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TITLE: Weapon carrying in and out of school among pure bullies, pure victims and bully-victims: A systematic review and meta-analysis of cross-sectional and longitudinal studies

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Highlights

- Pure bullies, pure victims and bully-victims have greater odds of carrying a weapon in general compared to children who are not affected by bullying episodes.
- Pure victims and bully-victims are significantly more likely to carry a weapon in school than out of school, supporting the ‘vulnerability/self-protection’ hypothesis.
- Pure bullies have the same odds of carrying a weapon inside and outside the school context, supporting the persistent antisocial personality theoretical framework.
- Given the strong link between school bullying and weapon carrying, effective anti-bullying strategies should be promoted in schools.
- Other multi-component violence reduction programs may be equally effective in reducing antisocial behaviors such as bullying and weapon carrying.

ABSTRACT

Weapon carrying has detrimental effects for perpetrators and victims alike. It is therefore imperative that research efforts are invested into establishing those contextual factors that are associated with this antisocial behavior. This systematic and meta-analytic review investigates the association of weapon carrying with bullying perpetration and victimization inside and outside the school context. Results on pure bullies, pure victims and bully-victims are also presented.

Further to extensive searches, across 20 databases and 46 journals, and careful screening of reports, in line with pre-established methodological criteria, a total of 35 manuscripts are included in the meta-analysis. Narrative results based on longitudinal studies are also presented but not meta-analyzed given the variability in study characteristics and the small number of studies.

Weapon carrying is significantly associated with both bullying perpetration (adjusted $OR = 2.64$; $p < .001$) and victimization (adjusted $OR = 1.58$; $p < .05$). Effect sizes are larger when looking at discrete categories of pure bullies (adjusted $OR = 3.24$; $p < 0.01$), pure victims (adjusted $OR = 1.79$; $p < 0.05$) and bully-victims (adjusted $OR = 5.66$; $p < .001$) when compared with non-involved school children. Subgroup analyses suggest that pure victims ($Q = 6.77$; $p < .01$) and bully-victims ($Q = 8.01$; $p < .01$) are significantly more likely to carry a weapon inside than outside the school, thus rendering support to the 'vulnerability/self-protection' hypothesis. Pure bullies have the same odds of carrying a weapon inside and outside the school context ($Q = 0.60$; $p = .44$), supporting a persistent antisocial personality theoretical framework.

Implications for policy and practice arising from our results are discussed.

Key words: Meta-analysis, bullying, weapon carrying, cross-sectional studies, longitudinal studies.

1. Introduction

Violence associated with weapons has emerged as a major public health problem among school-aged children in the United States (Bradshaw, Waasdorp, Goldweber, & Johnson, 2013), Australia (Hemphill et al., 2011), New Zealand (McGee, Carter, Williams, & Taylor, 2005), and Europe (McKeganey & Norrie, 2000) alike. Prevalence rates of school-aged students who reported carrying a weapon are indicative of this disturbing social problem. For example, a representative study in the US estimated that 15% of 10,269 adolescents aged 12 to 21 carried a weapon in the last 30 days (Lowry, Powell, Kann, Collins, & Kolbe, 1998). In the UK, a survey of 10,677 students found weapon carrying among 18% of males and 3% of females aged 11-12 and 29% of males and 9% of females aged 15-16 (Balding, Regis, Wise, Bish, & Muirden, 1996).

Weapon carrying increases the risk of adolescent injury, with a recent comparative study between North American and European countries suggesting that weapon carrying was significantly associated with elevated risks for medically treated, multiple, and hospitalized injury events across seven countries (Pickett et al., 2005). Weapon carrying is also associated with other violent and antisocial behaviors such as involvement in serious group fights (Forrest, Zychowski, Stuhldreher, & Ryan, 2000), gang membership (Bradshaw et al., 2013), drug dealing (Lizotte, Krohn, Howell, Tobin, & Howard, 2000), and illegal drug use (McKeganey & Norrie, 2000).

Weapon carrying and weapon-related violent incidents in schools have detrimental effects on the healthy psychosocial development of perpetrators and victims alike (Flannery, Wester, & Singer, 2004; Simon, Richardson, Dent, Chou & Flay, 1998). With recent examples of mass shootings in US schools (Leary, Kowalski, Smith, & Phillips, 2003) and with a series of, primarily, knife-related homicides in the UK (Eades, 2006), the time is ripe to investigate the contextual explanatory factors for weapon carrying, a form of antisocial behavior, in a thorough systematic way.

The option to ban gun ownership or the option to confiscate or buy back all guns from the population may not be open to the United States, but it has been a viable approach in

various other countries, including Australia (Mouzos, 1999) and the UK (Her Majesty's Stationery Office, 1997). Nevertheless, it has been argued that it is not so much the issue of ownership, but rather the carrying of and the ready access to weapons that is linked to criminal injury and violence in general (Moore, 1980). It is therefore imperative that research efforts are invested into establishing those contextual factors that may explain why young people opt for carrying a weapon in the first place.

