"ASSAULT WEAPON" LETHALITY

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INTRODUCTION

"Assault weapon" bans are a popular form of gun-control legislation. Such bans have been enacted in direct response to mass shootings[1] or as part of comprehensive legislation aimed at reducing

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1. *See, e.g.*, Thomas Kaplan & Danny Hakim, *Intent on Being First, Cuomo Used All Means to Enact Gun Limits*, N.Y. TIMES (Jan. 23, 2013), https://www.nytimes.com/2013/01/24/nyregion/cuomo-used-all-his-means-to-pass-gun-control-package.html.

gun violence.[2] While handguns are the overwhelming weapon of choice for mass shooters[3] and rifles of every kind are used in only 2%–3% of murders nationwide,[4] gun-control advocates nevertheless single out "assault weapons" as uniquely deserving of prohibition. The reason, they say, is that "assault weapons" are far more dangerous than other modern firearms and ill-suited for lawful activities like self-defense. They use descriptors like "weapons of war," "uniquely lethal," and "high-powered" to suggest that these firearms cause much more harm than they prevent and therefore ordinary citizens should not have them.

"Assault weapons" long have been portrayed as exceptionally powerful firearms designed for killing large numbers of people. When enacting the nation's very first "assault weapon" ban in 1989, the California legislature found that "each firearm has such a high rate of fire and capacity for firepower that its function as a legitimate sports or recreational firearm is substantially outweighed by the danger that it can be used to kill and injure human beings."[5] One primary consideration that prompted the federal "assault weapon" ban 1994–2004 was the "perceived dangerousness" of these firearms, which purportedly allow shooters "to fire high numbers of shots rapidly, thereby potentially increasing both the number of person[s] wounded per gunfire incident (including both intended targets and innocent bystanders) and the number of gunshot victims suffering multiple wounds."[6]

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2. *See, e.g.*, Trip Gabriel, *New Gun Restrictions Pass the Legislature in Maryland*, N.Y. TIMES (Apr. 4, 2013), https://www.nytimes.com/2013/04/05/us/tighter-gun-rules-pass-the-maryland-legislature.html.

3. Elzerie de Jager et al., *Lethality of Civilian Active Shooter Incidents with and Without Semiautomatic Rifles in the United States*, 320 JAMA 1034, 1034 (2018) (stating that 187 of 248 active shooter incidents in the United States involved handguns). Between 2000 and 2017, "assault weapons" were used in only about 25% of active shooter events. Polly Mosendz, *Assault Rifles Aren't the Weapon of Choice for 'Active Shooters'*, BLOOMBERG (Sept. 11, 2018, 11:00 AM), https://www.bloomberg.com/news/articles/2018-09-11/semi-autos-aren-t-the-weapon-of-choice-for-active-shooters.

4. *See Expanded Homicide Data Table 8*, FED. BUREAU OF INVESTIGATION: UNIF. CRIME REPORTING (2018), https://ucr.fbi.gov/crime-in-the-u.s/2018/crime-in-the-u.s.-2018/tables/expanded-homicide-data-table-8.xls.

5. People v. James, 94 Cal. Rptr. 3d 576, 580 (Ct. App. 2009) (quoting CAL. PENAL CODE § 12275.5 (repealed 2012)).

6. CHRISTOPHER S. KOPER ET AL., AN UPDATED ASSESSMENT OF THE FEDERAL ASSAULT WEAPONS BAN: IMPACTS ON GUN MARKETS AND GUN VIOLENCE, 1994–2003, at 80 (2004).

Present-day ban advocates continue this narrative. The Giffords Law Center to Prevent Gun Violence says "assault weapons" are "highly lethal" and "specifically designed to kill humans quickly and efficiently."[7] Everytown for Gun Safety calls such firearms "high-powered" and "exceptionally deadly."[8] According to the Brady Campaign to Prevent Gun Violence, "assault weapons" are "designed for military use and quick, efficient killing" and are "uniquely lethal because of their rapid rate of fire and high muzzle velocity."[9] Prior to House Judiciary Committee hearings in September 2019 on pending federal legislation to ban "assault weapons," Senator Diane Feinstein (D-CA) called these weapons the "deadliest" of firearms.[10]

While there is no generally agreed-upon definition of "assault weapon,"[11] the main target of "assault weapon" bans is the semiautomatic AR-15 rifle. The AR-15 is the most popular rifle in America today, owned by millions for self-defense and other lawful purposes.[12] While the AR-15 looks like a fully automatic military M16

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7. *Assault Weapons*, GIFFORDS L. CTR. TO PREVENT GUN VIOLENCE, https://lawcenter.giffords.org/gun-laws/policy-areas/hardware-ammunition/assault-weapons/ (last visited Oct. 7, 2020).

8. *Assault Weapons and High-Capacity Magazines*, EVERYTOWN FOR GUN SAFETY SUPPORT FUND (Mar. 22, 2019), https://everytownresearch.org/assault-weapons-high-capacity-magazines/#foot_note_anchor_2.

9. *What are Assault Weapons and High-Capacity Magazines?*, BRADY UNITED, https://www.bradyunited.org/fact-sheets/what-are-assault-weapons-and-high-capacity-magazine (last visited Oct. 7, 2020).

10. Press Release, Dianne Feinstein, Sen., U.S. Senate, Mass Shootings Involving Assault Weapons Kill More People than Other Weapons (Sept. 20, 2019), https://www.feinstein.senate.gov/public/index.cfm/press-releases?id=576E306C-5FD4-4144-A28A-2C034628D888.

11. *See, e.g.*, David B. Kopel, *Defining "Assault Weapons,"* REGUL. REV. (Nov. 14, 2018), https://www.theregreview.org/2018/11/14/kopel-defining-assault-weapons/. The scope of this Article is limited to semiautomatic rifles and does not include semiautomatic pistols and shotguns included in many "assault weapon" bans.

12. *See* Jon Schuppe, *America's Rifle: Why So Many People Love the AR-15*, NBC NEWS (Feb. 15, 2018, 8:08 AM), https://www.nbcnews.com/news/us-news/america-s-rifle-why-so-many-people-love-ar-15-n831171?cid=public-rss_20171228 ("[T]he AR-15 remains a jewel of the gun industry, the country's most popular rifle, irreversibly lodged into American culture."); *see also NSSF Releases Firearms Production Figures*, NAT'L SHOOTING SPORTS FOUND. (Dec. 4, 2019), https://www.nssf.org/nssf-releases-firearms-production-figures/ (reporting that "[a]pproximately half of all rifles produced in 2017 were modern sporting rifles" like the AR-15 and that approximately 17.7 million such rifles were produced in the United States or imported 1990–2017); Alex Yablon, *How Many Assault Weapons Do Americans Own?*, TRACE (Sept. 22, 2018), https://www.thetrace.org/2018/09/how-many-assault-weapons-in-the-us/ (noting that there are "between fifteen and twenty million modern sporting rifles like the AR-15 now in circulation"). This Article uses "AR-15" as a shorthand term for all AR-15 variants.

rifle or M4 carbine, it is not a machine gun, nor does it fire as rapidly as a machine gun. It has a semiautomatic-only firing mechanism like most modern handguns and fires a smaller projectile than most modern hunting rifles. Legislatures enacting "assault weapon" bans nevertheless have concluded that the AR-15 is exceptionally deadly, and federal courts have agreed.

Five federal circuit courts have relied on the lethality rationale in upholding "assault weapon" bans against Second Amendment challenges.[13] Three circuits have declared that "assault weapons" have "a capability for lethality—more wounds, more serious, in more victims—far beyond that of other firearms in general, including other semiautomatic guns."[14] In *District of Columbia v. Heller (Heller II)*, the D.C. Circuit endorsed claims that "assault weapons" like the AR-15 are designed "to shoot multiple human targets very rapidly"[15] and "fire almost as rapidly as automatics."[16] The Second Circuit in *New York State Rifle & Pistol Ass'n v. Cuomo (NYSRPA)* concluded that the banned firearms "pose unusual risks" and are "particularly hazardous."[17] In *Kolbe v. Hogan*, the Fourth Circuit described firearms like the AR-15 as "exceptionally lethal weapons of war" and found "scant evidence . . . that the banned assault weapons . . . are possessed or even suitable[] for self-protection."[18] *Kolbe* went so far as to hold that "assault weapons" are not protected arms under the Second Amendment because of their deadly similarity to machine guns.[19] Most recently, the First Circuit in *Worman v. Healey* declared that "[s]emiautomatic assault weapons permit a shooter to fire multiple rounds very quickly, allowing him to hit more victims in a

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13. Worman v. Healey, 922 F.3d 26, 41 (1st Cir. 2019); Kolbe v. Hogan, 849 F.3d 114, 140–41 (4th Cir. 2017) (en banc); N.Y. State Rifle & Pistol Ass'n v. Cuomo (*NYSRPA*), 804 F.3d 242, 269 (2d Cir. 2015); Friedman v. City of Highland Park, 784 F.3d 406, 412 (7th Cir. 2015); Heller v. District of Columbia (*Heller II*), 670 F.3d 1244, 1247–48, 1264 (D.C. Cir. 2011).

14. *Worman*, 922 F.3d at 31 (internal quotation marks omitted) (quoting H.R. REP. NO. 103-489, at 19–20 (1994)); *Kolbe*, 849 F.3d at 125, 137, 144 (same); *NYSRPA*, 804 F.3d at 262 (same).

15. 670 F.3d at 1262 (internal quotation marks omitted) (citation omitted).

16. *Id.* at 1263 (citation omitted); *see also Friedman*, 784 F.3d at 411 ("[A]ssault weapons with large-capacity magazines can fire more shots, faster, and thus can be more dangerous in [the] aggregate. Why else are they the weapons of choice in mass shootings?").

17. 804 F.3d at 262.

18. 849 F.3d at 124, 141, 145 (footnote omitted).

19. *See id.* at 124–28, 135–37.

shorter period of time."[20] It further asserted that using "assault weapons" for home defense "is tantamount to using a sledgehammer to crack open the shell of a peanut."[21]

For these courts, "assault weapon" lethality is the driving factor in their constitutional interest balancing: first, because "assault weapons" are exceptionally lethal, the government has a substantial interest in banning them to ensure public safety; and second, because "assault weapons" are too dangerous for self-defense and there are alternative weapons for protecting oneself, such bans are a permissible burden on the Second Amendment interests[22] of those affected. Given the magnitude of disinformation about "assault weapons,"[23] judges must carefully assess whether there is reliable evidence to support these claims. If "assault weapons" are not more lethal than non-banned firearms and are equally useful for self-defense, then courts must find other justifications for upholding laws that keep such firearms out of the hands of law-abiding citizens.

All guns are lethal, of course. Every firearm is capable of causing serious bodily harm or death. Being dangerous is essential to accomplishing a firearm's core function. The question is whether "assault weapons" like the AR-15 are *far more* dangerous than handguns, shotguns, and other rifles. Ban advocates and federal courts say they are, but why? What makes the AR-15 "exceptionally lethal"? Answers typically come in two forms. The first draws an analogy to military weapons by labeling the AR-15 as an extremely dangerous "weapon of war." In *Shew v. Malloy*, for example, the state argued to the Second Circuit that "it is common sense that weapons with the same killing capacity as modern military weapons are too dangerous for the public sphere."[24] The second uses metrics based on the AR-15's rate of fire and terminal performance (wounding ability). Federal courts have relied on these metrics in declaring that the AR-15 has "a capability for lethality—more wounds, more serious, in more

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20. 922 F.3d 26, 39 (1st Cir. 2019).

21. *Id.* at 37.

22. *See* District of Columbia v. Heller, 554 U.S. 570, 599 (2008) (holding that the Second Amendment protects the individual right to keep and bear arms for self-defense and other lawful activities).

23. *See* E. Gregory Wallace, *"Assault Weapon" Myths*, 43 S. ILL. U. L.J. 193, 196–200, 211–14, 226 (2018).

24. Brief of Defendants-Appellees at 34, Shew v. Malloy (No. 14-319-cv), *consolidated with* N.Y. State Rifle & Pistol Ass'n v. Cuomo (*NYSRPA*), 804 F.3d 242 (2d Cir. 2015).

victims—far beyond that of other firearms in general, including other semiautomatic guns."[25]

This Article provides an evidence-based analysis of AR-15's lethality as justifying bans on these rifles. Part I considers whether the AR-15 is like a combat weapon and thus too lethal for civilian use. Part II examines the claims that the AR-15 is exceptionally lethal because it fires much faster and causes far more serious wounds than non-banned firearms. Part III answers two related questions: first, why have mass shootings with "assault weapons" resulted in much higher casualties? And second, do the same features that make "assault weapons" useful for self-defense also make them the most deadly choice for mass shooters?

I. LETHALITY BY ANALOGY

The lethality by analogy argument begins with the implicit premise that the military selects uniquely lethal small arms for use in combat. The next premise is explicit: there is no real difference between the civilian AR-15 and the military's combat rifles—the AR-15 is a "weapon of war."[26] The conclusion that follows is that the AR-15 also is extremely dangerous and too lethal for civilian use.[27]

The military uses the M16 rifle and smaller M4 carbine for combat.[28] Both are "select" or "selective" fire weapons, meaning they

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25. *Worman*, 922 F.3d at 31 (internal quotation marks omitted) (quoting H.R. REP. NO. 103-489, at 19–20 (1994)); Kolbe v. Hogan, 849 F.3d 114, 125, 137 (4th Cir. 2017) (en banc) (same); N.Y. State Rifle & Pistol Ass'n v. Cuomo (*NYSRPA*), 804 F.3d 242, 262 (2d Cir. 2015) (same).

26. *See, e.g.*, *Kolbe*, 849 F.3d at 121 (disclaiming the power to extend Second Amendment protection to "weapons of war"); *id.* at 124 (describing the banned firearms as "exceptionally lethal weapons of war"); *id.* at 136 ("[T]he AR-15 shares the military features—the very qualities and characteristics—that make the M16 a devastating and lethal weapon of war."); *id.* at 141 (faulting the dissent for wanting to expand constitutional protection to "exceptionally lethal weapons of war"). For a discussion of political and judicial claims that the AR-15 is a "weapon of war," see Wallace, *supra* note 23, at 199–211.

27. *See Kolbe*, 849 F.3d at 127 (holding that "banned assault weapons further pose a heightened risk to civilians" and that civilians are given a "'military-style advantage' in firefights with law enforcement officers").

28. The M16 has a twenty-inch barrel and a fixed stock, while the smaller, lighter M4 carbine has a 14.5-inch barrel and an adjustable-length stock. *See generally* U.S. DEP'T OF THE ARMY, TRAINING CIRCULAR 3-22.9: RIFLE AND CARBINE 2-1–2-10 (2016) [hereinafter ARMY TRAINING CIRCULAR]. Special forces and other select units began

can be fired either in automatic mode or semiautomatic mode by toggling a selector switch on the side of the rifle.[29] The M16/M4 is a machine gun—in automatic mode, it fires continuously so long as the shooter presses and holds the trigger.[30] Unlike the M16/M4, the civilian AR-15 has a semiautomatic-only firing mechanism, which means that it fires only one round (bullet) with each trigger pull and thus can fire only as fast as the shooter can pull the trigger.[31]

There are several flaws with measuring the AR-15's lethality by analogy to combat weapons. To begin with, the lethality by analogy argument rests on a dubious first premise. Ban proponents and judges mistakenly assume that the analogous military rifles are themselves exceptionally lethal. The military does not use the M16 and M4 solely because of their hit and kill capability; rather, these rifles incorporate various trade-offs among multiple factors relevant to small unit combat. When the military selects its combat rifles, it considers not just lethality but other factors such as mission adaptability, weight,

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using the smaller M4 carbine in the 1990s. Over the last several years, the military has been replacing the M16 with the M4 in infantry units. *See* Christian Beekman, *Here's Why the US Military is Replacing the M16*, BUS. INSIDER (Oct. 28, 2015, 5:13 PM), http://www.businessinsider.com/heres-why-the-us-military-is-replacing-the-m16-2015-10.

29. U.S. DEP'T OF THE ARMY, FIELD MANUAL 3-22.9: RIFLE MARKSMANSHIP: M16-/M4-SERIES WEAPONS at 4-11–4-12 (2008) [hereinafter ARMY FIELD MANUAL]. Some earlier versions of the M16/M4 replaced the automatic mode with a three-round burst mode as a mechanical substitute for training soldiers to operate the automatic mode effectively. The burst mode now is being replaced with the automatic mode. *See* Max Slowik, *Army Infantry Beginning Adoption of Upgraded M4A1 Carbines*, GUNS.COM (May 24, 2014, 8:00 AM), https://www.guns.com/news/2014/05/24/army-infantry-beginning-adoption-of-upgraded-m4a1-carbines.

30. *See* Staples v. United States, 511 U.S. 600, 602 n.1 (1994) ("[T]he terms 'automatic' and 'fully automatic' refer to a weapon that fires repeatedly with a single pull of the trigger. That is, once its trigger is depressed, the weapon will automatically continue to fire until its trigger is released or the ammunition is exhausted. Such weapons are 'machine guns' within the meaning of the [National Firearms] Act."); *see also* 26 U.S.C. § 5845(b) (2018) (defining "machinegun" to mean "any weapon which shoots . . . automatically more than one shot, without manual reloading, by a single function of the trigger").

31. *See Staples*, 511 U.S. at 602 n.1 ("We use the term 'semiautomatic' to designate a weapon that fires only one shot with each pull of the trigger, and which requires no manual manipulation by the operator to place another round in the chamber after each round is fired."); *see also* 18 U.S.C. § 921(a)(28) (2018) (defining "semiautomatic rifle" as "any repeating rifle which utilizes a portion of the energy of a firing cartridge to extract the fired cartridge case and chamber the next round, and which requires a separate pull of the trigger to fire each cartridge").

reliability, maintenance, and cost.[32] To illustrate the trade-offs involved, consider this hypothetical. Suppose bullet A has a 10% chance of killing or incapacitating the enemy in a single battle, but because it is smaller and lighter, the soldier can carry three hundred rounds of A. Suppose bullet B has a 30% chance of killing or incapacitating the enemy in a single battle, but because bullet B is larger and heavier, the soldier can carry only fifty rounds of B. A soldier carries thirty kills with bullet A but only fifteen with bullet B, so bullet A must be better; but in an actual firefight with the enemy, bullet B will be more effective. Should soldiers carry more rounds having less terminal effectiveness or fewer rounds having greater terminal effectiveness?

The military has opted for the former with its combat small arms. The M16 rifle and M4 carbine both fire 5.56x45mm NATO rounds, which is nearly identical in size to the commercial .223 Remington caliber round.[33] This is a smaller and lighter bullet than the .30 caliber rounds previously used by the military in its M1 and M14 combat rifles and currently used by civilians in many modern hunting rifles.[34] It also is smaller than the 7.62x39mm round fired from the AK-style rifles used by various countries and terror groups such as

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32. *See, e.g.*, Kyle Mizokami, *Why the Army Can't Say Goodbye to the M4 Rifle*, NAT'L INT. (Aug. 2, 2019), https://nationalinterest.org/blog/buzz/why-army-cant-say-goodbye-m4-rifle-71236 ("No rifle is an ideal fit for the U.S. Armed Forces, which must expect to fight in all environments and climates. A heavier round, harder-hitting round would reduce the amount of ammunition soldiers could carry and place additional burdens on the logistical system. A longer rifle barrel imparts greater range and velocity but make a weapon unwieldy indoors. Design tradeoffs and compromises are inevitable and must be made with existing and future battlefields in mind.").

33. *See* Robert H. Scales, *Gun Trouble*, ATLANTIC (Jan./Feb. 2015), https://www.theatlantic.com/magazine/archive/2015/01/gun-trouble/383508/ (explaining that the 5.56mm cartridge used in the M16 "was a modification not of the M14's cartridge but of a commercial Remington rifle cartridge that had been designed to kill small varmints"). Scales is a retired major general and former commandant of the Army War College.

34. *See id.* ("Stoner's little 5.56-mm cartridge was ideal for softening the recoil of World War II infantry calibers in order to allow fully automatic fire. But today's cartridge is simply too small for modern combat."); *see also* Walter Christian Håland, *Assault Rifle Development in the 70 Years Since the Sturmgewher,* SMALL ARMS DEF. J. (Mar. 18, 2016), http://www.sadefensejournal.com/wp/assault-rifle-development-in-the-70-years-since-the-sturmgewehr/ ("The M4 with its round is actually less powerful than most hunting rifles used for animals like deer.").

Islamic State and al-Qaida.[35] The 5.56mm round has several advantages, including: (1) its higher velocity makes it "affected less by wind and gravity," giving it a straighter trajectory, (2) it produces less recoil, permitting more accurate follow-up shots in semiautomatic mode and more control in automatic mode, and (3) its lighter weight allows soldiers to carry more ammunition.[36] This last point is critical, given that the modern soldier on the battlefield typically carries more than one hundred pounds—including helmet, body armor, weapons and ammunition, night vision, communications and electronics gear, batteries, medical kit, food, and water.[37]

Many have criticized the 5.56mm round as lacking sufficient terminal effectiveness in combat.[38] Combat veteran and military

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35. *See* Gary Roberts, Time for a Change: U.S. Military Small Arms Ammunition Failures and Solutions (May 21, 2008) (presentation slides available at https://ndiastorage.blob.core.usgovcloudapi.net/ndia/2008/Intl/Roberts.pdf) [hereinafter Roberts, *Time for a Change*] (discussing how 7.62mm cartridges are often "fired by AK47 rifles commonly used by our opponents").

36. *See* Håland, *supra* note 34.

37. *See* David Hambling, *The Overloaded Soldier: Why U.S. Infantry Now Carry More Weight than Ever*, POPULAR MECHS. (Dec. 26, 2018), https://www.popularmechanics.com/military/research/a25644619/soldier-weight/.

