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## Bullying and physical violence and their association with handgun carrying among youth growing up in rural areas

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### Abstract

**Objectives.**—This study builds on prior research showing a strong relationship between handgun carrying and delinquent behaviors among urban youth by examining the association between handgun carrying trajectories and various types of violence in a rural sample.

**Methods:** This study uses data from a longitudinal cohort study of 2,002 public school students in the United States from 12 rural communities across 7 states from ages 12–26 (2005–2019). We used logistic regressions to assess associations of various bullying and physical violence behaviors with latent trajectories of handgun carrying from adolescence through young adulthood.

**Results.**—Compared to youth with very low probabilities of carrying a handgun in adolescence and young adulthood, trajectories with high probabilities of handgun carrying during adolescence or young adulthood were associated with greater odds of using bullying (odds ratios (ORs) ranging

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from 1.9–11.2) and higher odds of using physical violence during adolescence (ORs ranging from 1.5–15.9) and young adulthood (ORs ranging from 1.9–4.7). These trajectories with higher probabilities of handgun carrying were also associated with greater odds of experiencing physical violence like parental physical abuse and intimate partner violence, but not bullying.

**Conclusion and implication.**—Experiencing and using bullying and physical violence were associated with specific patterns of handgun carrying among youth growing up in rural areas. Handgun carrying could be an important focus of violence prevention programs among those youth.

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Bullying (e.g., teasing, threatening, spreading rumors, shoving, or hurting someone repeatedly)<sup>1</sup> and physical violence (e.g., child abuse, dating violence, intimate partner violence, hitting, punching, kicking, attacking someone with the intent to seriously hurt them) occur frequently among youth and young adults and are detrimental to both mental and physical health.<sup>2–5</sup> In the United States, about 1 in 3 youth ages 12–18 in rural areas experience bullying each year compared to 1 in 5 youth in urban areas.<sup>3,6</sup> Evidence suggests longer bus rides, a lower tax base to support prevention programs, school systems without separate middle schools, and norms about aggression as well as other factors may play a role in these differences.<sup>7,8</sup> Using physical violence against someone else occurs with similar frequency in rural and urban areas among youth ages 12–17 (e.g., 4.0% in both large metro and nonmetro areas in 2020).<sup>9</sup>

Many youth who experience one form of bullying or physical violence also experience other forms of violence by different individuals (e.g., family members, intimate partners, peers) across their lifetime.<sup>10,11</sup> Bullying and physical violence are often mutual with individuals both experiencing and using these behaviors concurrently or at different times.<sup>12–15</sup> While there are distinct risk factors for certain forms of violence, many risk factors are common to multiple forms of violence (e.g., poverty, family conflict). For example, adolescents who are physically abused by a parent are more than twice as likely to be physically violent with an intimate partner during young adulthood.<sup>16</sup> Exposure to one form of violence is a central shared risk factor for other forms of violence.<sup>17,18</sup>

Bullying and multiple forms of physical violence are associated with weapon carrying including handgun carrying in urban areas.<sup>19,20</sup> Due, in part, to mixed evidence on whether handgun carrying precedes, follows, or co-occurs with bullying and physical violence, the directionality of these behaviors has not been established.<sup>21–23</sup> Regardless of direction between these risk factors, if the use or experience of bullying and physical violence occur among the same people in developmental stages with high probabilities of handgun carrying, it may escalate both injury, harm, and risk of death during these incidents. Further, the association of these behaviors can provide important context about elevated risk to inform prevention. The current study uses a person-centered, pattern-based approach to unearth the confluence of these violence-related risk factors that could contribute to firearm-related harm to inform prevention efforts building on prior studies among urban youth.<sup>24–27</sup>

Prior studies have focused on the experiences of urban youth, and it is unknown whether similar associations between bullying, physical violence, and handgun carrying exist among rural youth.<sup>28,29</sup> The prevalence of handgun carrying was greater among rural than urban

adolescents ages 12–18 in 2020 (3.2% large metro, 4.9% small metro, 7.1% nonmetro).<sup>9</sup> It has also increased more rapidly over time among rural adolescents, from 4.3% in 2002–2006 to 6.9% in 2015–2019, compared to their urban peers, where carrying increased from 2.9% to 3.8% during this time.<sup>30</sup> Our research group previously identified six distinct trajectories of handgun carrying among a sample of youth growing up in rural areas which differed somewhat from those among youth in urban areas.<sup>31</sup> Given a higher prevalence of handgun carrying and similar risk for bullying and physical violence among rural compared to urban youth, similar if not stronger associations may exist between these behaviors among rural youth. However, it is also possible these associations are less consistent among rural youth, as handgun carrying in rural settings may also emerge as a part of involvement in firearm culture (e.g., hunting, shooting sports).

In the current study, we examined whether handgun carrying trajectories were associated with bullying and physical violence during adolescence and young adulthood. There are several contributions of our work. First, we build upon prior literature on strong associations between urban handgun carrying and a confluence of risk behaviors by examining similar associations among a sample of rural youth. Second, we employ longitudinal within-person methods to understand whether different handgun carrying trajectories are associated with different experiences and uses of bullying and physical violence in both adolescence and young adulthood. Since handgun carrying is a developmentally heterogeneous behavior, examining the association between bullying and physical violence and handgun carrying using longitudinal patterns helps identify those at greatest risk (e.g., sustained or escalating co-occurrence of risk behaviors) and informs when, how, and among whom to intervene to prevent violence. We hypothesized that trajectories with a higher probability of carrying during adolescence would be associated with bullying and physical violence partially because handgun possession at ages younger than 18 years is generally barred by US federal law and more likely to be associated with problem behaviors like bullying and physical violence. Because handgun carrying during young adulthood in rural areas may be an expression of participation in firearm culture and community, we hypothesized a weaker association between bullying and physical violence among trajectories with high probabilities of handgun carrying limited to young adulthood.

## METHODS

### Study Design, Participants, and Setting

The study sample included 2,002 participants in the control arm of the Community Youth Development Study (CYDS), a community-randomized trial of the Communities That Care (CTC) prevention system in communities across 7 states (Colorado, Illinois, Kansas, Maine, Oregon, Utah, Washington).<sup>32–34</sup> All public school students in the 5<sup>th</sup> grade in 2003–2004 were eligible to participate. Parental consent and student assent were obtained for 77% of the eligible population. The analyses in this study used survey responses from ten waves of data collected across two developmental periods: six waves in adolescence (from ages 12–18) with at least 89.8% retention through Age 18 and four waves in young adulthood (ages 19–26) with at least 86.4% retention through age 26. These retention rates refer to response rates at each study wave rather than cumulative retention. Participants were retained in the

sample even if they did not respond in a particular survey wave. Most participants had fully populated survey response data across all study waves. For example, responses on handgun carrying were fully populated or only missing in one study wave for 79.7% of the sample (1595 of 2002). The sample was gender-balanced and ethnically and racially diverse; additional details about procedures and the demographic characteristics of participants are provided in the Appendix. The CYDS protocol and this study were reviewed and approved by the University of Washington Human Subjects Review Committee.