Various contextual factors and intervening mechanisms should be taken into account when explaining weapon carrying (Brennan & Moor, 2009). For example, fear of victimization due to crime involvement and the need for self-protection is the main motive among weapon carriers in both the US (DuRant, Krowchuk, Kreiter, Sinal, & Woods, 1999) and the UK (Bennett & Holloway, 2004). Notably, the need for self-protection is a shared feeling and common incentive for weapon carrying among perpetrators and victims correspondingly (Melde, Esbensen, & Taylor, 2009). It has been suggested that one of the driving factors behind weapon carrying in schools is involvement in bullying incidents as a perpetrator or a victim (Dukes, Stein, & Zanne, 2010). Remarkably, in-depth investigation of 15 case studies of school shootings between 1995 and 2001 established that acute or chronic rejection—in the form of ostracism, bullying, and/or romantic rejection—was present in all but two of these incidents (Leary et al., 2003).

Various theoretical models could explain a significant association between school bullying (perpetration and victimization) and weapon carrying inside or outside the school. By definition, bullying involves a repetitive behavior that is based on an intention to harm and a power differential between the perpetrator and the target (Centers for Disease Control and Prevention, 2014). It may be that this element of repetition and imbalance in power dynamics encourages bullied children to opt for carrying a weapon at school for self-protection. This is consistent with earlier research that has highlighted how repeat incidents of victimization (Chang, Chen, & Brownson, 2003) and feeling vulnerable to being victimized (Simon, Dent, & Sussman, 1997) are linked to increased likelihood of weapon carrying. Such a theoretical model --based on a 'vulnerability/self-protection hypothesis'-- may be supported if among

bullied children the odds of carrying a weapon within school are significantly higher than the odds of carrying a weapon outside school. In other words, school victims may not feel the need for self-protection outside the school framework, thus resulting in smaller effect sizes for the association of victimization with weapon carrying outside the school setting (compared to weapon carrying within the school setting).

On the other hand, bullies may carry a weapon to intimidate their victims and to further enhance their social status in schools, consistent with studies on how weapon carrying might function as a status symbol in friendship networks and, consequently, be subject to peer influence (Dijkstra et al., 2010). Furthermore, and in line with earlier research (Ttofi, Farrington, Lösel, & Loeber, 2011b; Ttofi, Farrington, & Lösel, 2012), bullying perpetration and weapon carrying could both be seen as indicators of the same latent construct, such as a general underlying antisocial tendency. A theoretical model of a more general underlying antisocial tendency can be supported if school bullies have the same odds of carrying a weapon inside and outside the school context. If pure bullies do not feel a greater need for self-protection inside the school setting, then they would have the same likelihood of carrying a weapon across different (and not just the school) settings, thus rendering support to a more general antisocial behavioural pattern.

2. Current study

The current study aims to investigate, through a systematic review and a series of meta-analyses, the extent to which involvement in school bullying (as perpetrator, victim, or bully-victim) is associated with weapon carrying based on cross-sectional and longitudinal studies. Previous research is indicative of the detrimental effects of school bullying and victimization on the healthy psychosocial development of children (Arseneault, Bowes, & Shakoor, 2010). School bullies are more likely to be involved in both criminal (Ttofi et al., 2011b) and violent (Ttofi et al., 2012) incidents in their adult life, while bullied children are more likely to suffer from depression in later years (Ttofi, Farrington, Lösel, & Loeber, 2011a). To the extent that involvement in bullying is significantly associated with weapon

carrying, effective bullying-prevention programs could successfully contribute to a reduction in weapon-related violence (Ttofi, 2015).

The current study focuses on cross-sectional and longitudinal studies that investigate whether school bullying (perpetration and victimization) is linked to weapon carrying. Ideally, longitudinal data from primary studies should aim to investigate the directionality of relationships identified, based on multiple assessments of both bullying and weapon carrying. Such studies could tease out the extent to which weapon carrying is facilitated by a 'bullying persona' (i.e. bullying qualities function as a stepping stone towards carrying a weapon inside/outside the school) or, alternatively, the extent to which bringing a weapon to school is a more effective way to bully (i.e. bullying incidents are facilitated by carrying a weapon at school). Within the school aggression literature, however, very few studies have examined the directionality of effects between school bullying and various outcomes, none of which on weapon carrying (Kochenderfer & Ladd, 1996; Kim, Leventhal, Koh, Hubbart, & Boyce, 2006).

