

The Mental Health Consequences of Mass Shootings

Sarah R. Lowe¹ and Sandro Galea²

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Abstract

Mass shooting episodes have increased over recent decades and received substantial media coverage. Despite the potentially widespread and increasing mental health impact of mass shootings, no efforts to our knowledge have been made to review the empirical literature on this topic. We identified 49 peer-reviewed articles, comprised of 27 independent samples in the aftermath of 15 mass shooting incidents. Based on our review, we concluded that mass shootings are associated with a variety of adverse psychological outcomes in survivors and members of affected communities. Less is known about the psychological effects of mass shootings on indirectly exposed populations; however, there is evidence that such events lead to at least short-term increases in fears and declines in perceived safety. A variety of risk factors for adverse psychological outcomes have been identified, including demographic and pre-incident characteristics (e.g., female gender and pre-incident psychological symptoms), event exposure (e.g., greater proximity to the attack and acquaintance with the deceased), and fewer psychosocial resources (e.g., emotion regulation difficulties and lower social support). Further research that draws on pre-incident and longitudinal data will yield important insights into the processes that exacerbate or sustain post-incident psychological symptoms over time and provide important information for crisis preparedness and post-incident mental health interventions.

Keywords

mass shootings, school shootings, mass trauma, posttraumatic stress, major depression, psychosocial resources, risk and protective factors

Over the past few decades, *mass shooting episodes*—defined as events involving one or more persons attempting to kill multiple people, and at least one unrelated person, in an area occupied by multiple unrelated persons (Blair & Martaindale, 2013)—have received substantial media coverage and captured public attention. Recent investigations have suggested that mass shooting episodes are becoming more frequent. For example, a report by researchers at the Texas State University identified 84 episodes in the United States between 2000 and 2010 and noted a trend toward increasing frequency of time (Blair & Martaindale, 2013). An investigation by the Mother Jones news organization, using a slightly different definition of mass shootings (events that were “senseless, random, or at least public in nature”), identified 70 episodes occurring between 1982 and 2012 and noted a recent surge in these events, with nearly half occurring since 2006.

In addition to the increasing frequency of mass shootings episodes, key events over the past decade have had unusually large numbers of fatalities and injuries—for example, 33 fatalities and 23 injuries in the 2007 Virginia Tech massacre, 12 fatalities and 58 injuries in the 2012 Aurora, Colorado theater shooting, and 28 fatalities and 2 injuries in the Sandy Hook elementary school shooting in Newtown, Connecticut (Follman, Aronsen, & Pan, 2014). In an epidemiological review of school shootings, Shultz, Cohen, Muschert, and Flores de Apodaca,

(2013) noted that just three events (Columbine, Sandy Hook, and Virginia Tech) accounted for over half of the fatalities in the 215 incidents between 1990 and 2012.

Research indicates that exposure to assaultive violence, or learning that a close friend or loved one has faced such exposure, is associated with an increased incidence of a range of negative mental health outcomes, among them posttraumatic stress disorder (PTSD) and major depression (MD; e.g., Breslau et al., 1996; Lowe, Blachman-Forshay, & Koenen, 2015). It is therefore likely that mass shootings exert a psychological toll on their direct victims and members of the communities in which they took place. Moreover, media coverage of mass shootings and their aftermath reaches far beyond affected communities to the entire nation and beyond. As shown in the

¹ Department of Epidemiology, Columbia University, Mailman School of Public Health, New York, NY, USA

² Department of Epidemiology, Boston University School of Public Health, Boston, MA, USA

Corresponding Author:

Sarah R. Lowe, Department of Epidemiology, Columbia University, Mailman School of Public Health, 722 West 168th Street, Room 720-F, New York, NY 10032, USA.

Email: srlowe@gmail.com

aftermath of the September 11 terrorist attacks (9/11), such indirect exposure can have mental health consequences (Henricksen, Bolton, & Sareen, 2010). For example, in the National Epidemiologic Survey of Alcohol and Related Conditions, indirect exposure to 9/11 through the media was associated with increased risk for mood, anxiety and substance use disorders, and PTSD, relative to no reported 9/11 exposure (Henricksen et al., 2010).

Despite the potentially widespread and increasing mental health impact of mass shooting episodes, no efforts to our knowledge have been made to synthesize the extant literature on this topic. In this article, we therefore aim to conduct a review of empirical investigations on the mental health consequences of mass shootings. We provide an overview of this body of research, including the prevalence and predictors of various mental health outcomes. Based on this review, we make recommendations for future research and post-incident interventions.

Method

We conducted a literature search in PsycInfo and PubMed databases, using both general terms (e.g., shooting, tragedy), and names of specific events (e.g., Columbine, Sandy Hook) compiled from comprehensive lists of mass shootings (Follman, Aronsen, Pan, & Caldwell, 2013; Henriques, 2013; Shultz et al., 2013). In our review, we used the aforementioned definition of mass shootings: events involving one or more persons attempting to kill multiple people, and at least one unrelated person, in an area occupied by multiple unrelated persons (Blair & Martaindale, 2013). We included events that took place in any country in the world. We limited our search to articles in peer-reviewed, English language journals that included quantitative indices of post-event mental health, including symptoms of psychiatric disorders (e.g., PTSD and MD) and general symptoms that cut across disorders (e.g., psychological distress and fear). We therefore excluded qualitative studies, and quantitative studies that focused solely on other outcomes (e.g., perceptions of social solidarity and coping strategies). In addition to studies identified through database searches, reference lists of articles on this topic were reviewed to identify additional studies.

The coding processes consisted of two main steps. First, we coded for study characteristics. We recorded the mass shooting event that was the focus of each study, including the year, location, context, demographic characteristics of the perpetrator, and numbers of injuries and fatalities during the incident, and whether the study focused on more than one event. We noted instances in which data from the same sample were used across different analyses to determine how many independent samples were there across the studies. In addition, we noted whether the sample was *affected* (defined as direct victims of the shooting or members of the community in which the shooting took place) or *remote* (defined as consisting primarily of members outside of the affected community, e.g., national samples or students at a university in a difficult region), basic characteristics of the

sample (e.g., whether participants were students or emergency personnel), sample sizes, and timing of assessments.

Second, we coded the prevalence estimates and predictors of mental health outcomes in each study. We recorded the mental health outcomes assessed, the measures and diagnostic classification systems used, and the prevalence of psychiatric disorders. We then listed significant predictors of mental health outcomes and, in doing so, specified the mental outcome included in the analysis (e.g., diagnosis or symptom severity score, change in symptoms over time) and timing of assessment. Finally, we noted results that went beyond prevalence estimates and predictors, such as those focused on mechanisms leading to mental health outcomes.

Both authors formulated the article selection process, inclusion criteria, and coding scheme. The first author conducted the literature search, coded selected articles, and checked and rechecked coding for accuracy, and the second author oversaw the review process and provided regular feedback.

Study Characteristics

We identified a total of 49 studies on 15 different mass shooting incidents that took place from 1984 to 2008. Three of the studies focused on two different events combined. Table 1 provides basic information on each event (e.g., location, number of injuries, and fatalities) in chronological order. Thirteen events took place in the United States, and two took place in Finland. The majority of events ($n = 9$) were in a secondary school or university context, whereas the remainder took place in other locations (e.g., local businesses). In total, there were 27 independent samples (three from studies focusing on two different events combined). Of the 27 independent samples, 22 were classified as affected samples and 5 as remote samples (two affected and one remote from the studies focusing on two different events combined).

Post-Shooting Mental Health Outcomes

Table 2 denotes the mental health outcomes included in each study, as well as the measures used to assess them and the classification system used to determine prevalence estimates if this information was available.

Psychiatric Disorders and Prevalence Estimates

PTSD. Posttraumatic stress symptoms (PTSS) were reported in the majority of studies—36 studies from 18 independent samples. Eighteen of these studies (from 14 independent samples) included a prevalence estimate of PTSD. The lowest PTSD prevalence reported was 3% among parents of children exposed to an elementary school shooting 6–14 months post-incident, determined using conservative *Diagnostic and Statistical Manual of Mental Disorders*, Third Edition, Revised (DSM-III-R) criteria with the PTSD–Reaction Index (PTSD-RI; Schwarz & Kowalski, 1991a). The highest prevalence reported was 91% among children in the same study, using liberal

Table 1. Summary of Mass Shooting Incidents and Characteristics of Peer-Reviewed Studies.

Year	Location	Context	Perpetrator	Fatalities	Injuries	Peer-Reviewed Articles	Samples (Affected, Remote)
1984	Los Angeles, CA	Elementary school	Adult African American male	3	14	2	1 (1, 0)
1984	San Ysidro, CA	Fast food restaurant	Adult White male	21	15	1	1 (1, 0)
1987	Russellville, AR	Four local businesses	Adult White male	2	4	1	1 (1, 0)
1988	Winnetka, IL	Elementary school	Adult White female	2	5	6	3 (3, 0)
1991	Killeen, TX	Cafeteria-style restaurant	Adult White male	24	20	5	2 (2, 0)
1992	St. Louis, MO	Courthouse	Adult White male	1	5	1	1 (1, 0)
1993	San Francisco, CA	Office building	Adult White male	6	14	1	1 (1, 0)
1994	Brooklyn, NY	Brooklyn Bridge	Adult Lebanese-born immigrant male	1	3	1	1 (1, 0)
1999	Columbine, CO	High school	Two adolescent White males	15	21	3	3 (0, 3)
2006	Montreal, Quebec, Canada	University (Dawson College)	Adult Indo-Canadian male	2	17	1	1 (1, 0)
2007	Tuusula, Finland	High school (Jokela High School)	Adolescent White male	9	19	3	1 (1, 0)
2007	Blacksburg, VA	University (Virginia Polytechnic Institute and State University)	Adult South Korean male	33	25	11	4 (3, 1)
2008	DeKalb, IL	University (Northern Illinois University)	Adult White male	6	18	8	2 (2, 0)
2008	Conway, AR	University (University of Central Arkansas)	Four adult African American males	2	1	1	1 (1, 0)
2008	Kauhajoki, Finland	University (Seinäjäki University of Applied Sciences)	Adult White male	11	1	1	1 (1, 0)

Note. Affected samples included participants who lived in the communities in which the incident occurred; participants did not have to be directly exposed to the event. Remote samples included members of other communities and nationally representative samples. Table does not include three studies that each focused on two different events (two affected samples, one remote sample).

(proposed) DSM-IV criteria and the children's version of the PTSD-RI (Schwarz & Kowalski, 1991b).

Major depression. The second most commonly assessed psychiatric disorder was MD. MD symptoms were assessed in 16 studies using 10 independent samples, and the prevalence of MD was estimated in 8 studies using 7 independent samples. The lowest prevalence of MD was 4.9% among survivors of the 1991 cafeteria shooting in Killeen, TX, assessed 1 year after the event using the Diagnostic Interview Schedule for DSM-III-R (North, Smith, & Spitznagel, 1997). The highest prevalence was 71%, detected in a combined sample of Virginia Tech and Northern Illinois University (NIU) students 2 weeks after the attacks at their respective campuses, assessed using the Center for Epidemiologic Studies Short Depression Scale (Vicary & Fraley, 2010).