### Exposure: Handgun carrying patterns

Participants were asked how many times they carried a handgun in the prior year from age 12–26. We used latent class growth analysis (LCGA), a person-centered, data-driven, probabilistic, full information maximum likelihood model to estimate handgun carrying trajectories from age 12–26 for all participants in the sample in Mplus software version 8.<sup>31</sup> Six distinct trajectories of handgun carrying among all 2,002 study participants were identified (Figure 1).<sup>31</sup> Each participant was assigned to a trajectory based on the highest posterior probability of group membership for the present analyses.<sup>35,36</sup> A *never/low probability of carrying* across the entire study period was the most common pattern (n=1,590;79.4%). LCGA grouped these participants with a zero probability of handgun carrying and very low probabilities of handgun carrying from age 12–26 into one trajectory, suggesting there are little to no meaningful differences in those who never or rarely carry. A small proportion of the sample (n=6;0.3%) had a *high and persistent* probability of carrying throughout both adolescence and young adulthood. About 12% of the sample had elevated probabilities of carrying during adolescence. Of these, one trajectory (n=53;2.6%) was characterized by moderately high probabilities of *carrying a handgun during early adolescence* that declined rapidly into young adulthood. A smaller group (n=24;1.2%) carried with high probabilities in adolescence and gradually *declining* probabilities into young adulthood. The largest adolescent group (n=163;8.1%) had carrying probabilities that *steadily increased* from adolescence into young adulthood. The final trajectory (n=166;8.3%) initiated handgun carrying later with positive probabilities of *carrying limited to young adulthood*.

### Outcomes: Bullying and physical violence.

We measured experiences and uses of different forms of violence: (1) experiencing bullying during adolescence, (2) using bullying during adolescence, (3) experiencing parental physical violence more than once before age 18, (4) using physical violence (e.g. beating or attacking with intent) during adolescence, (5), experiencing intimate partner physical violence during young adulthood, and (6) using physical violence during young adulthood, including the same forms during adolescence as well as intimate partner violence. All of these measures were coded as equal to one if a participant reported the behavior in any wave during the developmental period and zero otherwise. Additional details about the survey questions used to create these measures are available in the Appendix. These forms of violence have been noted in urban literature as associated with weapon carrying, particularly handgun carrying. These measures are developmentally appropriate for the age ranges of the study (e.g., bullying in adolescence and intimate partner violence in young adulthood),

but do not fully describe all possible exposures to bullying or physical violence in both developmental periods.

### Statistical Analysis

All participants were included in all analyses. First, we used latent class growth analysis (LCGA) to estimate handgun carrying trajectories from age 12–26. Next, data on participants in each wave were assessed across two time periods, adolescence (ages 12–18) and young adulthood (ages 19–26), and each violence measure captured whether a participant ever endorsed the behavior in each developmental period. Although many questions remained the same across study waves, there were adjustments over time to reflect changing developmental salience. Details on the availability of survey questions for the measures used in this study are provided in Table A1. There was no missingness for exposure or outcome measures, but missing information for component questions is provided in Table A2. We described the proportion of each violence measure overall and among each handgun carrying trajectory. To characterize the strength of the association between the handgun carrying patterns (exposure) and six measures of experiencing and using physical violence (outcomes) we used logistic regressions. In all regressions, the never/low carrying trajectory was the reference trajectory to capture whether handgun carrying patterns are risk markers for each form of violence. We used single-level regressions because intraclass correlation (ICC) of handgun carrying at the community-level was low in LCGA (ICC = 0.000554, se = 0.0029168), and a higher degree of clustering increases the need for a multi-level regressions.<sup>37</sup> Covariates were not included because this study uses a within-person approach to examine patterns of behavior in a group of rural youth. There is no temporal order between the exposure and the outcome, and many potential confounders (e.g., peer behavior, parental monitoring) may be intermediaries on the various causal pathways between handgun carrying, bullying, and physical violence.<sup>38</sup>

## RESULTS

### Bullying, physical violence, and handgun carrying in this rural sample

Most participants reported experiencing (73.2%) and using (52.4%) bullying during adolescence (Figure 2). The majority of youth who experienced bullying also bullied others during adolescence (59.3%; 869 of 1,466), and these behaviors were persistent over time. Of those who experienced bullying, 71.4% (1046 of 1466) reported this in multiple waves. Of those who used bullying, 59.5% (624 of 1049) reported doing so in multiple waves. Around 36.0% of youth reported using physical violence during adolescence, and 36.7% reported using physical violence during young adulthood (Figure 2). The use of physical violence co-occurred less frequently with experiencing physical violence, and physical violence behaviors were less persistent than bullying. Most participants who reported physical violence in young adulthood did so only once (experiencing: 64.8%, 406 of 627; using: 58.0%, 426 of 734). One exception was many who experienced physical violence by an intimate partner during young adulthood also used physical violence during young adulthood (82.3%; 516 of 627). Most participants never reported carrying a handgun (70%; 1401 of 2,002), but among those who did, some handgun carrying trajectories had high estimated probabilities of carrying in adolescence and/or young adulthood (Figure 1).

Overall, 20.7% of participants reported carrying a handgun at least once during adolescence and 17.5% reported handgun carrying during young adulthood (Figure 2).

The most striking differences in bullying and physical violence across handgun carrying trajectories were related to the uses of these behaviors during adolescence and young adulthood (Figure 3). Trajectories with elevated probabilities of carrying during adolescence (e.g., *declining, adolescent*) had the highest proportions (91.7%, and 79.2%, respectively) of bullying others during adolescence. These patterns with high probabilities of carrying during adolescence were also more likely to report using physical violence during adolescence (range:59.5–87.5%) compared to the *never/low carrying* trajectory (30.6%), and the group with *carrying limited to young adulthood* (40.4%). Similarly, there were sizeable proportions of young adults who reported using physical violence between ages 19 and 26 among those with a pattern of *high/persistent* carrying (66.7%), *declining* carrying (70.8%), and *steadily increasing* carrying (49.7%) compared to the *never/low* trajectory (34.2%).

### Associations between handgun carrying trajectories and experiencing bullying and physical violence

Almost all handgun carrying trajectories had higher odds of experiencing physical violence in both adolescence (between 1.5 and 2 times) and young adulthood (between 1.5 and 2.5) compared to the *never/low* trajectory though only some of these differences were precisely estimated (Table 1). The trajectory with handgun *carrying limited to adolescence* had 1.93 (95% CI=[1.07,3.48]) and 2.19 (95% CI=[1.26,3.79]) times the odds of experiencing physical violence during adolescence and young adulthood, respectively. Similarly, the trajectory with handgun *carrying during young adulthood* had around 1.5 times the odds of experiencing physical violence during adolescence and young adulthood (OR=1.47,95% CI=[1.02,2.12] and OR=1.50,95% CI=[1.07,2.09], respectively). The *steadily increasing* trajectory with increasing probabilities of handgun carrying through young adulthood also had 1.62 times the odds of experiencing physical violence during young adulthood (95% CI=[1.17,2.26]). Notably, all six individuals assigned to the *high/persistent* trajectory reported experiencing bullying during adolescence.