38. *See, e.g.*, Joseph P. Avery, *An Army Outgunned: Physics Demands a New Basic Combat Weapon*, MIL. REV., July–Aug. 2012, at 2, 5, (noting "many instances, especially in close quarters, house-to-house combat in Iraq, when the small 5.56mm projectile . . . would zip right through an enemy combatant center mass without causing effective incapacitation, allowing further attacks on our forces"); Glenn Dean & David LaFontaine, *Small Caliber Lethality: 5.56mm Performance in Close Quarters Battle*, WSTIAC Q., Jan. 2008, at 3, 3 (noting multiple reports from U.S. soldiers in Afghanistan that when using 5.56mm rounds in close quarters engagements they "were experiencing multiple 'through-and-through' hits on an enemy combatant where the target continued to fight"); Thomas P. Ehrhart, Increasing Small Arms Lethality in Afghanistan: Taking Back the Infantry Half-Kilometer 49 (Sept. 21, 2009) (unpublished manuscript) (available at https://apps.dtic.mil/dtic/tr/fulltext/u2/a512331.pdf) (concluding in part that 5.56mm rounds are proven to be ineffective after two hundred meters and that attempts to improve the lethality of the 5.56mm rounds have failed); Roberts, *Time for a Change*, *supra* note 35 (discussing how, when compared to 5.56mm cartridges, 6.8mm cartridges have proven to have superior terminal effectiveness in all environments); Peter Donaldson, *Infantry Weapons Conference Report*, SMALL ARMS DEF. J. (Jan. 9, 2012), http://www.sadefensejournal.com/wp/infantry-weapons-conference-report/ (discussing the international movement away from 5.56mm cartridges); Anthony F. Milavic, *The Last 'Big Lie' of Vietnam Kills U.S. Soldiers in Iraq*, AM. THINKER (Aug. 24, 2004), https://www.americanthinker.com/articles/2004/08/the_last_big_lie_of_vietnam_ki.html ("[The] 5.56mm cartridge was nothing more than the full-metal jacket military version of the commercial .223 caliber Remington cartridge. The .223 caliber Remington was and is today commercially advertised and sold as a 'varmint cartridge' for hunting groundhogs, prairie dogs[,] and woodchucks."); Scales, *supra* note 33

small arms expert Jim Schatz explains that "[t]he disturbing failure of the 5.56x45mm caliber to consistently offer adequate incapacitation has been known for nearly [twenty] years."[39] He describes one Special Forces (SF) mission in Afghanistan when an insurgent was shot seven to eight times in the torso, got back up, climbed over a wall, and reengaged other SF soldiers, killing a SF medic. The insurgent then was shot another six to eight times from about twenty to thirty yards before finally being killed by a SF soldier with an M1911 handgun.[40] Schatz knows experienced law enforcement snipers who no longer use .223/5.56 sniper rifles even though they can shoot superior non-military hollow-point projectiles "because this cartridge is simply not considered an effective 'one-shot man-stopper.'"[41] Rob Maylor, a former Australian SAS sniper, has "on several occasions witnessed bad guys being hit multiple times by 5.56mm . . . at varying ranges and then continue[] to fight."[42] He explains that while the 5.56mm round is designed to yaw and fragment, "[t]his isn't happening all the time and as a result projectiles are passing through the body with minimal damage."[43] The bestselling book *Black Hawk Down* gives

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(arguing that the 5.56mm cartridge is "too small for modern combat" and limits the weapon's range); Jim Schatz, *Do We Need a New Service Rifle Cartridge?*, SMALL ARMS DEF. J. (Jan. 6, 2012), http://www.sadefensejournal.com/wp/do-we-need-a-new-service-rifle-cartridge/ (discussing how 5.56mm NATO M855 rounds have shown to have degraded terminal effectiveness beyond 150 meters in M4 carbines and at any range from the shorter-barreled MK18 close-combat carbines due to insufficient striking velocities).

39. Schatz, *supra* note 38. Schatz is a former 82nd Airborne Division infantryman and advanced marksmanship instructor and shooter with the U.S. Army Marksmanship Unit. He currently works as an independent consultant in modern small arms and ammunition.

40. *Id.*

41. *Id.* Schatz stated that he personally knows of one incident where a SWAT officer was tragically killed by an assailant with a shotgun after the assailant was "drilled dead center mass in the torso with a [fifty-five]-grain M193 FMJ 5.56x45mm round at less than [one hundred] yards." *Id.*

42. Rob Maylor, *5.56mm vs 6.8mm: Can a Better Bullet Keep a Bad Guy Down?*, SOFREP (Mar. 7, 2017), https://sofrep.com/news/5-56mm-vs-6-8mm-can-better-bullet-keep-bad-guy/.

43. *Id.*; *see also* Milavic, *supra* note 38 (recounting numerous instances where enemy combatants were shot repeatedly with the 5.56mm round only to continue fighting).

vivid accounts of the less-than-lethal performance of the Army's green-tip 5.56mm bullet (M855) in the Battle of Mogadishu in 1993.[44]

Military surveys have confirmed these reservations about the 5.56mm round. The Center for Naval Analyses (CNA) surveyed 2,600 soldiers who had fought with small arms in Iraq and Afghanistan.[45] Twenty percent of M4 users requested a larger caliber bullet than the 5.56mm to give the M4 increased stopping power and lethality.[46] The CNA report states that "[w]hen speaking to experts and soldiers on site, many commented on the limited ability to effectively stop targets, saying that those personnel targets who were shot multiple times were still able to continue pursuit."[47] The U.S. Army Small Arms Capabilities-Based Assessment (CBA) noted reports "from individual soldiers and their leaders that they required 'greater lethality' and 'more knockdown power.'"[48] Former Marine general and Secretary of Defense James Mattis acknowledged that the 5.56mm round lacks sufficient lethality and proposed that the military switch to the larger 6.8mm caliber.[49] He established the Close Combat Lethality Task Force in 2018 to address the erosion of close-combat capability within U.S. forces, specifically ordering the task force to develop options

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44. *See* MARK BOWDEN, BLACK HAWK DOWN: A STORY OF MODERN WAR 208 (1999) (describing how one Delta operator's "rounds were passing right through his targets. When the Sammies were close enough he could see when he hit them. . . . [I]t was like sticking somebody with an ice pick. The bullet made a small, clean hole, and unless it happened to hit the heart or spine, it wasn't enough to stop a man in his tracks. [The operator] felt like he had to hit a guy five or six times just to get his attention."); *id.* at 234–35 (describing how the operator was "disgusted again with this 5.56[mm] ammo" after shooting three Somalis, two of whom struggled to their feet and dragged the third one off).

45. SARA M. RUSSELL, SOLDIER PERSPECTIVES ON SMALL ARMS IN COMBAT 1 (Dec. 2006).

46. *Id.* at 30.

47. *Id.* at 29. *See* ANDREW FEICKERT, CONG. RSCH. SERV., RS22888, THE ARMY'S M-4 CARBINE: BACKGROUND AND ISSUES FOR CONGRESS 4 (2010) ("The 'larger bullet' recommendation for lethality purposes may, in fact, be a valid recommendation based on observations from Iraq and Afghanistan, but the 'bigger bullet debate' has been a source of contention for many small arms experts ever since the Army adopted the [5.56mm] M-16 during Vietnam in lieu of the [7.62mm] M-14 rifle.").

48. FEICKERT, *supra* note 47, at 6.

49. *See* Schatz, *supra* note 38 (describing Mattis's visit to Walter Read Hospital where he heard multiple accounts of 5.56mm failures, including one Marine lieutenant who "lost a leg to a suicide bomber when he and other Marines emptied a magazine (5.56x45mm) into the man charging them, at close range" (internal quotation marks omitted)); *see also* Russ Read, *Mattis Admits the M16 Lacks Lethality*, DAILY CALLER (Jan. 12, 2017, 12:54 PM), https://dailycaller.com/2017/01/12/mattis-admits-its-time-to-upgrade-the-m16s-lethality/#ixzz4Vrn0JLbj.

including "more lethal and discriminating individual weapons systems."[50]

There has been longstanding debate within the military community about which caliber round is most effective in combat. Military testing performed in the late 1920s and early 1930s confirmed that the intermediate .256 caliber (6.5mm) round and .276 caliber (7.0mm) Pedersen round were more effective at distances under three hundred yards than the military's standard .30-06 round.[51] Douglas McArthur, then Chief of Staff of the Army, rejected the test results and chose the less effective .30-06 round because the Army had huge stockpiles left over from World War I and because moving to a new round would complicate logistics.[52] Modern testing supports the same conclusion about the most effective round for combat rifles. Based on data from more than 10,000 test shots at various distances with multiple caliber rounds, the 2006 U.S. Joint Service Wound Ballistics Integrated Product Team (JSWB-IPT) concluded that the optimum caliber for terminal performance is not the 5.56mm round but the 6.8mm round.[53] The next generation of combat rifles likely will use a more effective intermediate caliber round between 6.5 and 7.0mm rather than the smaller 5.56mm round.[54]

None of this suggests that the military's M16 rifle and M4 carbine are less than lethal on the battlefield; to the contrary, they have

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50. Nick Adde, *New 6.8 mm Round a Game-Changer for Ground Troops*, NAT'L DEF., 2009, at 8, 9 (quoting Defense Secretary Mattis).

51. *See* Ehrhart, *supra* note 38, at 8–9. *See generally* THOMAS L. MCNAUGHER, MARKSMANSHIP, MCNAMARA AND THE M16 RIFLE: ORGANIZATIONS, ANALYSIS AND WEAPONS ACQUISITION 13–15 (1979) (discussing the history of the military's rifle caliber debate).

52. *See* Ehrhart, *supra* note 38, at 9.

53. *See* Roberts, *Time for a Change*, *supra* note 35 (stating that "the clear and unequivocal best performing cartridge in the JSWB-IPT testing was 6.8mm."); Schatz, *supra* note 38 (quoting the draft report stating that "[t]he best performing systems emphasizing tissue damage, on the average, in this study were of larger caliber than 5.56mm," that "[t]he 6.8mm performance observed in this test suggests that an intermediate caliber is the answer to the trade-off balance issue," and that "[t]he 6.8 mm projectile had a near optimum balance of mass, velocity, and configuration to maintain its effectiveness, even at lower impact velocity." (internal quotation marks omitted)).

54. *See* Scales, *supra* note 33; Todd South, *New Rifle, Bigger Bullets: Inside the Army's Plan to Ditch the M4 and 5.56*, ARMYTIMES.COM (May 7, 2017), https://www.armytimes.com/news/your-army/2017/05/07/new-rifle-bigger-bullets-inside-the-army-s-plan-to-ditch-the-m4-and-5-56/.

proven capability to kill or incapacitate. But the lethality by analogy argument only works if the AR-15 is like military weapons which themselves are exceptionally lethal. Reports about the terminal underperformance of the smaller projectile fired by the M16/M4 suggest that these rifles are adequately lethal but not exceptionally so when compared to alternatives.

There are additional reasons why the lethality by analogy argument does not work. As a simple factual matter, the civilian semiautomatic AR-15 is not a combat weapon. No national military uses the AR-15 or any other semiautomatic-only rifle as its standard service rifle.[55] Because the AR-15 lacks selective-fire capability—it does not fire in automatic (machine gun) mode like the M16/M4—it is neither designed for nor used on the battlefield.[56] Ban supporters try to downplay this distinction,[57] but as attorney and former infantry officer Dennis Chapman points out, selective-fire capability "is the single, essential feature that makes a military firearm more useful in combat than its civilian counterpart."[58] The AR-15 fires much slower than a machine gun, and therefore lacks the utility of a modern military combat rifle.[59]

The military weapon analogy also is used to highlight the AR-15's "military features"—pistol grip, barrel shroud, flash suppressor, and adjustable stock—that supposedly make the AR-15 exceptionally dangerous. Three circuits have concluded that these features give the AR-15 a lethal capability "far beyond" other firearms.[60] They simply are wrong about this as anyone familiar with the AR-15 knows. While such features may make the AR-15 look menacing, they do not render the AR-15 more deadly by making it fire faster, shoot with much

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55. Wallace, *supra* note 23, at 205–06.

56. For an extended discussion of why the AR-15 is not a "weapon of war" because it lacks the capability for automatic fire, see *id.* at 207–11.

57. *See, e.g.*, Brief of Defendants-Appellees at 23, Worman v. Healey, 922 F.3d 26 (1st Cir. 2019) (No. 18-1545) ("The U.S. military does not consider the capacity for automatic fire to be a critical feature that makes the firearm military in nature.").

58. Dennis Chapman, *The 'Weapons of War' Myth*, PULSE | LINKEDIN (Dec. 7, 2015), https://www.linkedin.com/pulse/weapons-war-myth-dennis-chapman [hereinafter Chapman, *Myth*]; *see* Dennis Chapman, *Firearms Chimera: The Counter Productive Campaign to Ban the AR-15 Rifle*, 8 BELMONT L. REV. (forthcoming 2020) (manuscript at 13) (available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3466567) [hereinafter Chapman, *Firearms Chimera*] ("Automatic and selective fire is *the only significant truly military firearms feature*.").

59. *See infra* text accompanying notes 89–93.

60. Kolbe v. Hogan, 849 F.3d 114, 137 (4th Cir. 2017) (en banc); N.Y. State Rifle & Pistol Ass'n v. Cuomo (*NYSRPA*), 804 F.3d 242, 262 (2d Cir. 2015); *see* Heller v. District of Columbia (*Heller II*), 670 F.3d 1244, 1262–63 (D.C. Cir. 2011).

greater accuracy, or impact with far more power.[61] They mostly serve the same ergonomic functions as similar features on non-banned firearms, making the AR-15 easier and safer to use.[62] To be sure, by making the AR-15 easier to use they also can make it marginally more accurate, but there is no evidence that such features materially increase the AR-15's lethality in mass public shootings or other criminal activities.[63] Having these features on multiple military rifles may increase accuracy in the aggregate and make a small difference in infantry combat.[64] But mass public shootings are not like small unit combat—typically there is a lone shooter and no one shooting back.[65] Any marginal increase in the accuracy of a single weapon due to these features will have little, if any, lethal effect.[66] Having a slightly more accurate weapon will make no real difference to the mass shooter, especially when firing from an unsupported position while standing or moving.

The lethality by analogy argument also proves too much. Civilians have been using "weapons of war" since musket days, often with little

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61. Taking advantage of public and judicial ignorance about firearms, gun-control advocates emphasize these "scary-looking" features as proof of the AR-15's enhanced lethality. *See, e.g.*, Josh Sugarmann, *Assault Weapons and Accessories in America*, VIOLENCE POL'Y CTR., http://www.vpc.org/studies/awaconc.htm (last visited Feb. 21, 2021) ("The [assault] weapons' menacing looks, coupled with the public's confusion over fully automatic machine guns versus semi-automatic assault weapons—anything that looks like a machine gun is assumed to be a machine gun—can only increase the chance of public support for restrictions on these weapons.").

62. *See* Wallace, *supra* note 23, at 226–34 (explaining the function and effects of these features). I do not claim that these features are merely cosmetic; rather, they are functional, but their functions do not make the AR-15 exceptionally lethal.

63. *See* KOPER ET AL., *supra* note 6, at 80 n.94 ("While it is conceivable that changing features of [assault weapons] other than their magazines might prevent some gunshot victimizations, available data provide little if any empirical basis for judging the likely size of such effects. . . . While [pistol grips] may prove useful in military contexts . . . it is unknown whether civilian attacks with semiautomatic rifles having pistol grips claim more victims per attack than do those with other semiautomatic rifles.").

64. Chapman, *Myth*, *supra* note 58 ("The ergonomic features that proponents of an 'assault' weapons ban view as 'military' in nature are valuable in combat. By making the firearm more comfortable and more convenient to use, they offer the potential to improve the individual [s]oldier's marksmanship. Not dramatically, usually, but to a small degree. But in a situation as fiercely competitive as infantry combat, a small advantage enjoyed by a number of [s]oldiers individually can have enough of an impact cumulatively to influence the outcome of the battle.").

65. *See generally id.* (discussing the contextual differences between typical mass shootings and military combat).

66. *See id.*

or no difference between military and civilian versions.[67] Civilian firearms that are used or have been used by military forces include the most popular handguns in the world—the iconic Browning-designed 1911, Sig Sauer P226, Glock 17, and Beretta 92FS—as well as familiar hunting rifles and shotguns, such as the Remington 700 bolt-action rifle and Remington 870 and Mossberg 500 pump-action shotguns.[68] If firearms are exceptionally lethal because they are military or military-style weapons, then a wide array of popular handguns and long guns are too dangerous for civilian use.

The final flaw in the "weapons of war" analogy is that the Supreme Court repeatedly has recognized that the Second Amendment protects military or military-style small arms commonly used by civilians.[69] As *District of Columbia v. Heller* explains, "[i]n the colonial and revolutionary era, [small arms] weapons used by militiamen and weapons used in defense of person and home were one and the same."[70] The Court in *United States v. Miller* recognized that citizens have the right to possess weapons that are part of the militia's "ordinary military equipment" or that "could contribute to the common defense."[71] While *Heller* rejects the dissent's narrow reading of *Miller* to protect "*only* those weapons useful in warfare"[72] (which, if true, would prove this point with even greater force), it clarifies that the "ordinary military equipment" referenced in *Miller* also includes civilian small arms commonly used for lawful purposes.[73] Such firearms do not lose their constitutional protection because they are "weapons of war."

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67. Wallace, *supra* note 23, at 200.

68. *See id.* at 201–02.

69. *See id.* at 202–03.

70. 554 U.S. 570, 624–25 (2008) (internal quotation marks omitted) (quoting State v. Kessler, 614 P.2d 94, 98 (Or. 1980)).

71. 307 U.S. 174, 178 (1939) (citing Aymette v. State, 21 Tenn. (1 Hum.) 154, 158 (1840)).

72. 554 U.S. at 624–25 (emphasis added). The *Heller* dissenters argued that the Second Amendment protects only military-style arms. *See id.* at 636 (Stevens, J., dissenting) ("The Second Amendment plainly does not protect the right to use a gun to rob a bank; it is equally clear that it *does* encompass the right to use weapons for certain military purposes."); *id.* at 646 (noting that the phrase "[t]o keep and bear arms" describes a "unitary right: to possess arms if needed for military purposes and to use them in conjunction with military activities").

73. *Id.* at 624–25 (majority opinion).

II. LETHALITY AS A METRIC

Ban proponents also argue that the AR-15 is exceptionally lethal because it fires much faster and causes far more serious wounds than other firearms. These two metrics are used in all five federal circuit court cases. The First, Second, and Fourth Circuits identically asserted that the banned weapons have "a capability for lethality—more wounds, more serious, in more victims—far beyond that of other firearms in general, including other semiautomatic guns."[74] The D.C. Circuit declared that the banned weapons' rate of fire and large-capacity magazines "greatly increase the firepower of mass shooters."[75] The Seventh Circuit concluded that "assault weapons" can be more dangerous in the aggregate than other firearms because they "enable shooters to fire bullets faster" and because their "spray fire" design make them more dangerous in mass shootings.[76] Most recently, the First Circuit emphasized the terminal effects of the AR-15, noting that "such weapons can fire through walls, risking the lives of those in nearby apartments or on the street," and citing medical sources asserting that "assault weapons" cause far more massive and devastating wounds than other firearms.[77]

What makes one gun more dangerous or deadly than another? While there is no official or formal standard for measuring firearm lethality, analysis typically focuses on the projectile (bullet) the gun fires and how the gun fires that projectile. Projectile factors include its size (caliber), shape, construction, muzzle velocity (speed of the bullet as it leaves the weapon), and terminal ballistics (bullet–tissue interaction). Firearm factors include (1) the firearm's speed in putting bullets on the intended target, including its effective rate of fire, magazine capacity, and features that make it easier or faster to deploy and fire, and (2) the firearm's accuracy, which typically depends on barrel design, quality, and length, aiming devices, and recoil. In short,

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74. Worman v. Healey, 922 F.3d 26, 31 (1st Cir. 2019) (internal quotation marks omitted) (quoting H.R. REP. NO. 103-489, at 19–20 (1994)); Kolbe v. Hogan, 849 F.3d 114, 125, 137 (4th Cir. 2017) (en banc) (same); N.Y. State Rifle & Pistol Ass'n v. Cuomo (*NYSRPA*), 804 F.3d 242, 262 (2d Cir. 2015) (same).

75. Heller v. District of Columbia (*Heller II*), 670 F.3d 1244, 1263 (D.C. Cir. 2011) (internal quotation marks omitted) (citations omitted).

76. Friedman v. City of Highland Park, 784 F.3d 406, 409, 411 (7th Cir. 2015). The claim that the civilian semiautomatic-only AR-15 is designed for "spray fire" is factually false. *See* Wallace, *supra* note 23, at 211–22.

77. *Worman*, 922 F.3d at 37, 39–40.

everything else being equal, a gun's lethality typically depends on how fast it fires, how accurately it shoots, and how destructively it strikes.

But everything else is never equal in real shootings. A firearm's actual lethality involves several additional variables. Most critical is the bullet's point of impact. A small-caliber round to the brain, spinal cord, or heart has a far greater chance of causing serious damage or death than a large-caliber round to an extremity. That is why the skill and training of the shooter at shot placement is the most important factor for firearm lethality—any gun will be more dangerous in the hands of a skilled shooter than a novice. The shooter's intent and motivation to do harm likewise may affect the firearm's lethality. Even a small-caliber handgun can be very effective in the hands of a determined shooter. Proximity to the target is another factor. In some circumstances, a small, concealable handgun may be more lethal than a larger firearm because the shooter can carry it much closer to the intended victim and deliver a lethal shot. When concealment is unnecessary, a shotgun may prove more deadly to a single target in close proximity, while a scoped bolt-action rifle will pose a greater lethal threat to a single target several hundred yards away.

Given these variables, generalizations about the lethality of "assault weapons" based solely on their rate of fire, accuracy, and bullet impact will never accurately describe or predict their actual lethality. Firearm lethality is a complex subject, not easily reduced to static comparisons or simplistic catchphrases. It may be impossible to speak meaningfully and consistently in policy debates or legal decisions about the comparative lethality of "assault weapons."

Federal courts nevertheless have upheld "assault weapon" bans on the ground that the banned weapons are exceptionally lethal. A firearm's rate of fire, accuracy, and terminal performance are questions of fact that can be established by firearms and ballistics experts, objective testing, and military documentation. Instead of consulting such evidence to determine whether "assault weapons" are more dangerous than other firearms, federal judges have relied on proof by assertion, repeatedly citing unsupported claims by ban advocates, federal agencies justifying their policy decisions, and individuals having little or no experience with how the banned firearms operate.[78] They have taken such assertions at face value without examining whether they are true because they support the result the judges want to reach. These judges have shown little

78. *See* Wallace, *supra* note 23, at 195 (using *Kolbe* as an example); *infra* text accompanying notes 79–82.

willingness to engage in a rigorous and impartial review of relevant facts before drawing legal conclusions about the relative dangerousness of "assault weapons." Their uncritical acceptance of pro-ban claims about "assault weapon" lethality calls into question the legitimacy of their decisions.

Facts matter. What follows is an evidence-based comparative analysis of the AR-15's lethality based on its rate of fire, accuracy, and terminal ballistics.

A. The AR-15's Rate of Fire

A firearm with a high rate of fire can be more dangerous than other firearms, especially when intended victims are crowded in a single place as sometimes happens in mass public shootings. More bullets fired can mean more victims and more wounds in each victim. Firearms with the highest rate of fire are automatic weapons—typically called machine guns—which fire continuously so long as the shooter presses and holds the trigger.