Other psychiatric disorders. In addition to PTSD and MD, prevalence estimates were provided for the following psychiatric disorders: generalized anxiety disorder (GAD; three studies and three independent samples): range: 0.0–0.9%; acute stress disorder (one study): 33%; alcohol-related conditions (e.g., alcohol abuse, alcohol dependence, alcoholism; four studies, four independent samples) range: 0–9%; drug use disorder (one study): range: 0–0.7%; panic disorder (two studies and two independent samples) range: 1–2.4%; adjustment disorder (one study): 9.1%; social phobia (one study): 3%; and antisocial personality

disorder (one study): 0–0.8% (Classen, Koopman, Hales, & Spiegel, 1998; Johnson, North, & Smith, 2002; North, Smith, McCool, & McShea, 1989; North et al., 1997; Séguin et al., 2013; Trappler & Friedman, 1996).

Comparing Prevalence Estimates

There are at least four issues to consider when comparing the prevalence estimates of mental health outcomes across the studies in our review. First, variation in sample characteristics that, as discussed in more detail later, could influence post-event mental health, including variation in demographic characteristics and exposure to the incident. Second, there is wide variation in the timing of assessments, spanning from approximately 1 week to 32 months post-incident. As shown in studies with multiple waves (e.g., Nader, Pynoos, Fairbanks, & Frederick, 1990; North et al., 1997), the prevalence of psychiatric disorders tends to decrease over time, limiting the extent to which estimates at varying time points after different events can be compared. Third, different measures and diagnostic criteria were used across the studies, which could certainly affect prevalence rates. The influence of diagnostic criteria on prevalence rates was most clearly demonstrated in the aftermath of the 1988 elementary school shooting, wherein the prevalence of PTSD among child survivors at 6–14 months post-incident ranged from 8% to 91% and among their parents from 3% to 54% using conservative DSM-III-R criteria and liberal

Table 2. Summary of the Findings From Peer-Reviewed Studies on the Psychological Effects of Mass Shooting Incidents.

Author (Year)	N	Sample	Timing	Mental Health Outcomes (Measure: Classification System)	Prevalence	Predictors
1984—Elementary school in Los Angeles, CA (1a) Pynoos et al. (1987)	159	Elementary school students (affected)	1 month	PTSD (PTSD-R, DSM-III)	PTSD: 60.4%	PTSS, 1 month: Proximity to attack, greater acquaintance with the deceased victim PTSS, 14 months: Proximity to attack, greater acquaintance with the deceased victim; Grief: greater acquaintance with the deceased
(1b) Nader, Pynoos, Fairbanks, and Frederick (1990)	100 ^a		1 month, 14 months	PTSD (PTSD-R, DSM-III); Grief (brief inventory)	—	
1984—Fast-food restaurant in San Ysidro, CA (1) Hough et al. (1990)	303	Middle-aged Mexican American women from the community, but who were not directly involved in the incident (affected)	6–9 months	PTSD (scale derived for the study, based on the DIS; DSM-III); MD (CES-D)	PTSD, post-incident: 12.6%; PTSD, past-month: 6.8%	Severe PTSD (significance of trends not tested): widowed, separated or divorced status, older age, no children at home, lower income, unemployment, having friends/relatives involved in event, fair–poor physical health, higher MD symptoms. Mild PTSD (significance of trends not tested): middle-age, having three or more children at home, middle income, having friends/relatives involved in the event, fair–poor physical health
1987—Four local businesses in Russellville, AR (1) North, Smith, McCool, and Shea (1989)	18	Employees at two of the four local businesses who were either at work during the shooting (n = 15) or absent (n = 11; affected)	4–6 weeks	PTSD, MD, GAD, Alcoholism (DIS/Disaster Supplement, DSM-III)	PTSD: 5.6%; MD: 16.7%; GAD: 0.0%; Alcoholism: 0.0%	—
1988—Elementary school in Winnetka, IL (1a) Schwarz and Kowalski (1991a)	130	Elementary school students (n = 64) and their parents (n = 66; affected)	6–14 months	PTSD (PTSD-R, DSM-III-R, liberal moderate and conservative criteria)	PTSD, children, DSM-III-R: 50% (liberal), 41% (moderate), 8% (conservative); PTSD, parents, DSM-III-R, proposed: 39% (liberal), 24% (moderate), 3% (conservative)	PTSD, children (predictors of diagnosis based on liberal, moderate, or conservative criteria): perception that he or she would get shot or was in danger during event, increased physical symptoms, increased visits to school nurse, increased or new fears, guilt. PTSD, parents (predictors of diagnosis based on liberal, moderate, or conservative criteria): felt numb, scared, or fearful that the alleged perpetrator was still on the loose

(continued)

Table 2. (continued)

Author (Year)	N	Sample	Timing	Mental Health Outcomes (Measure; Classification System)	Prevalence	Predictors
(1b) Schwarz and Kowalski (1991b)	130 ^a		6–14 months	PTSD (PTSD-R; DSM-III, DSM-III-R [same prevalences as Schwarz & Kowalski, 1991a], proposed DSM-IV, liberal, moderate, and conservative criteria)	PTSD, children, DSM-III, proposed DSM-IV: 91%, 41% (liberal), 61%, 41% (moderate), 16%, 9% (conservative); PTSD, parents, DSM-III, proposed DSM-IV: 52%, 54% (liberal), 16%, 24% (moderate), 4%, 6% (conservative)	—
(2a) Schwarz and Kowalski (1992a)	24	School personnel (<i>affected</i>)	6 months	PTSD (PTSD-R; DSM-III)	—	PTSS: personality traits—guilt and resentment, insecurity, and psychasthenia
(2b) Schwarz and Kowalski (1992b)	24	Subsample completed 2 waves ($n = 13$; <i>affected</i>) ^a	6 months, 18 months	PTSD (PTSD-R; DSM-III); MD (BDI); GAD (STAI)	—	PTSS, 6 months: loss to follow-up
(2c) Schwarz, Kowalski, and McNally (1993)	24	Subsample completed 2 waves ($n = 12$; <i>affected</i>) ^a	6 months, 18 months	PTSD (PTSD-R; DSM-III); MD (BDI); GAD (STAI)	—	PTSS, 6 months: enlargement of recall of emotional experiences (hyperarousal), life threat experiences (hyperarousal), and sensory experiences (avoidance, hyperarousal, total PTSS), lack of diminishment in recall of emotional experiences (intrusion); PTSS, 18 months: enlargement in recall of sensory experiences (hyperarousal); MD symptoms, 18 months: lack of diminishment in recall, perceived ability to handle stress; GAD symptoms: lack of diminishment in recall of emotional experiences
(3) Sloan, Rozensky, Kaplan, and Sanders (1994)	140	Emergency responders (<i>affected</i>)	6 months	PTSD (IES Intrusion and Avoidance)	—	PTSS: five indicators of job stress during the event—exposure to traumatic stimuli, adverse work environment, time pressure, quantitative workload, and qualitative workload (intrusion and avoidance)
1991—Cafeteria-style restaurant in Killeen, TX (1a) North, Smith, and Spitznagel (1994)	136	Survivors (e.g., restaurant patrons and employees, emergency responders; <i>affected</i>)	1–2 months	PTSD, MD, PD, GAD, AA/AD, DA/DD, ASPD (DIS; DSM-III-R)	At 1–2 months—PTSD: 28.6%	PTSD, 1–2 months: female gender, pre-incident MD (among female participants only), any pre-incident psychiatric diagnosis (among female participants only), post-incident MD, any post-incident psychiatric disorder (among female participants only), seeing a doctor or counselor, taking medication

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Table 2. (continued)

Author (Year)	N	Sample	Timing	Mental Health Outcomes (Measure; Classification System)	Prevalence	Predictors
(1b) North, Smith, and Spitznagel (1997)	124 ^a		1–2 months, 1 year	PTSD, MD, PD, GAD, AA/ AD, DA/DD, ASPD (DIS; DSM-III-R)	At 1–2 months—MD: 10.3%, PD: 2.3%, GAD: 0.7%, AA/ AD: 7.5%, DA/DD: 0.0%, ASPD: 0.0%; At 1 year— PTSD: 17.7%, MD: 4.9%, PD: 2.4%, GAD: 0.9%, AA/ AD: 5.7%, DA/DD: 0.8%, ASPD: 0.7%	PTSD, either/both 1–2 months and 1 year: female gender, any pre-incident psychiatric diagnosis (among female participants only), any other post- incident psychiatric disorder, any other lifetime psychiatric disorder, pre- incident MD, MD at 1–2 months, lifetime MD
(1c) North, Spitznagel, and Smith (2001)	136 ^a		1–2 months, 1 year, 3 years	PTSD, MD, PD, GAD, AA/ AD, DA/DD, ASPD (DIS; DSM-III-R)	—	PTSD, 1–2 months: lower active outreach and informed pragmatism coping at 1–2 months; PTSD, 1 year: lower informed pragmatism coping at 1–2 months; PTSD, 3 years: lower informed pragmatism coping at 1–2 months; MD, 1–2 months: lower informed pragmatism coping at 1–2 months; MD, 3 years: lower active outreach coping at 1–2 months; Any disorder, 1–2 months: lower active outreach and informed pragmatism coping at 1–2 months; Any disorder, 1 year: lower informed pragmatism coping at 1–2 months; Any disorder, 3 years: lower informed pragmatism and reconciliation acceptance coping at 1–2 months
(1d) North, McCutcheon, Spitznagel, and Smith (2002)	116 ^a		1–2 months, 1 year, 3 years	PTSD, MD, PD, GAD, AA/ AD, DA/DD, ASPD (DIS; DSM-III-R)	At 3 years—PTSD: 18%, MD: 10%	Nonrecovery from PTSD, 3 years: functional interference due to symptoms, having seen a mental health professional at 1–2 months; nonrecovery from MD, 3 years: family history of depression, parental history of treatment for drinking problems
(2) Sewell (1996)	92	Persons either directly exposed (e.g., restaurant patrons) or indirectly exposed (e.g., relatives of directly exposed; affected)	1 week, 3 months	PTSD (module from the PDI, DSM-IV)	PTSD, 1 week: 38.7%	PTSD, 1 week: Pre-incident PTSD; PTSD nonrecovery, 3 months: Lower trauma- related construct elaboration

(continued)

Table 2. (continued)