### Associations between handgun carrying trajectories and using bullying and physical violence

Trajectories with high estimated probabilities of handgun carrying during adolescence (*declining, adolescent, steadily increasing*) were associated with 11.22 (95% CI=[2.63,47.89]), 3.89 (95% CI=[1.99,7.62]), and 1.95 (95% CI=[1.39,2.73]) times higher odds, respectively, of using bullying during adolescence (Table 1). While the estimated association between the *declining* trajectory and using bullying during adolescence is imprecisely estimated, these results show there is a sizeable and strong association between these trajectories and bullying. While only 50% of those in the *never/low* carrying trajectory ever reported bullying someone, 92% of those in the *declining* trajectory did.

All five handgun carrying trajectories were associated with higher odds of using physical violence during adolescence compared to the *never/low* trajectory, and several were also

associated with using physical violence during young adulthood (Table 1). The *adolescent* (9.74, 95%CI=[4.85,19.54]) and *declining* trajectories (15.85, 95%CI=[4.71,53.40]) had the largest associations with using physical violence during adolescence. While both estimates are imprecisely estimated due to small sample sizes, both trajectories were associated with large increases in the odds of using physical violence when the probability of handgun carrying was elevated. Similarly, the *steadily increasing* trajectory was associated with over three times the odds (OR=3.33, 95%CI=[2.39,4.63]) of using physical violence during adolescence and almost twice the odds (OR=1.90, 95%CI=[1.37,2.63]) of using physical violence during young adulthood. Overall, these three trajectories with higher probabilities of handgun carrying during adolescence were associated with various measures of violence perpetration across both adolescence and young adulthood. The findings described here are generally robust to regressions adjusting for male gender which varies across trajectories and is associated with both bullying and physical violence (Table A3 and Figure A1).

## DISCUSSION

In our sample of youth growing up in rural areas, 3 in 4 adolescents experienced bullying, and just over 1 in 2 adolescents used bullying between the ages of 12–18. Our findings are consistent with prior research showing rural youth may have more exposure to both using and experiencing bullying than urban youth.<sup>6</sup> Over 35% of participants used physical violence in adolescence and young adulthood, and a smaller proportion between 20–30% experienced physical violence in adolescence and young adulthood. All handgun carrying trajectories identified among youth growing up in rural areas were a marker for elevated bullying and physical violence risk either in adolescence or young adulthood. Notably, trajectories with elevated probabilities of handgun carrying in adolescence were associated with higher odds of using bullying and physical violence in adolescence and in young adulthood compared to the *never/low* trajectory, whereas a pattern of handgun *carrying emerging mostly in young adulthood* was more strongly associated with experiencing physical violence.

These high odds of using bullying and physical violence and high probabilities of handgun carrying during adolescence may elevate the risk of firearm-related violence. For these trajectories, these behaviors seem to emerge in tandem with handgun carrying. For example, youth in the *declining* trajectory carried with high probabilities during adolescence when many of them were also using bullying and physical violence. The *adolescent* trajectory associations were similar, with higher handgun carrying probabilities during adolescence and a high prevalence of experiencing physical violence by a parent, using bullying, and using physical violence during this developmental period. Similarly, the probability of handgun carrying among the *steadily increasing* trajectory increased over time when the prevalence of using physical violence during adolescence and young adulthood was high. Each of these trajectories were also significantly associated with higher odds of using these behaviors compared to the *low/never* carrying trajectory.

Of the five trajectories characterized by some handgun carrying, the *emerging adulthood* trajectory was most similar to the *never/low* trajectory, exhibiting the smallest increases in estimated odds for most of the reported behaviors. These findings demonstrate preventing

handgun carrying and delaying the behavior until young adulthood when carrying is generally permitted by law may be an important area for health promotion and prevention of violence. In addition, the *emerging adulthood* trajectory had elevated odds of experiencing parental physical abuse and using physical violence during adolescence often prior to the initiation of handgun carrying and before the probability of handgun carrying was elevated during young adulthood. For this trajectory, experiencing parental physical abuse and using physical violence may be a precursor of handgun carrying. Research exploring the motivations for handgun carrying and establishing how these behaviors and handgun carrying develop, co-occur, and influence one another is critically needed, particularly if risk and protective factors differ between handgun carrying patterns.

Given the high burden of experiencing and using bullying and physical violence and their association with handgun carrying trajectories among youth growing up in rural areas, future studies should strive to examine the directionality of these associations and their strength. If bullying leads to handgun carrying, state anti-bullying laws and evidence-based bullying prevention programs may reduce both potentially harmful behaviors among youth.<sup>39,40</sup> If parental physical abuse and enactment of physical violence leads to handgun carrying, available and effective prevention programs need to be implemented to address adverse childhood experiences and reduce physical violence perpetration.<sup>41</sup> However, if handgun carrying subsequently contributes to using bullying and physical violence, there will be a great need to develop prevention programs and policies focusing on this behavior. Youth education programs on firearms, firearm violence, and how to resolve conflicts without firearms may be suitable for rural areas and could be adapted to align with rural firearm culture. Firearm-specific programs such as Straight Talk About Risks (STAR) and Hands Without Guns could be adapted for rural contexts and implemented to achieve these goals.<sup>42,43</sup> Evidence-based programs established for the Communities that Care prevention system addressing local risks to positive adolescent development could also be harnessed to address handgun carrying coinciding with bullying and physical violence.<sup>32,33</sup>

This study had limitations. All survey responses were obtained by self-report and may be subject to recall and social desirability biases. In addition, almost all questions posed to participants asked them to report both handgun carrying and other behaviors based on the prior 12 months. Therefore, we cannot observe the directionality of these associations, especially because they were often reported for the first time in the same wave. For example, we cannot evaluate whether bullying occurred before or after handgun carrying among the *declining* handgun carrying trajectory. Further, questions used to examine experiencing physical violence only included family violence (parental abuse in adolescence, intimate partner violence in young adulthood) while the questions used to examine using physical violence were broad and included any physical violence regardless of the relationship to the study respondent. We did not have access to information on other types of physical violence (e.g., being attacked or beat up by a classmate, firearm-related harm). Since there are other forms of violence that were not measured here, it is likely that these findings understate associations between handgun carrying patterns and experiences of and uses of physical violence. The study sample from CYDS was not designed to be representative of people in rural areas, so these findings may not generalize to all youth and young adults living in rural areas. In addition, latent trajectory identification of handgun carrying could be



different in a different sample, change over time, and many participants had a positive but small probability of following another handgun carrying trajectory.<sup>35,36</sup> Lastly, coefficient estimates of the association between bullying, physical violence, and handgun carrying trajectories and confidence intervals were imprecise for some trajectories, especially for the *high/persistent* and *declining* trajectories, due to the small sample sizes of these trajectories. Future studies can build on this work to examine important antecedents of handgun carrying (e.g., peer behavior, parental monitoring, community factors) as well as violence-related consequences.