Judicial claims about the AR-15's lethality turn largely on comparing its rate of fire to that of a machine gun. *Heller II* declares that semiautomatic firearms like the AR-15 "fire almost as rapidly as automatics."[79] *Kolbe* concludes that the rate of fire for the semiautomatic-only AR-15 is "nearly identical" to the military M16 firing in automatic mode.[80] It claims that any difference in the rates of fire is "slight," citing as authority a 1994 congressional report stating that "[s]emiautomatic weapons can be fired at rates of [three hundred] to [five hundred] rounds per minute, making them virtually indistinguishable in practical effect from machine guns."[81] Both *Heller II* and *Kolbe* assert that a semiautomatic rifle like the AR-15 can empty a thirty-round magazine in five seconds.[82] *Heller II* concludes that "it is difficult to draw meaningful distinctions between the AR-15 and the M-16."[83]

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79. 670 F.3d at 1263 (internal quotation marks omitted) (citation omitted).

80. Kolbe v. Hogan, 849 F.3d 114, 136 (4th Cir. 2017) (en banc).

81. *Id.* at 125 (internal quotation marks omitted) (quoting H.R. REP. NO. 103-489, at 18 (1994)).

82. *Id.* at 125, 136; 670 F.3d at 1263.

83. 670 F.3d at 1263 (citations omitted).

These assertions about the AR-15's rate of fire are badly flawed.[84] The cited sources for the rate-of-fire claims are not firearms experts, military operators, or even experienced AR-15 shooters; instead, they are advocates for "assault weapon" bans.[85] *Kolbe's* "[three hundred] to [five hundred] rounds per minute" figure can be traced to 1991 congressional testimony from Dewey R. Stokes, president of the national Fraternal Order of Police and a leading gun-control advocate.[86] *Heller II*'s "empty a [thirty-round] magazine in five seconds" figure comes from Brian Siebel, an attorney and lobbyist for the Brady Center to Prevent Gun Violence, a leading gun-control organization, who obtained that figure from a 1988 police trade magazine article by Joseph McNamara, another gun-control advocate.[87] The claims in *Kolbe* and *Heller II* about the AR-15's high rate of fire are based on two unsubstantiated reports three decades old from ban proponents.[88]

1. Measuring the AR-15's Rate of Fire

The AR-15 has a slower firing mechanism than the military's M16 rifle and smaller M4 carbine. As explained above, the M16/M4 are selective-fire weapons, meaning they can be fired either in automatic or semiautomatic mode.[89] When firing in automatic mode, they have a cyclic (mechanical) rate of fire of seven hundred to nine hundred rounds per minute (twelve to fifteen rounds per second),[90] and thus can empty a standard thirty-round magazine in 2–2.5 seconds. By contrast, the civilian AR-15 lacks the ability to fire multiple shots with one pull of the trigger and therefore does not fire nearly as fast as an

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84. *See generally* Wallace, *supra* note 23, at 211–26 (providing a more detailed refutation of these assertions).

85. *Id.* at 195.

86. *Id.* at 220–21 (citing H.R. REP. NO. 103-489, at 18).

87. *Id.* at 221 (citation omitted). For further discussion of Stokes's and McNamara's pro-ban advocacy, see generally Eric C. Morgan & David B. Kopel, *The "Assault Weapon" Panic: Political Correctness Takes Aim at the Constitution* (Nat'l Crim. Just. Reference Serv. Indep.: Indep. Inst. Issue Paper, Paper No. 12-91, 1993).

88. *See* Brief of Amicus Curiae Law Enforcement Groups et al. in Support of Petitioners' Petition for Writ of Certiorari at 16, Kolbe v. Hogan, 849 F.3d 114 (4th Cir. 2017) (No. 17-127) ("Determinations by courts that affect the fundamental constitutional rights of citizens should not be based on uncritical acceptance of fifth hand, unverified, anecdotal reports.").

89. *See supra* notes 28–30 and accompanying text.

90. ARMY FIELD MANUAL, *supra* note 29, at 2-1. A cyclic rate of fire measures how fast the weapon can fire mechanically and does not consider operator factors such as reaction time, reloading, and aiming.

automatic weapon. Because it has a semiautomatic-only firing mechanism, it fires only one round with each trigger pull and thus can fire only as fast as the shooter can pull the trigger.

Judicial declarations about the AR-15's high rate of fire are both counterintuitive and counterfactual, as anyone who has operated the AR-15 knows. To fire a semiautomatic rifle three hundred to five hundred per minute, as *Kolbe* claims, the shooter must pull the trigger *five to eight times per second* and maintain that rate for sixty seconds. To empty a thirty-round magazine in five seconds, as both *Heller II* and *Kolbe* claim, the shooter must pull the trigger *six times per second* for that span. Only the world's fastest expert shooters using highly-tuned AR-15 rifles can pull the trigger five or six times in one second while firing at a single stationary target, and that rate cannot be maintained for an entire minute.[91] The average shooter with an AR-15 will be much slower, firing at most two to three rounds per second and thus, taking ten or more seconds to empty a thirty-round magazine.[92] An inexperienced shooter will take even longer.[93]

Because the AR-15 fires much slower than a machine gun, it lacks the lethality of a machine gun. Consider this: A typical shooter firing a military M16 in automatic mode can empty a one hundred-round magazine in less time than it would take the same shooter firing a civilian AR-15 to empty a thirty-round magazine. If that shooter fires indiscriminately into a crowded bar, church, or classroom, the fully automatic M16 would produce far more casualties than the semiautomatic AR-15, launching some seventy more bullets into the crowd. Using either weapon in such a scenario would be tragic, but the automatic rifle much more so. And yet, relying on *Heller II* and *Kolbe*, one federal district court recently declared that the variance

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91. *See* Wallace, *supra* note 23, at 215–18.

92. *See id.* at 218; *see also* Angela Sauaia et al., *Case Fatality Rates Do Not Tell the Whole Story*, 229 J. AM. COLL. SURGEONS 441, 442 (2019) ("[W]e have personally documented that a non-experienced individual can fire [thirty] bullets from an [AR-15] within [ten] seconds."). Louis Klarevas writes that an average shooter will fire two rounds per second from an AR-15, which would require about fifteen seconds to empty a thirty-round magazine. *See* LOUIS KLAREVAS, RAMPAGE NATION: SECURING AMERICA FROM MASS SHOOTINGS 211–12 (2016).

93. *See* Tim Dickinson, *All-American Killer: How the AR-15 Became Mass Shooters' Weapon of Choice*, ROLLING STONE (Feb. 22, 2018, 4:20 PM), https://www.rollingstone.com/politics/politics-features/all-american-killer-how-the-ar-15-became-mass-shooters-weapon-of-choice-107819/ (explaining that the author, who had never shot a firearm before, fired twenty rounds from an AR-15 at a single stationary target in less than a minute).

between automatic and semiautomatic rates of fire is a "distinction without a difference."[94]

The AR-15's rate of fire slows even more when the shooter engages in aimed semiautomatic fire at multiple or moving targets, as often occurs in mass public shootings.[95] The United States Army Field Manual on Rifle Marksmanship (Army Field Manual) explains that "[t]he most important firing technique during fast-moving, modern combat is rapid semiautomatic fire. It is the most accurate technique of placing a large volume of fire on poorly defined targets or target areas, such as short exposure, multiple, or moving targets."[96] *Kolbe* asserts that the civilian AR-15, like its military counterparts, is designed "to shoot a large number of rounds across a battlefield at a high rate of speed"[97] but fails to quantify how large the number of rounds or how high the speed of fire. Military documents supply the missing numbers by describing the rate of "rapid semiautomatic fire" for the M16/M4 when shooting at multiple or moving targets. Because the military M16/M4 and civilian AR-15 have identical rates of semiautomatic fire, these numbers also apply to the AR-15.

What the military counts as a "large volume of fire" when using "rapid semiautomatic fire" is much slower than the rates cited in *Kolbe* and *Heller II*. The Army Field Manual specifies that rapid semiautomatic fire for the M16/M4 "will result in a well-aimed shot every one to two seconds."[98] The Manual sets the maximum *effective* rate of fire for an M16/M4 in semiautomatic mode at forty-five rounds

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94. Rupp v. Becerra, 401 F. Supp. 3d 978, 987 (C.D. Cal. 2019); *see also* Jonathan E. Lowy, *Comments on Assault Weapons, the Right to Arms, and the Right to Live*, 43 HARV. J.L. & PUB. POL'Y 375, 382 (2020) (describing the difference between automatic and semiautomatic fire as "not great" and "not much").

95. *See* Dave B. Kopel, *Rational Basis Analysis of "Assault Weapon" Prohibition*, 20 J. CONTEMP. L. 381, 389 (1994) ("[T]he only meaningful rate of fire for a weapon is how fast a person, shooting at actual targets, can hit those targets."). The U.S. Army's Rifle and Carbine Training Circular similarly explains:

> The rifleman's primary role is to engage the enemy with well-aimed shots. . . . In this capacity, the rate of fire for the M4 rifle is not based on how fast the [s]oldier can pull the trigger. Rather, it is based on how fast the [s]oldier can consistently acquire and engage the enemy with accuracy and precision.

ARMY TRAINING CIRCULAR, *supra* note 28, at 5.

96. ARMY FIELD MANUAL, *supra* note 29, at 7-8.

97. Kolbe v. Hogan, 849 F.3d 114, 125 (4th Cir. 2017) (en banc) (internal quotation marks omitted) (citation omitted).

98. ARMY FIELD MANUAL, *supra* note 29, at 7-9.

per minute.[99] This means that for aimed semiautomatic fire at multiple or moving targets, the rate for M16/M4 rifles typically is less than one shot per second. This rate is slower because the shooter needs to acquire a good sight picture for each target; the interval it takes to obtain that sight picture dictates the timing of the next shot. While the M16/M4's lower recoil enables the shooter to get back on multiple or moving targets more quickly for follow-up shots, it does not increase the effective rate of fire beyond forty-five rounds per minute. Even at that rate, the rifle's barrel becomes extremely hot, degrading accuracy and function. The M16 and M4 were not designed for prolonged rapid semiautomatic fire. The Army Field Manual states that the maximum *sustained* rate of fire for the M16/M4—the rate at which the weapon can continue to be fired indefinitely without overheating—is even lower at twelve to fifteen rounds per minute, which is one round every four to five seconds.[100] These rates change the lethality assessment considerably, with the capability for aimed fire "measured in seconds per shot," not shots per second.[101]

It is quite clear that federal court claims about the semiautomatic AR-15's high rate of fire are far off the mark. The actual rate for an average shooter firing indiscriminately (or at a single stationary target) will not exceed two to three shots per second over a short period of time.[102] Trained shooters will fire slightly faster while inexperienced shooters will be slower. The highest rate of aimed fire to achieve hits on multiple or moving targets typically will be slower than one shot per second and, again, for a short duration to avoid barrel overheating. These rates are nowhere near machine-gun-like rates for the semiautomatic AR-15 asserted by *Heller II* and *Kolbe*.

To the extent rates of fire can be known in actual mass shootings with "assault weapons," they do not exceed two to three shots per second over a short duration. In a recording of the Orlando nightclub shooting, the shooter is heard firing twenty-four shots in nine seconds,

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99. *Id.* at 2-1.

100. *Id.*

101. Dennis P. Chapman, *Features and Lawful Common Uses of Semi-Automatic Rifles* 28 (Soc. Sci. Rsch. Network (SSRN) Working Paper, Paper No. 3436512, 2019), https://ssrn.com/abstract=3436512 ("[T]he *practical* rates of fire for semi-automatics are measured in *seconds per shot*, not the scores of shots per second often claimed for them.").

102. *See* ARMY FIELD MANUAL, *supra* note 29, at 2-1.

a rate of about 2.7 shots per second.[103] The Dayton nightclub shooter fired forty-one shots in thirty seconds, which is about 1.4 shots per second.[104] Sounds of thirty shots can be heard in a recorded twenty-seven-second call to 911 during the Aurora movie theater shooting, which is slightly more than one shot per second.[105]

The only exception is the Las Vegas shooting, where the shooter apparently used bump stocks—an accessory that replaces the original stock—to increase the AR-15's rate of fire to nine rounds per second, according to an audio recording of the incident.[106] The ATF has since ruled that bump stocks come within the definition of "machineguns" under federal law and must be treated as such.[107] All existing bump stocks must be destroyed or be abandoned at an ATF office.[108] Whether the bump stock rule is lawful remains to be seen, but it is proportional in that it regulates the firearm accessory rather than

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103. Larry Buchanan et al., *Nine Rounds a Second: How the Las Vegas Gunman Outfitted a Rifle to Fire Faster*, N.Y. TIMES (Oct. 5, 2017), https://www.nytimes.com/interactive/2017/10/02/us/vegas-guns.html. The Orlando shooter used a semiautomatic Sig Sauer MCX carbine, which is similar to an AR-15. Larry Buchanan et al., *How They Got Their Guns*, N.Y. TIMES (Feb. 16, 2018), https://www.nytimes.com/interactive/2015/10/03/us/how-mass-shooters-got-their-guns.html.

104. Holly Yan et al., *The Dayton Gunman Killed 9 People by Firing 41 Shots in 30 Seconds. A High-Capacity Rifle Helped Enable that Speed*, CNN (Aug. 5, 2019, 5:57 PM), https://www.cnn.com/2019/08/05/us/dayton-monday-shooter-stopped-in-seconds/index.html.

105. Casey Wian et al., *'He Intended to Kill Them All,' Prosecutor in Theater Shooting Says*, CNN (Jan. 9, 2013, 7:14 PM), https://www.cnn.com/2013/01/09/justice/colorado-theater-shooting/index.html. For average rates of fire in other mass shootings, see Wallace, *supra* note 23, at 222–25.

106. Larry Buchanan et al., *What is a Bump Stock and How Does It Work?*, N.Y. TIMES (Mar. 28, 2019), https://www.nytimes.com/interactive/2017/10/04/us/bump-stock-las-vegas-gun.html. It's not entirely certain that bump stocks were used in the Las Vegas shooting, but it seems likely given the rate of fire heard in the audio recording and the fact that more than half the rifles found in the shooter's hotel room were equipped with bump stocks. *See* LAS VEGAS METRO. POLICE DEP'T, CRIMINAL INVESTIGATIVE REPORT OF THE 1 OCTOBER MASS CASUALTY SHOOTING 96–104, 125 (2018). *See generally* Bureau of Alcohol, Tobacco, Firearms & Explosives, Las Vegas Recovered Weapons and Ammunition (n.d.) (presentation slides available at https://archive.org/details/ATFVegasWeaponsAmmunition/mode/2up).

107. Bump-Stock-Type Devices, 83 Fed. Reg. 66,514 (Dec. 26, 2018) (to be codified at 27 C.F.R. pt. 447, 478, 479). The new rule, which took effect March 26, 2019, has been challenged in several court cases. *See, e.g.*, Guedes v. Bureau of Alcohol, Tobacco, Firearms & Explosives, 920 F.3d 1, 6 (D.C. Cir. 2019) (denying motion for preliminary injunction to halt rule from going into effect), *cert. denied*, 140 S. Ct. 789 (2020); Ilya Shapiro et al., Gun Owners of America v. Barr, CATO INST.: LEGAL BRIEFS (June 25, 2019), https://www.cato.org/publications/legal-briefs/gun-owners-america-v-barr.

108. *Bump Stocks*, BUREAU OF ALCOHOL, TOBACCO, FIREARMS & EXPLOSIVES, https://www.atf.gov/rules-and-regulations/bump-stocks (last updated Feb. 21, 2019).

banning the entire firearm. Heightened constitutional scrutiny should require the more narrowly tailored regulation.

The fact that the AR-15's rate of fire can be increased by "bump-firing" does not make the AR-15 exceptionally lethal. Bump-fire is notoriously inaccurate, erratic, and difficult, thereby decreasing the firearm's effectiveness.[109] That is why bump fire is not used by military, law enforcement, or civilian target shooters. With the apparent exception of Las Vegas, there is no evidence that bump fire has been used in mass public shootings or other criminal activity.[110] Furthermore, the Las Vegas shooter's increased rate of fire was not the only factor contributing to the tragically-high casualty count. He fired for more than ten minutes from an elevated, stationary, and secluded position into a densely-packed crowd of 22,000 people who had limited avenues of escape.[111]

2. Comparing the AR-15's Rate of Fire

It is widely assumed that "assault weapons" like the AR-15 are more lethal because they fire bullets much faster than other firearms. Indeed, to those unfamiliar with modern semiautomatic firearms, the AR-15's ability to fire more than one bullet per second seems very fast. But nearly identical rates of fire can be achieved by semiautomatic handguns, shotguns, and non-banned rifles. Because all semiautomatic firearms operate the same way—one round fired for each trigger pull with automatic loading of the next round—it is not

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109. *See, e.g.*, Destroy Everything, *How to Bump Fire*, YOUTUBE (Jan. 17, 2018), https://www.youtube.com/watch?v=9Yjcj9jBvIY (explaining how to bump fire without a bump stock and showing inaccuracy of bump-firing from hip); Jerry Miculek, *Miculek VS. Bump Stock*, YOUTUBE (Jan. 11, 2019), https://www.youtube.com/watch?v=grgfKJT4Z48 (showing fast-shooter Jerry Miculek's mostly unsuccessful attempt to operate a bump stock).

110. *See* Harry Cheadle, *A 'Bump Stock' Ban Would Barely Affect Gun Violence in America*, VICE: LAS VEGAS SHOOTING (Oct. 5, 2017, 4:39 PM), https://www.vice.com/en_us/article/wjxypw/a-bump-stock-ban-would-barely-affect-gun-violence-in-america.

111. *See* Geoffrey Mohan, *The Trigonometry of Terror: Why the Las Vegas Was So Deadly*, L.A. TIMES (Oct. 4, 2017, 3:00 AM), https://www.latimes.com/nation/la-las-vegas-shooting-live-updates-carnage-concert-leaves-50-dead-100-injured-20171002-htmlstory.html#the-trigonometry-of-terror-why-the-las-vegas-shooting-was-so-deadly; Yuliya Talmazan, *Las Vegas Shooter's Position in Mandalay Bay Room Amplified Massacre*, NBC NEWS (Oct. 2, 2017, 10:52 AM), https://www.nbcnews.com/storyline/las-vegas-shooting/las-vegas-shooter-s-position-mandalay-bay-room-amplified-massacre-n806491.

surprising they have comparable rates of fire. The AR-15 is no more lethal in its rate of fire than other semiautomatic firearms.

There is little if any difference between the rates of fire for the semiautomatic AR-15 and a semiautomatic handgun. The average shooter can fire a semiautomatic handgun at a rate of about two to three rounds per second while pointing at a single stationary target. In a study of police-attacker shooting performance, the Force Science Research Center found that a large majority of inexperienced handgun shooters in the test group could fire three rounds from a semiautomatic handgun in 1.5 seconds (two rounds per second), and some were able to fire three rounds in one second.[112] After consulting firearms experts, Louis Klarevas in *Rampage Nation: Securing America from Mass Shootings* set the average shooter's rates of fire for a semiautomatic handgun and semiautomatic "assault rifle" at an identical two rounds per second, with the expert shooter firing both weapons at three rounds per second.[113] Using a Glock 19 semiautomatic handgun with a thirty-three-round magazine, the Tucson shooter fired thirty-three rounds in fifteen seconds, slightly faster than two rounds per second.[114] In my own testing, I fired three rounds from a semiautomatic handgun in 0.93 seconds.[115] Even non-semiautomatic handguns can be fired quickly. The shooter who attempted to assassinate President Reagan in March 1981 fired six shots in 1.7 seconds from a .22 caliber revolver, which is 3.5 rounds per second.[116] These rates of fire are nearly identical to the AR-15.

Like the AR-15, the rate of fire for semiautomatic shotguns also depends on how fast the shooter can pull the trigger. Shotguns with gas-operated firing systems similar to the AR-15, such as the Benelli

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112. Chuck Remsberg, *New Tests Show Deadly Accuracy & Startling Speed Even Inexperienced Shooters Can Achieve in Shooting Cops*, FORCE SCI. INST. (Feb. 23, 2007), https://www.forcescience.org/2007/02/new-tests-show-deadly-accuracy-startling-speed-even-inexperienced-shooters-can-achieve-in-shooting-cops/. The results include reaction time. *Id.*

113. KLAREVAS, *supra* note 92, at 211–12.

114. *Id.* at 209; *see* Press Release, Fed. Bureau of Investigation: Phx. Div., Jared Lee Loughner Sentenced in Arizona on Federal Charges in Tucson Shooting (Nov. 8, 2012), https://archives.fbi.gov/archives/phoenix/press-releases/2012/jared-lee-loughner-sentenced-in-arizona-on-federal-charges-in-tucson-shooting; David Nakamura et al., *Videos Show Details of Tucson Shooting*, WASHINGTON POST (Jan. 19, 2011, 12:00 AM), http://www.washingtonpost.com/wp-dyn/content/article/2011/01/18/AR2011011801155.html.

115. I fired at a single stationary target using a Sig Sauer P226 Legion 9mm SAO (single action only) handgun and PACT Club shot timer. The results include reaction time. Wallace, *supra* note 23, at 219.

116. JILL LEPORE, THESE TRUTHS: A HISTORY OF THE UNITED STATES 672 (2018).

M4, Mossberg 930, and Winchester SX3, can fire as fast or faster than the AR-15.[117] For example, fast-shot expert Jerry Miculek fired twenty-three rounds from a Mossberg 930 shotgun in 3.73 seconds, which is about six rounds per second and nearly identical to his rate of fire with an AR-15.[118] A shotgun's rate of fire will be much faster than the AR-15 if you count the multiple small, spherical projectiles it can fire with each pull of the trigger. A twelve-gauge shotgun loaded with a 2.75-inch No. 00 buckshot shell can fire eight to twelve pellets, each having a nominal diameter of .33 inches (.33 caliber).[119] A twelve-gauge shotgun firing a three-inch shell with No. 4 buckshot can launch forty-one projectiles of .24 caliber size with a single trigger pull.[120] By comparison, typical ammunition for the AR-15 is .223 caliber (although elongated with greater mass). This means that with five trigger pulls in five seconds, a shotgun can fire as many as sixty .33 caliber projectiles or more than two hundred .24 caliber projectiles, while the AR-15 fires only five .223 caliber projectiles.

The rate of fire for many non-banned semiautomatic rifles also is nearly identical to the AR-15. As explained above, the AR-15's maximum effective rate of fire is forty-five rounds per minute. The popular semiautomatic Ruger Mini-14 rifle comes without a folding or telescoping stock or pistol grip, exempting it from typical "assault

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117. *See generally* Gun News Daily, *Like Shotguns? You Have to Try Out These Semi-Automatic Beasts*, NAT'L INT.: THE BUZZ (Dec. 12, 2019), https://nationalinterest.org/blog/buzz/shotguns-you-have-try-out-these-semi-automatic-beasts-103947 ("[Q]uick reloading and ejecting allows for the rapid-fire ability of [semiautomatic] shotguns").