A previous narrative review has investigated theories and other contextual factors that explain the association between weapon carrying and violence in general (Brennan & Moore, 2009), without any reference to the association of weapon carrying with school bullying in particular. Another meta-analytic review (Van Geel, Vedder & Tanilon, 2014) has investigated the association between school bullying and weapon carrying. The current paper extends the earlier review of Van Geel and colleagues (2014) in many ways.

First, the current study is based on systematic searches of the literature in twenty databases rather than six databases. Comprehensive searches of the literature could explain why the current review has located ten new manuscripts (i.e., Alsubaie, 2010; Baly, Cornell, & Lovegrove, 2014; Esselmont, 2014; Luster & Oh, 2001; Rajan, Namdar, & Ruggles, 2015; Sapouna & Wolke, 2013; Shetgiri, Lin, & Flores, 2012; Trajtenberg & Eisner, 2014; Turner, Phillips, Tigri, Williams, & Hartman, 2016; Wong, 2009).

Secondly, the earlier review combined studies with adjusted and unadjusted effect sizes (e.g., Andershed, Kerr, & Stattin, 2001; DeVoe, 2007; DeVoe & Murphy, 2011; Greene,

2003; Meyer-Adams & Conner, 2008; Stein, Dukes, & Warren, 2007; Testani-Cafiero, 2003). Unadjusted effect sizes show the bivariate association between two variables (here, bullying and weapon carrying), without controlling for potential confounds. Furthermore, unadjusted effect sizes tend to be larger, thus providing an overestimated effect on how two factors are associated (Ttofi et al., 2011a; Ttofi et al., 2012). In the present review, summary effect sizes are shown separately for unadjusted and adjusted effect sizes.

Finally, the earlier review has combined cross-sectional and longitudinal data (e.g., Hemphill, et al., 2011). However, effect sizes based on cross-sectional data tend to be larger than effect sizes based on longitudinal data, as shown by earlier meta-analyses on the association between school bullying and drug use based on cross-sectional (Valdebenito, Ttofi, & Eisner, 2015) and longitudinal (Ttofi, Farrington, Lösel, Crago, & Theodorakis, 2016) studies.

3. Methodology

3.1 Search strategies

We conducted electronic searches in 20 different databases (e.g., Web of Science, MEDLINE, ERIC, PsychInfo, Google Scholar), including searches of manuscripts produced in Latin America and other Spanish and Portuguese-speaking countries (e.g., SciELO-Scientific Electronic Library Online). These extensive searches were conducted to identify and retrieve an exhaustive collection of empirical studies, thus minimizing the possibility of publication bias. Electronic searches were complemented with hand searching of all volumes of 46 journals. References of retrieved articles, including references of previous reviews, were also scanned to find any additional studies.

We explored published and unpublished reports (e.g., Ethos-Electronic Theses Online Service) from any country, written in any language as long as the title and abstract were written in English. Searches were conducted using a selected set of key-words, in various different combinations, for the association between the variables involved in the present study (i.e., *school bullying*, *bully**, *victim**, *bully-victim*, *bullies*, *school*, *school children*, *student**,

weapon carrying, carrying weapon, gun carrying). Figure 1 presents the relevant flow chart of searches.

FIGURE 1 ABOUT HERE

3.2 Criteria for inclusion or exclusion of reports

For the purpose of the present review, included studies met the following criteria:

- We focused on studies measuring school bullying exclusively (Centers for Disease Control and Prevention, 2014). Manuscripts on bullying within other settings, such as bullying at work, or other manifestations of victimization or violence (e.g., fights, school shouting) outside or inside the school were not included (e.g., Vossekuil, Fein, Reddy, Borum, & Modzeleski, 2002).
- Databases and journals were searched from inception to end of 2015.
- Included studies specified a statistical measure of the association between bullying involvement (i.e., bullies, victims and bully-victims) and weapon carrying. This last variable refers to the carrying a weapon generally, carrying a weapon to school (e.g., Nansel, Overpeck, Haynie, Ruan, & Scheidt, 2003) or carrying and using a weapon at school (e.g., Srabstein & Piazza, 2008). The following were identified as weapons: knives, sticks/clubs (e.g., Dukes et al., 2010) brass knuckles, mace/pepper sprays (e.g., Kukaswadia, Craig, Janssen, & Picket, 2012) and firearms or guns (e.g., Fernando, 2009).
- We excluded studies in which bullying or weapon carrying were measured as part of a total score scale, for instance externalizing behavior scales, or violent behavior scales (e.g., Kuntsche & Klingemann, 2004; Sapouna & Wolke, 2013).
- Included studies sampled school-aged children and adolescents from the general community so that results can be generalized to the wider population.
- Qualitative studies or studies with not enough statistical information that would allow calculation of an effect size were excluded (e.g., Azevedo da Silva et al., 2012; Rajan et al., 2015).