## CONCLUSIONS

Experiencing and using bullying during adolescence were highly prevalent in this sample of youth who grew up in rural areas. The use of bullying and physical violence were reported most often among those who were more likely to carry a handgun during adolescence. The heightened odds of experiencing and using physical violence extended into young adulthood among many handgun carrying trajectories with higher probabilities of carrying during adolescence. Given that the presence of a handgun can escalate the consequences of interpersonal violence, existing programs focused on reducing youth bullying and physical violence should be adapted to include strategies to delay and reduce handgun carrying among youth.

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## APPENDIX

### Methods: Study sample and procedures

All communities in CYDS were rural incorporated towns (total populations from 1,500–41,000 in 2003 when the study began). Public school students in the fifth-grade in 2003–2004 were eligible to participate, and parental consent and student assent were obtained for 77% of the eligible population.<sup>29</sup> Data were collected from participants using surveys conducted in schools in adolescence and online in young adulthood. There were six data collection waves during adolescence (ages 12–18) with at least 89.8% retention (1797 of 2001 active, living participants) through grade 12 (2011) and four waves during young adulthood (ages 19–26) with at least 86.4% retention (1711 of 1980 active, living participants) through age 26 (2019). These retention rates refer to response rates at each study wave rather than cumulative retention. Participants were provided small monetary incentives for completing each study wave. Analyses were limited to data from participants

in the 12 control communities to avoid potential confounding that the CTC intervention may have had on bullying, physical violence, and handgun carrying. Study participants were a mean age of 12 years in grade 6 in 2005.

## **Methods: Outcomes, bullying and physical violence**

Table A1 and A2 describe component questions that were asked to participants in adolescence and young adulthood used to generate the bullying and physical violence outcome measures. Each specific outcome is described in more detail below.

### **Experienced bullying during adolescence.**

Participants were asked if they were bullied at school (teased or called names, had rumors spread about them, been deliberately left out of things, threatened physically, or actually hurt) during adolescence. Response options were: “No,” “Yes: less than once a week,” “Yes: about once a week,” and “Yes: most days.” Responses were dichotomized as equal to one if a participant responded yes at any time during adolescence, and zero otherwise.

### **Used bullying during adolescence.**

Participants were also asked if they took part in bullying another student at school using the same behaviors during adolescence. Responses were dichotomized in the same manner. Both bullying measures included only bullying at school and not other forms of bullying (e.g., cyber bullying).

Because many forms of physical violence co-occur, share common risk factors, and expected to be associated with handgun carrying in similar ways, we created the following composite variables to assess general associations between handgun carrying and physical violence. Several composite measures contained more than one type of physical violence (Table A1).

### **Experienced parental physical violence before age 18.**

Participants were retrospectively asked two questions as young adults if during the first 18 years of their life a parent hit, beat, kicked, or physically hurt them and if a parent hit them so hard they had marks. Both questions had response options: Never, Once, or More than once. Responses were dichotomized as equal to one if a participant endorsed parental physical violence more than once to either question.

### **Used physical violence during adolescence.**

Participants were asked if they used physical violence in two questions 1) by attacking someone with the idea of seriously hurting them or 2) by beating up someone so badly they probably needed to see a doctor or nurse. Responses were dichotomized as equal to one if a participant ever reported using physical violence from ages 12–18. This composite measure captures physical violence that is not specific to a particular person or relationship.

### **Experienced intimate partner physical violence during young adulthood.**

In young adulthood (ages 19–26), participants were asked two questions about how frequently an intimate partner had pushed, shoved, kicked, bit, or punched them in the

past year. Response options for both questions were: Once; Twice; 3–5 times; 6–10 times; 11–20 times; More than 20 times; Not in the past year, but it did happen before; or This has never happened. Responses were dichotomized into ever versus never having experienced intimate partner violence during young adulthood.

### **Used physical violence during young adulthood.**

In young adulthood, participants were asked two questions about if they pushed, shoved, kicked, bit, or punched an intimate partner with the same response options as the experiencing physical violence questions. During this developmental period, participants were also asked 1) if they used physical violence by attacking someone with the idea of seriously hurting them or 2) by beating up someone so badly they probably needed to see a doctor or nurse. Responses from these four questions were dichotomized as equal to one if a participant reported using physical violence against a partner or others between the ages of 19–26.

In general, less severe physical violence was more common than more severe physical violence and made a larger contribution to the composite measures (Table A1). For example, of the 36.0% of participants used physical violence during adolescence, about 88.8% of participants indicated this included attacking someone with the idea of seriously hurting them, and about 53.6% indicated it included beating someone up so badly they needed medical attention.

### **Results: Sample demographic information**

A total of 962 students (48.1%) were female, and 1040 (51.9%) were male; 532 (26.6%) were Hispanic, Latino, Latina, or Latinx; 67 were Black (3.4%), 43 were Asian (2.2%), 116 were Native American (5.8%), 15 were Pacific Islander (0.8%), a large number, 546 (27.3%), selected Other and provided a write-in with the words Hispanic, Spanish, or Latin, and 1310 (65.4%) were White. The highest level of educational attainment of either parent was a high school degree or less for 649 youth participants (32.4%).

**Table A1.** Study question availability and component questions on bullying and physical violence contributing to overall composite measures

Composite measure	Number of participants ever endorsing one or more component measures	% of sample (n=2,002) ever endorsing	Component study question	Proportion of participants who reported yes to each component question and contribute to yes coding for the composite measure	X marks the study waves where each component question was asked to participants. Shaded regions show the waves for which each behavior was measured											
					(Grade 6) Age 12 2005	(G7) Age 13 2006	(G8) Age 14 2007	(G9) Age 15 2008	(G10) Age 16 2009	(G12) Age 18 2011	Age 19 2013	Age 21 2015	Age 23 2017	Age 26 2019		
<b>Handgun carrying in adolescence or young adulthood</b>	601	30.0%	How many times in the past year (12 months) have you carried a handgun?	100%	X	X	X	X	X	X	X	X	X	X	X	X
<b>Experiencing bullying in adolescence</b>	1,466	73.2%	During the past year at school, have you been bullied (teased or called names, had rumors spread about you, been deliberately left out of things, threatened physically, or actually hurt)?	100%	X	X	X	X	X							
<b>Using bullying in adolescence</b>	1,049	52.4%	During the past year at school, have you taken part in bullying another student?	100%	X	X	X	X	X							
<b>Experiencing physical violence in adolescence (more than once)</b>	240	12.0%	During the first 18 years of your life, did a parent hit, beat, kick, or physically hurt you?	96.9%									X			X
			During the first 18 years of your life, did a parent hit you so hard you had marks?	56.7%										X		X
<b>Using physical violence in adolescence</b>	720	36.0%	How many times in the past year (12 months) have you attacked someone with the idea of seriously hurting them?	88.8%	X	X	X	X	X	X	X	X	X	X	X	X

