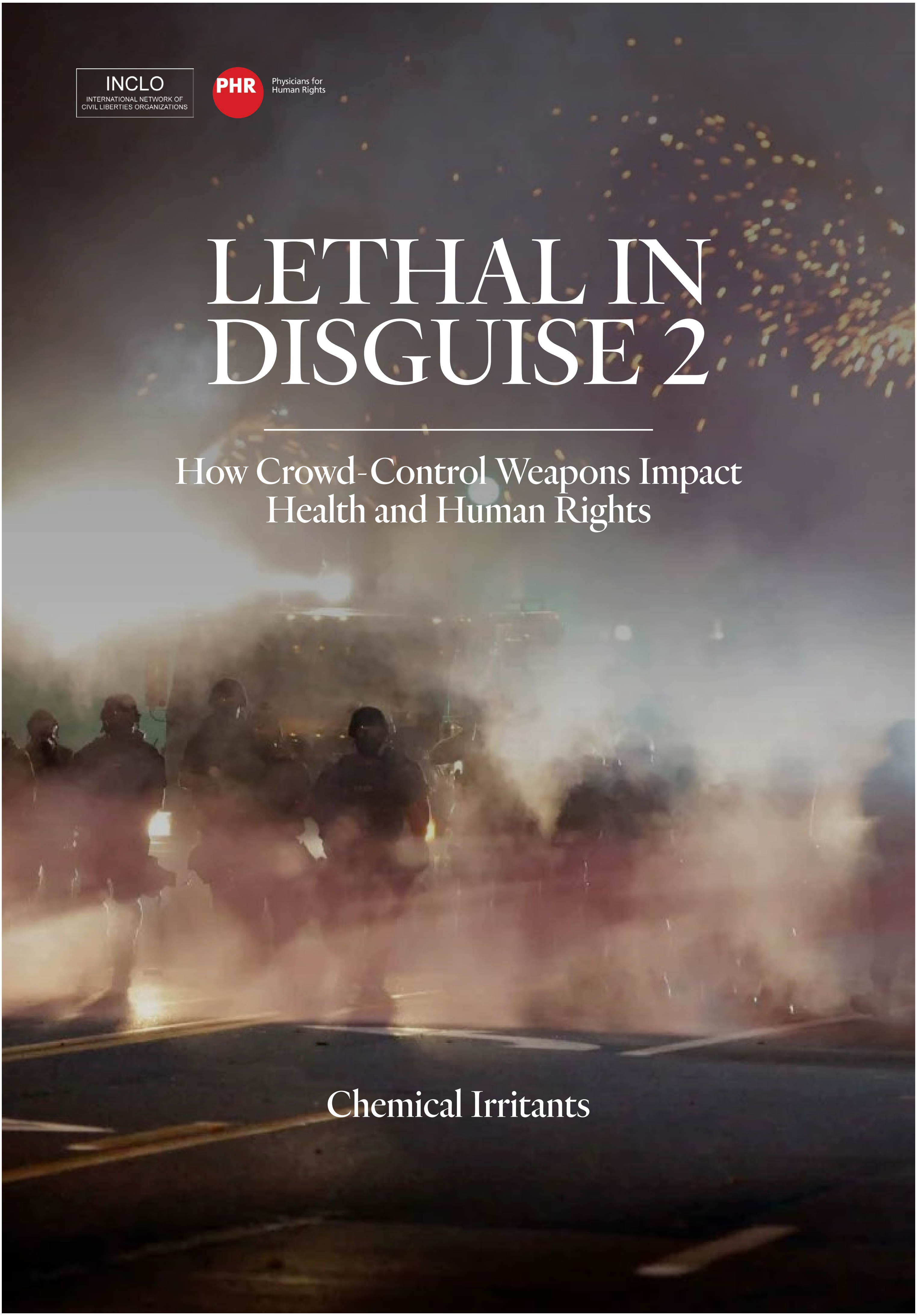


INCLO
INTERNATIONAL NETWORK OF CIVIL LIBERTIES ORGANIZATIONS

PHR Physicians for Human Rights

LETHAL IN DISGUISE 2

How Crowd-Control Weapons Impact Health and Human Rights

Chemical Irritants

CHEMICAL IRRITANTS

06 APRIL 2018, PALESTINIAN TERRITORIES, KHAN YUNIS:'PALESTINIAN PROTESTERS RUN FOR COVER WHEN ISRAELI SOLDIERS BOMB THEM WITH TEAR GAS. 2 PALESTINIANS HAVE BEEN KILLED AND 250 INJURED SINCE THE MASSIVE PROTESTS STARTED LAST FRIDAY. A SPEAKER OF THE PALESTINIAN HEALTH SERVICE TOLD THE PRESS THAT MORE PEOPLE HAVE BEEN CRITICALLY WOUNDED. MOHAMMED TALATENE | PICTURE ALLIANCE/DPA/AP IMAGES

Weapon profile

Chemical irritants include a variety of chemical compounds intended to produce sensory irritation and pain. Conventionally referred to as "tear gas" or "riot control agents," chemical irritants come in a variety of formulations, sizes, concentrations, and delivery mechanisms, depending on the manufacturer and the context for which they are intended. Historically categorised as non-lethal or less lethal, the general perception is that the weapon does not cause permanent injury or death but instead has mostly short-term effects such as transient lacrimation (flowing of tears), ocular irritation and pain, blepharospasm (eyelid spasm), dermal pain, respiratory distress, and transient psychological effects of disorientation and agitation.[86] This perception is now being challenged, with more evidence of associated longer-term and even permanent injuries as well as deaths.

Chemical irritants include a wide range of agents that have been developed and deployed for many decades, in addition to ones that are currently under development. There are four chemical compounds that have been most frequently cited in purchase orders, reports, and studies in the past three decades: chlorobenzalmalononitrile (agent CS), chloroacetophenone (agent CN), oleoresin capsicum (agent OC, known as pepper spray), and OC's synthetic form, PAVA. Of these four, the two most commonly used by law enforcement agencies in recent years for crowd control are agents CS and OC.

Lacrimator (tear-producing) agents are older and still frequently used across the globe. They act on TRPA1 receptors that are

86 MM Stark, "CS Spray," *Journal of Accident & Emergency Medicine* 15, no. 4 (July 1998): 288.

located on the plasma membranes of many human cells and are sensors for pain, cold, itch, and for environmental irritants to initiate protective responses such as tears, airway resistance, and cough. Of the lacrimator agents, agent CS is the most commonly used. It was developed in the 1920s in the United States and was introduced as a weapon by the US military to replace agent CN in the 1950s.[87] Agent CS then became a frequently used military weapon in the second half of the twentieth century and was famously deployed by the U.S. military in the Vietnam War.[88] Military use is now banned, but agent CS is now widely used by law enforcement agencies in many countries – often as the weapon of choice in the context of protest and civilian crowd management. While the US is still the largest manufacturer of CS, many other countries have developed the industry, among them Brazil, South Korea, India, Israel and France. Despite the United States remaining the biggest producer of CS, the US Environmental Protection Agency (EPA) has not set a minimum threshold of concentration at which the general population could experience "notable discomfort, irritation, or certain asymptomatic, non-sensory but transient effects,"[89] because even the lowest concentrations cause these symptoms. The volume of chemicals in each spray and gas varies considerably among manufacturers and countries.[90]

Agent OC, the second most-commonly cited capsaicin agent, is essentially a highly concentrated form of hot pepper and acts as an agonist on TRPV1 pain receptors, causing a burning sensation from stimulation of the nerve. Agent OC and its synthetic form, PAVA, have recently increased in popularity as potent and effective crowd-control agents. Also developed by the United States and originally used as a deterrent against wild animals (and by the U.S. Postal Service against dogs), OC was developed in the late 1970s and became a law enforcement weapon in the late 1980s.[91] It is now available both as a spray and in gas form, with lower concentrations being available as a self-defence "pepper spray" for the public. More potent variants are developed for military and law enforcement agencies. These have increasingly become weapons of choice for crowd control. The potency of these weapons depends both on the concentration of OC within the solvent and the strength of the "capsicum" – the active chemical that makes pepper spicy. It is worth noting that OC may also potentially include toxic chemicals, such as alcohol, halogenated hydrocarbons, and propellants, such as Freon.