Author (Year)	N	Sample	Timing	Mental Health Outcomes (Measure; Classification System)	Prevalence	Predictors
1992—Courthouse in St. Louis, Missouri (1) Johnson, North, and Smith (2002)	80	Employees at courthouse and offices of involved individuals; subsample completed 2 waves ($n = 77$; affected)	6–8 weeks, 1 year, 3 years	PTSD, MD, PD, GAD, AUD, DUD (DIS/Disaster supplement)	At 6–8 weeks—PTSD: 5%, MD: 4%; PD: 1%; GAD: 0%; AUD: 9%; DUD: 0%; At either 6–8 weeks, 1 year, or 3 years—PTSD: 10%	PTSS, 6–8 weeks: younger age, being married, lower education, feeling like the incident had caused them a great deal of harm (total PTSS, reexperiencing), reporting that the incident was very upsetting (avoidance), perceived lack of recovery (avoidance), mental health service utilization (reexperiencing, avoidance, and hyperarousal)
1993—Office building in San Francisco, CA (1) Classen, Koopman, Hales, and Spiegel (1998)	36	Office employees; subsample completed 2 waves ($n = 32$; affected)	1 week, 7–10 months	PTSD (IES, DTS, DSM-III-R); ASD (SASRQ)	At 1 week—ASD: 33.3%	PTSD, 7–10 months: ASD symptoms (DTS total, IES-R intrusion, and IES-R avoidance)
1994—Brooklyn Bridge in Brooklyn, NY (1) Trappler and Friedman (1996)	22	Youth who were in the van that was target of shooting (survivors); 11 students, age-matched and from the same community (comparison: affected)	8 weeks	PTSD (DSM-IV; PTSD symptom scale, IES-R, clinical information); MD (BDI, clinical information); GAD symptoms (BAI, clinical information)	Among survivors—PTSD: 36.4%; MD: 45.5%; Adjustment Disorder with anxiety: 9.1%; Adjustment disorder with mixed anxiety and depressed mood: 9.1%	PTSS: being a survivor (vs. member of comparison group: intrusion and avoidance); MD symptoms: being a survivor (vs. member of comparison group); GAD symptoms: being a survivor (vs. member of comparison group)
1999—High school in Columbine, CO (1) Stretesky and Hogan (2001)	122	Female college student at Rochester Institute of Technology, assessed pre-incident ($n = 20$) and post-incident ($n = 102$; remote)	(varied)	Perceived safety (6 items)	—	Perceived safety: pre-incident sample (vs. post-incident sample), being in the Fine Arts or Language and Literature departments (vs. the Sociology department)
(2) Brenner, Simon, Anderson, Barrios, and Small (2002)	15,349	Participants in the 1999 national school-based Youth Risk Behavior Survey, assessed pre-incident ($n = 12,049$) and post-incident ($n = 3,300$; remote)	(varied)	Interpersonal violence (8 items), Suicide (5 items)	—	Item “felt too unsafe to go to school”: post-incident sample (vs. pre-incident sample), effect stronger in rural (vs. suburban and urban) areas. Item “considered suicide”: pre-incident sample (vs. post-incident sample), effect only in suburban and rural areas. Item “made a suicide plan”: pre-incident sample (vs. post-incident sample), effect only in suburban and rural areas

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Table 2. (continued)

Author (Year)	N	Sample	Timing	Mental Health Outcomes (Measure; Classification System)	Prevalence	Predictors
(3) Addington (2003)	8,397	Participants in the 1999 School Crime Supplement to the National Crime Victimization Survey, assessed pre-incident ($n = 5,620$) and post-incident ($n = 2,777$; remote)	(varied)	Avoidance (7 items), Fear of victimization (2 items)	—	Item "how often are you afraid that someone will attack or harm you at school?": post-incident sample (vs. pre-incident sample)
2006—Dawson College (DC) in Montreal, Quebec (1) Séguin et al. (2013)	948	DC students and employees (affected)	18 months	Lifetime and post-incident psychiatric disorders (measures adapted from the 2002 Canadian Community Health Survey)	Prevalence of any psychiatric disorder: 30%; Post-incident incidence rates—PTSD: 1.8%; MD: 5%; Alcohol dependency: 5%; Social phobia: 3%; Any psychiatric disorder at post-incident, with pre-incident onset: 12%	Incidence of any psychiatric disorder: Greater and closer exposure (statistics not reported)
2007—High school in Jokela, Finland (1a) Haravuori, Suomalainen, Berg, Kiviruusu, and Marttunen (2011)	231 ^a		4 months	Posttraumatic distress (IES); PTSD (IES); Psychiatric disturbance (GHQ)	—	Posttraumatic distress: being approached or interviewed by journalists; Psychiatric disturbance: higher media exposure
(1b) Suomalainen, Haravuori, Berg, Kiviruusu, and Marttunen (2011)	231	Jokela High School students. Unexposed comparison group of students from a different high school in Finland ($n = 526$; affected)	4 months	Posttraumatic distress (IES); PTSD (IES); Psychiatric disturbance (GHQ); Changes in substance abuse during past 6 months (1 item)	Among exposed— Posttraumatic distress: 42.8%; PTSD: 19.2%; Psychiatric disturbance: 31.7%; Increase in substance abuse during past 6 months: 13.3%	Posttraumatic distress: Exposed (vs. unexposed); PTSD: female gender, exposed (vs. unexposed), severe or extreme exposure (vs. mild to significant exposure), lower perceived support from family and friends; Psychiatric disturbance: older age, female gender, living with one biological parent or otherwise (vs. living with both biological parents), exposed (vs. unexposed), lower perceived social support from family, previous mental support from a nonguardian adult
(1c) Murtonen, Suomalainen, Haravuori, and Marttunen (2012)		Jokela High School students (affected)	4 months	Posttraumatic distress (IES); PTSD (IES); Psychiatric disturbance (GHQ)	—	Posttraumatic distress: having been offered crisis support; PTSD: not perceiving crisis support as helpful; Psychiatric disturbance: having been offered crisis support, not perceiving crisis support as helpful

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Table 2. (continued)

Author (Year)	N	Sample	Timing	Mental Health Outcomes (Measure; Classification System)	Prevalence	Predictors
2007—Virginia Tech (VT) in Blacksburg, VA (1a) Fallahi and Lesik (2009)	312	Students from Central Connecticut State University (remote)	3 weeks	ASD (13-items, DSM-IV)	—	ASD symptoms: older age (nightmares), female gender (fear), racial/ethnic minority status (suicidal ideation, replaying the event), more hours of TV watching (intrusive thoughts, sleep disturbances, distraction, fear, stomach upset, depression, disorganization, replaying of the event, and anger) Psychiatric symptoms: fears of being personally harmed on campus, fears that a similar incident could occur on campus, greater exposure to news media, greater time discussing the incident with family, greater time discussing the incident with friends
(1b) Fallahi, Austad, Fallon, and Leishman (2009)	312 ^a		3 weeks	Psychiatric symptoms (unspecified)	—	Psychological distress (latent variable of MD and GAD symptom subscales), 6 months: higher resource loss at 2 and 6 months, lower resource gain at 2 and 6 months
(2a) Littleton, Axsom, and Grills-Taquechel (2009)	193	Female VT students (affected)	Pre-incident, 2 months, 6 months	MD (CES-D); GAD (FDAS)	—	PTSD, 2 months: Higher resource loss at 2 months post-incident. PTSS, 6 months: higher resource loss at 2 and 6 months
(2b) Littleton, Grills-Taquechel, and Axsom (2009)	293 ^a		Pre-incident, 2 months, 6 months	PTSD (DSM-IV; PSS-SR)	At 2 months—PTSD: 30%; At 6 months—PTSD: 23%	GAD symptoms, 2 months (emotional, physiological, cognitive, and behavioral subscales): higher pre-shooting GAD symptoms (all subscales), higher exposure (behavioral), lower self-worth (all subscales), higher sense of randomness (emotional), lower family support (emotional, physiological, cognitive); Quality of Life, 2 months (physical, psychological, social, and environment subscales): lower exposure (physical), higher self-worth (all subscales), lower sense of randomness (physical, psychological), higher family support (all subscales), higher friend support (environment)
(2c) Grills-Taquechel, Littleton, and Axsom (2011)	298 ^a		Pre-incident, 2 months, 6 months	GAD (FDAS); Quality of Life (WHO-QOL)	—	

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Table 2. (continued)

Author (Year)	N	Sample	Timing	Mental Health Outcomes (Measure; Classification System)	Prevalence	Predictors
(2d) Littleton, Axsom, and Grills-Taquechel (2011)	368 ^a		Pre-incident, 2 months, 6 months, 1 year	PTSD (DSM-IV; PSS-SR); MD (CES-D); GAD (FDAS)	At 2 months—MD: 19%; At 6 months—MD: 22%; At 1 year—PTSD: 27%, MD: 24%	PTSS, 6 months: PTSS at 2 months, maladaptive coping at 2 months; PTSS, 1 year: PTSS and maladaptive coping at 6 months; Psychological distress (latent variable of MD and GAD symptom subscales), 2 months: pre-incident distress; Psychological distress, 6 months: Psychological distress and maladaptive coping at 2 months; Psychological distress, 1 year: Psychological distress and maladaptive coping at 6 months PTSS, 1 year: pre-incident sexual victimization, lower benevolence beliefs at 2 months, lower family support at 2 months; MD symptoms, 1 year: pre-incident sexual victimization, lower benevolence beliefs at 2 months, lower family support at 2 months PTSD: female gender, higher exposure to first incident of attack, inability to contact close friends during incident, death of a close friend, death of a friend of acquaintance
(2e) Littleton, Grills-Taquechel, Axsom, Bye, and Buck (2012)	215 ^a		Pre-incident, 2 months, 6 months, 1 year	PTSD (DSM-IV; PSS-SR); MD (CES-D)	—	Grief severity: higher PTSS at 3–4 months, lower self-efficacy, greater disrupted worldview
(3a) Hughes et al. (2011)	4,639	VT students (affected)	3–4 months, 1 year	PTSD (TSQ, DSM-IV)	PTSD: 15.4%	Lower emotional and behavioral well-being, 5 months, 9 months, and 13 months: lower social solidarity at 5 months, 9 months, and 13 months
(3b) Smith, Abeyta, Hughes, and Jones (2014)	245	Subsample of bereaved participants who completed follow-up assessments (affected) ^a	3–4 months, 1 year	PTSD (TSQ, DSM-IV); Grief (8-item measure)	—	Lower emotional and behavioral well-being: female gender, knowing a victim of the incident, lower overall social support, lack of participation on a community team, having seen a professional counselor after the incident, fewer in-person conversations with family, fewer virtual conversations with friends, and lower social solidarity
(4a) Hawdon and Ryan (2011)	363	VT students and faculty (affected)	5 months, 9 months, and 13 months	Emotional and behavioral well-being (CDC depression screener, WAI, item assessing productivity)	—	
(4b) Hawdon and Ryan (2012)	543	VT students (affected)	5 months	Emotional and behavioral well-being (CDC depression screener, WAI, item assessing productivity)	—	

(continued)

Table 2. (continued)