- Sources explored were book chapters (e.g., Beran, 2008), journal articles, government reports (e.g., Vossekul et al., 2002), and academic MSc and PhD theses (e.g., Fernando, 2009). Some statistical results were obtained through email communication with the authors (e.g., Van de Looij-Jansen, Goldschmeding, & De Wilde, 2006; Rudatsikira, Muula, & Siziya, 2008).

Two trained researchers conducted the eligibility assessment as well as the coding of included reports. When the study's inclusion was contentious, final decisions on inclusion or exclusion were shared with a third party. Following careful screening of all manuscripts, 87 studies were excluded, a list of which can be obtained upon request from the first author of this article. It is unfortunate that detailed information on this screening process was not recorded since this would enable us to provide statistics for interrater reliability in the form of Cohen's kappa.

3.3. Coding and combining effect sizes within a report relating to the same outcome measure

Some reports included in the meta-analyses presented *more than one effect size* that could be coded for the outcome measure of weapon carrying. For instance, Del Rey and Ortega (2008) reported results for carrying a weapon frequently and rarely. In such cases, results were combined into a single effect size. A similar strategy was followed when separate measures were provided for 'weapon carrying' and 'carrying a gun' (e.g., Fernando, 2009), with relevant data combined into a single effect size.

Additionally, some reports presented the same outcome for *different groups of respondents* (i.e., subgroups within the study), for instance boys and girls (e.g., Andershed, Kerr, & Stattin, 2001), different ethnic groups (Fernando, 2009) or respondents from different countries (Nansel, Craig, Overpeck, Saluja, & Ruan, 2004). In such cases, results were also combined in a single effect size for each study under investigation.

With regard to the *bullying measures*, few studies presented results based on different types of bullying, such as physical and relational types of bullying (e.g., Dukes et al., 2010).

Again, data were combined producing one effect for bullies, one for victims, and one for bully-victims. Given the limited number of studies that provided information on different types of bullying, we were unable to investigate the extent to which weapon carrying differs by type of bullying.

Table 1 reports the data that were obtained from each report for calculating an effect size. Three kinds of effect sizes were computed: effect sizes *based on means*; effect sizes *based on binary data* (e.g., odd ratios and confidence intervals; odd ratios and standard error; percentages, events and non-events; chi-squared); and effect sizes *based on correlational data* (e.g., Pearson correlation).

TABLE 1 ABOUT HERE

4. Results of cross-sectional studies

A total of 35 studies provided enough statistical data to calculate an effect size on the association between school bullying and weapon carrying. They represented a total of 588,974 school children, with their mean age ranging between 11 and 18 years. Data extracted from included papers were analyzed using the Version 3 of the Comprehensive Meta-Analysis software. All results are reported in the different meta-analytic sections using odds ratios (*OR*) along with their 95% confidence intervals.

As already mentioned, one of the aims of this review was to investigate whether bullying might be related to weapon carrying because of some confounding variable (e.g., ethnicity) that predicts both. The role of confounding variables can be addressed by investigating to what extent bullying is significantly associated with weapon carrying after controlling for them (Baron & Kenny, 1986). Therefore, in the meta-analytic sections below we analyze separately data from studies that presented unadjusted and adjusted effect sizes (i.e., after controlling for other major risk factors that are related to both school bullying and other outcomes). The focus will be on meta-analyzing the adjusted effect sizes relating to each individual study. This approach provides a summary estimate of the unique contribution of school bullying in weapon carrying *over and above* the effect of other confounding factors.

Table 1 presents the unadjusted effect as well as the adjusted effect sizes for each study along with the number and type of confounding variables that researchers controlled for in their analyses. In many studies, researchers have controlled for theoretically plausible confounders, namely: a) feeling unsafe at school (e.g., Alsubaie, 2010; Esselmont, 2014; Swahn et al., 2013); b) feelings of suicidality or earlier suicidal attempts (e.g., Alsubaie, 2010; Liang et al., 2007; Swahn et al., 2013); c) other problem behaviors (e.g., Liang et al., 2007; Shetgiri et al., 2012; Swahn et al., 2013); and d) physical victimization/injury or other types of victimization and abuse (e.g., Alsubaie, 2010; Dukes et al., 2010; Shetgiri et al., 2012). Most of the studies controlled for major background variables such as age, gender and ethnicity.

4.1.1 Weapon carrying among bullies

Figure 2.1 illustrates that *twelve* eligible studies reported effect sizes on the association of bullying *perpetration* and *weapon carrying*. The random-effects computational model was used for the calculation of the summary effect size. The adjusted summary effect size was $OR = 2.64$ (95% CI 2.06 and 3.38; $z = 7.71$; $p < .001$)¹. Given the heterogeneity in methodological features (e.g., sample size, location, etc.) of the included studies, heterogeneity tests were conducted. Cochran's test, Q , was significant at $p < .001$ level ($Q = 206.52$; $I^2 = 94.6$), supporting the presence of high dispersion in effect size across studies.