---

87 BB Corson and RW Stoughton, "Reactions of Alpha, Beta-Unsaturated Dinitriles," ***Journal of the American Chemical Society*** 50, no. 10 (1 October 1928): 2825–37, doi:10.1021/ja01397a037; M Lenhart, ed., ***Medical Aspects of Chemical Warfare*** (Office of the Surgeon General. Department of the Army, United States of America, 2008), chap. 13.

88 EJ Olajos and H Salem, "Riot Control Agents: Pharmacology, Toxicology, Biochemistry and Chemistry," ***Journal of Applied Toxicology: JAT*** 21, no. 5 (October 2001): 355–91.

89 B Ballantyne and S Callaway, "Inhalation Toxicology and Pathology of Animals Exposed to O-Chlorobenzylidene Malononitrile (CS)," ***Medicine, Science, and the Law*** 12, no. 1 (January 1972): 43–65.

90 "Acute Exposure Guidelines Levels (AEGLs) for Tear Gas (CS)" (National Advisory Committee for Acute Exposure Guideline Levels for Hazardous Substances, September 2009), accessible at: http://www.epa.gov/oppt/aegl/pubs/tear_gas_interim_sept_09_v1.pdf.

91 Lenhart, ***Medical Aspects of Chemical Warfare***, chap. 13.

Chloroacetophenone (CN), chloropicrin (PS), bromobenzylcyanide (CA), dibenzoxazepine (CR), and combinations of these chemicals–also classified as lacrimator agents, riot control or "tear gas"–function similarly, albeit with myriad toxicity and potency profiles. Agent CN, the oldest among them and the active ingredient in "Mace," is used by the military and law enforcement and is also available to the general public in many countries for personal protection or animal protection sprays. It has been less commonly used in public policing since the advent of CS because it is more potent and less toxic. Chloropicrin (PS), best known as an agricultural fumigant, was developed as a chemical warfare agent (military designation, PS). It was used in large quantities during World War I and was stockpiled during World War II. Agent PS is known to have a strong irritating smell and can cause extended lung, gastrointestinal and neurological injury at high doses. Dibenzoxazepine (CR); was developed by the British military in the 1950s and 60s. Six to ten times stronger than Agent CS, CR has been frequently called "firegas". Agent CR is less toxic than Agent CS at comparable doses, but it can be lethal in high doses or poorly ventilated spaces, even in short time spans and tight spaces; It is also known as a carcinogen and can persist on porous surfaces for weeks. Significantly, CR was used in Northern Ireland and Vietnam in military operations.

In policing, reports suggest it has been used by Turkish and Ukrainian police during protests and, more recently, in Egypt and France. CS1 and CS2 are newer versions of CS: they reduce degradation and extend the shelf life of CS or, in the case of CS2, increase weather resistance and flow into the respiratory system by microencapsulating the CS in silicone. Other lacrimator agents include Bromobenzyl cyanide (CA) and bromoacetone (BA). These are older, highly toxic lacrimators that have not been used in recent decades. Diphenylchlorarsine (DA), diphenylaminearsine chloride (Adamsite (DM)) and diphenylcyanarsine (DC) are known as vomiting agents and may be used in combination with lacrimators in some contexts.

Riot-control agents are banned by the 1997 Chemical Weapons Convention (CWC) for military use or as "a method of warfare." Discussions at the time reflected concerns about the indiscriminate nature of the weapons, the possibility of escalation, the uncertainty around the use of CCWs versus lethal chemical agents, and the unnecessary suffering they cause.[92] Despite this ban, there continues to be military use of riot control agents, albeit with caveats. For example, although the United States signed and ratified the CWC, it has reserved the right to use riot-control agents in certain situations, including counter-terrorist and hostage-rescue operations, as well as military operations against non-state actors initiating armed conflict. And while military use of chemical irritants is limited, the CWC does ***not*** restrict or regulate its use by domestic

92 Chemical Weapons Convention below n 333; and International Committee of the Red Cross, "Practice Relating to Rule 75. Riot Control Agents," ***Customary IHL Database*** (2005), Cambridge University Press, Cambridge, accessible at: https://ihl-databases.icrc.org/customary-ihl/eng/docs/v2_rul_rule75.

law enforcement in civilian contexts. Several countries have limitations[93] on the possession and use of OC and CS, in either spray or gas form, but they are wholly unregulated in most countries.[94]

Mechanism of action

Chemical irritants are utilised for crowd dispersal or for individual control or incapacitation by causing pain and sensory irritation. Commonly used lacrimator agents are synthetic organic halogen compounds that are potent triggers of the TRPA1 pain receptors present on the skin and mucous membranes (eyes, nose, mouth, respiratory tract) and cause pain, irritation, tearing, sensations of heat, cold, and itching (pruritis), and a host of involuntary reactions such as eyelid spasm (blepharospasm) and coughing. CS and CN have been found to be 10,000 times more potent than naturally found agonists of these receptors (such as mustard, garlic, very high temperatures and low pH compounds). CR is known to be twice as potent as Agent CS. Oleoresin capsicum (OC) and PAVA, the synthetic and more highly concentrated form of OC, produce similar effects compared to the lacrimator agents and are also common pathways of inflammation, resulting in more generalised sensations of inflammation and pain.

CS and other gases can be released into the air as fine particulate smoke, vapour or liquid spray (aerosol). They can also contaminate water and food. They are typically deployed in two ways: in the form of a spray or as a canister/grenade in crowd-control settings. However, mechanisms of delivery vary. These include pellets and pepper balls, used in targeting individuals, as well as water cannons, which, along with grenades and canisters, provide more indiscriminate means of crowd control. Pellets can be designed for a "pepper spray gun", which uses a compressed gas cartridge capable of firing 21 rounds. Per the manufacturers, the rounds travel at 320 feet per second, with an effective range of over 150 feet and release a 4–5-foot cloud of smoke when they explode.[95] Newer forms include plastic balls filled with chemical irritants that act as a combination of plastic bullet and gas weapon.

The spray variant for CS, OS, and other gases is usually available in the form of an enclosed unit under pressure and is released as a fine spray by means of a propellant gas. These aerosolised forms of chemical irritants are typically released from 0.3 to 3 metres from the target, and the spray pattern can be variable depending on the design of the weapon, the pressure of the spray mechanism, and wind conditions. Powder forms of chemical irritants are contained in canisters or grenades and typically are triggered to conduct a thermal explosion and disperse widely in the surrounding area.

Chemical irritants are indiscriminate weapons by design, especially when delivered by firing a grenade or a canister. Limiting the exposure to individuals or small groups is virtually impossible, and the risk of affecting bystanders

93 Limitations vary by country. Some countries have limitations on use by law enforcement, especially regarding concentration, amount of volume carried, etc. Many other countries have limitations on possession/use by the general population.

94 Medical News Today, "What Is Pepper Spray? Is Pepper Spray Dangerous?," *Medical News Today*, (25 November 2011, accessible at: http://www.medicalnewstoday.com/articles/238262.php.

95 SALT Supply Co., "s1 Pepper Spray Gun Starter Kit," accessible at: https://www.saltsupply.com/collections/pepper-spray-gun/products/s1-pepper-spray-gun-starter-kit.

and individuals other than the intended targets is high. In addition, the diagnosis and treatment of chemical irritant exposure is complicated because of the combination of different chemicals and the lack of transparency about the agents used.

Agent CS, the most commonly used chemical irritant, is not actually a gas but rather a powder at room temperature that is aerosolized by a triggered thermal explosion and disperses widely from a canister. A gas canister is estimated to have between 80 and 120 grams of CS, usually in concentrations between 0.1 and 10 per cent, but much higher concentrations are also commercially available.[96] The concentration of CS, however, can be significantly increased by the firing of multiple canisters in the same location. This practice often occurs in crowd-control situations and further complicates the analysis of the toxicity of the chemical as actually used.