Author (Year)	N	Sample	Timing	Mental Health Outcomes (Measure; Classification System)	Prevalence	Predictors
2008—Northern Illinois University (NIU) in DeKalb, IL (1a) Stephenson, Valentiner, Kumpula, and Orcutt (2009)	691	Female NIU students (<i>affected</i>)	Pre-incident, 2–4 weeks	PTSD (DEQ, DSM-IV)	—	PTSS, 2–4 weeks: higher anxiety sensitivity (physical and cognitive concerns), higher exposure
(1b) Fergus, Rabenhorst, Orcutt, and Valentiner (2011)	58	Subsample of participants with highest and lowest levels of exposure participated in a laboratory experiment (<i>affected</i>) ^a	6 weeks	PTSD (DEQ, DSM-IV); MD (DASS-21); GAD (DASS-21)	—	PTSS, 6 weeks: Higher negative affect while writing and reading about event; MD symptoms, 6 weeks: Higher negative affect while reading about the incident; GAD symptoms, 6 weeks: Higher negative affect while writing and reading about the incident
(1c) Kumpula, Orcutt, Bardeen, and Varkovitzky (2011)	532 ^a		Pre-incident, 2–4 weeks, 8 months	PTSD (DEQ, DSM-IV)	Pre-incident—Significant PTSS: 20.8%; At 2–4 weeks—Significant PTSS: 49.4%; At 8 months—Significant PTSS: 11.4%	PTSS, 2–4 weeks: non-White race/ethnicity (avoidance and hyperarousal), higher pre-incident trauma exposure, higher pre-incident experiential avoidance, higher peritraumatic dissociation; PTSS, 8 months: higher exposure, higher PTSS at 2–4 weeks, higher experiential avoidance at 2–4 weeks
(1d) Littleton, Kumpula, and Orcutt (2011)	691 ^a		Pre-incident, 2–4 weeks, 8 months	PTSD (DEQ, DSM-IV)	—	PTSS, 2–4 weeks: non-African American race/ethnicity, higher pre-incident trauma exposure, higher pre-incident stress, higher exposure; PTSS, 8 months: Asian American race/ethnicity, higher pre-incident trauma exposure, higher pre-incident GAD symptoms, higher exposure, higher PTSS at 2–4 weeks, higher resource loss
(1e) Mercer et al. (2012)	235	Subsample of participants who provided DNA samples (<i>affected</i>) ^a	Pre-incident, 2–4 weeks	PTSD (DEQ, DSM-IV)	—	PTSS, change in symptoms from pre-incident to 2–4 weeks: rs25531 A/A genotype, 5-HTTLPR multimarker low-expressing genotypes

(continued)

Table 2. (continued)

Author (Year)	N	Sample	Timing	Mental Health Outcomes (Measure; Classification System)	Prevalence	Predictors
(1f) Bardeen, Kumpula, and Orcutt (2013)	691 ^a		Pre-incident, 2–4 weeks, 8 months	PTSD (DEQ, DSM-IV); MD (DASS-21); GAD (DASS-21); Stress (DASS-21)		PTSS, 2–4 weeks: higher pre-incident posttraumatic stress, higher exposure, higher emotion regulation difficulties at pre-incident and 2–4 weeks; PTSS, higher emotion regulation difficulties at 2–4 weeks and 8 months; General Distress (latent construct of MD, GAD, and stress), 2–4 weeks: pre-incident general distress, higher exposure, higher emotion regulation difficulties at 2–4 weeks; General distress (latent construct of MD, GAD, and stress), 8 months: higher emotion regulation difficulties at 2–4 months and 8 months
(1g) Orcutt, Bonanno, Hanna, and Miron (2014)	660 ^a		Pre-incident, 2–4 weeks, 8 months, 14 months, 20 months, 26 months, and 32 months	PTSD (DEQ, DSM-IV)	—	Posttraumatic stress, chronic dysfunction trajectory: Pre-incident trauma exposure, higher pre-incident experiential avoidance, higher exposure, higher emotion regulation difficulties (limited access to strategies, lack of emotional clarity) at 8 months
(2) Hartnett and Skowronski (2010)	55	NIU students (<i>affected</i>)	Pre-incident, 2–3 weeks	Mood (PoMS)	—	—
2008—Central Arkansas University (CAU) in Conway, AR (1) McIntyre, Spence, and Lachlan (2011)	569	CAU students (<i>affected</i>)	1 week	Emotional Reactions (7-item scale)	—	Emotional reactions: female gender (confusion, fear, sadness, lack of calmness, and panic)
2008—Seinäjohti University of Applied Sciences (SUAS) in Kauhajoki, Finland (1) Turunen, Haravuori, Punamäki, Suomalainen, and Marttunen (2014)	137	SUAS students (<i>affected</i>)	4 months, 16 months, and 28 months	PTSD (IES); Dissociative symptoms (A-DES), PTG (PTGI)	—	PTSS, 4 months: preoccupied attachment style (total PTSS, avoidance subscale); Dissociative symptoms, 4 months: nonsecure attachment styles; Dissociative symptoms, 16 months: nonsecure attachment styles; Lower PTG, 16 months: avoidant attachment style (relating to others subscale); Lower PTG, 28 months: avoidant attachment style (relating to others subscale)

(continued)

Table 2. (continued)

Author (Year)	N	Sample	Timing	Mental Health Outcomes (Measure; Classification System)	Prevalence	Predictors
2007 and 2008—Schools in Joleka and Kauhajoki, Finland (combined) (1) Vuori, Hawdon, 649 Atte, and Räsänen (2013)	649	Random sample of residents in Joleka (<i>n</i> = 330) and Kauhajoki (<i>n</i> = 391; affected)	6–7 months	Worry (3 items)	—	Worry (about terrorism, local crime, and school shootings): Lower social solidarity, more punitive attitudes toward crime
2007 and 2008—VT and NIU (combined) (1) Kaminski, 1,952 Koons-Witt, University of South Thompson, and Carolina (remote) Weiss (2010)	1,952	College students from the University of South Carolina (remote)	Pre-Virginia Tech, post-Virginia Tech, pre-NIU, post-NIU (1 time point per participant)	Fear (5 items)	—	Fear of walking alone during the day: post-Virginia Tech assessment, pre-NIU assessment, non-White race/ethnicity, residence on campus; Fear of walking alone after dark: assessment after Virginia Tech, younger age, female gender, residence on campus; Fear of crime: post-Virginia Tech assessment, younger age, female gender, residence on campus; Fear of murder: post-Virginia Tech assessment, post-NIU assessment, younger age, female gender, non-White race/ethnicity, residence on campus; Fear of weapon attack: post-Virginia Tech assessment, post-NIU assessment, younger age, female gender
(2) Vicary and Fraley (2010)	284	VT (<i>n</i> = 124) and NIU (<i>n</i> = 160) students (affected)	2 weeks and 8 weeks	PTSD (PSS-SR), MD (CESD-10)	At 2 weeks—PTSD: 64%; MD: 71%; At 8 weeks—PTSD: 22%; MD: 30%	PTSD, 2 weeks: Female gender, knowing one of the victims; MD symptoms, 2 weeks: Female gender, knowing one of the victims

Note. Under each event, numbering is used to denote when studies used data from the same sample, with studies presented in chronological order by publication date. For example, for the 1984 elementary school shooting in Los Angeles, CA, two studies from the same sample are listed and labeled accordingly: (1a) Pynoos et al. (1987) and (1b) Nader, Pynoos, Fairbanks, and Frederick (1990). When there were multiple samples under each event, the samples were ordered chronologically by publication date of the first study within each sample. The table lists bivariate associations only if multivariate results were unavailable; if prevalence was reported in multiple publications for the same sample, the figure that included a higher # of participants is included. AA/AD = alcohol abuse or dependence; ASD = acute stress disorder; ASPD = antisocial personality disorder; AUD = alcohol use disorder; BAI = Beck Anxiety Inventory; BDI = Beck Depression Inventory; CDC = Centers for Disease Control; CES-D = 10-item Center for Epidemiologic Studies Short Depression Scale; DASS-21 = Depression and Anxiety Stress Scales-21 item version; DA/DD = drug abuse or dependence; DEQ = Distressing Events Questionnaire; DIS = diagnostic interview schedule; DTS = Davidson Trauma Scale; DUD = drug use disorder; FDAS = Four Dimensional Anxiety Scale; GAD = generalized anxiety disorder; GHQ = General Health Questionnaire; IES = Impact of Events Scale; MD = major depression; NIU = Northern Illinois University; PD = panic disorder; PDI = psychiatric diagnostic interview; PoMS = Profile of Mood States; PTGI = Posttraumatic Growth Inventory; PSS-SR = PTSD Symptom Scale-Self Report; PTSD = posttraumatic stress disorder; PTSD-RI = Posttraumatic Stress-Reaction Index; PTSS = posttraumatic stress symptoms/severity; SASRQ = Stanford Acute Stress Reaction Questionnaire; STAI = State Trait Anxiety Inventory; TSQ = Trauma Screening Questionnaire; VT = Virginia Tech; WAI = Weinberger Adjustment Inventory; WHO-QOL = World Health Organization Quality of Life Scale—Brief.

^aSame sample description as the preceding study.

(proposed) DSM-IV criteria, respectively (Schwarz & Kowalski, 1991a, 1991b).

Other Mental Health Outcomes

Although most studies in our review reported on symptoms and prevalence estimates of psychiatric disorders, others included mental health outcomes that were not specific to any disorder. Fourteen studies (12 independent samples) utilized inventories or items assessing constructs that cut across disorders, including psychiatric disturbance, stress, grief, mood, emotional reactions, worry, and fear (e.g., McIntyre, Spence, & Lachlan, 2011; Suomalainen, Haravuori, Berg, Kiviruusu, & Marttunen, 2011; Vuori, Hawdon, Atte, & Räsänen, 2013). Four studies (three independent samples) included positive indices of mental health—emotional and behavioral well-being, quality of life, and posttraumatic growth (Grills-Taquechel, Littleton, & Axsom, 2011; Hawdon & Ryan, 2011, 2012; Turunen, Haravuori, Punamäki, Suomalainen, & Marttunen, 2014). Finally, one study (Orcutt, Bonanno, Hanna, & Miron, 2014) utilized trajectory analysis of PTSS over seven waves to (one pre- and six post-incident) in the context of the NIU campus shooting. The majority of participants (60.9%) were in a *minimal impact resilience* trajectory, reporting low levels of symptoms at each wave and a small elevation in symptoms at the first post-incident wave only.

Assessing the Mental Health Impact of Mass Shootings

In reviewing the studies, we noted how investigators assessed whether participants' symptoms reflected the impact of the mass shooting, versus ongoing mental health difficulties that might have been present before the incident took place. Certainly, personality disorders, which are conceptualized as enduring and pervasive phenomenon, are unlikely to be the result of a single event. Symptoms that were asked without reference to the mass shooting episode, including MD and GAD symptoms, also might have been present prior to the shooting incident. Although other outcomes were directly in reference to the mass shooting incident, including PTSD and acute stress disorder, they too could be influenced by preexisting psychopathology.