118. *Compare* Jerry Miculek, *23 Rounds in 3.73 Seconds with a Mossberg 930 Shotgun*, YOUTUBE (May 13, 2013), https://www.youtube.com/watch?time_continue=108&v=N5QTFvnENRc&feature=emb_logo, *with* Jerry Miculek, *30 Caliber Magazine Clip in a Half Second! (With the World's Fastest Shooter, Jerry Miculek)*, YOUTUBE (Feb. 6, 2014), https://www.youtube.com/watch?v=REdjjLBaiOs (firing thirty rounds from an AR-15 in 5.3 seconds for an average of almost six rounds per second), *and* Jerry Miculek, *AR-15 5 Shots in 1 Second with Fastest Shooter Ever, Jerry Miculek (Shoot Fast!)*, YOUTUBE (June 20, 2013), https://www.youtube.com/watch?v=v3gf_5MR4tE (firing five rounds from an AR-15 in one second). Patrick Flanigan, known as the world's fastest shotgun shooter, fired twelve rounds from a semiautomatic Winchester SX3 in 1.44 seconds, which is over eight rounds per second. AccurateShooter, *Rapid-Fire Shotgun—World's Fastest*, YOUTUBE (Dec. 8, 2007), https://www.youtube.com/watch?v=cebOI-NS5Kc.

119. *See* Richard Mann, *Buckshot Basics*, NRA SHOOTING ILLUSTRATED (Jan. 31, 2012), https://www.shootingillustrated.com/articles/2012/1/31/buckshot-basics/.

120. *See* Buckshot 12 Gauge, FED., https://www.federalpremium.com/shotshell/premium-slug-buckshot/vital-shok-buckshot/11-P158+4B.html (last visited Sept. 26, 2020) (listing product specifications of buckshot for a twelve-gauge shotgun).

weapon" bans.[121] It fires the same .223/5.56 round as the AR-15 and has an effective rate of fire of forty rounds per minute.[122] Another example is the Soviet-era 7.62x39mm SKS semiautomatic rifle, which has a fixed ten-round magazine and is sold in the civilian market.[123] It has an effective (practical) rate of fire of forty to fifty rounds per minute.[124]

Despite declaring the AR-15 far more lethal than other firearms, federal courts have compared the AR-15's rate of fire only to machine guns and not to other semiautomatic firearms.[125] The above comparisons show that the AR-15 is no more dangerous in its rate of fire than modern semiautomatic handguns, shotguns, and non-banned rifles. The semiautomatic firing system—one round fired for each trigger pull with automatic loading of the next round—produces a fairly consistent rate of fire across all modern semiautomatic firearms. Contrary to widely-held belief, the AR-15 does not fire bullets much faster than other semiautomatic firearms.

3. Assessing the Lethal Effects of the AR-15's Magazine Capacity

A related argument is that the AR-15 is exceptionally lethal because its capability to use "large capacity magazines" (those holding more than ten rounds) enables it to fire more rounds faster than other firearms. The AR-15 uses a standard thirty-round detachable magazine, with aftermarket sixty-round and one hundred-round magazines available in box and drum versions. *Kolbe* says that larger-capacity magazines enhance the AR-15's lethality by enabling a shooter "to shoot multiple human targets very rapidly."[126] *Heller II* emphasizes that such "assault weapons" with such magazines "result

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121. Kyle Mizokami, *Meet the Ruger Mini-14 Rifle: The Most Underappreciated Gun on the Planet?*, NAT'L INT. (Feb. 26, 2019), https://nationalinterest.org/blog/buzz/meet-ruger-mini-14-rifle-most-underappreciated-gun-planet-45607.

122. *Id.*

123. Aaron Smith, *The Long History of the Gun Used in the GOP Baseball Attack*, CNN MONEY (June 16, 2017, 8:10 AM), https://money.cnn.com/2017/06/15/news/sks-rifle-gop-baseball-field-attack/index.html.

124. U.S. DEP'T OF THE ARMY, SKS RIFLE: SIMONOV TYPE 56, at 13 (1969). The SKS originally was manufactured in the Soviet Union in the 1940s and later versions were produced in China and Soviet bloc countries. *See id.* at 1–2.

125. *See, e.g.*, Heller v. District of Columbia (*Heller II*), 670 F.3d 1244, 1263 (D.C. Cir. 2011) ("[I]t is difficult to draw meaningful distinctions between the AR-15 and the M-16." (citations omitted)).

126. Kolbe v. Hogan, 849 F.3d 114, 125 (4th Cir. 2017) (en banc) (internal quotation marks omitted) (citation omitted).

in more shots fired, persons wounded, and wounds per victim than do other gun attacks."[127]

The ability to accept larger-capacity magazines is not unique or specific to the AR-15. Most non-banned semiautomatic weapons—including constitutionally-protected handguns—also accept larger-capacity magazines.[128] Modern full-size semiautomatic handguns typically are sold with standard magazines holding fifteen to eighteen rounds, but they also accept magazines having even higher capacities, such as the Glock 9mm thirty-three-round factory magazine and aftermarket magazines holding up to one hundred rounds.[129]

Larger-capacity magazines do not make the AR-15 fire any faster. Whether the shooter uses a ten-round, thirty-round, or one hundred-round magazine, the AR-15's semiautomatic firing system still fires just one bullet for each trigger pull. Nor do larger-capacity magazines make bullets fired from an AR-15 strike more accurately or more powerfully than the same bullets fired from a ten-round magazine.[130] The weight and size of aftermarket sixty-round and one hundred-round magazines for the AR-15 actually can degrade the gun's accuracy by making it more difficult to handle, and drum versions of

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127. 670 F.3d at 1263 (internal quotation marks omitted) (quoting KOPER ET AL., *supra* note 6, at 97).

128. *See* Duncan v. Becerra, 970 F.3d 1133, 1142 (9th Cir. 2020) (quoting District of Columbia v. Heller, 554 U.S. 570, 629 (2008)) ("LCMs [large-capacity magazines] are commonly used in many handguns, which the Supreme Court has recognized as the 'quintessential self-defense weapon'"); *Kolbe*, 849 F.3d at 158 (Traxler, J., dissenting) ("[T]he [majority's] suggestion that the ability to accept large-capacity magazines facilitates a firearm's military usefulness applies to all semiautomatic weapons, including constitutionally-protected handguns, [because] any firearm that can hold a magazine can theoretically hold one of any size.").

129. *See Glock Gen 4/5 Glock 17, 19, 26, 34 9mm 33-Round Factory Magazine*, GUNMAG WAREHOUSE, https://gunmagwarehouse.com/glock-magazine-gen-4-glock-17-19-26-34-9mm-luger-33-round-polymer-black.html (last visited Sept. 27, 2020). Aftermarket manufacturers sell forty-round, fifty-round, and even one hundred-round drum magazines for popular semiautomatic handguns. *See, e.g.*, *KCI Glock 9mm 50-Round Drum Magazine*, GUNMAG WAREHOUSE, https://gunmagwarehouse.com/kci-glock-9mm-50-round-drum-magazine.html (last visited Sept. 27, 2020); *100 Round Drum Magazine 9MM*, GLOCKPARTS, https://www.glockparts.com/custom/BET-GLOCK.htm (last visited Oct. 1, 2020).

130. *See* Christopher S. Koper, *Assessing the Potential to Reduce Deaths and Injuries from Mass Shootings Through Restrictions on Assault Weapons and Other High-Capacity Semiautomatic Firearms*, 19 CRIMINOLOGY & PUB. POL'Y 147, 149 (2020) (noting that besides accepting larger-capacity magazines, "assault weapons" like the AR-15 "do not operate differently than other comparable semiautomatics, nor do they fire more lethal ammunition").

such magazines are highly prone to jamming.[131] These magazines can render the AR-15 *less* lethal. The Aurora shooter's AR-15 with a one hundred-round drum jammed after firing sixty-five rounds, prompting the prosecutor to declare that "[h]ad the AR-15 not jammed, he would have killed more people."[132]

Both ban proponents and federal courts say that restricting magazine capacity to only ten rounds will force the shooter to make additional magazine changes, resulting in fewer shots fired and giving bystanders more opportunities to subdue the shooter or to escape the scene while the shooter is reloading.[133] They point to studies showing that larger-capacity magazines frequently are used in high-fatality mass public shootings.[134] This should not come as a surprise, given the ubiquity of such magazines. Larger-capacity magazines have long been sold both individually and as standard equipment on the most popular semiautomatic handguns and rifles.[135] Current estimates

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131. *See* Matthew Larosiere, *Losing Count: The Empty Case for "High-Capacity" Magazine Restrictions*, CATO INST. (July 17, 2018), https://www.cato.org/publications/legal-policy-bulletin/losing-count-empty-case-high-capacity-magazine-restrictions (noting that "extremely high-capacity magazines, such as 'drums' with [one hundred] or [two hundred] rounds" are more likely to malfunction).

132. Wian et al., *supra* note 105 (quoting the prosecutor); *see also* TRIDATA DIV., SYS. PLAN. CORP., AURORA CENTURY 16 THEATER SHOOTING: AFTER ACTION REPORT FOR THE CITY OF AURORA 12–13 (2014) [hereinafter AURORA AFTER ACTION REPORT] (indicating that the shooter fired sixty-five rounds from the rifle until it jammed).

133. *See, e.g.*, Kolbe v. Hogan, 849 F.3d 114, 127, 128 (4th Cir. 2017) (en banc) (explaining that large-capacity magazines "depriv[e] victims and law enforcement officers of opportunities to escape or overwhelm the shooters while they reload their weapons" and that "reducing the number of rounds that can be fired without reloading increases the odds that lives will be spared in a mass shooting"); *Large Capacity Magazines*, GIFFORDS L. CTR. TO PREVENT GUN VIOLENCE: HARDWARE & AMMUNITION, https://lawcenter.giffords.org/gun-laws/policy-areas/hardware-ammunition/large-capacity-magazines/ (last visited Jan. 30, 2020) ("Because shooters with such magazines can fire at large numbers of people without taking the time to reload, those in the line of fire do not have a chance to escape, law enforcement does not have the chance to intervene, and the number of lives shattered by acts of gun violence increases dramatically.").

134. *See, e.g.*, *Kolbe*, 849 F.3d at 126–27 (citing unnamed studies). For the most recent studies, see generally Louis Klarevas et al., *The Effect of Large-Capacity Magazine Bans on High-Fatality Mass Shootings, 1990–2017*, 109 AM. J. PUB. HEALTH 1754 (2019); Koper, *supra* note 130; Daniel Webster et al., *Evidence Concerning the Regulation of Firearms Design, Sale, and Carrying on Fatal Mass Shootings in the United States*, 19 CRIMINOLOGY & PUB. POL'Y 171 (2020).

135. *See* David Kopel, *Magazines over 10 Rounds Were Well-Known to the Founders*, REASON: THE VOLOKH CONSPIRACY (Feb. 11, 2020, 7:16 PM), https://reason.com/2020/02/11/magazines-over-10-rounds-were-well-known-to-the-founders/ ("[G]uns with ammunition capacity greater than [ten] rounds have existed

suggest that there are more than 100 million magazines holding more than ten rounds in circulation in the United States.[136] Thus, associating larger-capacity magazines with higher fatality rates may be evidence "only of popularity, not of lethality."[137]

Studies measuring larger-capacity magazine use in high-fatality mass public shootings ask the wrong question. What matters is not whether larger-capacity magazines were used in such shootings but whether smaller magazines would have reduced the number of casualties. If a shooter uses a thirty-round magazine, fires ten rounds, and kills eight people, a smaller magazine would not have changed the outcome. If potential victims are not in a position to overpower or escape the shooter when he reloads, a smaller magazine would not have changed the outcome. If alternate weapons are readily available to the shooter, again, smaller magazines would not have changed the outcome. Simply counting incidents and casualties overestimates the effects of magazine size on mass public shootings.

To determine the effects of magazine size, researchers must consider a wide array of variables, such as the shooter's determination to kill, how long the shooting lasted, the shooter's rate of fire, the total number of rounds fired, how often and how fast the shooter changed magazines, how many magazines or alternate weapons were readily available to the shooter, and the location, number, density, and posture of the victims. In the only study to date that attempts to analyze some of these variables, Gary Kleck presents evidence that larger-capacity magazines do not produce more lethal outcomes in

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since the sixteenth century, were well-known to the Founders (including the Continental Congress), and were mass market consumer items by the time of the Fourteenth Amendment.").

136. *See* Duncan v. Becerra, 970 F.3d 1133, 1142 (9th Cir. 2020) (noting that half of the 230 million magazines in circulation in America hold more than ten rounds); Griff Witte, *As Mass Shootings Rise, Experts Say High-Capacity Magazines Should Be the Focus*, WASHINGTON POST (Aug. 18, 2019, 6:23 PM), https://www.washingtonpost.com/national/as-mass-shootings-rise-experts-say-high-capacity-magazines-should-be-the-focus/2019/08/18/d016fa66-bfa3-11e9-a5c6-1e74f7ec4a93_story.html (noting the NRA estimates "that more than 250 million magazines with a capacity of [eleven] rounds or greater are in circulation. . . . [with] 100 million hav[ing] a capacity of at least [thirty] rounds"). Because popular semiautomatic handguns and long guns are not sold with standard magazine capacity exceeding thirty rounds, the vast majority of these magazines hold thirty rounds or less. Thus, larger forty to one hundred round magazines compose only a limited portion of the magazines in circulation.

137. Larosiere, *supra* note 131.

mass shootings.[138] Until more data are collected and analyzed, studies examining the frequency of larger-capacity magazine use in high-fatality mass shootings may make good headlines but reveal little about the actual effects of magazine capacity on firearm lethality.[139]

Larger-capacity magazines do allow a shooter to fire more shots before pausing to reload. If a shooter fires *continuously*—round after round without pause—a larger-capacity magazine will allow him to fire more shots than a smaller magazine, thereby increasing the firearm's lethality. The Dayton nightclub shooter fired forty-one shots in thirty seconds with an AR-15 equipped with a one hundred-round drum magazine before being shot by police.[140] Using a Glock 19 semiautomatic handgun with a thirty-three-round magazine, the Tucson shooter fired thirty-three rounds in fifteen seconds, after which he was tackled by bystanders when his handgun jammed either during or after reloading.[141] In both of these tragic shootings, a smaller magazine almost certainly would have meant fewer rounds fired—and likely fewer casualties—before the shooter was stopped. But, as these examples illustrate, larger-capacity magazines do not make the AR-15 "exceptional" or "far more lethal" in its rate of fire; rather, they show that the AR-15 with a larger-capacity magazine is no more lethal in its rate of fire than a semiautomatic handgun with a larger-capacity magazine.

Mass public shootings rarely involve continuous firing without interruption. The vast majority take place over several minutes, during which the shooter repeatedly pauses firing.[142] Because changing a magazine takes only a few seconds,[143] pauses due to reloading will not take any longer than pauses between shots when not reloading. Thus, it is unlikely that reloading will significantly slow the shooter and reduce the total rounds fired.[144] The Sutherland Springs church shooter changed magazines fifteen times, firing at

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138. *See* Gary Kleck, *Large-Capacity Magazines and the Casualty Counts in Mass Shootings: The Plausibility of Linkages*, 17 JUST. RES. & POL'Y 28, 44 (2016).

139. A significant problem with many of these studies is that they fail to disaggregate "assault weapons" and large-capacity magazines, thus inflating the figures for both. *See* Wallace, *supra* note 23, at 235.

140. Yan et al., *supra* note 104.

141. KLAREVAS, *supra* note 92, at 209; Press Release, Fed. Bureau of Investigation: Phx. Div., *supra* note 114.

142. *See* Gary Kleck, *Mass Shootings in Schools: The Worst Possible Case for Gun Control*, 52 AM. BEHAV. SCIENTIST 1447, 1451 (2009) ("[C]lose examination of mass shootings also indicates that killers typically take their time, firing deliberately at individual victims over fairly long periods of time.").

143. *See* Wallace, *supra* note 23, at 236.

144. *Id.* at 238.

least 450 rounds in seven minutes;[145] the Parkland school shooter fired more than 150 rounds in 5.5 minutes, changing magazines five times;[146] the Newtown shooter fired 156 rounds in five minutes, emptying three thirty-round magazines and replacing two other thirty-round magazines while they still contained ammunition;[147] the Fort Hood shooter used a semiautomatic handgun with twenty-round and thirty-round magazines, firing 214 rounds in ten minutes.[148] In none of these incidents did reloading so slow the shooters that potential victims were able to subdue the shooter or escape.[149]

Smaller magazines made little or no difference in the number of casualties in two tragic high-fatality mass public shootings. The Virginia Tech shooter fired 174 rounds from two handguns in ten to twelve minutes while walking back and forth among classrooms.[150]

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145. John Bridges et al., *Hundreds of Shell Casings, 15 Empty Magazines Found at Church*, STATESMAN (Sept. 22, 2018, 3:39 AM), https://www.statesman.com/news/20171107/hundreds-of-shell-casings-15-empty-magazines-found-at-church; Nomaan Merchant & Paul J. Weber, *Texas Church Shooter Devin Kelley Fired at Least 450 Rounds*, GLOB. NEWS (Nov. 6, 2017, 2:29 PM), https://globalnews.ca/news/3846016/texas-church-shooter-devin-kelley-assault-animal-cruelty/.

146. MARJORY STONEMAN DOUGLAS HIGH SCH. PUB. SAFETY COMM'N, INITIAL REPORT SUBMITTED TO THE GOVERNOR, SPEAKER OF THE HOUSE OF REPRESENTATIVES AND SENATE PRESIDENT 25–34, 91, 108 (2019); Evan Perez, *Florida School Shooter Could Have Fired Many More Bullets*, CNN (Feb. 27, 2018, 6:59 PM), https://www.cnn.com/2018/02/27/us/florida-school-shooter-ammunition-left/index.html.

147. OFF. OF THE STATE'S ATT'Y JUD. DIST. OF DANBURY, REPORT OF THE STATE'S ATTORNEY FOR THE JUDICIAL DISTRICT OF DANBURY ON THE SHOOTINGS AT SANDY HOOK ELEMENTARY SCHOOL AND 36 YOGANANDA STREET, NEWTOWN, CONNECTICUT ON DECEMBER 14, 2012, at 17–22 (2013). The Newtown shooter emptied three thirty-round magazines but did not wait until two other thirty-round magazines were empty to change them. *Id.* at 21–22.

148. Rick Jervis, *Fort Hood Massacre Trial: Hasan Goes on the Defense*, USA TODAY (July 8, 2013, 6:33 PM), https://www.usatoday.com/story/news/nation/2013/07/08/fort-hood-shooting-trial-hasan-court-martial/2427095/; Charley Keyes, *Fort Hood Witness Says He Feared There Were More Gunmen*, CNN (Oct. 20, 2010, 6:10 PM), http://www.cnn.com/2010/CRIME/10/20/texas.fort.hood.shootings/index.html?hpt=T1.

149. The Fourth Circuit in *Kolbe* twice claimed without any supporting citation that nine children ran from a classroom during the Newtown shooting when the gunman paused to change a thirty-round magazine. Kolbe v. Hogan, 849 F.3d 114, 120, 128 (4th Cir. 2017) (en banc). While initially reported in a few media accounts, this fact was never confirmed and does not appear in the official report on the shooting. Other news articles indicated that the shooter's gun jammed. *See* Wallace, *supra* note 23, at 239. Clearing a jam causes the shooter to pause longer because it requires more steps than simply removing and replacing the magazine.

150. *See* TRIDATA DIV., MASS SHOOTINGS AT VIRGINIA TECH: ADDENDUM TO THE REPORT OF THE REVIEW PANEL 74, 92 (2009) (discussing the Virginia Tech shooting).

During this period, he changed magazines seventeen times, including several ten-round magazines.[151] The shooting review panel considered whether a ban on larger-capacity magazines might have resulted in fewer casualties, but concluded that "[ten-round] magazines . . . would have not made much difference in the incident."[152] At Columbine, one shooter used a 9mm TEC-DC9 semiautomatic pistol with one twenty-eight-round, one thirty-two-round, and one fifty-two-round magazine to fire a total of fifty-five rounds.[153] The other shooter used thirteen ten-round magazines in a 9mm Hi-Point 995 semiautomatic carbine to fire ninety-six rounds during the same period of time.[154] What mattered more in both of these shootings was number of magazines readily available to the shooters, not their capacity.

While there are good reasons to question both the constitutionality and effectiveness of magazine size restrictions, such issues are beyond the scope of this Article.[155] My point is that even if the ability to accept larger-magazines arguably makes the AR-15 more lethal, it does not make the AR-15 lethal "far beyond" other non-banned firearms because many of those firearms also accept larger-capacity magazines. Moreover, the AR-15 does not require standard thirty-round magazines to function, so any enhanced lethal effects of larger-capacity magazines can be addressed by regulating magazine size.[156] The more narrowly-tailored solution under heightened judicial scrutiny is to ban the magazine rather than the firearm.

The AR-15 is no more dangerous in its rate of fire than other modern semiautomatic handguns, shotguns, and non-banned rifles.

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151. *Id.*

152. *Id.* at 74.

153. Carey Vanderborg, *Columbine Shooting Anniversary: Five Other Deadly School Shootings*, INT'L BUS. TIMES (Apr. 20, 2012, 11:14 AM), https://www.ibtimes.com/columbine-shooting-anniversary-five-other-deadly-school-shootings-555158; *The Point of No Return*, COAL. TO STOP GUN VIOLENCE, https://www.csgv.org/point-return/ (last visited Feb. 11, 2020). The two shooters also fired a combined thirty-seven shotgun rounds.

154. Vanderborg, *supra* note 153.

155. *See generally* Duncan v. Becerra, 970 F.3d 1133, 1169 (9th Cir. 2020) (striking down a California state law barring citizens from owning large capacity magazines because it imposed a substantial burden on the right to bear arms in self-defense); David B. Kopel, *The History of Firearm Magazines and Magazine Prohibitions*, 78 ALB. L. REV. 849 (2014) (analyzing the constitutionality of magazine prohibitions in light of precedents that rely on history and tradition in judging Second Amendment cases); Larosiere, *supra* note 131 ("[T]here is little evidence that high-capacity magazine restrictions have any positive effects on public safety.").

156. *See* Koper, *supra* note 130, at 149 (noting that without larger-capacity magazines, "AW-type firearms do not operate differently than other comparable semiautomatics, nor do they fire more lethal ammunition").