To accurately understand the effect of exposure to CS, a measurement of density or concentration (milligrams per cubic metre) for exposure time is necessary. Based on animal and human models, it is estimated that exposure to agent CS at a concentration of 140 mg/m^3 for 10 minutes or 11 mg/m^3 for one hour, or as little as 1.5mg/m^3 for four to eight hours, can be lethal.[97] Individuals exposed to high concentrations in closed spaces or for extended amounts of time, for instance, can suffer serious health consequences and even death. When used outside, a CS grenade or canister produces a cloud of chemicals, usually within 60 seconds, with the highest CS concentration of 2,000 to 5,000 mg/m^3 detected at the centre of the cloud. Because of the nature of the weapon, it is difficult to measure these concentrations in practical situations of deployment or to have accurate estimates in retrospect.

Agent OC, most commonly found in spray form, is available in different concentrations from 1 to 10 per cent of capsaicinoids as oil in a solvent. Studies suggest that even very low (0.003 mg/m^3) concentrations can lead to ocular irritation.[98] Because of the complexities in measuring concentrations of agent OC, lethal dose levels are difficult to verify.

To our knowledge, there are no known biomarkers that can be used to determine the presence of any chemical irritants in biological systems. Some on-scene testing for air samples can only be conducted by government bodies, and this testing only determines whether chemical irritants are present or absent. No additional testing is currently in place for environmental samples (e.g., filters, swabs, or wipes).[99]

---

96 "Combined Systems Inc, "Company site, ***CSI Inc. Supporting Military Forces and Law Enforcement Agencies World-Wide***, (24 April 2015), accessible at: https://www.combinedsystems.com/products/?cid=13.

97 National Advisory Committee for Acute Exposure Guideline Levels for Hazardous Substances, "Acute Exposure Guidelines Levels (AEGLs) for Tear Gas (CS)."

98 RC Gupta, ***Handbook of Toxicology of Chemical Warfare Agents*** (Academic Press, 2015).

99 United States Environmental Protection Agency, "Selected Analytical Methods for Environmental Remediation and Recovery (SAM)," accessible at: https://www.epa.gov/esam/selected-analytical-methods-environmental-remediation-and-recovery-sam.

Type	Name	Characteristics and properties	Duration of action	ID50 and LD50 (mg/min per m3) – Incapacitating Dose and Lethal Dose**	Treatment Considerations	Environmental Considerations	Other information
Lacrimator Agents Act on TRPA 1 pain receptors	Agent CN	Apple odour; white powder or emulsion; insoluble in water	10 – 20 minutes	20-50 8,500 – 25,000	Fresh air typically effective in decontamination	Powder at room temp, degrades quickly on surfaces	Historically in riot control, now primarily in sprays (MACE
	Agent CS	Yellow solid or powder, pepper odour; soluble in water	10 – 30 minutes	4-20 25,000 – 100,000	Water and fresh air commonly used, Alkaloids known to be a lay treatment	CS degrades in hours on surfaces, CS1 and CS2 can last on surfaces and skin for longer times	Most commonly used in riot control canisters globally
Capsaicin Agents Act on TRPV1 pain receptors	Agent CR	Pale yellow solid or powder, pepper odour, known as "firegas", very soluble in water	10 minutes to 48 hours	unknown	Use of water may exacerbate CR pain and inflammation up to 48 hours	Can last on surfaces > 60 days	Can be delivered in aerosol or water solution (for water cannons)
	Agent OC and PAVA	Pepper odour or odourless white solid; soluble in oil. OC is naturally concentrated, PAVA is synthetic (and can be more potent)	30 – 60 minutes	Not established	As an oil, must typically be washed off with soap and water	Persists for long periods as oil or solid	Most commonly used in sprays, growing use in riot control dispersals

*Figure 7: Characteristics of selected chemical irritants**

** Table adapted from Carron and Yerson, Management of the Effects of Exposure to Tear Gas, 2009.*[100] *** The Median Incapacitating Dose (ID50) is the amount of agent expected to incapacitate 50 per cent of a group of exposed, unprotected individuals. The Median Lethal Dose (LD50) is the amount of agent expected to kill 50 per cent of a group of exposed, unprotected individuals. In pharmacology, the margin of safety is the range between the usual effective dose and the dose that causes severe or life-threatening side effects. Agent CS has a lower effective dose and a higher toxicity dose than agent CN, resulting in a wider margin of safety.*

100 P Carron and B Yersin, "Management of the Effects of Exposure to Tear Gas," *BMJ (Clinical Research Ed.)* 338 (2009): b2283.

Health effects

The health effects of chemical irritants are highly dependent on the specific chemical of exposure, the dose (based on quantity and time), the conditions of exposure, the deployment mechanism, the risk factors of the individual, and the access to egress and care. Most exposures to chemical irritants result in temporary pain and discomfort lasting less than one hour. However, the lacrimator gases are known overall to be more toxic than the capsaicin agents, particularly to the respiratory system, and both have the potential for more serious or longer-lasting injury at higher doses. Dose exposure is dependent on numerous factors that together can lead to higher or lower concentrations of the chemicals to which individuals are exposed. The amount of chemical released per canister, the number of canisters released, the context (indoors, outdoors, wind conditions), and how long an individual is exposed can all change the dose exposure.

The individual health risks for an individual are related to the exposure as well as personal characteristics and access to care. For instance, certain groups that are particularly at risk from the effects of chemical irritants and for whom it may be life-threatening include older people, children, or people with respiratory problems or skin sensitivity. According to the American Academy of Paediatrics, "[c]hildren are uniquely vulnerable to physiological effects of chemical agents. A child's smaller size, more frequent number of breaths per minute and limited cardiovascular stress response compared to adults magnifies the harm of agents such as tear gas."[101] For many irritants, early decontamination can avoid the most severe injuries. Thus, the availability of water, soap, fresh air, or other treatments is an important factor to consider. Of note, different agents have different treatment considerations: fresh air is effective for all, but water can cause a transient exacerbation of symptoms for CS, CR and CN with eventual improvement, while soap is usually necessary for oil-based compounds such as OC and PAVA.

Transient and common symptoms from chemical irritant exposure include tearing, eye pain and redness, blepharospasm (eyelids involuntarily spasm and stay closed) and sensations of pain and burning on the skin. Exposed individuals often also feel pain in their mouth, airways and lungs and can have trouble breathing or have involuntary coughing fits. More serious injuries can affect all organ types: eye injuries, lung damage, skin burns and others. Perhaps most concerningly, the canisters and grenades that are directed at crowds are known to be a significant source of traumatic injury.

Results of the updated systematic review

We updated the systematic review of the medical literature documenting the health impact of different chemical irritants, which was initially carried out in 2016, to identify additional documented cases of injuries, deaths, and permanent disability. We

101 American Academy of Pediatrics, "AAP Statement in Response to Tear Gas Being Used Against Children at the U.S. Southern Border," 26 November 2018, accessible at: https://www.aap.org/en/news-room/news-releases/aap/2018/aap-statement-in-response-to-tear-gas-being-used-against-children-at-the-us-southern-border/.

followed the same search process but also included case reports describing injuries of five people or fewer in an effort to elucidate the more severe injuries documented in smaller case reports in order to deepen understanding of the health impacts of chemical irritants (There is no standard reporting mechanism for deaths and severe injuries from these weapons, so case reports are a critical source of information). Based on our systematic review findings, we have catalogued additional injuries documented in the medical literature between 1 January 2015 and 28 February 2022 (the previous study reviewed data between 1 January 1990 and 15 March 2015). A total of 41 studies (36 in English, 5 in other languages) were included in our analysis of health effects as well as the frequency, context of injuries, and risk factors (See the appendix for a list of the referenced papers).

The majority of papers utilised a cross-sectional analysis (n=20) or case report (n=18) methodology (3 were surveys). The majority of studies described health effects from events in which chemical irritants were used in the USA (n=16), followed by Turkey (n=8) and Hong Kong (n=4). There were also studies from Belgium, Canada, France, Iraq, Lebanon, Slovenia, Spain, Switzerland and Tunisia. Eleven of the studies reported that injuries occurred secondary to public demonstrations, six studies explored events that occurred in training, three studied injuries in accidental exposures, and others included police use of force cases and experimental studies.