Three methods were used to address this issue. First, three independent samples included both pre- and post-incident data. The significance of pre- to post-incident changes in mental health reached was assessed in one of these samples (Hartnett & Skowronski, 2010). The investigators found that students' ratings of four negative mood states (depression, tension, fatigue, and confusion) did not significantly differ between pre- and post-incident assessment; however, they reported significantly higher anger at the post-incident assessment. In the two other samples, significance of changes in mental health from pre- to post-incident was not assessed. However, descriptive data suggested short-term increases in depression and PTSS (e.g., Littleton, Axsom, & Grill-Taquechel, 2009; Orcutt et al., 2014).

Second, two studies assessed mental health impacts through comparison of samples who faced different levels of exposure,

with results indicating higher symptomatology in directly exposed subsamples. Students at Joleka High School in Finland, where a shooting took place, had significantly higher posttraumatic distress and psychiatric disturbance than students in another city in Finland (Suomalainen et al., 2011). In the aftermath of the 1994 Brooklyn Bridge shooting, levels of PTSS, depression, and anxiety were higher in youth who directly experienced the attack than an age-matched comparison group of youth in the same community who were not directly exposed (Trappler & Friedman, 1996).

Finally, three studies drew on data from ongoing investigations of remote samples to assess the mental health impact of mass shootings, as well as their broader effects on indirectly exposed populations. For example, in the aftermath of the 1999 Columbine massacre, researchers drew on national school-based surveys with assessments spanning from pre- to post-incident in 1999 and found that students' perceptions of safety at school declined after the attack (Addington, 2003; Brener, Simon, Anderson, Barrios, & Small, 2002). Interestingly, students' reports of suicidal ideation and plans also significantly decreased after Columbine, perhaps indicative some form of widespread posttraumatic growth (e.g., increased appreciation of life), although this finding was limited to students living in rural and suburban areas (Brener et al., 2002). Two other investigations of remote college student samples have shown increased fears (e.g., of walking alone, of crime) and decreased perceived safety from pre- to post-incident (Kaminski, Koons-Witt, Thompson, & Weiss, 2010; Stretesky & Hogan, 2001).

Predictors of Adverse Mental Health Outcomes

Table 2 also includes significant predictors of adverse mental health outcomes in each of the study. These predictors can be divided roughly into three categories: (1) demographics and pre-incident characteristics, (2) incident exposure, and (3) post-incident functioning and psychosocial resources.

Demographic and Pre-Incident Characteristics

Demographic characteristics have frequently been included as predictors of mental health. Most consistently, female gender has been shown to be a predictor of post-incident psychological adversity, associated with increased odds of PTSD (e.g., North, Smith & Spitznagel, 1994; Suomalainen et al., 2011), higher levels of fear (Fallahi & Lesik, 2009), and lower levels of emotional and behavioral well-being (Hawdon & Ryan, 2012) in affected samples, and higher fear in a remote sample (Vicary & Fraley, 2010). One proposed explanation for this difference is that women are more likely to employ a ruminative coping style, increasing the severity and chronicity of their symptoms (e.g., McIntyre et al., 2011; Palus, Fang, & Prawitz, 2012).

Indicators of socioeconomic disadvantage, although less often included in post-incident studies, have also been consistently associated with poor mental health. For example, in the aftermath of the 1984 shooting at a fast food restaurant in

California, higher prevalences of severe PTSD were documented among community members with lower income or who were unemployed, relative to their counterparts (Hough et al., 1990). Lower education was also associated with higher PTSS among survivors of the 1992 St. Louis courthouse shooting (Johnson et al., 2002). Among an adolescent sample, not living with two biological parents was associated with higher psychiatric disturbance (Suomalainen et al., 2011).

Other demographic characteristics have been less consistently associated with post-incident mental health outcomes. For example, younger and older age have each been associated with adverse outcomes in both community and college student samples (Fallahi & Lesik, 2009; Hough et al., 1990; Johnson et al., 2002; Kaminski et al., 2010). Racial/ethnic minority status has also been inconsistently associated with outcomes. Two studies have found non-White race to be associated with more severe post-incident symptoms (Fallahi & Lesik, 2009; Kaminski et al., 2010). In contrast, among female NIU students, African American ethnicity was associated with lower PTSS at 2–4 weeks post-incident, whereas Asian ethnicity was associated with higher PTSS at 8 months post-incident (Littleton, Kumpula, & Orcutt, 2011).

Few studies have investigated whether marital and parent status affect risk for post-incident adversity. Hough and colleagues (1990) found higher prevalences of severe PTSD among widowed, divorced, or separated persons (relative to married and single persons) and among adults with no children at home (relative to those with 1–3 or more children); however, the significance of these trends was not assessed. In contrast, Johnson, North, and Smith (2002) found that being married, relative to single or divorced, widowed, or separated, was associated with higher PTSS.

Only one study to our knowledge has investigated the role of genetic risk variants in predicting post-incident outcomes. Among a subsample of NIU female students who provided DNA samples, variants within the serotonin transporter gene were associated with significantly greater increases in PTSS from pre-incident to 2–4 weeks post-incident (Mercer et al., 2012). An additional finding showing that family history of mental illness predicted lack of recovery in MD at 3 years after the 1991 Killeen, TX, restaurant shooting also suggests a potential genetic contribution to post-incident responses (North, McCutcheon, Spitznagel, & Smith, 2002).

Similarly, the results of several investigations have shown that pre-incident psychological functioning is a strong predictor of post-incident functioning. A retrospective assessment of PTSD was found to predict post-incident PTSD among survivors of the 1991 Texas restaurant shooting (Sewell, 1996). In the aftermath of the same incident, reports of pre-incident psychiatric diagnosis were also associated with increased risk for PTSD among female survivors (North et al., 1994, 1997). Among adolescents exposed to the Joleka High School shooting, previous “mental support” from a nonguardian adult, a proxy for pre-event functioning, was associated with increased risk for psychiatric disturbance (Suomalainen et al., 2011). More recent studies in the aftermath of college shootings have drawn on

pre-incident data and found significant associations between pre- and post-incident assessments of mental health (e.g., Grills-Tauechel et al., 2011; Littleton, Kumpula, et al., 2011).

A related set of findings has found that prior trauma exposure increases risk for psychological adversity in the aftermath of shooting incidents. For example, in the study of female Virginia Tech survivors, those who had experienced sexual victimization prior to the event were at increased risk of PTSS and depression 1 year after the shooting (Littleton, Grills-Tauechel, Axson, Bye, & Buck, 2012). Among the NIU student sample, higher pre-incident trauma exposure was predictive of higher PTSS at two post-incident time points (Littleton, Kumpula, et al., 2011), as well as increased odds of a nonresilient trajectory of PTSS over time (Orcutt et al., 2014).

Incident Exposure

Indices of greater incident exposure, including proximity to an attack, acquaintance with the deceased, and higher scores on exposure inventories (with items assessing, e.g., seeing or hearing the events and physical injuries), have consistently been associated with more severe psychological reactions (e.g., Hawdon & Ryan, 2012; Littleton, Kumpula, et al., 2011; Pynoos et al., 1987). There is some evidence that the impact of milder forms of exposure on mental health decreases over time. For example, in the aftermath of the NIU shooting, moderate, severe, and extreme exposure (relative to no direct exposure) were associated with higher PTSS 2–4 weeks post-incident, whereas only extreme exposure was associated with higher PTSS at 8 months post-incident (Littleton, Kumpula et al., 2011).

In addition, emotional reactions during and after the incident have been found to predict later psychological responses. For example, students' perceptions that they would be shot or were in danger during the 1988 Illinois elementary school shooting increased risk for PTSD (Schwarz & Kowalski, 1991a). Kumpula, Orcutt, Bardeen, and Varkovitzky (2011) assessed NIU students' experiences of *peritraumatic dissociation*—altered awareness and depersonalization or derealization—during the event and found them to be predictive of higher PTSS 2–4 weeks post-incident. Other investigators have drawn on longitudinal data to show that earlier post-incident symptoms are positively associated with symptoms at later time points (e.g., Bardeen, Kumpula, & Orcutt, 2013; Smith, Abeyta, Hughes, & Jones, 2014). For example, acute stress disorder symptoms 1 week after the 1993 San Francisco office building shooting were associated with increased odds for PTSD 7–10 months post-incident. Being offered post-incident crisis support and early post-incident use of mental health services have also served as proxies of adverse initial responses, and have been predictive of higher psychiatric symptoms later on (e.g., Murtonen, Suomalainen, Haravuori, & Marttunen, 2012; North et al., 2002). Interestingly, Murtonen, Suomalainen, Haravuori, and Marttunen (2012) found that students' perceptions that early crisis support was unhelpful was also associated with

more severe symptoms, suggesting that survivors who do not benefit from early interventions might be at particular risk of long-term mental health problems.

How events are perceived and remembered have also been found to predict mental health outcomes. For example, after the 1992 St. Louis courthouse shooting, survivors' perception that the incident had caused them a great deal of harm, that it was very upsetting, and that they had not recovered were each associated with higher PTSS (Johnson et al., 2002). A small study of school personnel in the aftermath of the 1988 Illinois elementary school shooting assessed participants' changes in reports of emotional, life threat, and sensory experiences during the attack, and found that those whose reports became more intense over time (*enlargement* of recall) or did not become less intense over time (lack of *diminishment* of recall) tended to have more severe symptoms (Schwarz, Kowalski, & McNally, 1993).

Other investigations have focused on indirect exposure to events in affected and remote samples. For example, Joleka High School students who reported higher media exposure were at increased risk of post-incident psychiatric disturbance (Haravuori, Suomalainen, Berg, Kiviruusu, & Marttunen, 2011). In a remote college student sample, greater exposure to news media after the Virginia Tech shooting was associated with significantly higher psychiatric symptoms (Fallahi, Austad, Fallon, & Leishman, 2009). Significantly higher symptoms were also found among students who reported more time discussing the incident with family and friends, indicating that informal conversations may serve as an additional form of indirect exposure (Fallahi et al., 2009). Associations between indirect exposure and mental health could be due in part to self-selection and reverse causation, such that participants with more severe symptoms might be more likely to seek out media exposure and initiate conversations on the event. Further research employing longitudinal and experimental designs could address these considerations.

Post-Incident Functioning and Psychosocial Resources

As noted previously, early post-incident mental health responses have been found to prospectively predict later post-incident mental health responses (e.g., Bardeen et al., 2013). In a similar vein, different classes of psychiatric symptoms have been positively associated in cross-sectional assessments. For example, among female survivors of the 1991 Texas restaurant shooting, a diagnosis of any other psychiatric disorder was associated with increased odds of PTSD (North et al., 1994); among the full sample, there was also significant concordance between post-incident MD and PTSD. Studies have also documented associations between post-incident fears and PTSS in affected and remote samples (Fallahi & Lesik, 2009; Schwarz & Kowalski, 1991a).

