	0.797	0.951	0.910	0.829	0.999
Victim race black	0.865	0.762	0.983	0.906	0.795	1.033
Household income <20,000	1.440	1.293	1.603	1.705	1.519	1.913
Household income 20,000 to 39,999	1.341	1.202	1.497	1.478	1.312	1.665
Household income 40,000 to 74,999	1.238	1.113	1.378	1.243	1.102	1.402
Observations	**15,703**			**15,676**		
Pseudo R2	**0.160**			**0.184**		

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