		X marks the study waves where each component question was asked to participants. Shaded regions show the waves for which each behavior was measured																	
Composite measure	Number of participants ever endorsing one or more component measures	% of sample ever endorsing (n=2,002)	Component study question	Proportion of participants who reported yes to each question and contribute to yes coding for the composite measure	(Grade 6) Age		(G7) Age		(G8) Age		(G9) Age		(G10) Age		(G12) Age		Age		
					12	2005	13	2006	14	2007	15	2008	16	2009	18	2011	19	2013	21
			How many times in the past year (12 months) have you beat up someone so badly that they probably need to see a doctor or a nurse?	53.6%	X		X	X	X	X		X		X					
Experiencing physical violence in young adulthood	627	31.3%	In the past year, my partner pushed or shoved me.	83.5%										X	X	X	X	X	
			In the past year, my partner kicked, bit, or punched me	76.7%											X	X	X	X	X
			In the past year, I pushed or shoved my partner.	68.6%											X	X	X	X	X
Using physical violence in young adulthood	734	36.7%	In the past year, I kicked, bit, or punched my partner	57.6%										X	X	X	X	X	
			How many times in the past year (12 months) have you attacked someone with the idea of seriously hurting them?	36.0%											X	X	X	X	X
			How many times in the past year (12 months) have you beat up someone so badly that they probably need to see a doctor or a nurse?	16.6%										X	X	X	X	X	

**Table A2.**  
Component question missingness (n and %) at each wave

Measure	Study Question	(Grade 6) Age 12 2005	(G7) Age 13 2006	(G8) Age 14 2007	(G9) Age 15 2008	(G10) Age 16 2009	(G12) Age 18 2011	Age 19 2013	Age 21 2015	Age 23 2017	Age 26 2019
Experiencing bullying in adolescence	During the past year at school, have you been bullied (teased or called names, had rumors spread about you, been deliberately left out of things, threatened physically, or actually hurt)?	39 (2.0%)	107 (5.3%)	118 (5.9%)	120 (6.0%)	510* (25.5%)					
Using bullying in adolescence	During the past year at school, have you taken part in bullying another student?	46 (2.3%)	121 (6.0%)	121 (6.0%)	125 (6.2%)	514 (6.2%)					
Experiencing physical violence in adolescence	During the first 18 years of your life, did a parent hit, beat, kick, or physically hurt you?								213 (10.6%)	1,928 <sup>+</sup> (96.3%)	
	During the first 18 years of your life, did a parent hit you so hard you had marks?								214 (10.7%)	1,928 <sup>+</sup> (96.3%)	
Using physical violence in adolescence	How many times in the past year (12 months) have you attacked someone with the idea of seriously hurting them?	32 (1.6%)	104 (5.2%)	103 (5.1%)	120 (6.0%)	148 (7.4%)	208 (10.4%)				
	How many times in the past year	31 (1.6%)	99 (5.0%)	107 (5.3%)	119 (5.9%)	512* (25.6%)	216 (10.8%)				

Measure	Study Question	(Grade 6) Age 12 2005	(G7) Age 13 2006	(G8) Age 14 2007	(G9) Age 15 2008	(G10) Age 16 2009	(G12) Age 18 2011	Age 19 2013	Age 21 2015	Age 23 2017	Age 26 2019
	(12 months) have you beat up someone so badly that they probably need to see a doctor or a nurse?										
Experiencing physical violence in young adulthood	In the past year, my partner pushed or shoved me.							765 <sup>^</sup> (38.2%)	607 <sup>^</sup> (30.3%)	589 <sup>^</sup> (29.4%)	550 <sup>^</sup> (27.5%)
	In the past year, my partner kicked, bit, or punched me							765 <sup>^</sup> (38.2%)	608 <sup>^</sup> (30.4%)	588 <sup>^</sup> (29.4%)	549 <sup>^</sup> (27.4%)
Using physical violence in young adulthood	In the past year, I pushed or shoved my partner.							764 <sup>^</sup> (38.2%)	607 <sup>^</sup> (30.3%)	590 <sup>^</sup> (29.5%)	550 <sup>^</sup> (27.5%)
	In the past year, I kicked, bit, or punched my partner							765 <sup>^</sup> (38.2%)	608 <sup>^</sup> (30.4%)	588 <sup>^</sup> (29.4%)	549 <sup>^</sup> (27.4%)
	How many times in the past year (12 months) have you attacked someone with the idea of seriously hurting them?							214 (10.7%)	212 (10.6%)	280 (14.0%)	299 (14.9%)
	How many times in the past year (12 months) have you beat up someone so badly that they probably need to see a doctor or a nurse?							214 (10.7%)	216 (10.8%)	280 (14.0%)	298 (14.9%)

n and % missing of 2,002 at each study wave

\* indicates questions only asked of random subset of participants in some communities

+ indicates questions only asked of participants who did not provide a response in the prior study wave

<sup>^</sup> indicates questions only asked of participants who reported being in a romantic relationship in the last 12 months or currently casually dating or in a committed relationship