FIGURE 2.1 ABOUT HERE

A smaller number of (six) studies have looked at weapon carrying among discrete categories of pure bullies, pure victims and bully-victims. Figure 2.2 presents the forest plot for the effect sizes comparing the weapon carrying of pure bullies with children non-involved in bullying. Pure bullies were three times more likely to carry a weapon compared with non-involved students (adjusted $OR = 3.24$; 95% CI 2.37 and 4.44; $Q = 102.26$, $p < .001$; $I^2 = 95.11$).

¹ Seventeen studies reported data for the unadjusted association between bullying perpetration and weapon carrying. Under the random model the association produced an $OR = 3.75$ (95% CI 2.20 and 6.40; $z = 4.87$; $p < .001$) larger than the adjusted association.

FIGURE 2.2. ABOUT HERE**4.1.2 Weapon carrying among bullies: publication bias analysis**

We ran analyses for testing the likelihood of publication bias based on studies presented in Figure 2.1. Duval and Tweedie's trim-and-fill analysis exhibits the differences in effect sizes that could potentially be attributed to bias; the technique imputes effect sizes until the error distribution gets close to normality. In this way, the test offers the best estimate of the unbiased effect (Borenstein, Hedges, Higgins, & Rothstein, 2009). Results suggest that there were no differences in effect sizes attributable to bias. Under a fixed effect model, the point estimate for the combined studies did not differ when comparing the original and the adjusted estimate (in both cases it was $OR = 2.79$; 95% CI 2.65 and 3.20). Correspondingly, under the random effect model, the values again did not vary (in both cases they were $OR = 2.64$; 95% CI 2.06 and 3.38).

Additionally, Rosenthal's fail-safe N test is a technique for computing the number of additional missing studies with no effect that would be necessary to nullify the observed effect. Small numbers of missing studies are indicative of a higher likelihood of biased effects. The fail-safe N test suggested that there would be need to 297 missing studies with no effects for every observed study for the effect to be nullified. It is highly unlikely that we have missed such a large number of studies.

4.2.1. Weapon carrying among victims

Thirteen studies were concerned with the association between bullying victimization and weapon carrying. Individual effect sizes across studies are shown in Figure 3.1. The adjusted summary effect size was an OR of 1.58 (95% CI 1.05 and 2.38; $z = 2.191$ $p < .05$)² suggesting a moderate but significant association. Cochran's Q suggests substantial variability in the estimates among studies (Cochran's $Q = 625.25$; $p < .001$; $I^2 = 98$).

FIGURE 3.1 ABOUT HERE

² Twenty studies reported data for the unadjusted association between bullying victimization and weapon carrying. Under a random model an $OR = 1.48$ (95% CI 1.29 and 1.69; $z = 5.81$ $p < .001$) suggests no important differences between adjusted and adjusted effects.

The adjusted summary effect size is notably larger when looking at the distinct category of pure victims. Figure 3.2 presents the forest plot for the effect sizes comparing the weapon carrying of pure victims with children non-involved in bullying. Pure victims were roughly two times more likely to carry a weapon compared with non-involved students (adjusted $OR = 1.79$, 95% CI 1.03 and 3.11; $p < .05$; $Q = 303.05$, $p < .001$; $I^2 = 98.35$).

FIGURE 3.2. ABOUT HERE

4.2.2 Weapon carrying among victims: publication bias analysis

We ran publication bias analyses based on data from the studies included in Figure 3.1. After running Duval and Tweedie's trim-and-fill procedure, there were no differences in effect sizes attributable to bias resulting from systematically missing studies from the meta-analysis. Results revealed that under a fixed effect model, the point estimate for the combined studies did not vary when comparing the original and the adjusted estimated (in both cases it was $OR = 2.21$; 95% CI 2.10 and 2.32). The same was true for the random effects model (in both cases it was $OR = 1.57$; 95% CI 1.04 and 2.37). In other words, Duval and Tweedie's trim-and-fill procedure shows that results cannot be invalidated because of publication bias.

Furthermore, Rosenthal's fail-safe N test suggested that it would be necessary to locate and include 94 missing studies in order to nullify the observed effect. After a systematic review that involved a search on 20 databases from different countries and in different languages, it seems improbable that this huge number of studies could be available yet missed.

4.3.1 Weapon carrying among bully-victims

Six studies reported data for the association between bully-victims and weapon carrying. Individual effect sizes for each independent study as well as summary effect sizes across all studies are shown in Figure 4. After controlling for covariates, a summary effect size was obtained of $OR = 5.66$ (95% CI 3.59 and 8.89; $z = 7.50$ $p < .001$)³ suggesting that

³ Seven studies reported unadjusted data for the prevalent association between bullying-victimization and weapon carrying. Reported results suggest a smaller effect when data is not controlled by covariates ($OR = 4.73$; 95% CI 2.04 and 10.95; $z = 3.63$; $p < .001$).

bully-victims have roughly six times greater odds of carrying a weapon compared to children who are not affected by bullying incidents. Cochran's test, Q , was significant at $p < .001$ (Cochran's $Q = 163.56$; $I^2 = 96$), supporting the presence of high dispersion in effect size across studies.