The review identified 119,113 people who were exposed to chemical irritants since 2015 reported in the medical literature. They had 129,451 injuries (some people had more than one injury). Of those injuries, 56% (n=72,468) resulted in transient symptoms such as pain, tearing, or respiratory distress that resolved quickly and spontaneously. 37% (n=47,629) constituted minor injuries that were visible on medical examination but expected to spontaneously resolve either with time or through first aid or other short-term interventions. Four per cent of injuries (n=5246) were severe, requiring medical interventions such as a hospital stay or surgery. And 3 per cent (n=4108) did not specify the severity. In this analysis, 19 people were permanently disabled, and 14 people died.

These numbers represent a significant increase in reporting and publication of data from the previous study. Our earlier study identified 8311 people who suffered injuries (of whom 13 people died and 70 people suffered permanent disability). Of note, the updated review includes three papers summarising large database analyses of persons reporting to toxicology centres or documented in national databases that include data on 104,940 people with tear gas and pepper spray exposures which significantly expands the sample for this updated review. While greater numbers of people were reported on, these large databases provide limited information beyond deaths and general injury categories, limiting analysis of their raw data. The majority of people from 1900 and 2015 who were injured also fully recovered from

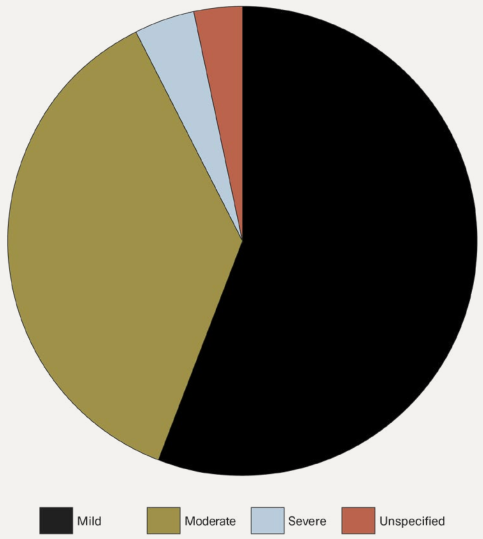


Figure 8: Severity of injuries caused by chemical irritants.

their injuries (98.7%).[102] Similar proportions of individuals had severe injuries in the updated analysis to the previous report (8.7% in the past report).

The updated analysis further found more cases of blunt trauma from canisters. All of the people who died suffered blunt head trauma from canisters being fired directly at them (11 individuals in Iraq, 3 in Syria). In all of these cases, the canisters were suspected to be highdensity military-grade canisters. The deaths were documented in the literature review; one as a result of respiratory arrest after CS was fired inside a home, and twelve from traumatic brain injury sustained after the victim was directly hit by a canister. Ten of the deaths from head injury were reported in a study from Iraq on violence occurring during protests in 2019 and another from a separate case report in Iraq. No cases of death associated with OC were identified.

Nineteen people reported permanent disabilities, including permanent vision loss (two from a pepper ball that hit the eye and another from a direct spray of OC into the eye). Three people suffered from cardiac arrests (heart-stopping and requiring CPR), and two suffered permanent heart damage after exposure to chemical irritants. One person developed Guillain-Barre Syndrome, a neurological syndrome that causes paralysis after exposure.

Severe injuries surveyed included injuries to multiple body systems, with the majority of injuries being to the skin, eyes, and cardiopulmonary system (lung, heart, and chest).

Many of the studies reviewed for this report included injury data on children (some as

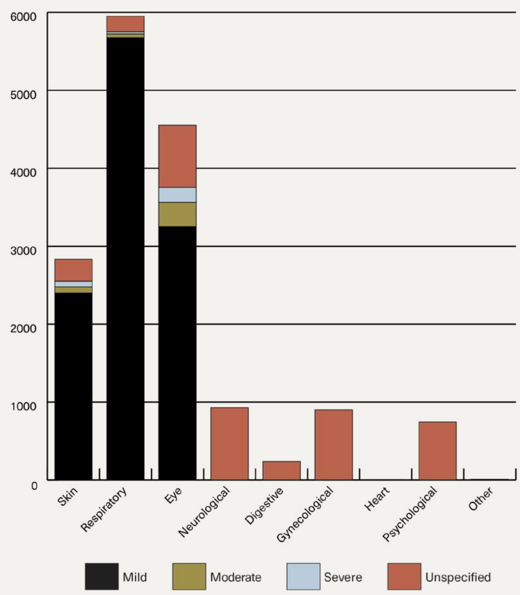


Figure 9: Severity of injuries caused by chemical irritants by body system.

102 RJ Haar, V Lacopino, N Ranadive, SD Weiser, and M Dandu. "Health impacts of chemical irritants used for crowd control: a systematic review of the injuries and deaths caused by tear gas and pepper spray." *BMC Public Health* 17, no. 1 (2017): 1-14.

young as three months old). Studies suggest that children are more vulnerable to severe injuries from chemical toxicity.[103] The elderly and those with chronic diseases may also be more prone to worse outcomes from chemical irritants.[104] The data also identified chronic respiratory conditions and allergic skin conditions in people who had previous medical conditions and severe lung and heart injuries in individuals with no past history of any medical concerns (including police officers).

The review also found that the severity of injuries from chemical irritants was correlated with the kind of chemical agent used and the method of deployment.

- Type of chemical agent: Most of the injuries documented were caused by CS or OC, but the injuries were rarely disaggregated by the chemical involved. In many cases, the specific agent was not known. Among the studies where the chemical agent was identified as CS, 573 injuries were reported. Of those, 10% suffered severe injuries, 38% suffered moderate injuries, and 51% experienced mild injuries. Among the studies where the chemical agent was identified as OC or PAVA, 2925 injuries were reported. Of those, 12% were severe, 18% were moderate, and 70% were mild.

  Narrative data collected from reviewed literature suggested that agent CS can cause unexpected skin reactions, such as chemical burns and hypersensitivity reactions, as well as respiratory illness. OC can also cause such reactions. Significant severe reactions, such as cardiac arrest, strokes and skin burns, were reported with both agents.

- Deployment mechanism: The selected studies documented injuries caused by both spray and gas forms of both chemicals. While the previous review demonstrated that gas forms of chemical irritants (contained in canisters or grenades and released and widely dispersed by a thermal explosion) contributed to a marginally higher percentage of severe injuries, the updated data does not deepen

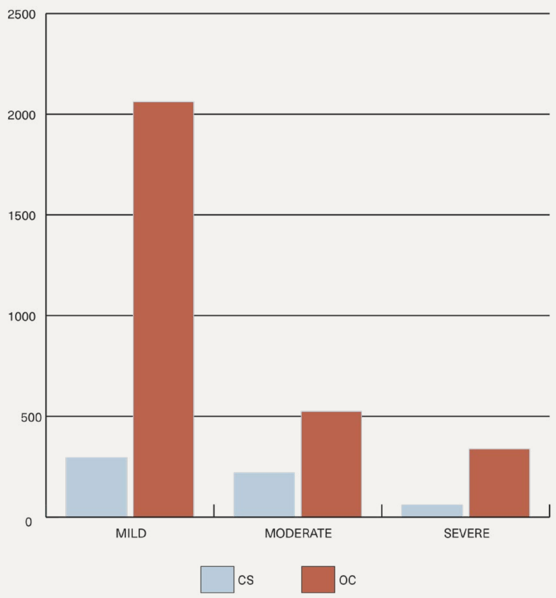


Figure 10: Injury severity by chemical agent.

103 PJ Landrigan, “Children as a Vulnerable Population,” *International Journal of Occupational Medicine and Environmental Health* 17, no. 1 (2004): 175–77.

104 PA Routledge, MS O’Mahony, and KW Woodhouse, “Adverse Drug Reactions in Elderly Patients,” *British Journal of Clinical Pharmacology* 57, no. 2 (February 2004): 121–26, doi:10.1046/j.1365-2125.2003.01875.x.

> this analysis given the lack of quality data on deployment. The current review reinforced the importance of both distance/proximity to the area where the chemical was released and the force of the propellant as factors influencing the severity of the health effect on individuals.

The additional data since 2016 has underscored the concern over blunt trauma injuries from chemical irritant canisters. Direct hits by the canisters themselves were documented to have caused 59 injuries, 55 of which were to the head. A study from Iraq highlights the importance of the design of the canister and the apparently deliberate targeting of the heads of individual protesters. The canisters developed in Iran were denser than most other canister designs.