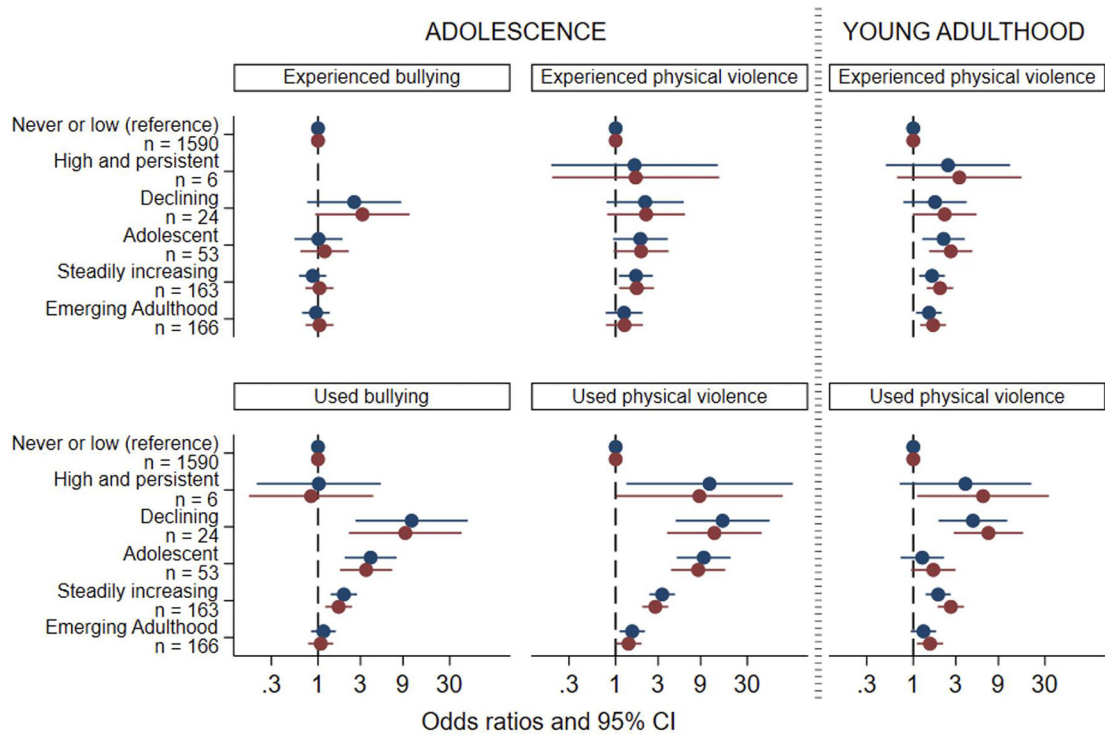
**Table A3.**

Demographic characteristics of the sample and handgun carrying trajectories

	High and persistent pattern (n=6; 0.3%)		Declining pattern (n=24; 1.2%)		Adolescent pattern (n=53; 2.6%)		Steadily increasing pattern (n=163; 8.1%)		Emerging adulthood pattern (n=188; 8.3%)		Never or low pattern (n=1,590; 79.4%)		All participants n=2,002	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
<b>Gender</b>														
Male	6	100	22	91.7	42	79.2	136	83.4	108	65.1	726	45.7	1040	51.2
Female	0		2	8.3	11	20.8	27	16.6	58	34.9	864	54.3	962	48.1
<b>At least one parent/guardian college educated</b>														
Yes	2	33.3	10	41.7	21	39.6	67	41.1	62	37.4	632	39.8	794	39.7
No	4	66.7	12	50.0	31	58.5	88	54.0	100	60.2	880	55.4	1115	55.7
Missing	0		2	8.3	1	1.9	8	4.9	4	2.4	78	4.9	93	4.7
<b>Hispanic ethnicity</b>														
Yes	2	33.3	11	45.8	13	24.5	37	22.7	40	24.1	429	27.0	532	26.6
No	4	66.7	13	54.2	40	75.5	126	77.3	126	75.9	1161	73.0	1470	73.4
<b>Race</b>														
Asian	0		0		2	3.7	4	2.5	5	3.0	21	1.3	32	1.6
Black	0		2	8.3	1	1.9	4	2.5	2	1.2	46	2.9	55	2.8
Multiracial	0		2	8.3	2	3.8	13	8.0	7	4.2	76	4.8	100	5.0
Native American	1	16.7	0		1	1.9	5	3.1	4	2.4	63	4.0	74	3.7
Pacific Islander	0		0		1	1.9	0		0		7	0.4	8	0.4
White	3	50.0	8	33.3	33	62.3	102	62.6	109	65.7	965	60.7	1220	60.9
Other	2	33.3	11	45.8	11	20.8	33	20.3	39	23.5	398	25.0	494	24.7
Missing	0		1	4.2	2	3.8	2	1.2	0		14	0.9	19	1.0

Note. Race categories were not mutually exclusive and race was missing for n = 19 participants.





**Figure A1.**  
Sensitivity analysis

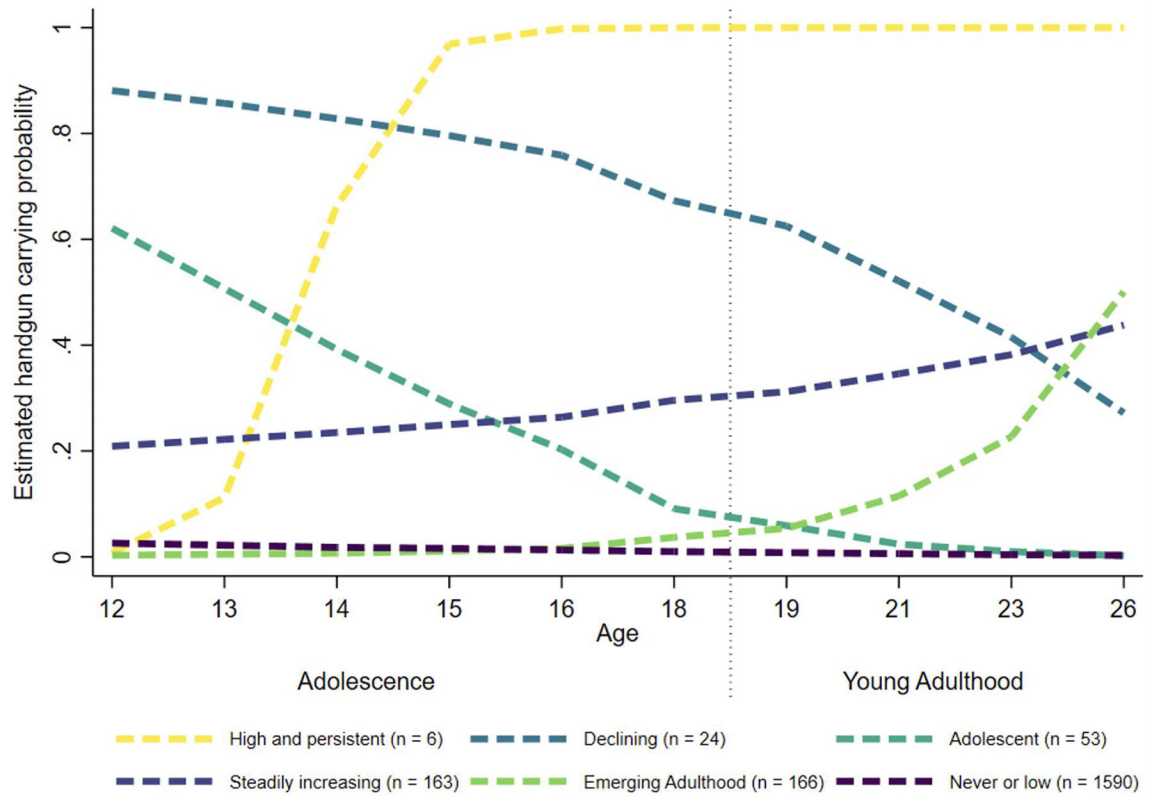
Notes. a indicates that exposure perfectly correlates with a non-zero outcome so odds ratio cannot be estimated, and these participants were excluded from regressions. In adolescence, experiencing physical violence includes only violence by a parent while using physical violence is not specific to a particular person/relationship. In young adulthood, experiencing physical violence includes only intimate partner violence (IPV) while using physical violence includes both IPV and violence that is not specific to a person/relationship.