Its semiautomatic firing system produces a rate of fire comparable to all modern semiautomatic firearms, including constitutionally-protected semiautomatic handguns. Based on the rate of fire metric, the AR-15 is not exceptionally lethal.

B. The AR-15's Accuracy

There is no discussion of the AR-15's accuracy as enhancing its lethality in *Heller II*, *Friedman*, or *Worman* and only passing reference to accuracy in *NYSRPA* and *Kolbe*.[157] Instead, federal courts have focused on the AR-15's rate of fire and terminal effects to support their claims that the AR-15 is exceptionally lethal. This omission is understandable given the fact that mass public shootings typically occur at shorter distances against unarmed and unsuspecting victims where precise accuracy is not necessary to inflict casualties.

The AR-15 is easier to shoot more accurately than a handgun—but then so are *all* shoulder-fired long guns. Their size and weight provides greater stability, resulting in better accuracy when aiming and managing recoil. The long gun has three points of support—the buttstock is pressed against the shoulder, the dominant arm grips the stock or pistol grip, and the support arm holds the forend. The handgun has only two points of support—both arms hold the handgun in one place (around the grip) in front of and away from the body. The long gun also has a longer sight radius (distance between front and rear sight) than a handgun, which is more forgiving of sight alignment errors.

When compared to other long guns, the AR-15 is not exceptionally lethal in its accuracy; in fact, there are non-banned long guns widely sold in the civilian market that are more accurate than AR-15. Rifle accuracy typically is measured in MOA (Minutes of Angle), which refers to the capability to fire a certain-sized grouping of shots at a particular distance.[158] MOA accuracy is best measured when shooting from a stable position (e.g., prone) with the rifle supported by a bipod

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157. *See* Kolbe v. Hogan, 849 F.3d 114, 136 (4th Cir. 2017) (en banc) (stating that the semiautomatic fire of an AR-15 is more accurate and lethal than the automatic fire of an M16); N.Y. State Rifle & Pistol Ass'n v. Cuomo (*NYSRPA*), 804 F.3d 242, 262 (2d Cir. 2015) (asserting that features that make a firearm more accurate also make it more deadly).

158. *See* Ryan Cleckner, *What is MOA? Understanding and Using Minute of Angle,* GUN U. (Feb. 10, 2019), https://gununiversity.com/what-is-moa-understanding-and-using-minute-of-angle/.

or other shooting rest. A one-MOA rifle is capable of consistently firing three to five shot groupings no more than one inch apart at a distance of one hundred yards.[159] A one-MOA rifle can fire a two-inch group at two hundred yards, a three-inch group at three hundred yards, and so on.[160] Lower-priced AR-15s (under $1,000) typically shoot around two to three MOA (two to three inch groups at one hundred yards) with factory ammunition while high-end AR-15s (over $1,500) often shoot one MOA or sub-MOA (between 0.75 and one inch groups at one hundred yards).

A standard AR-15 generally is more accurate than the AK-47, another popular "assault weapon,"[161] but less accurate than bolt-action hunting and precision rifles, most of which shoot sub-MOA with some shooting sub-one-half-MOA.[162] Even with precision semiautomatic rifles, bolt-action rifles normally are more accurate, especially at longer distances.[163] At very short ranges, shotguns can more easily hit targets without the need for precise aim due to their spread fire pattern. At ten yards, the nine .33 caliber round pellets in 00 buckshot spread about 2–2.5 inches; at twenty yards, the spread pattern is seven to nine inches.[164] This capability to strike at short-ranges is one reason why some people choose a shotgun for home defense.

The AR-15's smaller rounds, straight-line design, and firing mechanism reduce recoil, which allows better second-shot accuracy than a shotgun or hunting rifle when firing rounds in quick succession. The benefit of increased second-shot accuracy depends on shooter skill, rate of fire, and target distance, but it is unlikely to turn average shooters into marksmen. Most firearms are mechanically more accurate than an average shooter can fire them. This especially is true when the shooter is moving and firing unsupported at targets

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159. One MOA at one hundred yards actually is 1.047 inches, but it is rounded off to one inch. *See id.*

160. *See id.*

161. *See* Nick Irving, *AK-47 Accuracy and Reliability*, SOFREP (July 19, 2018), https://sofrep.com/gear/ak-47-accuracy-and-reliability/.

162. *See* John B. Snow, *The 10 Most Accurate Factory Hunting Rifles We've Ever Tested*, FIELD & STREAM (Sept. 17, 2019), https://www.fieldandstream.com/10-most-accurate-factory-hunting-rifles-weve-ever-tested/. I have shot less than half-inch groups with my precision bolt-action rifle at one hundred yards.

163. *See* Nick Irving, *Sniper's Choice: Bolt-Action vs. Semi-Auto Precision Rifles*, SOFREP (Jan. 1, 2020), https://sofrep.com/gear/snipers-choice-bolt-action-vs-semi-auto-precision-rifles/.

164. *See* Kevin Davis, *Buckshot Myth Busting: How Today's 00 Buck Loads Fare Downrange*, TACTICAL LIFE (Mar. 21, 2018), https://www.tactical-life.com/gear/ammo/00-buckshot-ammo-test/.

short distances away as typically occurs in mass public shootings. While the AR-15 is accurate, there is no evidence that its accuracy far exceeds other firearms.[165]

C. The AR-15's Terminal Ballistics

Courts upholding "assault weapon" bans also assume the AR-15 is exceptionally lethal because it causes more devastating wounds than other firearms. The First, Second, and Fourth Circuits have declared that the AR-15 and other banned weapons have "a capability for lethality—more wounds, more serious, in more victims—far beyond that of other firearms in general, including other semiautomatic guns."[166] More wounds in more victims is a function of the AR-15's rate of fire, about which judicial claims are greatly exaggerated, as shown above. More serious wounds are a function of the AR-15's terminal ballistics, which studies the behavior and effects of a firearm's projectile when it strikes a target. The following examines the terminal performance of the AR-15's standard .223/5.56 round and compares it with other handgun, rifle, and shotgun rounds to determine whether the AR-15 is exceptionally lethal.

1. Measuring Bullet Over-penetration

Two circuits have specified that one reason "assault weapons" are more deadly than other firearms is that their bullets can penetrate walls and endanger people on the other side. The Fourth Circuit in *Kolbe* twice emphasized that the banned weapons "pose a heightened risk to civilians in that rounds from assault weapons have the ability to easily penetrate most materials used in standard home

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165. *See* Irving, *supra* note 163 (noting that military snipers opt for bolt-action rifles when solely looking for accuracy). Accurate firearms are more dangerous for the shooter's target but less dangerous for innocent bystanders. *See* Friedman v. City of Highland Park, 784 F.3d 406, 409 (7th Cir. 2015). It would be odd to ban accurate firearms while allowing possession and use of inaccurate firearms.

166. Worman v. Healey, 922 F.3d 26, 31 (1st Cir. 2019) (internal quotation marks omitted) (quoting H.R. REP. NO. 103-489, at 19–20 (1994)); Kolbe v. Hogan, 849 F.3d 114, 125, 137, 144 (4th Cir. 2017) (en banc) (same); N.Y. State Rifle & Pistol Ass'n v. Cuomo (*NYSRPA*), 804 F.3d 242, 262 (2d Cir. 2015) (same).

construction, car doors, and similar materials."[167] Citing *Kolbe*, the First Circuit in *Worman* declared that "unlike the use of handguns[,] the use of semiautomatic assault weapons implicates the safety of the public at large. After all, such weapons can fire through walls, risking the lives of those in nearby apartments or on the street."[168] What *Kolbe* implies, *Worman* makes explicit: "assault weapon" bullets penetrate walls, but handgun bullets do not.

Nearly all handgun, rifle, and shotgun rounds will pass through walls.[169] FBI testing indicates that to be reliably effective, bullets must penetrate soft body tissue twelve to eighteen inches, a range necessary to reach and disrupt a vital organ in a human target.[170] This penetration capability also means that bullets will penetrate walls if the shooter misses the target. Contrary to *Kolbe* and *Worman*, handgun rounds will penetrate several layers of sheetrock as well as exterior house walls.[171] The difference between handgun and rifle rounds is how they behave when passing through walls. A pistol round typically remains relatively stable, while the AR-15's longer and thinner profile .223/5.56-caliber round is likely to fragment or to lose

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167. 849 F.3d at 127, J.A. 279 (internal quotation marks omitted) (quoting a declaration of Henry Stawinski, a deputy police chief); *id.* at 139. Stawinski subsequently admitted that he had not been trained in the use of an AR-15 or other banned "assault weapons" and that he had fired an AR-15 on only one occasion. *Id.* at J.A. 2487–88.

168. 922 F.3d at 37 (citation omitted) (citing *Kolbe*, 849 F.3d at 127).

169. For a high-speed video demonstration of AR-15, handgun, and shotgun rounds fired through sheetrock, see Beck's Armory, *5.56, 12 Gauge, and 9mm vs Drywall in Slow Motion*, YOUTUBE (Jan. 17, 2015), https://www.youtube.com/watch?v=AXOIQgfvVlE. Both handgun and shotgun rounds penetrated fourteen layers of sheetrock, while a small fragment of the AR-15 round penetrated fifteen layers. For additional range testing of AR-15, handgun, and shotgun rounds, see *The Box O'Truth #1—The Original Box O'Truth*, https://www.theboxotruth.com/the-box-o-truth-1-the-original-box-o-truth/ (last visited Feb. 17, 2020), and *The Box O'Truth #14—Rifles, Shotguns, and Walls*, https://www.theboxotruth.com/the-box-o-truth-14-rifles-shotguns-and-walls/ (last visited Feb. 17, 2020).

170. *See* Mike Callahan, *Why Bullet Size Matters in Officer-Involved Shootings*, POLICEONE.COM (Aug. 2, 2017), https://www.policeone.com/police-products/firearms/accessories/ammunition/articles/why-bullet-size-matters-in-officer-involved-shootings-Ff0sxVITdSX8iAn7/.

171. *See* R.K. Campbell, *Handgun Bullets: How Do They Penetrate in Home Materials?*, GUNTESTS (Mar. 19, 2020), https://www.gun-tests.com/ammo/handgun-bullets-how-do-they-penetrate-in-home-materials-4/ (testing both wallboard and pine board penetration with various handgun rounds). *See generally* R.W. SCHEIFKE, CANADIAN POLICE RSCH. CTR., PENETRATION OF EXTERIOR HOUSE WALLS BY MODERN POLICE AMMUNITION (1997) (Can.) (showing that all tested handgun rounds except one passed through stucco, vinyl, and cedar siding with sufficient velocity to wound).

stability and tumble end-over-end (keyhole), bleeding energy rapidly due to the larger surface area hitting the drywall.[172] Generally, .223/5.56 bullets penetrate *less* through building materials than common handgun and shotgun rounds.[173] This is one reason law enforcement officers often use the select-fire M4 or semiautomatic AR-15 for raiding buildings and hostage situations, especially in urban areas.[174] Some bullet designs can reduce penetration through walls, but the best way to minimize the chances of hurting innocent persons is to make accurate hits on the target. As handguns also require more skill to fire accurately than rifles, they typically pose a greater risk to public safety from bullet over-penetration than the AR-15.[175]

Kolbe also emphasizes that rounds from "assault weapons" such as the AR-15 "easily pass through the soft body armor worn by most law enforcement officers."[176] But this is true of *all* rifles.[177] Soft body

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172. *See* Tom Hale, *Is an AR-15 Appropriate for Home Defense? Part One: Penetration Issues*, OUTDOOR HUB (Nov. 4, 2013), https://www.outdoorhub.com/stories/2013/11/04/ar-15-appropriate-home-defense-part-one-penetration-issues/; *[Study] Home Defense Overpenetration: Shotgun, Handgun, Rifle*, PEW PEW TACTICAL (Jan. 12, 2020), https://www.pewpewtactical.com/home-defense-overpenetration/#toc15.

173. *See* GABRIEL SUAREZ, THE TACTICAL RIFLE: THE PRECISION TOOL FOR URBAN POLICE OPERATIONS 38 (1999) (explaining that walls are more easily penetrated by pistol calibers, that concerns about .223/5.56 over-penetration and resulting danger to the public have been greatly exaggerated, and that such rounds are safer than pistol bullets because they tend to fragment when shot through a wall, reducing penetration); Gary K. Roberts, *The Wounding Effects of 5.56MM/.223 Law Enforcement General Purpose Shoulder Fired Carbines Compared with 12 GA. Shotguns and Pistol Caliber Weapons Using 10% Ordnance Gelatin as a Tissue Simulant*, WOUND BALLISTICS REV., 1998, at 16, 23–24 (describing testing results showing that .223/5.56 bullets fired through an interior wall had "significantly less penetration" than popular handgun and twelve gauge rounds and affirming that "stray 5.56mm/.223 bullets seem to offer a reduced risk of injuring innocent bystanders . . . where bullets miss their intended targets and enter or exit structures").

174. *See* Kolbe v. Hogan, 849 F.3d 114, J.A. 2168–68 (4th Cir. 2017) (declaration of Boone). Boone is a firearms and ballistics expert, firearms trainer, and former FBI agent who directed the FBI Ballistic Research Facility for fifteen years. When confronting outdoor threats, officers typically use "barrier blind" rounds that can penetrate vehicle sheet metal and glass. *See* Jeff Chudwin, *The Ammunition Factor*, LAW OFFICER (Jan. 18, 2017), https://www.lawofficer.com/the-ammunition-factor.

175. *See* David Schoenberg, *Top Gun . . . for Home Defense*, DAILY CALLER (Mar. 14, 2012, 2:08 PM), https://dailycaller.com/2012/03/14/top-gun…for-home-defense/.

176. *Kolbe*, 849 F.3d at 127 (internal quotation marks omitted).

177. *See* U.S. DEP'T OF JUST., SELECTION AND APPLICATION GUIDE TO PERSONAL BODY ARMOR 15 (2001) (noting that "body armor designed to defeat rifle fire" must have "semirigid or rigid construction").

armor (Levels I-IIIA) only stop rounds from handguns and shotguns; rifle rounds require steel, ceramic, or composite hard plates (Levels III-IV).[178] The Fourth Circuit's point might explain one way rifles are more dangerous than handguns, but it does not explain why the AR-15 is itself exceptionally lethal "far beyond" other rifles.[179]

Both *Kolbe* and *Worman* embrace the false narrative that the AR-15 is more lethal than other firearms because it poses a greater risk of bullet over-penetration. Experts on both sides pointed out to the Fourth Circuit in *Kolbe* that all rifles penetrate soft armor,[180] and plaintiffs' experts emphasized that all firearms penetrate building materials,[181] but the court nevertheless concluded that the banned weapons "pose *heightened* risks to innocent civilians and law enforcement officers—certainly because of the capability to penetrate building materials and soft body armor."[182] Heightened compared to what? Certainly not the risks posed by most other firearms in penetrating building materials as handgun and shotgun rounds typically penetrate as much or more than AR-15 rounds. And certainly not the risks posed by other rifles in penetrating soft body armor because the AR-15's capability to penetrate such armor is a feature common to all rifles and not exclusive to the AR-15 or other "assault weapons." Bullet over-penetration is not a reason to conclude that the AR-15 is exceptionally lethal.

2. Measuring Wound Severity

Wound ballistics is a subset of terminal ballistics and studies the effects of a penetrating projectile on living tissue. Dr. Martin Fackler, former military trauma surgeon and director of the Army's Wound Ballistics Laboratory, is the most widely-recognized modern expert on

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178. *See* JUST. TECH. INFO. CTR., UNDERSTANDING NIJ 0101.06 ARMOR PROTECTION LEVELS CENT (2016). *See generally Body Armor Performance Standards*, NAT'L INST. OF JUST. (Feb. 22, 2018), https://nij.ojp.gov/topics/articles/body-armor-performance-standards (describing the National Institute of Justice's general requirements for body armor worn by law enforcement and corrections officers).

179. *Kolbe*, 849 F.3d at 125, 137, 144 (internal quotation marks omitted).

180. *Id.* at 127 (quoting *id.* at J.A. 279 (noting the state's expert declared that "rounds from many handguns also can penetrate through such materials")); *id.* at 129, 139 (describing plaintiffs' evidence).

181. *Id.* at 129, 139.

182. *Id.* at 139 (emphasis added).

the subject.[183] He observed in 1987 that "[p]robably no scientific field contains more misinformation than wound ballistics."[184] Research by Dr. Fackler and others helped correct these misconceptions.[185] Despite this research, erroneous beliefs about wound ballistics persist, even among medical doctors who treat gunshot wounds.[186] "Assault weapon" ban proponents—including physician advocates—continue to spread multiple myths about the wounding effects of such firearms, and some of these myths have made their way into federal court decisions upholding "assault weapon" bans.

Kolbe, for example, misleadingly asserts that military field testing from Vietnam in 1962 reported that high-velocity projectiles from the AR-15 caused "[a]mputations of limbs, massive body wounds, and decapitations."[187] This AR-15 was the selective-fire prototype for the military M16, not today's semiautomatic-only civilian AR-15. The testing was conducted as part of Project AGILE, part of a

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183. *See* David B. Powers & O. Bailey Robertson, *Ten Common Myths of Ballistic Injuries*, 17 ORAL MAXILLOFACIAL SURGERY CLINICS N. AM. 251, 251 (2005) ("Any investigation of ballistic injuries after 1970 is in some way based on the work of Martin Fackler, from the International Wound Ballistics Association, who is generally considered to have brought true scientific, critical evaluation to the study of ballistics."); W. Hays Parks, *Father of Modern Wound Ballistics*, SMALL ARMS DEF. J. (Aug. 11, 2017), http://www.sadefensejournal.com/wp/father-of-modern-wound-ballistics/.

184. MARTIN L. FACKLER, WHAT'S WRONG WITH THE WOUND BALLISTICS LITERATURE, AND WHY 1 (1987).

185. *See, e.g.*, MARTIN L. FACKLER, WOUND BALLISTICS RESEARCH OF THE PAST TWENTY YEARS: A GIANT STEP BACKWARDS 1 (1990); Martin L. Fackler, *Gunshot Wound Review*, 28 ANNALS EMERGENCY MED. 194, 195 (1996) [hereinafter Fackler, *Gunshot Wound Review*]; Martin L. Fackler, *Wound Ballistics: A Review of Common Misconceptions*, 259 JAMA 2730, 2730 (1988) [hereinafter Fackler, *Common Misconceptions*].

186. *See* Peter M. Rhee et al., *Gunshot Wounds: A Review of Ballistics, Bullets, Weapons, and Myths*, 80 J. TRAUMA ACUTE CARE SURGERY 853, 853–55 (2016) ("[M]any health care providers' understanding of ballistics, bullets, and guns . . . are falsely propagated because of media, uneducated beliefs, and urban legends" (footnotes omitted)). *See generally* Stephen C. Hafertepen et al., *Myths and Misinformation About Gunshot Wounds May Adversely Affect Proper Treatment*, 39 WORLD J. SURGERY 1840 (2015) (identifying several myths about wound ballistics appearing in current trauma literature and prevalent among 115 clinicians who provided both surgical and emergency medical care for a large number of gunshot wounds in three California urban trauma centers).

187. Kolbe v. Hogan, 849 F.3d 114, 124, J.A. 968 (4th Cir. 2017) (en banc) (internal quotation marks omitted) (quoting KEVIN DOCKERY, SPECIAL WARFARE: SPECIAL WEAPONS: THE ARMS & EQUIPMENT OF THE UDT AND SEALS FROM 1943 TO THE PRESENT 131 (2009)).

counterinsurgency research program in southeast Asia initiated by the Defense Department's Advanced Research Projects Administration (ARPA).[188] At the time, the military was considering whether to replace the M14 with the AR-15 (later renamed the M16) as its primary combat rifle.[189] Project AGILE supplied AR-15 selective-fire rifles to South Vietnamese combat troops for field trials to determine whether the AR-15 would perform satisfactorily in combat.[190] The subsequent report included claims of massive injuries from the AR-15's 5.56mm round, including two amputations and a decapitation—types of injuries "rarely observed from rifle bullets."[191]

The claims of massive wounding, amputations, and decapitations in the Project AGILE report were never substantiated.[192] The military subsequently ordered worldwide testing of the AR-15 and M14, but these trials eventually broke down amid cross-accusations of bias and collusion from proponents of each rifle.[193] Nevertheless, the Army's Wound Ballistic Laboratory at Edgewood Arsenal tested the lethality of the AR-15 in gelatin, animals, and cadavers but could not duplicate the "theatrically grotesque wounds" reported by Project AGILE.[194] "No matter what they did," writes C.J. Chivers, who extensively researched the testing, "they were unable to reproduce the effects that the participants in Project AGILE claimed to have seen."[195] Testing included hollow-point rounds like those used by civilians, but "even the hollow-points failed to duplicate anything like the spectacular effects recorded by the Vietnamese unit commanders and their American advisors, which had subsequently been taken as fact and much used in the . . . campaign to sell the AR-15."[196] The Wound Ballistic Laboratory's lethality study was kept secret for more than

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188. *See M16 Rifle*, DEF. ADVANCED RSCH. PROJECTS AGENCY, https://www.darpa.mil/about-us/timeline/agile-and-m16 (last visited Feb. 24, 2020).

189. *Id.*

190. *Id.*

191. C.J. CHIVERS, THE GUN 283 (2010) ("In order to accept these descriptions at face value, one would have to believe that in a small sampling of injuries the AR-15 had caused two traumatic amputations—a type of injury rarely observed from rifle bullets. But such coolheaded skepticism did not work its way into the report. A sales pitch was gathering momentum: The AR-15 was the most lethal rifle the world had known.").

192. *See id.* at 288.

193. *See id.* at 283–90; R. BLAKE STEVENS & EDWARD C. EZELL, THE BLACK RIFLE: M16 RETROSPECTIVE 110–16 (2004).

194. CHIVERS, *supra* note 191, at 283–88; STEVENS & EZELL, *supra* note 193, at 116.

195. CHIVERS, *supra* note 191, at 288.

196. STEVENS & EZELL, *supra* note 193, at 116.

four decades, with the result that "at the most important time, during the early and mid-1960s, the Project AGILE report, with its suspicious observations and false conclusions, remained uncontested. The AR-15 continued to rise, boosted by a reputation for lethality and reliability that it did not deserve."[197] *Kolbe* omits these facts, leaving the impression that civilian AR-15s today produce the same gruesome and horrific wounds reported by Project AGILE.