Many of the reviewed studies identified additional factors that may potentiate injuries, such as environmental conditions (heat, humidity, and wind conditions), prolonged exposure, and exposure in enclosed spaces. Utilising the weapons in confined spaces and in areas where people could not easily escape was noted to potentially increase the exposure to the irritant either in quantity or over time.[105] Use of chemical irritants in areas with high heat or humidity potentially exacerbated skin irritation, and windy conditions risked the contamination of law enforcement officers, bystanders, or nearby residences and businesses.[106] Direct targeting of the face and eyes by spray has been noted to cause trauma and toxicity to the cornea and conjunctiva of the eye.

In addition to documenting injuries, the review identified other factors that may affect injury severity. Inherent qualities of the chemical agents may play some role in injuries. Chemical irritants, especially those deployed in gas forms, are inherently indiscriminate and can impact not only the intended targets but also other demonstrators, bystanders, neighbourhood businesses and residences, and law enforcement officers themselves. Several of the reviewed studies demonstrated that accidental exposure is common and sometimes difficult to avoid. Because of the indiscriminate nature of chemical irritants, limiting the exposure to individuals or small groups is difficult, while exposing large and diverse groups to the weapons poses the risk of widespread injuries, including to potentially vulnerable people.

We also note that combinations of OC and CS are becoming more common, both in spray and gas forms as well as within projectiles such as the "pepper ball."[107] These forms, along with chemical agents dissolved in water cannons, have not been well studied and could cause other injuries.[108] Perhaps even more concerning are the unknown

105 AMB Zekri et al., "Acute Mass Burns Caused by O-Chlorobenzylidene Malononitrile (CS) Tear Gas," ***Burns*** 21, no. 8 (1995): 586–89, doi:10.1016/0305-4179(95)00063-H.

106 RJ Thomas et al., "Acute Pulmonary Effects from O-Chlorobenzylidenemalonitrile 'Tear Gas': A Unique Exposure Outcome Unmasked by Strenuous Exercise after a Military Training Event," ***Military Medicine*** 167, no. 2 (February 2002): 136–39.

107 EJ Olajos and H Salem, "Riot Control Agents: Pharmacology, Toxicology, Biochemistry and Chemistry," ***Journal of Applied Toxicology: JAT*** 21, no. 5 (October 2001): 355–91.

108 ***Tear Gas Devices***, ***Code of Federal Regulations***, vol. 173.340, 2001, accessible at: https://www.law.cornell.edu/cfr/text/49/173.340.

effects of these chemical agents in chronic exposure settings in which safety has never been studied and cannot reasonably be assumed. This should be particularly concerning for law enforcement officers with repeated exposure, frequent protesters, and health workers who may sustain multiple occupational exposures. More research on these possible health harms is needed. (For specific recommendations on chemical irritants, see Section 4).

What has changed?

Much of the research in the past six years amplifies the concerns presented in LiD1. In addition, a number of new concerns have emerged.

- Extensive use: Tear gas has continued to be used extensively across the globe. From Hong Kong to Chile, chemical irritants continue to be the primary riot control agent utilised by police to repress and disperse demonstrations. In the United States, the police response to anti-police violence protests in the wake of George Floyd's murder included widespread use of different forms of tear gas in dozens of cities.

- New ways of deployment: In Colombia, the use of the US-made "venom" launchers, which can deploy dozens of grenades at once from stations mounted on vehicles, shields or static installations, led to the rapid diffusion of massive quantities of chemical irritants at protests across the country in 2021. Beyond the use of traditional canisters and grenades, the use of chemical irritants diluted in water cannons is a growing problem, with reports of resulting skin irritation and pain. There has also been growing use of other composite weapons, such as pepper balls. These composite weapons are anecdotally considered less dangerous than traditional kinetic impact projectiles but must be regarded as both projectile and chemical weapons and have been few studies.

- Few advances in knowledge or dissemination of knowledge on composition: In the past six years, there have been little to no efforts on the part of governments or regulating bodies to better understand the composition of chemical irritants or make that knowledge available to the public or to healthcare workers. As examples:

    - The United States National Institute for Occupational Safety and Health (NIOSH) still does not index Agent CS in its database (though it does have Agent CN).
    - Data on the chemical makeup of various formulations, made by numerous manufacturers, are challenging to obtain and remain opaque to the public.

    - Police documentation of the use of force is haphazard and limited: deployment records are not readily available and, when they are, frequently lack sufficient quality to analyse records.

- A review of recent papers also highlights that in light of the lack of a clear standard for how to report chemical irritant injuries, studies are heterogeneous in their approaches. This heterogeneity makes systematic comparisons across studies difficult.

- New hazards recognized as a result of the airborne transmission of viruses, such as COVID-19: Since 2020, the ongoing COVID-19 pandemic has resulted in millions of deaths from respiratory illness. In this context, the extensive use of chemical irritants during the pandemic has increased the risk of adverse medical effects due to COVID-19's effects on breathing and the lungs, as well as the risk of infection through induced coughing or sneezing. This risk is especially high for those in enclosed or indoor spaces, or for communities with high incidence of COVID-19 and low vaccination rates. Numerous health organisations demanded a moratorium on the use of chemical irritants during demonstrations, citing the lack of crucial research, the escalation of tear gas use by law enforcement, and the likelihood of compromising lung health and promoting the spread of COVID-19" (American Thoracic Society, 2020). They were specifically worried that the use of chemical irritants could increase the risk of COVID-19 by making the respiratory tract more susceptible to infection, exacerbating existing inflammation, and inducing coughing (Greiner et al., 2020). While there is limited information on the incidence of COVID-19 in the setting of tear gas exposure, this issue continues to be of concern as the pandemic rages on and others likely will follow.

- The effects of chemical irritants on women: An area of increasing importance, but where no clinical studies have yet been published, is the growing awareness of the effects of chemical irritants on women and reproductive health. Anecdotal reports have suggested that there may be a relationship between the use of tear gas and miscarriage, but following the widespread use of large quantities of chemical irritants during BLM and other protests in the US in the summer of 2020, media reports also emerged of irregular menstruation, exacerbated cramping, or both of these in the weeks after chemical irritant exposure.[109] Self-reported menstrual issues were documented in Portland in 2020 in a convenience sample survey where, of people who could menstruate, 36% reported increased cramping, and 24% reported increased bleeding. Stress and other confounders may also play a role. As a result of such reports and the

109 See, for example, A Slisco, "Tear Gas May Have Led To Abnormal Menstrual Cycles in Seattle and Portland," ***Newsweek*** (5 September 2020), accessible at: https://www.newsweek.com/tear-gas-may-have-led-abnormal-menstrual-cycles-seattle-portland-1529912; M Stunson, "Protesters complain of unexpected side effect from tear gas: Period changes," *Miami Herald* (14 July 2020), accessible at: https://www.miamiherald.com/news/nation-world/national/article244212707.html; and C Nowell, "Protesters Say Tear Gas Caused Them to Get Their Period Multiple Times in a Month," *Teen Vogue* (2 July 2020), accessible at: https://www.teenvogue.com/story/protestors-say-tear-gas-caused-early-menstruation.

lack of research, several organisations are undertaking further research.[110]

- Environmental and long-term risks: The mounting worries about the environment have led to more thoughtful consideration of the contamination of ground and water by the deployment of chemical irritants. There is a concern not only about the locations immediately surrounding where chemical irritants are used but also areas where their degradation products may spread. A study by members of this research team in Aida Camp in Palestine examined the effects of tear gas canister rounds left on the street (see case study below).[111] Children and others who handled these canister rounds days after they had been fired reported symptoms and signs consistent with chemical irritant exposure. In multiple settings, concerns have been reported about the degradation products of chemical irritants such as cyanide (a deadly poison). While the dose from a small canister may be low, evidence of expired canisters being used across the globe underscores the risk that numerous expired canisters could harm demonstrators, members of surrounding communities, and the environment. Degradation products in both ground and run-off streams are now being studied by several groups to answer some of these questions.