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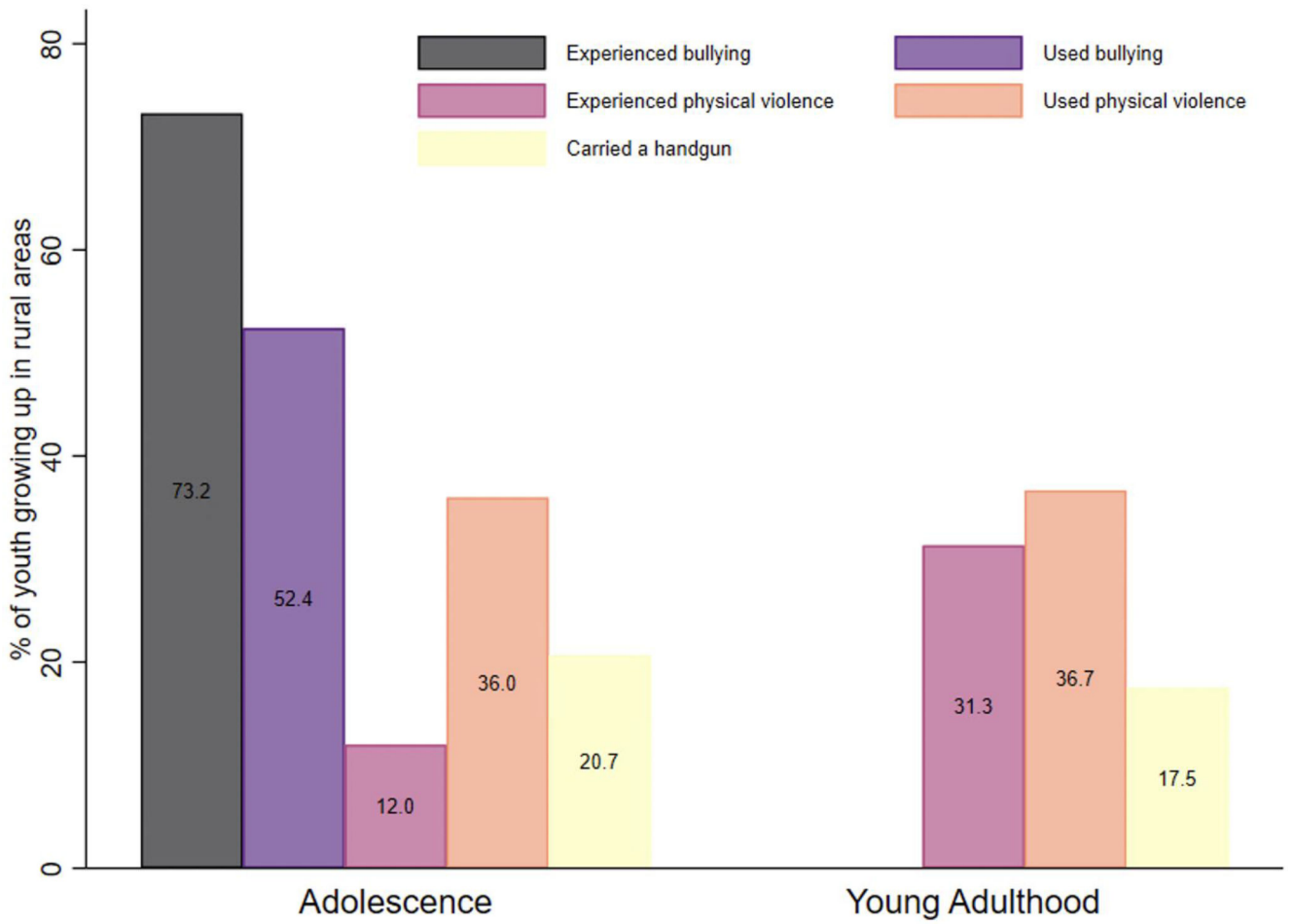
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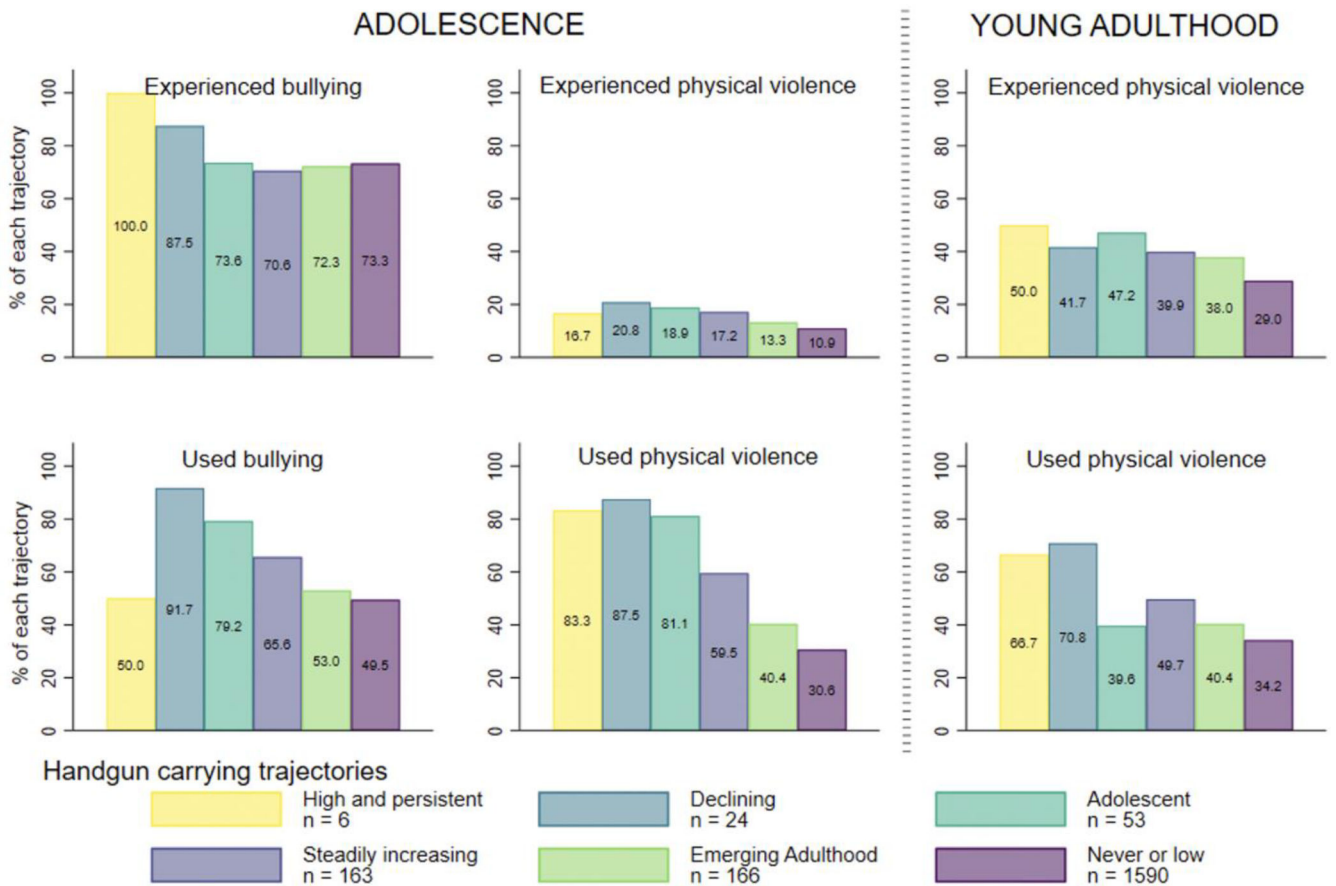
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**Figure 1.** Estimated probability of handgun carrying by trajectories among youth growing up in rural areas<sup>31</sup>