FIGURE 4 ABOUT HERE

4.3.2 Weapon carrying among bully-victims: publication bias analysis

Duval and Tweedie's trim-and-fill procedure suggested no differences in effect sizes attributable to bias resulting from systematically missing studies from the meta-analysis. Under the fixed effect model, the point estimate for the combined studies did not vary when comparing the original and the adjusted estimated (in both cases it was $OR = 6.66$; 95% CI 6.25 and 7.09). The same was true for the random effect model (in both cases it was $OR = 5.65$; 95% CI 3.59 and 8.89). Rosenthal's fail-safe N test indicated that 599 missing studies with no effects would be needed to nullify the observed effect, which seems most unlikely.

4.4. Weapon carrying inside and outside the school context

Subgroup analyses were carried out to investigate whether the odds of weapon carrying among bullies, victims and bully-victims are significantly different inside and outside the school setting. Subgroup analyses were based on those studies that identified discrete categories of pure bullies, pure victims and bully-victims.

Results suggest that pure victims were significantly ($Q = 6.77$; $p < .01$) more likely to carry a weapon inside (adjusted $OR = 2.73$, $p < .001$) than outside (adjusted $OR = 1.37$, $p < .001$) the school setting. Similarly, bully-victims were significantly ($Q = 8.01$; $p < .01$) more likely to carry a weapon inside (adjusted $OR = 10.45$, $p < .001$) than outside (adjusted $OR = 3.37$, $p < .001$) the school setting. Pure bullies, on the other hand, had the same odds ($Q = 0.60$; $p = .44$) of carrying a weapon inside (adjusted $OR = 3.91$, $p < .001$) and outside (adjusted $OR = 3.07$, $p < .001$) the school context.

5. Results of longitudinal studies

Five reports provided data based on longitudinal studies, with three of these reports (Luster & Oh, 2001; Turner et al., 2015; Wong, 2009) relating to the same longitudinal study, namely the National Longitudinal Survey of Youth 1997. Another report (Baly et al., 2014) provided data based on a three-year follow-up survey in Virginia, US, while the last report (Hemphill et al., 2011) presented data from the International Youth Development Study, a major longitudinal study in Victoria, Australia. Two further reports included data on bullying and weapon carrying based on two longitudinal studies, namely the Youth Risk Behavior Surveillance System Study (Rajan et al., 2015) and the Edinburgh Study of Youth Transition and Crime (Sapouna & Wolke, 2013). However, both were excluded for reasons stated earlier (see above). Table 2 presents detailed information on the characteristics of each report along with main study findings. Given the limited number of reports, it seemed methodologically inappropriate to synthesize individual effect sizes in a meta-analytic investigation (Borenstein et al., 2009).

All five (published and unpublished) reports looked at the association between victimization (being bullied) and weapon carrying. Only one report (i.e., Hemphill et al., 2011) looked at the association of bullying perpetration and weapon carrying. No longitudinal study investigated the prevalence of weapon carrying among bully-victims. Across four studies (i.e., Baly et al., 2014; Hemphill et al., 2011; Turner et al., 2015; Wong, 2009), the clear pattern that emerged was that victimization is positively associated with weapon carrying, although in one study (Hemphill et al., 2011) the effect size did not reach significance level. The individual effect sizes were small to moderate with odds ratios in the range of 1.20 to 1.63. One report (i.e., Luster & Oh, 2001) provided a negative but non-significant effect size (i.e., suggesting lower prevalence of weapon carrying for victims than non-involved children).

TABLE 2 ABOUT HERE

All effect sizes presented in Table 2 are adjusted effect sizes, usually from regression analyses in which the authors controlled for potential confounders. One report (Turner et al.,

2015) found a significant positive association of victimization and weapon carrying after controlling for pre-existing gun carrying but only for childhood victimization (and not for adolescent victims or for chronic victims). Notably, those reports that used propensity score matching in an attempt to equate individuals to their probability of being victimized (i.e., Turner et al., 2015; Wong, 2009) found a small but significant effect on weapon carrying at significance level of 0.01. Both reports with propensity score matching used data from the National Longitudinal Survey of Youth 1997 (NLSY97), but the former used only what is called the 'cross-sectional NLSY97 sample' from baseline up to Wave 7 whilst the latter used both the cross-sectional NLSY97 sample and the supplemental sample of ethnic minority youth (again from baseline to Wave 7). Finally, it is interesting to notice that in one study (Baly et al., 2014), after validity screening (i.e., based on data for students who indicated 'not paying attention to the survey' or 'not telling the truth'), the association between victimization and weapon carrying was no longer significant.