- Psychological Impacts: The psychological impact of the use of CCWs has not been well studied or documented in the medical literature, but cases documented in this review indicate that exposure to chemical irritants may result in significant psychological symptoms and long-term disability. In one study of 297 individuals seeking care and/or evaluations of injuries following the 2013 Gezi Park protests in Turkey, 117 psychiatric evaluations were conducted. Some 43 per cent of the victims met the diagnostic criteria for acute stress disorder, 23 per cent met the diagnostic criteria for post-traumatic stress disorder (PTSD), and 7.7 per cent met the diagnostic criteria for major depressive disorder.[112] In 2020, 1635 (72.4%) of 2257 adults who reported tear gas exposure in Portland, US, described in a web-based survey that they were experiencing increased feelings of fear, fatigue, anxiety, and/or a startle response.

- Scant evidence on the treatment of chemical irritant exposure: Treatment of chemical irritant exposure has gained increased attention over the past six years. Studies and commentaries have reiterated prior recommendations that

110 Planned Parenthood North Central States, "Tear Gas and Reproductive Health Study," *plannedparenthood.org*, accessible at: https://www.plannedparenthood.org/planned-parenthood-north-central-states/about-ppncs/research/tear-gas-and-reproductive-health-study.

111 Human Rights Center, "No Safe Space: Health Consequences of Tear Gas Exposure Among Palestine Refugees," *University of California Berkeley*, accessible at: https://humanrights.berkeley.edu/programs-projects/past-projects/no-safe-space.

112 Umit Unuvar, et al. "Usage of Riot Control Agents and other methods resulting in physical and psychological injuries sustained during civil unrest in Turkey in 2013." *Journal of Forensic and Legal Medicine* 45 (2017): 47-52.

most symptoms of chemical irritant exposure should resolve spontaneously within an hour of the end of the exposure. There is anecdotal evidence to suggest that tear gas (CS and CN) exposure is best treated with fresh air or copious amounts of water irrigation and that pepper spray (OC and PAVA) might be best treated with soap and water (as it is an oil-soluble compound).[113] A small, randomised control trial noted that treatment with baby shampoo was no different than irrigation with water alone for both CS and OC exposures.[114]

» While there are anecdotal reports of a variety of substances helping with symptoms, there is little evidence to support their use. Nevertheless, antacids and alkaloids, such as Maalox or milk of magnesia, are commonly used around the world for symptomatic relief. In some cultures, onions, citrus fruits, CocaCola, and strong-smelling salts are used to counteract the immediate effects of chemical irritants. In one study, pre-treatment of police officers with Diphoterine (a common chemical rinsing agent) resulted in slightly less facial pain when they were exposed.115 Current evidence suggests that exposed individuals should attempt to remove contaminated clothing, and those with contact lenses should remove them immediately. Individuals with severe respiratory symptoms, prolonged palpitations, blisters/burns, or any symptoms lasting longer than an hour should seek medical attention. Anyone with blunt trauma from a tear gas canister, especially to the head or face, should seek immediate medical attention.

> The psychological impact of the use of CCWs has not been well studied or documented in the medical literature, but cases documented in this review indicate that exposure to chemical irritants may result in significant psychological symptoms and long-term disability.

113 See Fine, Kennet., Bassin, and Stewart. "Emergency care for tear gas victims." *Journal of the American College of Emergency Physicians* 6, no. 4 (1977): 144-146; and Carron, Pierre-Nicolas, and B Yersin. "Management of the effects of exposure to tear gas" *BMJ* 338 (2009).

114 JD Barry, RHD James, and JG McManus Jr. "A randomized controlled trial comparing treatment regimens for acute pain for topical oleoresin capsaicin (pepper spray) exposure in adult volunteers", *Prehospital Emergency Care* 12, no. 4 (2008): 432-437.

115 M Brvar, "Chlorobenzylidene malononitrile tear gas exposure: Rinsing with amphoteric, hypertonic, and chelating solution." *Human & Experimental Toxicology* 35.2 (2016): 213-218.

Case study

No safe space in refugee camps

Palestine

After the publication of LiD1 in 2016, aid workers in the Aida and Dheisheh refugee camps outside of Bethlehem, in Palestine, reached out to the authors. The camps are decades old, small, densely-populated–and adjacent to the Separation Wall in some places. Residents reported exposure to tear gas two to three times a week for more than a year. In some months, the exposure was almost daily. Staff in the camps worried the tear gas was used in breach of international norms and to the significant health detriment of the community.

Responding to the request for support, researchers at UC Berkeley and UC San Francisco put together a team to study the issue. The aim of the study was to: (1) identify the frequency of exposure to tear gas among refugees who live in Aida and Dheisheh camps; and (2) categorise potential medical and psychological symptoms (both acute and chronic) associated with this exposure.

In the summer of 2017, researchers travelled to Bethlehem to conduct the research. The findings, published in the report *No Safe Space* by the Human Rights Center at UC Berkeley School of Law, revealed that the use of chemical irritants in these camps likely far surpassed anything seen anywhere else on the globe. And because the camps are tightly packed with poor ventilation, tear gas was entering homes and lingering in the air as well as on the ground. Children were playing with used canisters, and nearly everyone, from babies to the elderly, was experiencing symptoms from the chronically high exposure. There truly was "no safe space" and no way out.

Researchers conducted 10 focus groups with over 75 participants and interviewed 236 individuals in the camp, ages ten and older, as part of a household population survey. Fully 100% of residents surveyed reported being exposed to tear gas in the past year. Respondents also reported being exposed in the past several years to stun grenades (87%), skunk water (a foul-smelling liquid; 85%), and pepper spray (54%). Respondents also reported witnessing the use of rubber bullets (52%), and several (6%) also reported witnessing the use of live ammunition (6%). Over half (55%) of respondents described between three and 10 tear gas exposures in the month before the survey was carried out, both indoors and outdoors. Indoor locations included homes, schools, and places of work.

Over the same period, 84.3% were exposed to tear gas in the home, 9.4% at work, 10.7% in school, and 8.5% elsewhere (in a car for instance). Fifty-three people (22.5%) said that they had been hit directly with a tear gas canister in the past. Community focus groups consistently and independently reported experiences of fear, worry, physiological reactivity, hyper-arousal, poor and disrupted sleep, lack of safety, and daily disruptions in basic activities of daily living–including caring for children and the sick, participating

ISRAELI FORCES FIRE TEAR GAS INTO AIDA REFUGEE CAMP, BETHLEHEM, WEST BANK, SEPTEMBER 27, 2013. THE CLASHES WERE IN REACTION TO RECENT PROVOCATIONS AT JERUSALEM'S AL AQSA MOSQUE BY RIGHT-WING JEWISH SETTLERS. RYAN RODRICK BEILER | ACTIVE STILLS

The use of military-grade ammunition for crowd control is unusual, and typical tear gas canisters do not pose the same magnitude of hazard. However, with little to no regulation of chemical irritants, these weapons were manufactured, purchased, and used against civilians, with no limitations. Worryingly, direct impacts to the head from "civilian grade" tear gas canisters have been documented to cause injuries ranging from traumatic brain injury,[1] skull fracture,[2] enucleation,[3] and death.[4]

1 Committee to Protect Journalists, "Video journalist injured by tear gas canister at Hong Kong protest," *Committee to Protect Journalists,* 5 August 2019, accessible at: https://cpj.org/2019/08/video-journalist-injured-by-tear-gas-canister-at-h/

2 Charis McGowan, "Mom Loses 3 Senses After Cops Threw Tear Gas Canister Into Her Face, Sparking a Movement Against 'Non-Lethal' Weapons in Chile," ***VICE News,*** September 17, 2020, accessible at: https://www.vice.com/en/article/wxq3qw/this-mom-lost-3-of-her-senses-after-being-hit-by-a-teargas-canister-sparking-a-movement-against-non-lethal-weapons-in-chile.

3 A Srikanth, "Indiana journalist loses eye to tear gas canister during demonstrations against George Floyd's death," ***The Hill***, June 1, 2020, accessible at: https://thehill.com/changing-america/respect/equality/500467-texas-journalist-loses-eye-to-tear-gas-canister-during/.