Research has further suggested interrelations between mental and physical health problems. Higher prevalences of both mild and severe PTSD were observed in affected community members with fair or poor physical health, versus those with

good or excellent physical health, in the aftermath of the 1984 California fast-food restaurant shooting. Among children directly exposed to the 1988 Illinois elementary school shooting, increased physical symptoms and visits to the school nurse were associated with increased risk of PTSD (Schwarz & Kowalski, 1991a). In the absence of longitudinal research, the direction of the relationship between post-incident mental and physical health remains unclear. Additional considerations are whether physical health symptoms are manifestations of poor mental health or whether preexisting physical health symptoms or pre- to post-incident changes in physical health account for significant associations.

In terms of psychosocial resources, research has focused on personality characteristics, beliefs and attitudes, coping styles, and social relationships as predictors of mental health outcomes. Personality characteristics that have been associated with adverse outcomes include guilt and resentment, insecurity, and anxiety sensitivity (Schwarz & Kowalski, 1992a; Stephenson, Valentiner, Kumpula, & Orcutt, 2009). Beliefs that events are random and uncontrollable, and punitive attitudes toward crime have also been associated with adverse outcomes, whereas greater self-efficacy, sense of meaning, spirituality and perceived benevolence of others have shown to be protective factors (Littleton et al., 2012; Smith et al., 2014; Vuori, Hawdon, Atte, & Räsänen, 2013).

Coping styles have been differentially associated with outcomes. Forms of coping that involve taking action, cognitive processing of the incident, and acceptance have been associated with lower levels of symptoms (e.g., North, Spitznagel, & Smith, 2001; Sewell, 1996), whereas ruminative and avoidant coping styles have been found to increase risk (e.g., Littleton et al., 2012). To some extent, means of coping in the aftermath of an incident could represent more pervasive difficulties and ways of approaching one's experiences. In this vein, studies drawing on pre-incident data have found those emotion regulation difficulties and *experiential avoidance*, or the tendency to disengage from difficult emotions, sensations, thoughts, and memories, to be prospective predictors of post-incident symptoms (e.g., Bardeen et al., 2013; Kumpula, Orcutt, Bardeen, & Varkovitzky, 2011).

Similarly, indicators of fewer social resources (e.g., lower perceived social support and lower social solidarity) have been consistently associated with adverse post-incident outcomes (e.g., Hawdon & Ryan, 2012; Littleton et al., 2012; Suomalainen et al., 2011), and these differences could be driven in part by stable personality characteristics. For example, nonsecure attachment styles were significantly associated with higher PTSS and lower posttraumatic growth in relationships with others among students after a college campus shooting in Finland (Turunen, Haravuori, Punamäki, Suomalainen, & Marttunen, 2014).

On the other hand, researchers have been informed by Conservation of Resources (COR) theory (Hobfoll, 1989), which suggests that *change* in psychosocial resources, rather than stability, increases risk for adverse psychological outcomes. Supporting COR theory, Littleton and colleagues found that

survivors' reports of loss of life direction and pride, optimism, and interpersonal resources (e.g., companionship) were associated with higher PTSS and psychological distress (Littleton Axsom, et al., 2009; Littleton, Grills-Tauechel, & Axsom, 2009; Littleton, Kumpula, et al., 2011). Lower levels of resource gain, however, were significantly associated with higher psychological distress, suggesting that only negative changes in resources are associated with adverse outcomes.

Processes Leading to Adverse Mental Health Outcomes

In our review, we noted findings that went beyond documenting prevalence estimates and predictors by exploring the mechanisms contributing to mental health outcomes over time. A total of seven studies (from three independent samples) did so, all conducted within the past decade. In general, two types of mechanisms were explored across these studies. First, studies assessed pathways from pre-incident risk factors to post-incident mental health through post-incident risk factors. One example is a study in the aftermath of the NIU shooting showing that students' pre-incident experiential avoidance was positively associated with their post-incident reports of peritraumatic dissociative experiences, which in turn were positively associated with PTSS (Kumpula et al., 2011). Another study of student survivors of the Virginia Tech attack found that prior sexual victimization was indirectly associated with PTSS and depression through lower self-worth, benevolence beliefs, and social support (Littleton et al., 2012).

Second, studies explored the ways in which risk factors and mental health influence each other over time through cross-lagged models. For example, a longitudinal study in the aftermath of the Virginia Tech shooting found reciprocal relationships between psychological distress and maladaptive coping from 2 months to 6 months, and 6 months to 1 year post-incident, suggesting that psychological distress could perpetuate itself by undermining coping mechanisms (Littleton, Axsom et al., 2011). This was not the case for the model containing PTSS, wherein the paths from PTSS to maladaptive coping reached statistical significance, but those from maladaptive coping to PTSS did not (Littleton et al., 2011). Another study employed cross-lagged modeling and found significant bidirectional relationships between emotion regulation difficulties and PTSS from pre-incident to 2–4 weeks after the NIU shooting, whereas only the path from emotion regulation difficulties to PTSS was significant from 2–4 weeks to 8 months post-incident (Bardeen et al., 2013). For the model containing general distress, only the path from distress to emotion regulation difficulties was significant from pre-incident to 2–4 weeks post-incident, whereas only the path from emotion regulation difficulties to distress was significant from 2–4 weeks to 8 months post-incident (Bardeen et al., 2013).

Taken together, the few studies in our review that investigated mechanisms contributing to post-incident mental health suggest a complex interplay between risk factors and outcomes that depend in part on the timing of assessment and outcome

assessed. Further research exploring these processes will help to establish conceptual models of pathways to post-shooting mental health.

Discussion

The purpose of this review has been to review the extant literature on mental health in the aftermath of mass shootings. The research to date provides evidence that these events can have mental health consequences for victims and members of affected communities, leading to increases in PTSS, depression, and other psychological symptoms. The few studies on remote samples further suggest that these events can have at least short-term psychological effects, for example, increased fears and declines in perceived safety, on persons living far outside of the affected communities. These effects are not distributed equally, however, and research has identified several risk factors for adverse outcomes, including demographic characteristics (e.g., female gender and lower socioeconomic status), higher pre-event trauma exposure and psychological symptoms, greater direct and indirect event exposure, and lack of psychosocial resources (e.g., emotional regulation difficulties, experiential avoidance, and low social support).

Although the extant body of research offers some conclusions about the mental health effects of mass shootings, more research is needed to better understand the mechanisms through which risk and protective factors contribute to longer term outcomes. There is a particular need for studies in the aftermath of high-impact events. For example, we identified no studies of affected samples in two recent events with unusually high numbers of casualties—the 2012 shootings at the Aurora movie theater and Sandy Hook elementary school. Researchers and institutional review boards might be hesitant to conduct studies in the aftermath of such events due to concerns about retraumatizing or otherwise taking advantage of victims. Notably, however, the majority (85%) of NIU students who completed a post-incident experimental study reported that they would participate in the study again (Fergus, Rabenhorst, Orcutt, & Valentiner, 2011). Although a single data source, these results suggest some evidence that study participation might not have adverse effects. Research in the aftermath of other traumatic events suggests that some persons who have experienced trauma may actually derive benefits from research participation (e.g., Griffin, Resick, Waldorp, & Mechanic, 2003).

Further studies that draw on pre-incident data from ongoing investigations would provide greater insight into the role of pre-event functioning and trauma exposure on psychological responses. In a similar vein, studies that include multiple waves of follow-up data would allow for an enhanced understanding of longitudinal patterns of responses and the processes that lead to chronic symptoms. The research could also be enriched by further studies that include positive outcomes (e.g., resilience and posttraumatic growth) and incorporate additional sources of data, including genetic variants and information on community characteristics and resources. In addition to further

research on affected samples, more investigations are needed to understand the broader impact of mass shootings on unaffected communities. It was notable that only 5 of the 28 identified samples focused on remote populations; as such, our conclusions regarding the widespread mental health effects of mass shootings are tentative at best.

Additional research would also inform interventions to prevent and treat post-incident mental health problems. The first step in prevention would be to decrease the likelihood that mass shooting events occur in the first place. The rarity of these events precludes the use of statistical modeling to predict their occurrence (Swanson, 2011). Researchers have accordingly advised against the use of risk profiles, which have the potential for false positives bias, and stigmatization (Reddy et al., 2001). Instead, a deductive threat assessment approach in which a team of professionals gathers information about a particular case to assess the likelihood that a violent episode will occur, and formulates a response based on that assessment, have been proposed (e.g., Cornell & Allen, 2011; Reddy et al., 2011). Others have suggested the need for promoting positive school climates in which there is open dialogue between students, teachers, and administrators to reduce the likelihood of school shootings (Mulvey & Cauffman, 2001), and efforts to improve access to and continuity of high-quality mental health services for people with serious mental illness to prevent violent behaviors among this group (Swanson, 2011). Finally, others have noted the high rates of gun ownership and firearm mortalities in the United States compared to those in other developed countries as evidence of the need for a range of efforts to reduce gun access (e.g., Shultz, Cohen, Muschert, & Flores de Apodaca, 2013). An observational study showing declines in firearm-related deaths, suicides and homicides, and a complete absence of mass shooting episodes, in Australia a decade after gun law reforms aiming to limit civilian access to semiautomatic and pump-action shotguns and rifles provides support for such efforts (Chapman, Alpers, Agho, & Jones, 2006).

In addition to preventing mass shootings, it would be important to develop interventions to address mental health problems in their wake. Trained crisis response teams that establish safety, evaluate the psychological needs of victims, connect survivors with a range of services to meet their needs, and evaluate response efforts have been proposed to mitigate the effects of school violence (Crepeau-Hobson, Sievering, Armstrong, & Stonis, 2012). Hobfoll and colleagues (2007) have also identified five empirically supported principles for mental health responses to mass trauma—promoting a sense of safety, calming, a sense of self- and community-efficacy, connectedness, and hope.

The empirical research also lends support for approaches that identify survivors most at risk of adverse outcomes, including women, persons of lower socioeconomic status, those who faced higher levels of exposure, and persons lacking strong social support networks. Furthermore, extant studies suggest interventions that enhance emotion regulation and active coping skills and that encourage engagement with and acceptance

of emotions, thoughts, memories, and sensory experiences (e.g., Metz et al., 2013). These skill-building interventions could be part of the standard curriculum and could promote resilience after a range of traumatic events and stressors.