**Figure 2.** Experiencing and using bullying and physical violence during adolescence and young adulthood among youth growing up in rural areas



**Figure 3.** Percent of each trajectory group experiencing and using bullying and physical violence behaviors across developmental periods  
 Note. In adolescence, experiencing physical violence includes only violence by a parent while using physical violence is not specific to a particular person/relationship. In young adulthood, experiencing physical violence includes only intimate partner violence (IPV) while using physical violence includes both IPV and violence that is not specific to a person/relationship.

**Table 1.**

Handgun carrying trajectories, bullying, and violence

HANDGUN CARRYING TRAJECTORIES							
	High and persistent pattern ( <i>n</i> =6; 0.3%)	Declining pattern ( <i>n</i> =24; 1.2%)	Adolescent pattern ( <i>n</i> =53; 2.6%)	Steadily increasing pattern ( <i>n</i> =163; 8.1%)	Emerging adulthood pattern ( <i>n</i> =188; 8.3%)	Never or low pattern ( <i>n</i> =1,590; 79.4%)	All participants ( <i>n</i> =2,002)
<b>SUMMARY OF BULLYING AND PHYSICAL VIOLENCE AGES 12-26</b>							
Number of different behaviors reported, median	4	4	3	3	3	2	2
Number of waves at least 1 behavior reported, median	6.5	6	5	4	4	3	3
<b>ADOLESCENCE</b>							
Experienced bullying	6 (100)	21 (87.5)	39 (73.6)	115 (70.6)	120 (72.3)	1,165 (73.3)	1,466 (73.3)
Earliest age reported (in years), median	12	12	12	12	12	12	12
Number of waves experienced, median	2	2	2	2	2	2	2
Used bullying	3 (50.0)	22 (91.7)	42 (79.3)	107 (65.6)	88 (53.0)	787 (49.5)	1,049 (52.4)
Earliest age reported, median	12	12	13	13	13	13	13
Number of waves used, median	1	2.5	2	1	1	0	1
Experienced parental violence more than once	1 (16.7)	5 (20.8)	10 (18.9)	28 (17.2)	22 (13.3)	174 (10.9)	240 (12.0)
Used physical violence (general)	5 (83.3)	21 (87.5)	43 (81.1)	97 (59.5)	67 (40.4)	487 (30.6)	720 (36.0)
Earliest age reported, median	14	12	13	13	14	13	13
Number of waves used, median	2	4	2	1	0	0	0
<b>YOUNG ADULTHOOD</b>							
Experienced IPV	3 (30.0)	10 (41.7)	25 (47.2)	65 (39.9)	63 (38.0)	461 (29.0)	627 (31.3)
Earliest age reported, median	21	21	21	19	21	19	19
Number of waves experienced, median	0.5	0	0	0	0	0	0
Used physical violence (general or IPV)	4 (66.7)	17 (70.8)	21 (39.6)	81 (49.7)	67 (40.4)	544 (34.2)	734 (36.7)

HANDGUN CARRYING TRAJECTORIES							
	High and persistent pattern (n=6; 0.3%)	Declining pattern (n=24; 1.2%)	Adolescent pattern (n=53; 2.6%)	Steadily increasing pattern (n=163; 8.1%)	Emerging adulthood pattern (n=188; 8.3%)	Never or low pattern (n=1,590; 79.4%)	All participants (n=2,002)
<i>Earliest age reported, median</i>	19	21	19	19	19	19	19
<i>Number of waves used</i>	1.5	1	0	0	0	0	0



**Table 2.**

Odds ratios [95% confidence intervals] from logistic regressions examining the association between handgun carrying trajectories and bullying and physical violence

EXPERIENCING	ADOLESCENCE		YOUNG ADULTHOOD
	(1)	(2)	(3)
Odds ratio [95%CI]			
	Experiencing bullying	Experiencing physical violence	Experiencing physical violence
<b>Handgun carrying trajectories</b>			
<i>Never/low (n=1590)</i>	Ref.	Ref.	Ref.
<i>High and persistent (n=6)</i>	<i>a</i>	1.63 [0.19, 14.0]	2.45 [0.49, 12.18]
<i>Declining (n=24)</i>	2.55 [0.76, 8.58]	2.14 [0.79, 5.81]	1.75 [0.77, 3.97]
<i>Adolescent (n=53)</i>	1.01 [0.54, 1.89]	1.89 [0.93, 3.83]	2.19 [1.26, 3.79]
<i>Steadily increasing (n=163)</i>	0.87 [0.61, 1.24]	1.69 [1.09, 2.61]	1.62 [1.17, 2.26]
<i>Emerging adulthood (n=166)</i>	0.95 [0.66, 1.36]	1.24 [0.77, 2.00]	1.50 [1.07, 2.09]
<b>N</b>	<b>1,996</b>	<b>2,002</b>	<b>2,002</b>
<b>USING</b>			
	(4)	(5)	(6)
Odds ratio [95%CI]	Using bullying	Using physical violence	Using physical violence
<b>Handgun carrying trajectories</b>			
<i>Never/low (n=1590)</i>	Ref.	Ref.	Ref.
<i>High and persistent (n=6)</i>	1.02 [0.21, 5.07]	11.32 [1.32, 97.19]	3.85 [0.70, 21.06]
<i>Declining (n=24)</i>	11.22 [2.63, 47.89]	15.85 [4.71, 53.40]	4.67 [1.92, 11.33]
<i>Adolescent (n=53)</i>	3.89 [1.99, 7.62]	9.74 [4.85, 19.54]	1.26 [0.72, 2.21]
<i>Steadily increasing (n=163)</i>	1.95 [1.39, 2.73]	3.33 [2.39, 4.63]	1.90 [1.37, 2.63]
<i>Emerging adulthood (n=166)</i>	1.15 [0.83, 1.59]	1.53 [1.10, 2.13]	1.30 [0.94, 1.80]
<b>N</b>	<b>2,002</b>	<b>2,002</b>	<b>2,002</b>

**Notes.** *a* indicates that exposure perfectly correlates with a non-zero outcome so odds ratio cannot be estimated, and these participants were excluded from regressions. In adolescence, experiencing physical violence includes only violence by a parent while using physical violence is not specific to a particular person/relationship. In young adulthood, experiencing physical violence includes only intimate partner violence (IPV) while using physical violence includes both IPV and violence that is not specific to a person/relationship.