Worman has the most extensive discussion of wound severity. It quotes from the affidavit of Dr. Christopher Colwell, a "seasoned trauma surgeon" (actually an emergency room doctor, not a surgeon),[198] who says that "assault weapon" injuries "tend to cause far greater damage to the muscles, bones, soft tissue, and vital organs."[199] *Worman* then cites two media articles that "substantiate the extreme damage such weapons are prone to cause."[200] One article from the *New York Times* quotes a doctor who says "[t]he tissue destruction is almost unimaginable. Bones are exploded, soft tissue is absolutely destroyed. The injuries to the chest or abdomen—it's like a bomb went off."[201] The other article from the *Washington Post* quotes a doctor who observes that "[i]f a 9mm bullet strikes someone in the liver . . . that person might suffer a wound perhaps an inch wide, . . . [b]ut if you're struck in the liver with an AR-15, it would be like dropping a

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197. CHIVERS, *supra* note 191, at 289 (footnote omitted). Dr. Fackler recounts that there were other claims in the 1960s and 70s that the M16's high-velocity bullets caused "massive" and "devastating" injuries, but these claims were disproven or contradicted by other reports. Delegates to war surgery conferences in the early 1970s "reported no unusual problems associated with 'high-velocity' bullet wounds in Vietnam. There were no reports of rifle bullet wounds causing traumatic amputations of an extremity." Fackler, *Gunshot Wound Review*, *supra* note 185, at 194–95.

198. Worman v. Healey, 922 F.3d 26, 39, J.A. 0853 (1st Cir. 2019) (citing an affidavit of Christopher Colwell, M.D.). For the differences between emergency room doctors and trauma surgeons, see Marijke Vroomen Durning, *Trauma Surgeons v. ER Doctors: What's the Difference?*, UCLA DAVID GEFFEN SCH. OF MED. (Feb. 28, 2017), https://medschool.ucla.edu/body.cfm?id=1158&action=detail&ref=937 (noting that trauma surgeons take care of severely injured patients from surgery through rehabilitation and discharge, while emergency room doctors initially stabilize the patient).

199. 922 F.3d at 39, J.A. 0854 (internal quotation marks omitted) (quoting the affidavit of Dr. Colwell, M.D.).

200. *Id.* (citations omitted).

201. *Id.* (internal quotation marks omitted) (quoting Gina Kolata & C.J. Chivers, *Wounds from Military-Style Rifles? 'A Ghastly Thing to See'*, N.Y. TIMES (Mar. 4, 2018), https://www.nytimes.com/2018/03/04/health/parkland-shooting-victims-ar15.html).

watermelon onto the cement. It just is disintegrated."[202] To understand why these accounts are misleading, factors that affect wound severity must be examined.[203]

a. The Fundamentals of Wound Ballistics

Like most modern rifles, the AR-15 fires "high-velocity" bullets while most modern handguns fire "low-velocity" bullets.[204] But more velocity does not necessarily mean greater wound severity—a ping-pong ball and a rifle bullet fired at the same velocity will produce very different terminal results.[205] Compare the wounding effects of 00-buckshot from a twelve-gauge shotgun, a .44 caliber Magnum hollow-point bullet, and .22 caliber rimfire bullet—all three fired from a distance of about fifteen feet.[206] The shotgun will cause far more tissue disruption than the .44 Magnum handgun, and the .44 Magnum handgun will cause far more disruption than the .22 rifle, despite the

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202. *Id.* at 39–40 (alteration in original) (internal quotation marks omitted) (quoting Tim Craig et al., *As the Wounded Kept Coming, Hospitals Dealt with Injuries Rarely Seen in U.S.*, WASHINGTON POST (Oct. 3, 2017), https://www.washingtonpost.com/national/health-science/as-the-wounded-kept-coming-hospitals-dealt-with-injuries-rarely-seen-in-the-us/2017/10/03/06210b86-a883-11e7-b3aa-c0e2e1d41e38_story.html).

203. What follows is a general discussion of wound ballistics as it ultimately relates to AR-15 lethality. For more detailed explanations of wound ballistics, see generally Martin L. Fackler, *Civilian Gunshot Wounds and Ballistics: Dispelling the Myths*, 16 EMERGENCY MED. CLINICS 17 (1998) [hereinafter Fackler, *Civilian Gunshot Wounds*]; Fackler, *Gunshot Wound Review*, *supra* note 185; Jeremy J. Hollerman et al., *Gunshot Wounds: 1. Bullets, Ballistics, and Mechanisms of Injury*, 155 AM. J. ROENTGENOLOGY 685 (1990); Panagiotis K. Stefanopoulos et al., *Wound Ballistics of Firearm-Related Injuries—Part 1: Missile Characteristics and Mechanisms of Soft Tissue Wounding*, 43 INT'L J. ORAL & MAXILLOFACIAL SURGERY 1445 (2014) [hereinafter Stefanopoulos et al., *Wound Ballistics of Firearm-Related Injuries*]; Panagiotis K. Stefanopoulos et al., *Wound Ballistics of Military Rifle Bullets: An Update on Controversial Issues and Associated Misconceptions*, 87 J. TRAUMA & ACUTE CARE SURGERY 690 (2019) [hereinafter Stefanopoulos et al., *Wound Ballistics of Military Rifle Bullets*]; Martin L. Fackler, *Wound Profiles*, WOUND BALLISTICS REV., 2001, at 25 [hereinafter Fackler, *Wound Profiles*].

204. Velocity is measured at the point the bullet leaves the muzzle of the firearm. There is no scientific or industry definition of "high-velocity." For American researchers who typically assign numerical values to the term, high-velocity bullets generally refer to bullets that travel at least 2,500 feet per second, while low-velocity bullets travel at 1,200 feet per second or less. *See, e.g.*, Rhee et al., *supra* note 186, at 855–56.

205. Thanks to Dr. Paul Maurer for this helpful illustration.

206. *See* Fackler, *Civilian Gunshot Wounds*, *supra* note 203, at 23.

fact that all three have approximately the same muzzle velocity.[207] While a bullet's velocity can affect wound severity, it is not the sole measure.[208]

A related factor is the amount of energy the bullet transfers or "deposits" to a body when it hits. This is commonly known as "kinetic energy" and is measured in foot pounds (a force of one pound moving through a distance of one foot) (ft/lbs).[209] Both velocity and bullet mass contribute to kinetic energy with velocity being the greater determinant as shown in the formula for calculating kinetic energy: one-half bullet mass times velocity squared ($KE = {}^1/_2mv^2$).[210] The following table compares the typical velocity and kinetic energy of modern handgun, rifle, and shotgun projectiles measured at the firearm's muzzle and at a distance of one hundred yards:[211]

Caliber	**Bullet Weight Grains**	**Velocity @Muzzle ft/s**	**Velocity @100 yds ft/s**	**Energy @Muzzle ft/lbs**	**Energy @100 yds Ft/lbs**
Handguns					
9 mm	115	1,140	954	332	232
.357 Magnum	125	1,500	1,147	624	365
.40 S&W	175	1,010	899	396	314
.44 Mag	200	1,500	1,196	999	635
.45 ACP +P	230	950	872	461	385
Long-guns					
.22LR Rimfire	40	1,070	908	102	73

207. *Id.*; *see, e.g.*, *Power-Shok Buckshot 12 Gauge*, FED. PREMIUM, https://www.federalpremium.com/shotshell/power-shok/power-shok-buckshot---low-recoil/11-F130+00.html (last visited Sept. 25, 2020) (listing the Federal Power-Shok twelve-gauge 2.75 inch 00-buckshot velocity as 1,290 ft/s); *Power-Shok Handgun 44 Rem Magnum*, FED. PREMIUM, https://www.federalpremium.com/handgun/power-shok/power-shok-handgun/11-C44A.html (last visited Sept. 25, 2020) (listing the Federal Power-Shok .44 Rem Magnum JHP 240 gram velocity as 1230 ft/s); *Small Game 22 LR*, FED. PREMIUM, https://www.federalpremium.com/rimfire/federal-small-game-and-target/game-shok/11-710.html (last visited Sept. 25, 2020) (listing the Federal Game-Shok .22LR 40 gram velocity as 1,240 ft/s).

208. *See* Fackler, *Civilian Gunshot Wounds*, *supra* note 203, at 18 ("The false belief that a bullet damages tissue in direct proportion to its velocity is widespread."); Stefanopoulos et al., *Wound Ballistics of Firearm-Related Injuries*, *supra* note 203, at 1448 ("[C]urrent thinking suggests that the impact velocity can be misleading as the sole indicator of the extent and severity of the inflicted wound." (footnotes omitted)).

209. Rhee et al., *supra* note 186, at 855–56.

210. *Id.* at 855.

211. The table figures are based on various bullet data available generally at hornady.com, federalpremium.com, and cci-ammunition.com.

.223/5.56	**55**	**3,240**	**2,854**	**1,282**	**995**
.223/5.56	**62**	**3,060**	**2,714**	**1,289**	**1,014**
.243 Win	90	3,150	2,911	1,983	1,693
.260 Rem	129	2,930	2,737	2,459	2,145
6.5 Creedmoor	143	2,700	2,557	2,315	2,076
.270 Win	145	2,970	2,796	2,840	2,516
.308 Win	165	2,700	2,496	2,670	2,282
.30-06	178	2,750	2,582	2,989	2,635
.300 Win Mag	180	2,960	2,766	3,502	3,058
.338 Lapua Mag	270	2,800	2,680	4,699	4,304
.50 BMG	750	2,820	2,728	13,241	12,388
12-gauge shotgun slug	438	1,610	1,139	2,521	1,262

Rifle and shotgun projectiles, including the AR-15's .223/5.56 bullet, strike with much higher kinetic energy than handgun bullets. But among rifle bullets, the .223/5.56 strikes with much less kinetic energy.

How bullets injure and kill has less to do with velocity and kinetic energy than with the location of impact, the bullet's physical characteristics (mass, shape, and construction), and the type of tissues disrupted along the bullet's path.[212] Two wounding mechanisms cause tissue damage: (1) the tissue in the bullet's path will be permanently *crushed*; and (2) the tissue surrounding the bullet's path may be temporarily *stretched*.[213] The tissue crushed by the bullet as it passes through the body is called the permanent cavity or wound track.[214] The size of the permanent cavity is proportional to the size of the bullet.[215] If the bullet is traveling fast enough, the pressure wave following the bullet also can cause transient displacement of tissue surrounding the wound track, which is called the temporary cavity.[216] Temporary cavitation also can cause significant wound damage, but "[t]he degree of injury produced by temporary cavitation is quite variable, erratic, and highly dependent

212. Fackler, *Civilian Gunshot Wounds*, *supra* note 203, at 19; Fackler, *Gunshot Wound Review*, *supra* note 185, at 202.

213. Hollerman et al., *supra* note 203, at 686–88.

214. *Id.* at 686.

215. Paul J. Dougherty et al., *Urban Gunshot Wound Ballistics*, 21 TECHS. ORTHOPEDICS 181, 182 (2006).

216. Fackler, *Gunshot Wound Review*, *supra* note 185, at 197–99; Hollerman et al., *supra* note 203, at 687–88.

on anatomic and physiologic considerations."[217] Such considerations include the size and location of the temporary cavity on the bullet's path and the elasticity of the tissue affected.[218] Less elastic tissue such as the brain, liver, and kidney and fluid-filled organs such as the heart are more likely to shatter, rupture, or tear due to temporary cavitation.[219] More elastic tissue such as muscle, lungs, skin, and blood vessels and empty or hollow organs such as the stomach, bladder, or intestines can absorb energy, making them much more resistant to injury caused by temporary cavitation.[220] Bone fractures from temporary cavitation are rare—when a bone is shattered, it typically is due to being struck by the bullet.[221] Wound injuries to extremities normally come from being hit by the bullet or bullet fragments (or bone fragments if the bone is hit) rather than by temporary cavitation.[222]

The bullet's shape and construction determine its tendency to deform, fragment, or yaw once it strikes, which can greatly affect its wounding potential.[223] When striking tissue with sufficient velocity, expanding hollow-point or soft-point bullets deform as their tip flattens or "mushrooms," giving the bullet a larger diameter, which crushes more tissue and increases the size of both the permanent and

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217. Letter from Gary K. Roberts, D.D.S., Stan. Univ. Med. Ctr. (Mar. 31, 2013) (available at http://nebula.wsimg.com/fb54bbe7bcde47ffde93ea48ce9b9f13?AccessKeyId=D0DCC35FC05D0FC60556&disposition=0&alloworigin=1); *see also* Fackler, *Gunshot Wound Review*, *supra* note 185, at 199 ("[T]he damage caused in the human body by a bullet's temporary cavity can vary greatly, depending on the size of the cavity and its anatomic location.").

218. Fackler, *Gunshot Wound Review*, *supra* note 185, at 199.

219. Hollerman et al., *supra* note 203, at 688.

220. Letter from Gary K. Roberts, *supra* note 217; *see also* Hollerman et al., *supra* note 203, at 688.

221. Fackler, *Gunshot Wound Review*, *supra* note 185, at 199 ("When a bone is broken by cavitation, the fracture is a simple one. A gunshot fracture with multiple bone fragments separated by several centimeters and usually mixed with fragments of the projectile is a clear sign that the bone was struck by the bullet and not damaged by temporary cavitation.").

222. Hollerman et al., *supra* note 203, at 688 ("[A]lthough formation of a large temporary cavity often has devastating effects in the brain or liver, its effects in wounds of the extremities has frequently been exaggerated . . . . Fracture of large bones not hit by the bullet and tearing of major vessels or nerves by the temporary cavity . . . are rare in clinical experience. This includes a systematic review of [1,400] rifle wounds sustained in the Vietnamese War and analyzed in the Wound Data and Munitions Effectiveness Team (WDMET) study." (citation omitted)).

223. Fackler, *Gunshot Wound Review*, *supra* note 185, at 195.

temporary cavities.[224] This occurs with both higher-velocity rifle bullets and lower-velocity handgun bullets, although temporary cavitation typically is not as large with medium and smaller caliber handgun rounds.[225] Depending on their velocity and construction, expanding soft-point bullets also can fragment in tissue, with the fragments spreading out and creating their own wound tracks separate from the main wound track.[226] These fragments greatly increase the permanent cavity size as they tear and detach tissue displaced by the temporary cavity.[227] For expanding rifle bullets, "[m]ushrooming increases the presented area by four to six times, making the bullet not only blunter but also stable, thus preventing tumbling," but creating early massive cavitation.[228] A deforming or fragmenting bullet from a powerful handgun "can also produce 'high-energy' effects to tissue, resembling those from a much faster assault rifle bullet."[229]

Full metal jacket (FMJ) bullets—sometimes called "ball ammo"—do not expand or flatten.[230] These non-deforming bullets penetrate to greater depths but make smaller permanent and temporary

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224. Stefanopoulos et al., *Wound Ballistics of Military Rifle Bullets*, *supra* note 203, at 696; *see also* Stefanopoulos et al., *Wound Ballistics of Firearm-Related Injuries*, *supra* note 203, at 1451–52; *id.* at 1446 (noting that expanding bullets [either] have their tip exposed (soft-point) or hollowed out (hollow-point)).

225. *See* Fackler, *Common Misconceptions*, *supra* note 185, at 2731 ("Temporary cavitation is not a modern phenomenon associated exclusively with projectiles of high velocity."); Fackler, *Gunshot Wound Review*, *supra* note 185, at 199–200 (describing the temporary cavitation caused by common expanding handgun rounds); Hollerman et al., *supra* note 203, at 687 ("The temporary cavity caused by common handgun bullets is too small to be a significant wounding factor in all but the most sensitive tissues (brain and liver). . . . [L]arge handgun bullets (e.g., .44 magnum) often induce a large temporary cavity . . . ." (footnotes omitted)).

226. Rhee et al., *supra* note 186, at 863; Stefanopoulos et al., *Wound Ballistics of Firearm-Related Injuries*, *supra* note 203, at 1451, 1454 (noting that expanding lower-velocity handgun rounds typically do not fragment unless they strike bone).

227. Fackler, *Civilian Gunshot Wounds*, *supra* note 203, at 22.

228. Stefanopoulos et al., *Wound Ballistics of Military Rifle Bullets*, *supra* note 203, at 696; *see* Hollerman et al., *supra* note 203, at 686.

229. Stefanopoulos et al., *Wound Ballistics of Military Rifle Bullets*, *supra* note 203, at 696.

230. With FMJ bullets, the soft lead inner core is covered by a thin jacket of harder metal (typically copper or steel alloy), which keeps the bullet from expanding or flattening in tissue. *Id.* The Hague Convention of 1899 banned the use of hollow-point ammunition in international warfare. The United States was not a signatory to the Convention but generally follows this practice. *See* Christian Beekman, *Why the US Military Should Switch to Hollow-Points*, TASK & PURPOSE (Jan. 8, 2015, 3:27 PM), https://taskandpurpose.com/argument-us-military-switch-hollow-points.

cavities.[231] Non-deforming rifle bullets can yaw after they strike, increasing wound severity. The center of gravity for the typical rifle bullet with a pointed, oblong shape (sometimes called a "Spitzer" bullet)[232] is closer to the bullet's base than its point. The natural tendency for the bullet to travel base-forward is overcome during flight by the firearm's rifled barrel spinning the bullet fast enough to give it sufficient gyroscopic stability to maintain an aerodynamic point-forward position.[233] When the bullet strikes, it produces minimal damage as it travels point-forward through tissue at the beginning of the wound track,[234] but as it goes deeper it decelerates, becomes unstable, and can yaw as much as 180 degrees so that the base becomes the leading edge.[235] "Yaw in tissue has a major influence on the wounding process because it involves a greater projectile area contacting and severing more tissue. As the bullet approaches [ninety degrees] of yaw, its entire length acts to [a]ffect tissue disruption in the extreme, resulting in maximum energy transfer."[236] Not only does the bullet's yaw create a larger permanent wound track, it also produces a larger temporary cavity.[237] Most non-deforming handgun bullets yaw to some degree, but usually not enough to cause significant additional damage.[238] Non-deforming bullets also may fragment due to stress from traveling sideways when yawing or after striking bone, increasing wound severity.[239]

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231. *See* Fackler, *Common Misconceptions*, *supra* note 185, at 2732 (noting that the damage from a nondeforming bullet was only slightly larger than the bullet dimensions).

232. Rhee et al., *supra* note 186, at 858 (noting that "Spitzer" comes from the German word Spitzgeschoss, meaning "pointy bullet").

233. Fackler, *Wound Profiles*, *supra* note 203, at 35 fig.21. A common misconception is that increased wound severity is due to a bullet yawing or tumbling *in flight* before it hits the target. Properly designed bullets fired from rifled barrels (i.e., having spiral grooves that spin the bullet as it travels down the barrel) yaw no more than a few degrees during flight. *See* Fackler, *Common Misconceptions*, *supra* note 185, at 2732.

234. *See* Fackler, *Gunshot Wound Review*, *supra* note 185, at 202 ("The damage caused by the [FMJ] military rifle bullet before it yaws . . . cannot be differentiated from that caused by a handgun bullet even by the most expert." (footnotes omitted)).

235. Rhee et al., *supra* note 186, at 863.

236. Stefanopoulos et al., *Wound Ballistics of Firearm-Related Injuries*, *supra* note 203, at 1450 (footnotes omitted).

237. Fackler, *Civilian Gunshot Wounds*, *supra* note 203, at 19.

238. Panagiotis K. Stefanopoulos et al., *Gunshot Wounds: A Review of Ballistics Related to Penetrating Trauma*, 3 J. ACUTE DISEASE 178, 182 (2014).

239. Hollerman et al., *supra* note 203, at 686–87.

The distance non-deforming rifle bullets travel in tissue before they yaw affects wound severity. About 70% of military 5.56mm FMJ bullets travel point-forward an average of about five inches before beginning to yaw.[240] About 15% yaw at a shallower depth of penetration while the other 15% yaw at greater depth.[241] One variable in determining the distance to yaw is the bullet's "angle of attack" (AOA) when initially striking the target at short distances. The straighter the bullet hits the target, the longer it will take to yaw after it strikes.[242] Thus, despite its high-velocity impact, a non-deforming FMJ rifle bullet can pass completely through a human target without significant yaw, causing minimal damage unless it strikes a vital organ, bone, or other critical structure.[243] This explains the multiple battlefield reports discussed earlier of 5.56mm FMJ bullets passing through enemy combatants.[244] Dr. Fackler recounts that:

> [i]n 1980, I treated a soldier shot accidentally with an M16 M 193 bullet from a distance of about ten feet. The bullet entered his left thigh and traveled obliquely upward. It exited after passing through about eleven inches of muscle. The man walked [into] my clinic with no limp whatsoever: the entrance and exit holes were about 4mm across, and punctate. X-ray films showed intact bones, no bullet fragments, and no evidence of significant tissue disruption caused by the bullet's temporary cavity. The bullet path passed well lateral to the femoral vessels. He was back on duty in a few days. Devastating? Hardly.[245]

Dr. Fackler further notes that "[i]n my experience and research, at least as many M16 users in Vietnam concluded that [the 5.56mm

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240. Fackler, *Gunshot Wound Review*, *supra* note 185, at 197 fig.4, 200 fig.7.

241. *Id.*

242. *See* Stefanopoulos et al., *Wound Ballistics of Military Rifle Bullets*, *supra* note 203, at 695.

243. *See* Stefanopoulos et al., *Wound Ballistics of Firearm-Related Injuries*, *supra* note 203, at 1451, 1454 tbl.2; Stefanopoulos et al., *Wound Ballistics of Military Rifle Bullets*, *supra* note 203, at 695.

244. *See* Stefanopoulos et al., *Wound Ballistics of Military Rifle Bullets*, *supra* note 203, at 695; *supra* text accompanying notes 38–44.

245. Martin L. Fackler, *Literature Review*, WOUND BALLISTICS REV., 2001, at 39, 40 [hereinafter Fackler, *Literature Review*].

M193 round] produced unacceptably minimal, rather than 'massive,' wounds."[246]

Both deforming (soft-point and hollow-point) and non-deforming (FMJ or "ball") ammunition for handguns and rifles are available on the civilian market, the latter typically costing less. To summarize the behavior of these bullets in tissue: soft-point and hollow-point rifle bullets begin to deform (expand or mushroom) within the first inch or two after striking tissue and often fragment, causing larger permanent and temporary cavities.[247] Depending on where they strike, these bullets can produce more severe wounds than non-deforming FMJ bullets, which do not expand or mushroom.[248] Non-deforming rifle bullets, however, typically begin to yaw after traveling about five inches in tissue and then may fragment.[249] Only when non-deforming rifle bullets yaw to ninety degrees or fragment is their most severe wounding potential realized.[250] Sometimes non-deforming rifle bullets exit the body before significant yaw occurs.[251] With a person who is smaller or slimmer in stature, a non-deforming rifle bullet may pass through and exit without tumbling or fragmenting, leaving a small wound channel and mild injury (assuming it misses vital organs or bones).[252] Even with larger persons, a non-deforming FMJ rifle bullet typically will pass through an extremity unless it strikes bone.[253] Most hollow-point handgun bullets will deform or mushroom on impact (although the degree of deformation varies), and FMJ bullets typically will yaw, but the permanent and temporary cavities

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246. *Id.*

247. Fackler, *Civilian Gunshot Wounds*, *supra* note 203, at 22 figs.3 & 4 (comparing the wound profile for a .308 soft-point hunting bullet with the wound profile for a military 7.62mm FMJ bullet); Fackler, *Common Misconceptions*, *supra* note 185, at 2731 fig.2, 2733 fig.5, 2734 (illustrating the wound profiles for the military 5.56mm FMJ bullet and the civilian .223 soft-point bullet). Dr. Stefanopoulos has compiled a helpful chart summarizing handgun and rifle bullet behavior in tissue. *See* Stefanopoulos et al., *Wound Ballistics of Firearm-Related Injuries*, *supra* note 203, at 1454 tbl.2.