The recommendations for future research, policy, and practice are made with caution, given the limitations of this review. For example, although our efforts to identify studies meeting our inclusion criteria were exhaustive, we did not track such data as the total number of articles identified across all of our searches, and the number that were dropped based on each criterion. In addition, although the first author checked and rechecked coding for accuracy, articles were not double-coded, and a system for establishing the reliability of the article screening and coding process was not developed and applied. Taken together, these limitations suggest a need for a more systematic review, particularly as additional literature on this topic is published. Further reviews could also apply broader inclusion criteria, for example, to provide insight into the influence of direct and indirect exposure to mass shootings on other domains of functioning (e.g., physical health and social functioning). Inclusion of non-English language articles could shed additional light on the influence of mass shootings on mental health cross-culturally. Qualitative studies could also be integrated to provide a richer sense of the patterns and predictors of mental health in the aftermath of shootings. Our review of predictors also focused on factors that account for significant variation in post-shooting mental health within each study, and we did not attend to potential between-study sources of variation, such as differences in samples (e.g., age-group and extent of exposure), procedures (e.g., timing of assessment), and event characteristics (e.g., single vs. multiple shooters, number of injuries and fatalities). Future research could examine within- and between-study variability simultaneously using meta-analytic techniques. Finally, we did not compare the prevalence estimates and predictors of mental health outcomes in the aftermath of mass shootings to those in the aftermath of other traumatic events. Inclusion of mass shootings on trauma inventories in future epidemiological studies would provide insight into this issue.

In summary, the limited research suggests that mass shooting incidents can lead to an array of mental health problems in survivors and members of affected communities. Furthermore, they have been associated with increased fears and decreased perceptions of safety in indirectly exposed populations. A variety of risk and protective factors have been identified, including demographic characteristics, pre-event trauma exposure and functioning, event exposure, and psychosocial resources. Further research that explores the processes contributing to long-term psychological responses will yield important implications for post-incident interventions to reduce mental health impacts.

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References

- Addington, L. A. (2003). Students' fear after Columbine: Findings from a randomized experiment. *Journal of Quantitative Criminology*, 19, 367–387. doi:10.1023/B: JOQC.0000005440.11892.27
- Bardeen, J. R., Kumpula, M. J., & Orcutt, H. K. (2013). Emotion regulation difficulties as a prospective predictor of posttraumatic stress symptoms following a mass shooting. *Journal of Anxiety Disorders*, 27, 188–196. doi:10.1016/j.janxdis.2013.01.003
- Blair, J. P., & Martaindale, M. H. (2013). *United States active shooter events from 2000 to 2010: Training and equipment implications*. Retrieved from alertrt.org/files/research/ActiveShooterEvents.pdf
- Brener, N. D., Simon, T. R., Anderson, M., Barrios, L. C., & Small, M. L. (2002). Effect of the incident at Columbine on students' violence- and suicide-related behaviors. *American Journal of Preventive Medicine*, 22, 146–150. doi:10.1016/S0749-3797(01)00433-0
- Breslau, N., Kessler, R. C., Chilcoat, H. D., Schultz, L. R., Davis, G. D., & Andreski, P. (1996). Trauma and posttraumatic stress disorder in the community: The 1996 Detroit Area Survey of Trauma. *Archives of General Psychiatry*, 55, 626–632. doi:10.1001/archpsyc.55.7.626
- Chapman, S., Alpers, P., Agho, K., & Jones, M. (2006). Australia's 1996 gun law reforms: Faster falls in firearm deaths, firearm suicides, and a decade without mass shootings. *Injury Prevention*, 12, 365–372. doi:10.1136/ip.2006.013714
- Classen, C., Koopman, C., Hales, R., & Spiegel, D. (1998). Acute stress disorder as a predictor of posttraumatic stress symptoms. *American Journal of Psychiatry*, 155, 620–624.
- Cornell, D., & Allen, K. (2011). Development, evaluation, and future directions of the Virginia Student Threat Assessment Guidelines. *Journal of School Violence*, 10, 88–106. doi:10.1080/15388220.2010.519432
- Crepeau-Hobson, F., Sievering, K. S., Armstrong, C., & Stonis, J. (2012). A coordinated mental health crisis response: Lessons learned from three Colorado school shootings. *Journal of School Violence*, 11, 207–225. doi:10.1080/15388220.2012.682002
- Fallahi, C. R., Austad, C. S., Fallon, M., & Leishman, L. (2009). A survey of perceptions of the Virginia Tech tragedy. *Journal of School Violence*, 8, 120–135. doi:10.1080/15388220802074017
- Fallahi, C. R., & Lesik, S. A. (2009). The effects of vicarious exposure to the recent massacre at Virginia Tech. *Psychological Trauma: Theory, Research, Practice, and Policy*, 1, 220–230. doi:10.1037/a0015052
- Fergus, T. A., Rabenhorst, M. M., Orcutt, H. K., & Valentiner, D. P. (2011). Reactions to trauma research among women recently exposed to a campus shooting. *Journal of Traumatic Stress*, 24, 596–600. doi:10.1002/jts.20682
- Follman, M., Aronsen, G., & Pan, D. (2014). *A guide to mass shootings in America*. Retrieved from <http://www.motherjones.com/politics/2012/07/mass-shootings-map>
- Follman, M., Aronsen, G., Pan, D., & Caldwell, M. (2013). *US mass shootings, 1982-2012: Data from Mother Jones' investigation*. Retrieved from <http://www.motherjones.com/politics/2012/12/mass-shootings-mother-jones-full-data>
- Griffin, M. G., Resick, P. A., Waldorp, A. E., & Mechanic, M. B. (2003). Participation in trauma research: Is there evidence of harm? *Journal of Traumatic Stress*, 16, 221–227. doi:10.1023/A: 1023735821900
- Grills-Tauchel, A. E., Littleton, H. L., & Axsom, D. (2011). Social support, world assumptions, and exposure as predictors of anxiety and quality of life following mass trauma. *Journal of Anxiety Disorders*, 25, 498–506. doi:10.1016/j.janxdis.2010.12.003
- Haravuori, H., Suomalainen, L., Berg, N., Kiviruusu, O., & Marttunen, M. (2011). Effect of media exposure on adolescents traumatized in a school shooting. *Journal of Traumatic Stress*, 24, 70–77. doi:10.1002/jts.20605
- Hartnett, J. L., & Skowronski, J. J. (2010). Affective forecasts and the Valentine's Day shootings at NIU: People are resilient, but unaware of it. *Journal of Positive Psychology*, 5, 275–280. doi:10.1080/17439760.2010.498615
- Hawdon, J., & Ryan, J. (2011). Social relations that generate and sustain solidarity after a mass tragedy. *Social Forces*, 89, 1363–1384. doi:10.1093/sf/89.4.1363
- Hawdon, J., & Ryan, J. (2012). Well-being after the Virginia Tech mass murder: The relative effectiveness of face-to-face and virtual interactions in providing support to survivors. *Traumatology*, 18, 3–12. doi:10.1177/1534765612441096
- Henricksen, C. A., Bolton, J. M., & Sareen, J. (2010). The psychological impact of terrorist attacks: Examining a dose-response relationship between exposure to 9/11 and Axis I mental disorders. *Depression & Anxiety*, 27, 993–1000. doi:10.1002/da.20742
- Henriques, J. (2013). *Mass shootings in America: A historical review*. Retrieved from <http://www.globalresearch.ca/mass-shootings-in-america-a-historical-review/5355990>
- Hobfoll, S. E. (1989). Conservation of resources: A new attempt at conceptualizing stress. *American Psychologist*, 44, 513–524. doi:10.1037//0003-066X.44.3.513
- Hobfoll, S. E., Watson, P., Bell, C. C., Bryan, R. A., Brymer, M. J., Friedman, M. J., . . . Ursano, R. J. (2007). Five essential elements of immediate and mid-term mass trauma intervention: Empirical evidence. *Psychiatry*, 70, 283–315. doi:10.1521/psyc.2007.70.4.283
- Hough, R. L., Vega, W., Valle, R., Kolody, B., Griswald del Castillo, R., & Tarke, H. (1990). Mental health consequences of the San Ysidro McDonald's massacre: A community study. *Journal of Traumatic Stress*, 3, 71–92. doi:10.1007/BF00975136
- Hughes, M., Brymer, M., Chiu, W. T., Fairbank, J. A., Jones, R. T., Pynoos, R. S., . . . Kessler, R. C. (2011). Posttraumatic stress among students after the shootings at Virginia Tech. *Psychological Trauma: Theory, Research, Practice, and Policy*, 3, 403–411. doi:10.1037/a0024565
- Johnson, S. D., North, C. S., & Smith, E. M. (2002). Psychiatric disorders among victims of a courthouse shooting spree: A three-year follow-up study. *Community Mental Health*, 38, 181–194.
- Kaminski, R. J., Koons-Witt, B. A., Thompson, N. S., & Weiss, D. (2010). The impacts of the Virginia Tech and Northern Illinois University shootings on fear of crime on campus. *Journal of Criminal Justice*, 38, 88–98. doi:10.1016/j.jcrimjus.2009.11.011