Overall, results from these five reports are indicative of a small to moderate effect of victimization on weapon carrying, although results should be treated with caution because of the small sample of available studies.

6. Discussion and Directions for Future Research

Weapons are used in a quarter of violent incidents in the US and the UK (Rand & Catalano, 2007; Kershaw, Nicholas, & Walter, 2008), although adolescent weapon carrying in schools accounts for less than 1% of the US homicides among those of school going age (Centers for Disease Control, 2008). Nevertheless, weapon carrying has detrimental effects on the psychosocial development of perpetrators and victims alike (Flannery et al., 2004). It is therefore imperative that research efforts are invested in establishing those contextual factors that may explain the reasons behind weapon carrying, particularly among youth.

The meta-analysis of cross-sectional studies provides clear evidence that school bullying (perpetration and victimization) is strongly associated with general weapon carrying. Notably, and in line with existing research on the importance of looking at discrete bullying

roles (Haynie et al., 2001; Wolke, Copeland, Angold, Costello, 2013), associations become clearer when synthesizing studies of pure bullies, pure victims and bully-victims. Compared with non-involved students, pure bullies were three times more likely to carry a weapon, pure victims were roughly twice more likely to carry a weapon, while bully-victims had roughly six times higher odds.

Findings on the association between weapon carrying and involvement in different bullying roles should come as no surprise. Potentially, all these externalizing problem behaviors could be seen as indicators of the same underlying latent construct (Corrado, Roesch, Hart, & Gierowski, 2002). In itself, however, the significant association between weapon carrying and school bullying is already cause for intervention because aggressive children who carry guns are at heightened risk of physical injuries (Pickett et al., 2005) and associated problem behaviors (Flannery et al., 2004), while victims who carry guns are likely to commit violence against others or to direct this violence towards themselves (Copeland, Wolke, Angold, & Costello, 2013).

Results of the sub-group analyses provide clear evidence that pure bullies had the same odds of carrying a weapon inside and outside the school context, thus rendering support for a theoretical model of a more general underlying antisocial tendency. Existing research supports the comorbidity of aggressive, violent and other problem behaviors (Loeber et al., 1998) as well as the marked shared variance in risk factors predicting these co-morbid behaviors (Farrington, 2002). Children who carry a weapon inside or outside the school are more likely to be aggressive, to be involved in fights and engage in other delinquent behaviors (Forrest et al., 2000; Lizotte et al., 2000; McKeganey & Norrie, 2000).

On the other hand, and in line with existing research (Chang et al., 2003, Simon et al., 1997), it was found that pure victims and bully-victims are significantly more likely to carry a weapon in school than out of school, supporting the 'vulnerability/self-protection' hypothesis. Effect sizes were notably larger for bully-victims. It has been suggested that bully-victims may have the highest incidence of weapon carrying exactly because they share the risk factors for both bullies and victims (Liang, Flisher, & Lombard, 2007).

This comorbidity in problem behaviors gives directions for future intervention research. Essentially, a holistic approach to school violence should be promoted through multi-component intervention strategies that address both risk factors and their associated behaviors (Corrado et al., 2002). Given the strong bullying-weapon carrying link, it could also be suggested that effective anti-bullying programs may be effective in reducing weapon carrying, at least among the category of pure-bullies.

With regard to the results of the longitudinal studies, it is interesting to note that those studies that used propensity score matching to equate individuals in their probability of repeat victimization found a highly significant positive association between incidents of victimization and weapon carrying (Turner et al., 2015; Wong 2009), confirming the need for appropriate methodological strategies in order to adequately explore these associations (Brennan & Moore, 2009). Consistent with earlier research, we also highlight the need for further longitudinal investigations on the bullying-weapon carrying link and, more importantly, for testing whether involvement in bullying increases weapon carrying or whether weapon carrying increases the involvement in bullying (Brennan & Moore, 2009; Ousey, Wilcox, & Brummel, 2008; Van Geel et al., 2014). Finally, future longitudinal studies should carefully investigate the actual time sequence—is it the case, for example, that victimization works as a stepping stone towards the decision to carry a weapon inside or outside the school, following a ‘need for self-protection’ hypothesis? Or is it the case that carrying a weapon simply increases to probability of future victimization?

Future research should also utilize better measures of weapon carrying, moving beyond existing superficial assessments of weapon-related behavior, such as asking respondents about their weapon carrying over the last 30 days (Brennan & Moore, 2009).