248. Hollerman et al., *supra* note 203, at 687–89.

249. *See id.* at 687.

250. *Id.* at 689.

251. *See* Fackler, *Literature Review*, *supra* note 245, at 40.

252. Stefanopoulos et al., *Wound Ballistics of Military Rifle Bullets*, *supra* note 203, at 695; Fackler, *Literature Review*, *supra* note 245, at 40.

253. Fackler, *Literature Review*, *supra* note 245, at 40; *see* Fackler, *Civilian Gunshot Wounds*, *supra* note 203, at 26 ("This is not to say, however, that a bullet could not cause considerable disruption in the muscles of the extremity and still have a small punctate entrance and exit wound.").

cause by the these bullets—unless they are larger caliber magnum bullets—typically are smaller than rifle bullets, causing less severe injury.[254]

Shotguns are low-velocity weapons, but at close range, their pellets or slugs have considerable wounding potential. At less than ten feet, "the shotgun produces the most devastating injuries of all small arms."[255] The kinetic energy of typical twelve-gauge 00 buckshot fired at 1,200 fps is about 1,700 ft/lbs at the muzzle.[256] Wounding is severe due to the pellets acting as a single large projectile, their rapid deceleration and transfer of all their energy to tissue, and the creation of multiple wound tracks due to the so-called "billiard ball effect" scattering the pellets inside the tissue.[257] Shotgun pellets do not produce a temporary cavity like expanding, yawing, or fragmenting handgun and rifle bullets, but "[t]hese wounding effects . . . are of lesser extent compared to the distinctively massive injuries produced by shotgun blasts."[258] Shotgun slugs deform and cause temporary cavitation, "produc[ing] massive internal injuries within a range of [one hundred] meters, comparable in severity to those encountered from hunting rifle bullets."[259] The kinetic energy of a typical twelve-gauge shotgun slug is around 2600 ft/lbs, which approximates the energy of larger caliber rifle bullets (see table above).[260]

b. Wound Ballistics and AR-15 Lethality

Banning the AR-15 because of its devastating wounding effects requires a level of generalization and decontextualization that ignores critical factors involving wound ballistics. First, the AR-15 does not *invariably* cause massive wounds—a point repeatedly omitted by medical advocates for "assault weapon" bans. The single most important determinant of wound severity is shot placement, not the

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254. *See* Stefanopoulos et al., *Wound Ballistics of Firearm-Related Injuries*, *supra* note 203, at 1454 tbl.2 (comparing the behavior of different bullets in human tissue).

255. *Id.* (footnotes omitted).

256. Jeff Johnston, *Muzzle-Energy Math: Comparing Shotgun Gauges for Home Defense*, NRA SHOOTING ILLUSTRATED (Dec. 30, 2018), https://www.shootingillustrated.com/articles/2018/12/30/muzzle-energy-math-comparing-shotgun-gauges-for-home-defense/.

257. Stefanopoulos et al., *Wound Ballistics of Military Rifle Bullets*, *supra* note 203, at 696 (footnotes omitted).

258. Stefanopoulos et al., *Wound Ballistics of Firearm-Related Injuries*, *supra* note 203, at 1454 (footnotes omitted).

259. *Id.* at 1453 (footnotes omitted).

260. *See supra* note 211 and accompanying text.

type of firearm used. Every projectile—whether fired from a handgun, rifle, or shotgun—can seriously injure or kill if it hits the brain, spinal cord, heart, or other vital organ. Wound severity depends largely on the type and quantity of tissue disruption, which in turn depends on the location of the bullet strike.[261] A small pistol wound to the brain will be far more devastating than a large rifle wound to an extremity or other non-vital part of the torso. Dr. Peter Rhee notes that "[m]ost experienced trauma surgeons will testify that what part of the body is hit by [the] gun is more important than the size of the gun."[262]

Precise shot placement is unlikely in many mass shootings where the shooter is firing on the move from an unsupported position, potential victims are fleeing or moving to cover, and greater distances exist between the shooter and his targets. When the mass shooter is moving slowly and potential victims are close and stationary, shot placement can be more precise. But in those cases, because all guns can kill, lethal outcomes are even less contingent on the type of weapon used.[263] Additionally, as explained above, there are other terminal variables that affect AR-15 wound severity, such as the type of ammunition used, whether the victim has a small or slender stature, and how the bullet interacts with tissue. While generalizations must be made at some point, courts should not do so without considering the variables involved. The more important question is whether the variables affecting AR-15 wound severity permit such broad and persistent generalizations when the deprivation of a constitutional right is at issue.

Second, to classify a firearm as "exceptionally lethal," there must be a baseline for comparison. Ban proponents attempt to make the AR-15 rifle appear exceptionally lethal by comparing it to less

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261. Stefanopoulos et al., *Wound Ballistics of Firearm-Related Injuries*, *supra* note 203, at 1449 ("It should also be remembered that it is the proximity of the wound to vital organs that ultimately determines the severity and outcome of the injury." (footnote omitted)).

262. Rhee et al., *supra* note 186, at 865.

263. Handguns were used exclusively in seven of the twenty highest-casualty mass shootings since 1984, rifles in four, and multiple firearms (handguns, rifles, shotguns) in eleven. *See* Mark Follman et al., *US Mass Shootings, 1982–2020: Data from Mother Jones' Investigation*, MOTHER JONES (Feb. 26, 2020, 4:15 PM), https://www.motherjones.com/politics/2012/12/mass-shootings-mother-jones-full-data/.

powerful handguns.[264] The AR-15 does fire high-velocity bullets that impact with much greater force than handguns.[265] But that is true of virtually *all* rifles—it is not unique to the AR-15.[266] The fact that handguns are less terminally effective than rifles is nothing new. Comparing "high-velocity" or "high-powered" AR-15 bullets to handgun bullets to prove the AR-15's exceptional lethality is like comparing a Ferrari to a minivan to prove the Ferrari is extremely fast. The AR-15-to-handgun comparison serves only to differentiate wounds caused by rifles from wounds caused by handguns. Multiple media articles describing massive and devastating wounds caused by the AR-15—such as those cited in *Worman*—almost never describe or compare similar massive and devastating wounds caused by larger-caliber rifles and shotguns.[267] This lack of context distorts the wounding effects of the AR-15.

There is no doubt that the AR-15 can cause serious and lethal wounds, but so can other rifles, shotguns, and powerful handguns. The AR-15's terminal performance is no more lethal than common hunting rifles. As the above table shows, the AR-15's smaller .223/5.56 bullets strike with only one-fourth to one-half of the energy of most other centerfire rifle bullets despite having higher velocities.[268] Wound profiles from the Army's Wound Ballistics Laboratory illustrate the permanent and temporary cavities, penetration depth, deformation, and fragmentation of both the deforming (soft-point) AR-15 .223 caliber bullet, the non-deforming 5.56mm FMJ bullet, and

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264. *See, e.g.*, Heather Sher, *What I Saw Treating the Victims from Parkland Should Change the Debate on Guns*, ATLANTIC (Feb. 22, 2018), https://www.theatlantic.com/politics/archive/2018/02/what-i-saw-treating-the-victims-from-parkland-should-change-the-debate-on-guns/553937/ (comparing "devastatingly lethal, high-velocity" AR-15 bullets with "low-velocity" handgun bullets that cause "routine" injuries); 60 Minutes, *The Explosive Force of AR-15 Style Rifles*, YOUTUBE (Nov. 4, 2018), https://www.youtube.com/watch?v=edsmI6UCj4w (comparing damage to ballistics gelatin and bone-in cut of pork by 9mm handgun bullet and AR-15 bullet, showing AR-15 bullet as much more devastating).

265. *See supra* note 211 and accompanying table.

266. *See supra* note 211 and accompanying table.

267. *See, e.g.*, Jenny Marder & Laura Santhanam, *What a Bullet Does to a Human Body*, PBS NEWS HOUR (Feb. 17, 2018, 11:05 AM), https://www.pbs.org/newshour/nation/what-a-bullet-does-to-a-human-body; Leana Wen, *What Bullets Do to Bodies*, N.Y. TIMES (June 15, 2017), https://www.nytimes.com/2017/06/15/opinion/virginia-baseball-shooting-gun-shot-wounds.html; Sarah Zhang, *What an AR-15 Can Do to the Human Body*, WIRED (June 17, 2016, 9:00 AM), https://www.wired.com/2016/06/ar-15-can-human-body/.

268. *See supra* note 211 and accompanying table.

other larger caliber bullets typically used in hunting rifles.[269] A comparison of profiles for the AR-15's .223/5.56 soft-point and FMJ bullets with the wound profiles for larger-caliber hunting and competition rifle bullets, such as the 6mm PPC (.243), .30-30, and .308 soft-point bullets, shows that the wounding effects of the larger-caliber bullets are at least as extensive as the .223/5.56, and typically more so.[270] Dr. Fackler notes that "[t]he 7.62 NATO rifle bullet is the civilian .308 Winchester: it is effective for shooting essentially all North American big game, including moose, elk, and grizzly bear. The 5.56mm NATO rifle bullet is the civilian .223 Remington: it is a 'varmint' cartridge, used effectively for shooting woodchucks, crows, and coyotes."[271] Because of its smaller size, there is an ongoing debate among hunters over whether the .223 round has adequate terminal performance for taking deer.[272] Some states ban the use of .223 caliber rifles when hunting deer and other animals larger than varmints because their rounds lack sufficient power.[273]

The AR-15's terminal performance also is no more lethal than shotguns. When firing at close range, as often occurs in mass public shootings, AR-15 wounds typically are less severe than shotgun wounds. Dr. Fackler observes that at close range "the [twelve-gauge] shotgun (using either buckshot or a rifled slug) is far more likely to incapacitate than is a .223 rifle. The [twelve-gauge] shotgun is simply

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269. *See generally* Fackler, *Wound Profiles*, *supra* note 203 (discussing the wound profiles of an AR-15 .223 caliber bullet, 5.56mm FMJ bullet, and others).

270. *See id.* at 29 fig.3, 30 fig.7, 31 figs.9 & 10, 33 fig.14, 34 fig.17.

271. Fackler, *Literature Review*, *supra* note 245, at 41.

272. *See, e.g.*, John Haviland, *Deer Cartridge Showdown: .223 Rem. Vs .30/30*, OUTDOOR LIFE (Nov. 15, 2019), https://www.outdoorlife.com/blogs/hunting/ammo-test-223-rem-vs-3030-whitetails/; Keith Wood, *Is the .223 Remington a Viable Deer Cartridge?*, N. AM. WHITETAIL (Feb. 26, 2014), https://www.northamerican whitetail.com/editorial/223-remington-viable-deer-cartridge/263043.

273. *See, e.g.*, COLO. CODE REGS. § 406-2:203(A)(1) (2020) (requiring, at a minimum, a .24 caliber round for hunting big game); Va. Dep't of Wildlife Res., *General Information & Hunting Regulations*, https://dwr.virginia.gov/hunting/regulations/general/#legal-use (last visited Feb. 25, 2021) (prohibiting centerfire rifle ammunition smaller than .23 caliber for deer, bear, and elk); Wash. Dep't of Fish & Wildlife, *Big Game Hunting Regulations*, http://www.eregulations.com/washington/hunting/equipment-hunting-methods/# (last visited Feb. 25, 2021) (requiring a minimum .24 caliber centerfire rifle for hunting "big game," such as deer, elk, bear, moose, antelope, mountain goat, and bighorn sheep).

a far more powerful weapon."[274] Dr. P. K. Stefanopoulos, trauma surgeon and former career military officer who has written extensively on wound ballistics, confirms that at distances of less than ten feet, "the shotgun produces the most devastating injuries of all small arms."[275]

My point is not that the AR-15 is *less* powerful or dangerous than other firearms. The AR-15 can cause severe wounds. But three federal appellate courts have asserted that the AR-15 is exceptionally lethal because it causes wounds that are "*more* serious . . . *far beyond* that of other firearms in general." That is plainly false. Wounds caused by the AR-15, while potentially serious or lethal, are no more serious or lethal than wounds caused by larger-caliber hunting rifles, shotguns, and even some powerful handguns.[276] This fact is obscured by media reporting of "assault weapon" wound damage, especially when those reports describe such damage in nonscientific and hyperbolic terms. Reports of medical professionals describing devastating wounds from AR-15s no doubt are disturbing, but most lack context and some may not be entirely accurate.

Such reporting is nothing new. Dr. Fackler describes how media accounts embellished the injuries suffered by five children tragically killed in 1989 at Cleveland Elementary School in Stockton, California, one of the first modern mass shootings.[277] He performed ballistics testing on the various types of ammunition used in the shooter's semiautomatic AK-47-style rifle and also examined the autopsies of the children killed. He explains:

> Much of the media coverage generated by the Stockton shooting has contained misstatements and exaggerations. The myth of "shock waves" resounding from these "high velocity" bullets "pulverizing bones and exploding organs" (even if they were not hit by the

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274. Fackler, *Questions and Comments*, WOUND BALLISTIC REV., 2001, at 5, 5 (2001); *see* Fackler, *Wound Profiles*, *supra* note 203, at 30 fig.6 (illustrating the wound profile of a twelve-gauge shotgun).

275. Stefanopoulos et al., *Wound Ballistics of Firearm-Related Injuries*, *supra* note 203, at 1453 (footnotes omitted).

276. See Roberts, *supra* note 173, at 16–28, for a comparison of the wounding effects of handguns, AR-15 style rifles, shotguns, including wound profiles of each.

277. Martin L. Fackler et al., *Wounding Effects of the AK-47 Rifle Used by Patrick Purdy in the Stockton, California, Schoolyard Shooting of January 17, 1989*, 11 AM. J. FORENSIC MED. & PATHOLOGY 185, 185 (1990) [hereinafter Fackler, *Wounding Effects*] ("The media seized on the Stockton incident with sensationalistic zeal. Distortions, exaggerations, and uninformed assumptions were presented as fact.").

> bullet) "like a bomb" going off in the body was repeated by the media, in certain cases even after they were furnished solid evidence that disproved these absurdities. None of the autopsies showed damage beyond the projectile path. One "expert" was quoted as stating that the death rate from "assault weapons . . . approaches 50[%]." Another, reporting on the effects of "high speed" bullets, stated that "most of those hit in an extremity will end up with amputations. If you're hit in the trunk, it becomes a lethal injury. . ." In the Stockton schoolyard, the death rate was 14% and none of the victims died later or required extremity amputation.[278]

Dr. Fackler also recounts how Joseph D. McNamara, Chief of Police in San Diego and noted "assault weapon" ban proponent,[279] publicly announced that "one bullet hitting a child in Stockton, took out his entire stomach."[280] He notes that the autopsy report for the only child killed who had stomach damage states "STOMACH: There is a perforating wound of the antrum due to passage of the bullet. The stomach is otherwise normal. There is no spillage of gastric contents."[281] Dr. Fackler worries that "[a]n unsuspecting public and medical community might accept Chief McNamara's highly exaggerated description as fact."[282]

c. Lethality as a Metric: Summing up

Ban advocates compare the AR-15 to machine guns to show that it fires more shots faster than other firearms, resulting in more injuries and more fatalities. They compare the AR-15 to handguns to show that the bullets fired by the AR-15 produce more devastating wounds. Federal courts have embraced such claims about the AR-15's exceptional lethality—mostly its supposed high rate of fire and

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278. *Id.* at 187–88 (alteration in original) (citations omitted).

279. *See* Morgan & Kopel, *supra* note 87, at 31.

280. Fackler et al., *Wounding Effects*, *supra* note 277, at 188 (internal quotation marks omitted) (citation omitted).

281. *Id.* (internal quotation marks omitted).

282. *Id.*

massive wounding power—to justify their decisions upholding "assault weapon" bans.

The foregoing discussion shows that such comparisons are misleading. The semiautomatic-only AR-15 is not exceptional either in its rate of fire or terminal ballistics. The AR-15 is not a machine gun—its semiautomatic-only firing system produces a rate of fire nearly identical to other semiautomatic handguns, rifles, and shotguns. The AR-15's high-velocity bullet can cause more serious wounds than a handgun, but such wounds typically are no more severe than those caused by projectiles fired from shotguns or larger-caliber hunting rifles. The round fired by the AR-15 normally penetrates less through walls than common handgun and shotgun rounds, reducing the risk to public safety from bullet over-penetration. While the AR-15's high-velocity bullet can penetrate soft body armor worn by law enforcement officers, almost every rifle bullet has this capability. The AR-15 is more lethal in some ways but less lethal in others. In short, the AR-15 is a lethal weapon but not an *exceptionally* lethal weapon.

III. AR-15 LETHALITY: TWO FINAL QUESTIONS

Two questions often arise in connection with AR-15 lethality. The first concerns data associating "assault weapons" with high-casualty mass public shootings. The second concerns whether the features that make the AR-15 suitable for self-defense also make it most deadly for mass public shootings.

A. AR-15 Lethality and Mass Public Shootings

If "assault weapons" like the AR-15 are not exceptionally lethal, why have mass public shootings with these firearms resulted in more injuries and fatalities? There is no question that "assault weapons" have been used in high-casualty mass shootings. One oft-cited study concludes that active shooters with semiautomatic rifles have killed or wounded more victims than shooters with other types of firearms.[283] While all mass public shootings have become more deadly over time,[284] more than half of high-fatality mass shootings 2010–2019 were committed with "assault weapons," compared to about one-

283. *See generally* de Jager et al., *supra* note 3.

284. *See* Adam Lankford & James Silver, *Why Have Public Mass Shootings Become More Deadly? Assessing How Perpetrators' Motives and Methods Have Changed over Time*, 19 CRIMINOLOGY & PUB. POL'Y 37, 38–39 (2020).

third in previous decades.[285] Since 1989, AR- or AK-style rifles have been used in two of the top three deadliest shootings (Las Vegas and Orlando) and in nine of the top twenty deadliest mass shootings.[286]

Does this prove that "assault weapons" like the AR-15 are far more lethal than other firearms? Not necessarily. Just because a murderer picks an "assault weapon" with which to perpetrate his crime does not make the firearm itself more deadly. Counting incidents and casualties in mass shootings involving "assault weapons" fails to answer the relevant question; namely, would there have been fewer injuries or deaths if the shooter had used a handgun, shotgun, or hunting rifle instead? If the mass shooter's bullet strikes the victim's head, heart, or other vital organ, it is unlikely the firearm type will make much difference. If the mass shooter fires several rounds that strike a stationary target at very close range, it is unlikely the firearm type will make much difference. Shooters with firearms other than "assault weapons" can and have produced high casualties in mass public shootings. Mass shooters armed only with handguns perpetrated high-casualty shootings at Virginia Tech (fifty-five casualties), Luby's (forty-four casualties), and Ft. Hood (forty-four casualties), where the total casualties exceed mass shootings with "assault weapons" at El Paso (forty-eight casualties), Sutherland Springs (forty-six casualties), and Parkland (thirty-four casualties).[287] Given these outcomes, how much does the type of weapon used matter?

To determine if "assault weapons" like the AR-15 are more lethal than other firearms, especially when used in mass public shootings, researchers must go beyond simply counting incidents and casualties. They must consider factors that are relevant to whether the type of weapon used in a mass shooting makes a difference in the outcome. This requires examining an array of variables and their interaction: the shooter's intent, skill, weapon caliber and type, rate of fire, and total rounds fired; the duration of the shooting; the location, size, density, and posture of potential victims; and, yes, even the age and

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285. *See id.* at 48 ("From 1966 to 2009, 31% of high-fatality public mass shootings were committed by perpetrators armed with a semi-automatic rifle or assault weapon, whereas from 2010 to 2019, that proportion rose to 56%.").

286. *See* Follman et al., *supra* note 263.

287. *Id.*

physical condition of those victims.[288] When a mass shooter fires into a large, dense crowd in a venue with limited routes of escape (Las Vegas, Orlando, Aurora) or shoots victims at extremely close range (Sutherland Springs, Orlando,[289] Sandy Hook, Virginia Tech, Columbine, and others), the type of firearm used may not make a significant difference in the outcome. If the mass shooter uses multiple types of firearms (Orlando, San Bernardino, Sandy Hook, Aurora, and others), it must be determined how many casualties are associated with each weapon.[290] "Assault weapons" alone were used in four of the twenty highest-fatality mass public shootings since 1989; in the remaining five highest-fatality shootings with "assault weapons," the shooter also used other types of firearms.[291] Until this data is collected and analyzed, studies simplistically counting incidents and casualties in mass shootings with "assault weapons" are incomplete and potentially misleading.

Two recent studies have examined at least some of these variables. One study considered for the first time the relationship between the type of firearm used, wounding characteristics, and probability of death in mass public shootings.[292] Researchers led by Dr. Babak Sarani, a trauma surgeon, studied firearm types and autopsy reports for 232 victims from twenty-three mass shootings, including shootings with "assault weapons" at Orlando and Las

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288. *See* D. C. Reedy & C. S. Koper, *Impact of Handgun Types on Gun Assault Outcomes: A Comparison of Gun Assaults Involving Semiautomatic Pistols and Revolvers*, 9 INJ. PREVENTION 151, 153 (2003) ("A number of factors such as gun caliber, wound location, and the physical condition of the victim influence whether a gunshot victim dies.").

289. Survivors of the Orlando shooting reported that the shooter stood over victims lying on the floor and "fired additional rounds into them at point-blank range without regard for whether they were alive or already dead." FRANK STRAUB ET AL., RESCUE, RESPONSE, AND RESILIENCE: A CRITICAL INCIDENT REVIEW OF THE ORLANDO PUBLIC SAFETY RESPONSE TO THE ATTACK ON THE PULSE NIGHTCLUB 18 (2017) (footnote omitted).