- Kumpula, M. J., Orcutt, H. K., Bardeen, J. R., & Varkovitzky, R. L. (2011). Peritraumatic dissociation and experiential avoidance as prospective predictors of posttraumatic stress symptoms. *Journal of Abnormal Psychology, 120*, 617–627. doi:10.1037/a0023927
- Littleton, H., Axsom, D., & Grills-Tauechel, A. E. (2011). Longitudinal evaluation of the relationship between maladaptive trauma coping and distress: Examination following the mass shooting at Virginia Tech. *Anxiety, Stress, and Coping, 3*, 273–290. doi:10.1080/10615806.2010.500722
- Littleton, H., Grills-Tauechel, A., & Axsom, D. (2009). Resource loss as a predictor of post trauma symptoms among college women following the mass shooting at Virginia Tech. *Violence and Victims, 24*, 669–686. doi:10.1891/0886-6708.24.5.669
- Littleton, H., Grills-Tauechel, A. E., Axsom, D., Bye, K., & Buck, K. S. (2012). Prior sexual trauma and adjustment following the Virginia Tech campus shootings: Examination of the mediating role of schemas and social support. *Psychological Trauma: Theory, Research, Practice, and Policy, 4*, 578–586. doi:10.1037/a0025270
- Littleton, H., Kumpula, M., & Orcutt, H. (2011). Posttraumatic symptoms following a campus shooting: The role of psychosocial resource loss. *Violence and Victims, 26*, 461–476. doi:10.1891/0886-6708.26.4.461
- Littleton, H. L., Axsom, D., & Grills-Tauechel, A. E. (2009). Adjustment following the mass shooting at Virginia Tech: The roles of resource loss and gain. *Psychological Trauma: Theory, Research, Practice, and Policy, 1*, 206–219. doi:10.1037/a0017468
- Lowe, S. R., Blachman-Forshay, J., & Koenen, K. C. (2015). Epidemiology of trauma and trauma-related disorders: Trauma as a public health issue. In U. Schnyder & M. Cloitre (Eds.), *Evidence-based treatments for trauma-related psychological disorders: A practical guide for clinicians* (pp. 11–40). New York, NY: Springer.
- McIntyre, J. J., Spence, P. R., & Lachlan, K. A. (2011). Media use and gender differences in negative psychological responses to a shooting on a university campus. *Journal of School Violence, 10*, 299–313. doi:10.1080/15388220.2011.578555
- Mercer, K. B., Orcutt, H. K., Quinn, J. F., Fitzgerald, C. A., Conneely, K. N., Barfield, R. T., . . . Ressler, K. J. (2012). Acute and posttraumatic stress symptoms in a prospective gene x environment study of a university campus shooting. *Archives of General Psychiatry, 69*, 89–97. doi:10.1001/archgenpsychiatry.2011.109
- Metz, S. M., Frank, J. L., Reibel, D., Cantrell, T., Sanders, R., & Broderick, P. C. (2013). The effectiveness of the Learning to BREATHE program on adolescent emotion regulation. *Research in Human Development, 10*, 252–272. doi:10.1080/15427609.2013.818488
- Mulvey, E. P., & Cauffman, E. (2001). The inherent limits of predicting school violence. *American Psychologist, 56*, 797–802. doi:10.1037/0003-066X.56.10.797
- Murtonen, K., Suomalainen, L., Haravuori, H., & Marttunen, M. (2012). Adolescents' experiences of psychosocial support after traumatisation in a school shooting. *Child and Adolescent Mental Health, 17*, 23–30. doi:10.1111/j.1475-3588.2011.00612.x
- Nader, K., Pynoos, R., Fairbanks, L., & Frederick, C. (1990). Children's PTSD reactions one year after a sniper attack at their school. *American Journal of Psychiatry, 147*, 1526–1530.
- North, C. S., McCutcheon, V., Spitznagel, E. L., & Smith, E. (2002). Three-year follow-up of survivors of a mass shooting episode. *Journal of Urban Health, 79*, 383–391. doi:10.1093/jurban/79.3.383
- North, C. S., Smith, E. M., McCool, R. E., & McShea, J. M. (1989). Short-term psychopathology in eyewitnesses to mass murder. *Hospital & Community Psychiatry, 40*, 1293–1295.
- North, C. S., Smith, E. M., & Spitznagel, E. L. (1994). Posttraumatic stress disorder in survivors of a mass shooting. *American Journal of Psychiatry, 151*, 82–88.
- North, C. S., Smith, E. M., & Spitznagel, E. L. (1997). One-year follow-up of survivors of a mass shooting. *American Journal of Psychiatry, 154*, 1696–1702.
- North, C. S., Spitznagel, E. L., & Smith, E. M. (2001). A prospective study of coping after exposure to a mass murder episode. *Annals of Clinical Psychiatry, 13*, 81–86. doi:10.3109/10401230109148952
- Orcutt, H. K., Bonanno, G. A., Hanna, S. M., & Miron, L. R. (2014). Prospective trajectories of posttraumatic stress in college women following a campus mass shooting. *Journal of Traumatic Stress, 27*, 1–8. doi:10.1002/jts.21914
- Palus, S. R., Fang, S. S., & Prawitz, A. D. (2012). Forward, together forward: Coping strategies of students following the 2008 mass shootings at Northern Illinois University. *Traumatology, 18*, 13–26. doi:10.1177/1534765612437381
- Pynoos, R. S., Frederick, C., Nader, K., Arroyo, W., Steinberg, A., Eth, S., . . . Fairbanks, L. (1987). Life threat and posttraumatic stress in school-age children. *Archives of General Psychiatry, 44*, 1057–1063. doi:10.1001/archpsyc.1987.01800240031005
- Reddy, M., Borum, R., Berglund, J., Vossekuil, B., Fein, R., & Modzeleski, W. (2011). Evaluating risk for targeted violence in schools: Comparing risk assessment, threat assessment, and other approaches. *Psychology in the Schools, 38*, 157–172.
- Schwarz, E. D., Kowalski, J. M., & McNally, R. J. (1993). Malignant memories: Post-traumatic changes in memory in adults after a school shooting. *Journal of Traumatic Stress, 6*, 545–553. doi:10.1007/BF00974322
- Schwarz, E. D., & Kowalski, J. M. (1991a). Malignant memories: PTSD in children and adults after a school shooting. *Journal of the American Academy of Child and Adolescent Psychiatry, 30*, 936–944. doi:10.1097/00004583-199111000-00011
- Schwarz, E. D., & Kowalski, J. M. (1991b). Posttraumatic stress disorder after a school shooting: Effects of symptom threshold selection and diagnosis by *DSM-III*, *DSM-III-R*, or proposed *DSM-IV*. *American Journal of Psychiatry, 148*, 592–597.
- Schwarz, E. D., & Kowalski, J. M. (1992a). Personality characteristics and posttraumatic stress symptoms after a school shooting. *Journal of Nervous and Mental Disease, 180*, 735–737. doi:10.1097/00005053-199211000-00013
- Schwarz, E. D., & Kowalski, J. M. (1992b). Malignant memories: Reluctance to utilize mental health services after a disaster. *Journal of Nervous and Mental Disease, 180*, 767–772. doi:10.1097/00005053-199212000-00005

- Sewell, K. W. (1996). Constructional risk factors for post-traumatic stress response after mass murder. *Journal of Constructivist Psychology, 9*, 97–107. doi:10.1080/10720539608404657
- Séguin, M., Chawky, N., Lesage, A., Boyer, R., Guay, S., Bleau, P., . . . Roy, D. (2013). Evaluation of the Dawson College Shooting Psychological Intervention: Moving toward a multimodal extensive plan. *Psychological Trauma: Theory, Research, Practice, and Policy, 5*, 268–276. doi:10.1037/a0027745
- Shultz, J. M., Cohen, A. M., Muschert, G. W., & Flores de Apodaca, R. (2013). Fatal school shootings and the epidemiological context of firearm mortality in the United States. *Disaster Health, 1*, 84–101. doi:10.4161/dish.26897
- Sloan, I. H., Rozensky, R. H., Kaplan, L., & Sanders, S. M. (1994). A shooting incident in an elementary school: Effects of worker stress on public safety, mental health, and medical personnel. *Journal of Traumatic Stress, 7*, 565–574. doi:10.1007/BF02103007
- Smith, A. J., Abeyta, A. A., Hughes, M., & Jones, R. T. (2014). Persistent grief in the aftermath of mass violence: The predictive roles of posttraumatic stress symptoms, self-efficacy, and disrupted worldview. *Psychological Trauma: Theory, Research, Practice, and Policy, 7*, 179–186. doi:10.1037/tra0000002
- Stephenson, K. L., Valentiner, D. P., Kumpula, M. J., & Orcutt, H. K. (2009). Anxiety sensitivity and posttrauma stress symptoms in female undergraduates following a campus shooting. *Journal of Traumatic Stress, 22*, 489–496. doi:10.1002/jts.20457
- Streetsky, P. B., & Hogan, M. J. (2001). Columbine and student perceptions of safety: A quasi-experimental study. *Journal of Criminal Justice, 29*, 429–443. doi:10.1016/S0047-2352(01)00100-3
- Suomalainen, L., Haravuori, H., Berg, N., Kiviruusu, O., & Marttunen, M. (2011). A controlled follow-up study of adolescents exposed to a school shooting—Psychological consequences after four months. *European Psychiatry, 26*, 490–497. doi:10.1016/j.eurpsy.2010.07.007
- Swanson, J. W. (2011). Explaining rare acts of violence: The limits of evidence from population research. *Psychiatric Services, 62*, 1369–1371. doi:10.1176/appi.ps.62.11.1369
- Trappler, B., & Friedman, S. (1996). Posttraumatic stress disorder in survivors of the Brooklyn Bridge shooting. *American Journal of Psychiatry, 153*, 705–707.
- Turunen, T., Haravuori, H., Punamäki, R., Suomalainen, L., & Marttunen, N. (2014). The role of attachment in recovery after a school-shooting trauma. *European Journal of Psychotraumatology, 5*. doi:10.3402/ejpt.v5.22728
- Vicary, A. M., & Fraley, R. C. (2010). Student reactions to the shootings at Virginia Tech and Northern Illinois University: Does sharing grief and support over the Internet affect recovery? *Personality and Social Psychology Bulletin, 36*, 1555–1563. doi:10.1177/0146167210384880
- Vuori, M., Hawdon, J., Atte, O., & Räsänen, P. (2013). Collective crime as a source of social solidarity: A tentative test of a functional model for response to mass violence. *Western Criminology Review, 14*, 1–15.

Author Biographies

Sarah R. Lowe, PhD, is an associate research scientist in the Department of Epidemiology at the Columbia University Mailman School of Public Health. Her research centers on long-term psychological responses to traumatic events and the roles of secondary stressors and social conditions in shaping outcomes. She is currently working on projects exploring such relationships among survivors of Hurricane Sandy in New York City, cleanup workers from the 2010 Deepwater Horizon oil spill, and trauma-exposed residents of Detroit, Michigan, and Atlanta, Georgia. She received her PhD in clinical psychology from the University of Massachusetts, Boston, in 2012, and completed her clinical internship at New York Presbyterian/Weill Cornell Medical Center. Her dissertation on trajectories of psychological distress among low-income female survivors of Hurricane Katrina was awarded the Chancellor's Distinguished Dissertation Award at University of Massachusetts Boston, as well as the Best Dissertation on a Topic Relevant to Community Psychology Award from the Society for Community Research in Action (American Psychological Association Division 27). She will be joining the Department of Psychology at Montclair State University as assistant professor in September 2015.

Sandro Galea is a physician and an epidemiologist. He is the dean and a professor at the Boston University School of Public Health. Prior to his appointment at Boston University, he served as the Anna Cheskis Gelman and Murray Charles Gelman Professor and Chair of the Department of Epidemiology at the Columbia University Mailman School of Public Health where he launched several new educational initiatives and substantially increased its focus on six core areas: chronic, infectious, injury, life course, psychiatric/neurological, and social epidemiology. He previously held academic and leadership positions at the University of Michigan and at the New York Academy of Medicine. In his own scholarship, he is centrally interested in the social production of health of urban populations, with a focus on the causes of brain disorders, particularly common mood-anxiety disorders, and substance abuse. He has long had a particular interest in the consequences of mass trauma and conflict worldwide, including as a result of the September 11 attacks, Hurricane Katrina, conflicts in sub-Saharan Africa, and the American wars in Iraq and Afghanistan. This work has been principally funded by the National Institutes of Health, Centers for Disease Control and Prevention, and several foundations. He has published over 500 scientific journal articles, 50 chapters and commentaries, and nine books, and his research has been featured extensively in current periodicals and newspapers. His latest book, coauthored with Dr. Katherine Keyes, is an epidemiology textbook, *Epidemiology Matters: A New Introduction to Methodological Foundations*. He has a medical degree from the University of Toronto and graduate degrees from Harvard University and Columbia University. He was named one of TIME magazine's epidemiology innovators in 2006. He is the past president of the Society for Epidemiologic Research and an elected member of the American Epidemiological Society and of the Institute of Medicine of the National Academies of Science. He serves frequently on advisory groups to national and international organizations. He has formerly served as chair of the New York City Department of Health and Mental Hygiene's Community Services Board and as member of its Health Board.