4 Wani et al., "Head injury caused by tear gas cartridge in teenage population," ***Pediatric Neurosurgery***, 2010, vol. 46, no. 1, pp. 25-28, doi:10.1159/000314054

Case study

Shrapnel in stun grenades and tear canisters cause over 28 deaths

Iraq

The 2019 October protests that affected central and southern Iraq were initially violently repressed by government and paramilitary forces, resulting in over 500 fatalities.[116] Although the majority of deaths resulted from live fire, the second wave of protests in late October was characterised by the deadly use of CCWs, with 28 deaths attributed to shrapnel from stun grenades and impacts from tear gas canisters.[117] Extensive video documentation revealed that tear gas canisters were direct-fired at protesters along a horizontal trajectory,[118] a method of use that poses a high risk of severe to fatal injury.[119]

The rounds responsible for these wounds were military-grade Serbian M99 grenades or Iranian M651 tear gas / M713 smoke grenades.[120] Although government sources denied the use and import of these weapons, instead blaming non-government instigators, further research revealed the Serbian grenades were part of a $235 million arms deal struck between Serbia and Iraq in 2008, with the intended end user being the Iraqi Ministry of Defense.[121] These "barrier-penetrating" rounds can have effects comparable to those of a 12-gauge shotgun slug and pose extreme danger in crowd-control settings.[122] A typical US CS canister weighs 25-50 grams. These weigh 250-280 grams.

116 Reuters Staff, "Iraq says nearly 560 killed in anti-government unrest," ***Reuters***, (30 July 2020), accessible at: https://www.reuters.com/article/us-iraq-protests-government/iraq-says-nearly-560-killed-in-anti-government-unrest-idUSKCN24V2JL.

117 United Nations Assistance Mission for Iraq, "Human Rights Violations and Abuses in the Context of Demonstrations in Iraq: October 2019 to April 2020," ***Office of the United Nations High Commissioner for Human Rights***, (August 2020), Baghdad, Iraq, accessible at: https://www.ohchr.org/sites/default/files/Documents/Countries/IQ/Demonstrations-Iraq-UNAMI-OHCHR-report.pdf.

118 Human Rights Watch, "Iraq: Teargas Cartridges Killing Protesters," ***Human Rights Watch***, 8 November 2019, accessible at: https://www.hrw.org/news/2019/11/08/iraq-teargas-cartridges-killing-protesters.

119 United Nations Assistance Mission for Iraq, "Demonstrations in Iraq: update," ***Human Rights Special Report***, 25 October - 4 November, 2019, Baghdad, Iraq, accessible at: https://www.ohchr.org/sites/default/files/Documents/Countries/IQ/3rd_UNAMI_report_Human_Rights_and_Demonstrations_9_Dec_2019.pdf.

120 Amnesty International, "Gruesome string of fatalities in Iraq as new tear gas grenades pierce protester's skulls," ***Amnesty International***, (13 October 2019), accessible at: https://www.amnestyusa.org/press-releases/gruesome-string-of-fatalities-in-iraq-as-new-tear-gas-grenades-pierce-protesters-skulls/.

121 M Ristic et al., "'Epic' Serbian Arms Deal Led to Pierced Skulls in Baghdad," ***Balkan Insight***, (13 December 2019), accessible at https://balkaninsight.com/2019/12/13/epic-serbian-arms-deal-led-to-pierced-skulls-in-baghdad/.

122 Amnesty International, "Smokescreen - Iraq's use of military-grade tear gas grenades to kill protesters," ***Amnesty International***, accessible at https://teargas.amnesty.org/iraq/.

SECURITY FORCES FIRED TEARGAS CARTRIDGES DIRECTLY AT PROTESTERS IN BAGHDAD, IRAQ ON NUMEROUS OCCASIONS SINCE PROTESTS RESUMED ON OCTOBER 25, 2019, KILLING DOZENS OF PROTESTERS, ACCORDING TO HUMAN RIGHTS WATCH. YOUTUBE | HUMAN RIGHTS WATCH

The use of military-grade ammunition for crowd control is unusual, and typical tear gas canisters do not pose the same magnitude of hazard. However, with little to no regulation of chemical irritants, these weapons were manufactured, purchased, and used against civilians, with no limitations. Worryingly, direct impacts to the head from "civilian grade" tear gas canisters have been documented to cause injuries ranging from traumatic brain injury,[123] skull fracture,[124] enucleation,[125] and death.[126]

123 Committee to Protect Journalists, "Video journalist injured by tear gas canister at Hong Kong protest," *Committee to Protect Journalists,* 5 August 2019, accessible at: https://cpj.org/2019/08/video-journalist-injured-by-tear-gas-canister-at-h/

124 Charis McGowan, "Mom Loses 3 Senses After Cops Threw Tear Gas Canister Into Her Face, Sparking a Movement Against 'Non-Lethal' Weapons in Chile," ***VICE News,*** September 17, 2020, accessible at: https://www.vice.com/en/article/wxq3qw/this-mom-lost-3-of-her-senses-after-being-hit-by-a-teargas-canister-sparking-a-movement-against-non-lethal-weapons-in-chile.

125 A Srikanth, "Indiana journalist loses eye to tear gas canister during demonstrations against George Floyd's death," *The Hill*, June 1, 2020, accessible at: https://thehill.com/changing-america/respect/equality/500467-texas-journalist-loses-eye-to-tear-gas-canister-during/.

126 Wani et al., "Head injury caused by tear gas cartridge in teenage population," ***Pediatric Neurosurgery***, 2010, vol. 46, no. 1, pp. 25-28, doi:10.1159/000314054

Case study

Byron Guatuca and the lethality of tear gas canisters

Ecuador

Byron Guatatuca, a member of the Kichwa community from San Jacinto, Puyo, a town in the Ecuadorian Amazon, was killed in a police operation while participating in a peaceful demonstration that was part of a national indigenous strike called by the Confederation of Indigenous Nationalities of Ecuador. On the night of 21 June 2022, the Ecuadorian national police and military began to clear roads blocked by the demonstrators. Security forces fired tear gas canisters, causing panic and choking among the crowd, including elderly people, women, and children. A tear gas canister fired from close range hit Guatatuca in the face, fractured his skull, and entered his brain, causing his death. He was shot from the front and at a short range. The impact from the canister had a grave effect on the cerebral region, which produced a haemorrhage, loss of consciousness and, finally, his death.

Videos posted on social media and local news[127] show clouds of tear gas, choking and running civilians, and chaos. Guatatuca is seen as he is hit by a tear gas canister and falls to the ground, smoke pouring from his head.[128] Mia Sonovision, a local media outlet, interviewed a demonstrator who was standing next to Guatatuca, who stated: "The boy was killed when he got shot from the front. He was next to me. I tried to take the canister out of his eye." The witness then showed his arm, stained with Byron's blood.[129]