290. Research shows that mass shooters with multiple firearms kill more victims on the average than those with a single firearm. *See id.*; Lankford & Silver, *supra* note 284, at 48 (citations omitted). One flaw in the de Jager study is that it "grouped all events that involved multiple firearms in which one firearm was an assault weapon into the same group. The authors were not able to trace a particular gunshot wound to the actual weapon used to create it. This was the case in 65% of events." Babak Sarani & E. Reed Smith, *A Holistic Approach to Firearm Legislation is Needed: In Reply to de Jager and Colleagues*, 229 J. AM. COLL. SURGEONS 324, 324 (2019). *See generally* de Jager et al., *supra* note 3.

291. *See* Follman et al., *supra* note 263.

292. Babak Sarani et al., *Wounding Patterns Based on Firearm Type in Civilian Public Mass Shootings in the United States*, 228 J. AM. COLL. SURGEONS 228, 229 (2019).

Vegas.[293] A previous study of gun homicide victims (not mass shooting victims) found that handguns were associated with more wounds per victim, a higher likelihood of vital organ injury, and a higher case fatality rate (CFR).[294] They nevertheless noted that, based on projectile velocity and accuracy, "it [made] sense to assume that" mass shootings with rifles would be more lethal than those with handguns.[295]

Dr. Sarani and his colleagues found that mass public shootings with a handgun are more lethal than those associated a rifle because they result in more wounds per victim and more injuries to vital organs.[296] "All of us were shocked," Dr. Sarani said, "[w]e came to the table with our bias that an assault weapon would be worse."[297] While recognizing that rifle projectiles cause more tissue injury than handgun projectiles, the study points out that the number of times a victim is shot also affects lethality.[298] Contrary to claims made by federal courts and ban advocates, the study indicates that "those who were shot with a handgun were almost four times more likely to have three or more wounds compared with those shot with a rifle."[299] Because the number of gunshot wounds increases the likelihood of sustaining a fatal injury, the study concludes that "the probability of death is higher for events involving a handgun than a rifle."[300] Twenty-six percent of those shot with handguns and 16% shot with shotguns had multiple fatal organ injuries, while only 2% of those shot by a rifle had two or more fatal organ injuries.[301] The study explains that "[w]ounds to the brain and heart have higher fatality rates than gunshots to other organs, and these were most likely to occur when

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293. *Id.* at 228–30.

294. *Id.* at 229 (citing Therese S. Richmond et al., *The Case for Enhanced Data Collection of Gun Type*, 57 J. TRAUMA INJ., INFECTION, & CRITICAL CARE 1356 (2004)). The CFR is "defined as the number killed divided by the number killed and wounded." *Id.* at 228.

295. *Id.* at 228–29.

296. *Id.* at 228, 232–33.

297. Carolyn Crist, *Handguns More Lethal than Rifles in Mass Shootings*, REUTERS (Dec. 31, 2018, 1:48 PM), https://www.reuters.com/article/us-health-gunshots/handguns-more-lethal-than-rifles-in-mass-shootings-idUSKCN1OU11G (internal quotation marks omitted) (quoting Dr. Sarani).

298. Sarani et al., *supra* note 292, at 232.

299. *Id.*

300. *Id.*

301. *Id.* at 230.

handguns were used."[302] Those shot with rifles were twice as likely to have a preventable death than those shot with other firearms.[303] The study's conclusions are different from those typically reached by incident-and-casualty counters.[304]

Professors Adam Lankford and James Silver recently examined what motivates mass public shooters to kill large number of victims.[305] After gathering data from a wide array of sources, they identify several factors that account for the increased lethality of mass public shootings, including the desire for fame, attention, or infamy both in society and among other mass shooters; the desire to kill large numbers of victims; the influence of high-profile mass shooters on subsequent shooters; extended planning periods; more extensive attack strategy development; and more extensive weapons acquisition.[306] Lankford and Silver observe that the shooter's motive can affect weapon choice and that "weapons make a difference, but they do not tell the whole story . . . . To understand why public mass shootings have grown deadlier over time, multiple factors—and their interaction—must be considered."[307]

The answer to the question about "assault weapons" and high-casualty mass shootings is that simply counting incidents and casualties is not enough. To date, current data allow for no evidence-based conclusions that the type of weapon used in a mass shooting is a major determining factor in the number of victims killed or wounded.[308] The few studies that have examined more relevant variables suggest that it may not be.

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302. *Id.* at 233.

303. *Id.* at 231.

304. *See, e.g.*, de Jager et al., *supra* note 3, at 1034 ("[M]ore people were wounded and killed in incidents in which semiautomatic rifles were used compared with incidents involving other firearms."). *But cf. id.* ("The percentage of persons who died if wounded in incidents with a semiautomatic rifle . . . was similar to the percentage who died in incidents without a semiautomatic rifle . . . ."); Sarani et al., *supra* note 292, at 232 (finding that mass shootings solely with a rifle "resulted in a much larger number of people injured, but a small number of people killed[,]" but researchers could not account for this finding with confidence due to a small sample size).

305. *See generally* Lankford & Silver, *supra* note 284.

306. *See id.* at 41–50.

307. *Id.* at 48–49.

308. *Id.* at 38 ("To date, no one has provided a clear and compelling explanation for why public mass shootings have become deadlier over time. That may be because finding evidence-based answers is so challenging.").

B. AR-15 Lethality and Self-defense

Do the same features that make the AR-15 useful for self-defense also make it the deadliest choice for mass shooters? The question assumes the AR-15 is both useful and used for self-defense, something federal appellate courts dispute.[309] They suggest that recognizing such firearms as suitable for self-defense conflicts with *Heller's* dicta that handguns are "the quintessential self-defense weapon."[310] They also claim that "assault weapons" like the AR-15 are too dangerous for self-defense—indeed, the First Circuit in *Worman* famously declared that using an "assault weapon" for home defense is "tantamount to using a sledgehammer to crack open the shell of a peanut."[311]

There is little doubt that the AR-15 carbine (sixteen-inch or shorter barrel) is well-suited for self-defense, especially as a primary home defense weapon. Effective self-defense requires incapacitating the attacker as quickly as possible. AR-15 ammunition typically has better terminal effectiveness than handgun rounds.[312] The AR-15 is comparatively easy to shoot. Its lighter weight, shorter barrel, and ergonomic stock and grip make it easier to handle than most long

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309. *See* Worman v. Healey, 922 F.3d 26, 37 (1st Cir. 2019) (noting that the record "offers no indication that the proscribed weapons have commonly been used for home self-defense purposes"); Kolbe v. Hogan, 849 F.3d 114, 138, 145 (4th Cir. 2017) (en banc) (finding "scant evidence" that the banned weapons "are possessed, or even suitable, for self-protection"); N.Y. State Rifle & Pistol Ass'n v. Cuomo (*NYSRPA*), 804 F.3d 242, 263 (2d Cir. 2015) (noting "the dearth of evidence that law-abiding citizens typically use these weapons for self-defense"); Heller v. District of Columbia (*Heller II*), 670 F.3d 1244, 1262 (D.C. Cir. 2011) (noting lack of proof "that semi-automatic rifles . . . are well-suited to or preferred for the purpose of self-defense"). *But see Kolbe*, 849 F.3d at 155 (Traxler, J., dissenting) (indicating that plaintiffs' expert offered evidence that self-defense is a primary reason for purchase of banned weapons, that a 1989 ATF report concluded self-defense is a suitable purpose for semiautomatic rifles, and that the state's expert conceded self-defense is one reason people keep the banned weapons in their homes).

310. *Worman*, 922 F.3d at 36–37 (internal quotation marks omitted) (quoting District of Columbia v. Heller, 554 U.S. 570, 629 (2008)); *Kolbe*, 849 F.3d at 132, 138, 145 (internal quotation marks omitted) (quoting *Heller*, 554 U.S. at 629); *Heller II*, 670 F.3d at 1268–69 (internal quotation marks omitted) (quoting *Heller*, 554 U.S. at 629).

311. 922 F.3d at 37; *see Kolbe*, 849 F.3d at 127 (claiming that "assault weapons" endanger bystanders by firing "more rounds than necessary" and penetrating barriers more easily than other firearms).

312. *See supra* Part II.C.2; *see also* Murphy v. Guerrero, No. 1:14-CV-00026, 2016 WL 5508998, at *17 (D. N. Mar. I. Sept. 28, 2016) ("[T]he guns that most effectively serve the purpose of self-defense also tend to cause the most grievous injuries.").

guns. Its reduced recoil makes it more manageable than shotguns or hunting rifles and helps increase the accuracy of follow-up shots. The AR-15's standard capacity thirty-round magazine is larger than standard capacities for semiautomatic handguns (fifteen to eighteen rounds), revolvers (five to six rounds), and shotguns (three to six rounds). This ensures the firearm user is prepared for multiple defensive scenarios without carrying additional ammunition and pausing to reload, such as when facing multiple attackers in a home invasion. By contrast, handguns require a higher degree of skill to shoot accurately and hold half as many (or fewer) rounds.[313] Shotguns have much greater recoil, making them more difficult to control and hold an even smaller number of rounds, forcing the individual to reload under the life-or-death conditions of home defense. The AR-15 also is safer for home defense than other firearms. With the right ammunition, its bullets will penetrate less in walls or building materials than handguns or shotguns.[314] Lights and lasers easily can be attached to the AR-15's handguard for better identification and targeting at in-house distances in low light conditions under stress. In short, the AR-15 is a relatively lightweight rifle that fires effective ammunition in a package with manageable recoil, good ergonomics, easy mounting of optics and lights, and a shorter learning curve. These features make it easier for most persons to hit human-sized targets at in-home distances in low-light conditions under stress.[315]

The AR-15 not only is useful for self-defense but also is commonly used for that purpose. Federal courts have focused narrowly the number of times "assault weapons" actually have been fired in response to a threat.[316] Contrary to their findings, numerous examples exist of AR-15s or similar firearms being used effectively against actual threats.[317] But "used" should not be defined so narrowly—it should include pointing or displaying a firearm to counter a threat or even having the gun readily available in case a

313. *See supra* Part II.B.

314. *See supra* Part II.B.; *supra* Part II.C.1.

315. For a comprehensive summary of why semiautomatic rifles like the AR-15 are among the best firearms for defensive shooting, see Boone Declaration at J.A. 128–33, 138–45, *Worman*, 922 F.3d 26 (No. 18-1545).

316. *See, e.g.*, *Kolbe*, 849 F.3d at 127.

317. *See, e.g.*, Amy Swearer, *8 Times Law-Abiding Citizens Saved Lives with an AR-15*, DAILY SIGNAL (Mar. 14, 2018), https://www.dailysignal.com/2018/03/14/8-times-law-abiding-citizens-saved-lives-ar-15/. On his blog, Clayton Cramer documents numerous instances when AR-15s and other "assault weapons" have been used in self-defense against attackers. *See* Clayton Cramer, *Civilian Gun Self-Defense Blog*, https://gunselfdefense.blogspot.com/search/label/assault%20weapon%20defense (last visited Oct. 31, 2020).

threat appears.[318] Many people use an AR-15 type firearm for self-defense. They routinely train with it for that purpose and safely deploy it in their homes to be ready for possible threats.[319] To suggest that the AR-15 is neither useful nor used for self-defense is simply false.

To be sure, handguns and shotguns also have features that make them useful for self-defense. Because of their size and concealability, handguns are much better suited for concealed or vehicle carry in public. Some prefer a handgun for home defense for the reasons stated in *Heller*: it is easier to store where it can be readily accessible; it is harder for an attacker to wrestle it away; it can be used by those who do not have the strength to lift and aim a long gun; and it can be pointed at the intruder with one hand, while dialing the police with the other. [320] Handguns typically are quicker to point and easier to maneuver around tight corners than a long gun, can be equipped with lights and lasers, and can provide substantial ammunition capacity for various scenarios. Some choose a handgun for home defense because they can use the same firearm for public carry, resulting in both proficiency and cost savings. Still others prefer a shotgun for home defense. Its ability to fire multiple projectiles every time the trigger is pulled gives it devastating firepower at close ranges, and there is less need for precise aiming than with handguns or rifles.[321] Handguns, rifles, and shotguns all have certain advantages for self-

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318. *See* James Agresti, *Defensive Gun Use Is More than Shooting Bad Guys*, FOUND. FOR ECON. EDUC. (Feb. 27, 2018), https://fee.org/articles/defensive-gun-use-is-more-than-shooting-bad-guys/?utm_source=zapier&utm.

319. *See, e.g.*, Stephen Gutowski, *Female Gun Owners: We Prefer the AR-15*, WASHINGTON FREE BEACON (Nov. 10, 2019, 5:00 AM), https://freebeacon.com/issues/female-gun-owners-we-prefer-the-ar-15/; Meghan Keneally, *AR-15 Owners Explain Why They Have Their Guns*, ABC NEWS (June 15, 2016, 4:41 PM), https://abcnews.go.com/US/ar-15-owners-explain-guns/story?id= 39873644; Charles Scudder, *Sticking to Their Gun: Aficionados Say the AR-15 is Ideal for Civilian Sport Shooting, Self-Defense*, DALL. MORNING NEWS (July 1, 2016), http://interactives.dallasnews.com/2016/gun-owners/.

320. District of Columbia v. Heller, 554 U.S. 570, 629 (2008).

321. *See Best Tactical Shotgun for Home Defense [2020 Reviews]*, GUNPROS, https://gunpros.com/best-tactical-shotgun-home-defense/ (last visited Oct. 5, 2020); *supra* text accompanying notes 164, 274.

defense both inside and outside the home, so it is impossible to say which firearm always is "best" for that purpose.[322]

To return to the question: do features that make the AR-15 well-suited for self-defense also make it the deadliest choice for mass killers? The question is not, as transposed in *Worman*, whether the features that make the AR-15 ideal for mass shooters also make it ideal for self-defense.[323] It is no answer to say that because the AR-15 has "utility" for criminal misuse it also has utility for self-defense, and therefore, "assault weapon" bans sweep too broadly. Any gun useful for self-defense can be misused by mass shooters or other criminals. The relevant question is whether the AR-15 has features that make it good for self-defense, especially in the home, but do not necessarily make it equally useful for mass shootings; in other words, does the AR-15 have *more* utility for self-defense than for mass shootings? If so, given recent studies showing that "assault weapon" bans do not deter mass public shootings,[324] federal courts must better explain why laws that deprive law-abiding citizens of the choice to use such firearms for home defense do not violate the Second Amendment.

There are several reasons why the AR-15 is more useful for self-defense than mass public shootings. First, the vast majority of mass shooters do not face someone shooting back, at least not for several minutes before police arrive.[325] Being the only ones armed, they are free to roam and fire at will at unarmed targets, often at close range. Any type firearm gives mass shooters a substantial advantage against unsuspecting and helpless victims, who become incapable of doing much more than hiding or running away, either of which may increase their risk of being shot. In the twenty highest-casualty mass shootings since 1984, handguns were used exclusively in seven, rifles in four,

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322. *See, e.g.*, Jake Christopher, *8 Experts Pick Their Home Defense Weapon of Choice*, BALLISTIC MAG. (Aug. 28, 2015), https://www.ballisticmag.com/2015/08/28/8-experts-pick-their-home-defense-weapon-of-choice/; Chad Hadley, *14 of America's Tactical Experts Give Their Take on the Best Home Defense Gun*, TACTICAL HYVE, https://tacticalhyve.com/best-home-defense-gun/ (last visited Mar. 4, 2020).

323. Worman v. Healey, 922 F.3d 26, 40 (1st Cir. 2019).

324. *See, e.g.*, Webster et al., *supra* note 134, at 188 ("[B]ans on assault weapons had no clear effects on either the incidence of mass shootings or on the incidence of victim fatalities from mass shootings."); *see also* ANDREW R. MORRAL ET AL., THE SCIENCE OF GUN POLICY: A CRITICAL SYNTHESIS OF RESEARCH EVIDENCE ON THE EFFECTS OF GUN POLICIES IN THE UNITED STATES, 61–68 (2018) (concluding that available evidence is inconclusive that "assault weapon" bans have any effect on mass shootings or firearm homicides).

325. *See generally* NAT'L CTR. FOR VICTIMS OF CRIME, MASS CASUALTY SHOOTINGS (n.d.) (noting that 66.9% of active shooter events between 2000 and 2013 ended before police arrived).

and multiple firearms (handguns, rifles, shotguns) in eleven.[326] The mass shooter's choice of weapon in a surprise attack against unarmed victims will not make as much difference to the outcome as it will to the homeowner whose life may depend on having a firearm that is highly effective at stopping multiple armed intruders.[327] For the homeowner facing one or more attackers most likely armed with handguns, having a superior defensive firearm like the AR-15 to overcome the assailants' advantage and gain the initiative may mean the difference between life and death for the homeowner and his or her family.

Second, mass shooters have time to plan and prepare beforehand, so they can carry multiple firearms and magazines to the scene. As noted above, multiple firearms have been used in more than half of the twenty highest-casualty mass public shootings since 1984.[328] The Aurora shooter, for example, was armed with a shotgun, an AR-15 rifle, and a semiautomatic handgun.[329] Mass shooters also have carried additional magazines to ensure they have sufficient ammunition to prolong their terror, including more than seventeen magazines at Virginia Tech, fifteen at Sutherland Springs, thirteen at Columbine, and five at Parkland and Newtown.[330] Because the mass shooter can carry multiple firearms and multiple magazines, the ammunition capacity of any single firearm is not as critical. By contrast, the homeowner who is awakened suddenly in the middle of the night by intruders has only seconds to grab a single defensive firearm and little else not already attached to that firearm. Homeowners typically do not sleep outfitted in gear holding extra magazines and, as one firearms expert observed, "[t]he sudden and unpredictable nature of such attacks, and their occurring in relatively confined spaces, generally do not permit gathering multiple firearms or magazines."[331] The AR-15 with its larger-capacity magazine will have more utility for the homeowner than for the mass shooter.

Third, the AR-15 is not well-suited for the mass shooter who wants to enter a school, business, or other venue undetected. As a long gun,

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326. *See* Follman et al., *supra* note 263.

327. *See* Chapman, *Firearms Chimera*, *supra* note 58, at 15–16.

328. *See supra* note 291 and accompanying text.

329. AURORA AFTER ACTION REPORT, *supra* note 132, at 12.

330. *See supra* notes 145–48, 151–54 and accompanying text.

331. *See* Declaration of Massad Ayoob in Support of Motion for Preliminary Injunction at 6–7, S.F. Police Officers Ass'n v. City & Cnty. of S.F., 18 F. Supp. 3d 997 (N.D. Cal. 2014) (No. 13-CV-13-5351).

the AR-15 is easier to shoot more accurately than a handgun but less concealable. The AR-15's length is an advantage for self-defense inside the home where concealability makes little difference, but it can be a disadvantage for the mass shooter who wants to approach his target unnoticed. The Virginia Tech shooter would not have been able to go into a student dormitory, kill two persons, return to his own room in another dormitory, and then walk across campus to the building where he killed thirty and wounded seventeen more if he had been carrying an AR-15.[332] In this instance, because of their concealability, the two handguns used by the Virginia Tech shooter were far more deadly than an AR-15.[333]

Fourth, the AR-15's safety advantage over handguns and shotguns in a home defense scenario is meaningless to the mass shooter. In a defensive encounter, stray rounds can injure or kill innocent persons in the next room or nearby household. As the AR-15 is easier to shoot more accurately than other firearms, there is less chance the homeowner will miss the intended target.[334] Rounds fired from the AR-15 also generally penetrate less in walls and other building materials than those from than handguns or shotguns.[335] The mass public shooter has no concern for stray rounds because he typically wants to shoot as many innocent persons as possible. More accuracy and less-penetrating rounds are not required to inflict casualties on unarmed and unsuspecting targets at close range.

The AR-15 is both useful and often used for self-defense. Many features that make the AR-15 effective for self-defense also make it effective for mass shooters, but not always so. The AR-15 has distinct advantages for self-defense, especially in the home, that do not translate into advantages for mass public shooters. Federal courts refuse to recognize that the AR-15 also can be a "quintessential" home-defense weapon because "assault weapon" bans then would pose a much greater burden on the right to keep and bear arms for self-defense. Hence, the First Circuit's resort to hyperbole in *Worman*.[336]

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332. *See* TRIDATA DIV., *supra* note 150, at 74 (noting that the shooter "carried his weapons in violation of university rules, and probably knew that it was extremely unlikely that anyone would stop him to check his bag. He looked like many others.").

333. *See* Francisco Alvarado, *Glock Pistols are the Overlooked Weapon in American Mass Shootings*, VICE NEWS (June 21, 2016, 4:18 PM), https://news.vice.com/en_us/article/gy9nj4/glock-pistol-omar-mateen-orlando-mass-shooting.

334. *See supra* Part II.B.

335. *See supra* Part II.C.1.

336. Worman v. Healey, 922 F.3d 26, 37 (1st Cir. 2019) (declaring that using an "assault weapon" for home defense is "tantamount to using a sledgehammer to crack open the shell of a peanut").

CONCLUSION

The facts do not support claims by gun-control advocates and federal courts that "assault weapons" like the AR-15 are exceptionally lethal, far beyond non-banned firearms. The AR-15's rate of fire is virtually identical to non-banned semiautomatic handguns, rifles, and shotguns. Its accuracy is better than some firearms but worse than others. Like any rifle, its bullets typically cause more serious wounds than handguns, but not as serious wounds as larger-caliber hunting and target rifles. And while the AR-15 has features that make it well-suited for home defense, those features do not necessarily make it far more deadly than other firearms in the hands of mass shooters. To be sure, "assault weapons" like the AR-15 have been used in some high-casualty mass public shootings, but the data does not tell us whether the casualty rate in those shootings is due to weapon type or to other factors such as shooter intent or skill, the duration and location of the shooting, or victim characteristics, location, or posture. Because "assault weapons" are not far more lethal than non-banned firearms and are equally useful for self-defense, courts must find other justifications for upholding laws that keep such firearms out of the hands of ordinary citizens.

Nobody wants guns in the hands of terrorists, criminals, or the dangerously mentally ill. Mass public shootings are unspeakable tragedies that take innocent lives, shatter families, and traumatize communities. But the question is whether "assault weapon" bans are an appropriate and effective response to the problem of mass shootings. The perception that the problem is more with the weapon than with the shooter obscures the complexities surrounding the actual causes of mass public shootings and diverts policymakers from effective prevention strategies. Lacking evidence-based reasons for concluding that AR-15s are exceptionally lethal, legislative bans are an overreaction—driven by emotion or political agendas rather than facts—and courts upholding them have no good justification for overriding the Second Amendment rights of law-abiding citizens who own (or want to own) the popular AR-15 rifle. These bans deprive such citizens of the right to choose for themselves the firearm most appropriate for their self-defense needs and do little, if anything, to deter the tragic violence perpetrated by mass shooters.