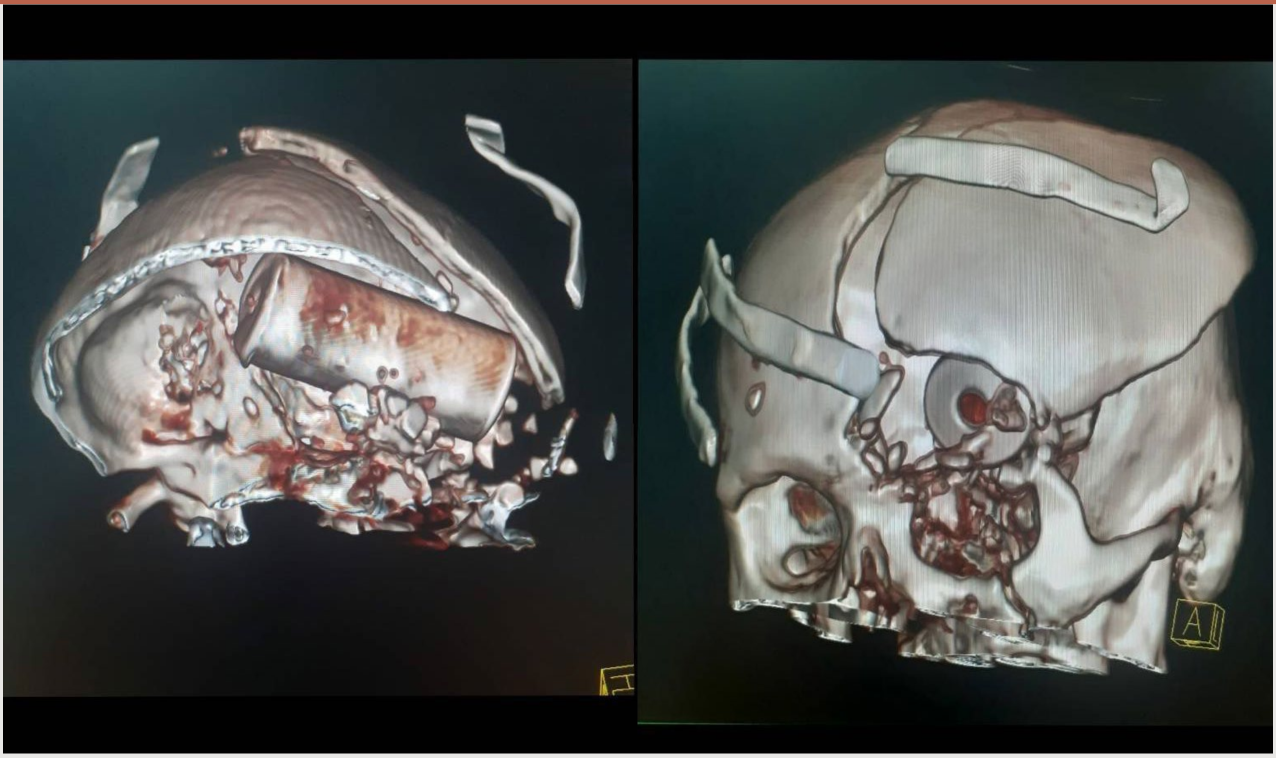
The police issued a statement arguing that Guatatuca died from "handling an explosive device," an account that was later supported by the Ministry of the Interior. However, shortly thereafter, images of the CT scans performed on Guatatuca at the Puyo Regional Hospital were posted on social media, showing a tear gas canister lodged in his skull. This evidence not only undermined the official account but showed that it was a deliberate falsification. The veracity of the medical studies was confirmed by the director of the Puyo Hospital.

The attack on Guatatuca represents an excessive and illegal use of force and led to a request for the State Attorney General's Office to open a criminal investigation. The Attorney General's Office of Pastaza Province involved more than 80 police officers in the preliminary investigation but has not yet made progress on key elements such as the list of officers who were carrying weapons capable of firing tear gas canisters. According to Jessika Delgado–the local lawyer who is leading the case alongside the Regional Human Rights Advisory Foundation (INREDH) –the attorney

127 See https://bit.ly/3Carg89.

128 See https://bit.ly/3Su3SYA.

129 https://bit.ly/3xXID9R.



SCAN IMAGES SHOW THE GAS CANISTER LODGED INSIDE THE VICTIMS' SKULL. | IMAGE PROVIDED BY LA CONFEDERACIÓN DE LAS NACIONALIDADES INDÍGENAS DE LA AMAZONIA ECUATORIANA (CONFENIAE) VIA TWITTER @CONFENIAE1

general's office seems to be deliberately delaying the investigation. Two months have elapsed and only six statements have been taken, none of which came from officers who admitted to being at the scene.

Byron Guatatuca was 42 years old and had four children. His family and several organisations continue to demand a thorough investigation to determine criminal liability and the chain of command and to hold those responsible accountable for the use of force, including the use of so-called "less-lethal weapons." Guatatuca's case makes clear that tear gas canisters can cause serious injury and even death, depending on how they are fired. Accordingly, they require far greater regulation and scrutiny than they currently receive.

Case study

Tear gas used by police causes panic in Kanjuruhan Stadium and 135 deaths

Indonesia

On 1 October 2022, the deadliest football tragedy of the 21st century unfolded at Kanjuruhan Stadium in Malang, Indonesia, after police shot tear gas in a packed stadium. As a result, 135 fans were crushed in the ensuing chaos, among which 40 children and over 500 supporters were injured.

That night, as the referee's whistle sealed the game's results, fans took to the pitch. Police immediately replied by shooting chemical irritants at the field and then at the stands. More than 40 rounds of tear gas, flash bangs and flares were shot at fans within ten minutes[130], creating mass panic and a rush towards the scant and narrow exits. The gates were only wide enough for two persons to exit at a time, and some were locked.[131]

These events were largely reported by local and foreign media. In the outcry following the tragedy, a multidisciplinary investigation was ordered by President Joko Widodo. The team, composed of government officials and football and security experts, concluded that the tear gas–prohibited in sports venues under Indonesian police protocol–was indeed the main cause of deaths. The Malang chief of police was dismissed and an investigation was opened on scores of police officers. In its 124-page report, the investigation team also asked for the resignation of the chairman and the executive board of PSSI, Indonesia's football association.[132]

Indonesian human rights NGO and INCLO member Commission for Disappeared Persons and Victims of Violence (KontraS) took part in the Civil Society Coalition Fact-Finding Team which led a parallel independent inquiry[133] of the police intervention. They discovered another set of facts also pointing to the police's responsibility in the tragedy, but they also highlight the systematic nature of these human rights violations whose planning involved high-ranking officials who were not accountable under the government commissioned investigation. KontraS also discovered that witnesses had suffered intimidation on behalf of authorities

---

130 R Tan, J Sohyun Lee, S Cahlan, I Piper and A Llewellyn, "How police action in Indonesia led to a deadly crush in the soccer stadium," The Washington Post, 6 Ocotber 2022. Accessible at: https://www.theguardian.com/world/2022/oct/19/indonesia-to-demolish-football-stadium-where-scores-died-in-crowd-crush

131 See Guardian, ***Indonesia to demolish football stadium where scores died in crowd crush*** (19 October 2022), accessible at: https://www.theguardian.com/world/2022/oct/19/indonesia-to-demolish-football-stadium-where-scores-died-in-crowd-crush.

132 CNN, ***Police's tear gas main cause of death in Indonesia soccer stampede: investigators***, accessible at: https://edition.cnn.com/2022/10/14/asia/indonesia-stadium-disaster-tear-gas-investigation-intl-hnk/index.html.

133 KontraS, 12 Initial Findings of the Civil Society Coalition Fact-Finding Team Regarding the Human Rights Violation Incident at Kanjuruhan Stadium, accessible at: https://kontras.org/en/2022/11/05/12-initial-findings-of-the-civil-society-coalition-fact-finding-team-regarding-the-human-rights-violation-incident-at-kanjuruhan-stadium/.

FOOTBALL SUPPORTERS ENTER THE PITCH AS SECURITY OFFICERS TRY TO DISPERSE THEM AFTER A SOCCER MATCH AT KANJURUHAN STADIUM IN MALANG, EAST JAVA, INDONESIA, 01 OCTOBER 2022. ACCORDING TO GOVERNMENT OFFICIALS, AT LEAST 174 PEOPLE INCLUDING POLICE OFFICERS WERE KILLED MOSTLY IN STAMPEDES AFTER RIOTS FOLLOWING A SOCCER MATCH. SURYANTO | ANADOLU AGENCY VIA GETTY IMAGES

after the events which are considered a means to deter survivors from telling their story.

KontraS interviewed many witnesses, some of which were still recovering from the array of injuries provoked by the stampede, ranging from bruises to fractures, concussions, rashes on the face and body, respiratory distress and post-traumatic stress. Most deadly victims are suspected to have perished from suffocation and internal bleeding, some crushed against walls, others trampled against the ground.

Numerous witness accounts claim that authorities gave no verbal warning before shooting, first at the pitch and then at the stands. Firing chemical irritants into closed spaces or open spaces where there is no safe egress should be prohibited, as clearly stated in the 2020 UN Guidance on the Use of Less-Lethal Weapons in Law Enforcement[134] and reiterated by FIFA guidelines. Following numerous football stadium tragedies across the globe in similar circumstances, the international soccer federation has also regulated against the use of tear gas in international games, but has done little or nothing for this to be enforced locally.

On 18 October 2022, Indonesia announced its plans to demolish Kanjuruhan Stadium and rebuild another one compliant with FIFA regulations. At that point, six people, including police officers and organizers, were facing charges over the crush for criminal negligence and causing death, which carries a maximum sentence of five years.[135]

134 See UN Guidance on LLWs above n 6 at 29.

135 BBC, *Kanjuruhan stadium: Indonesia to demolish site of arena disaster*, accessible at https://www.bbc.com/news/world-asia-63301863.