Future research should also investigate whether the association between school bullying and weapon carrying varies based on different types of school bullying. Very few of the included studies measured different forms of school bullying, such as relational/indirect and physical/direct, and their associated links with weapon carrying. Despite their overlapping, research has demonstrated the importance of distinguishing the two forms of

bullying because they may be differentially related to personal adjustment (Baldry, 2004; Crick & Bigbee, 1998). Future research should also aim to investigate how cyberbullying (as opposed to face-to-face traditional bullying) is associated with weapon carrying since current research directs towards differential associations with adverse outcomes (Wang, Nansel, & Iannotti, 2011).

The current systematic review has provided strong evidence that involvement in different bullying roles is significantly associated with weapon carrying. However, the most important question still remains unanswered: why do children involved in bullying opt for carrying a weapon inside or outside school? and what are the intervening mechanisms that may shed light to these associations? In future, qualitative studies and theoretically oriented studies should be carried out to clarify this question.

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(References with one asterisk indicate longitudinal studies. Double asterisk indicate reports included in the meta-analysis of cross-sectional studies)

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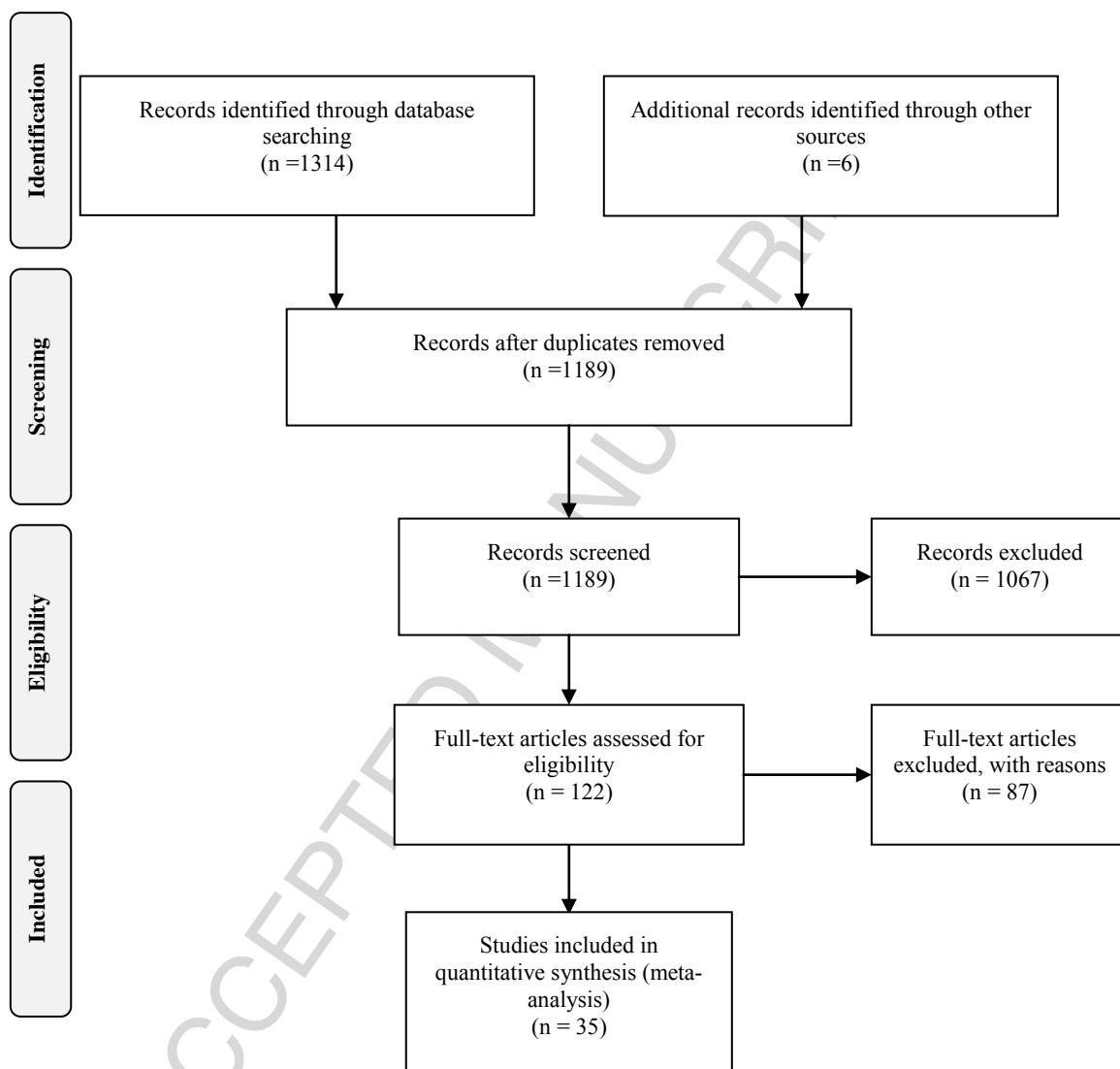
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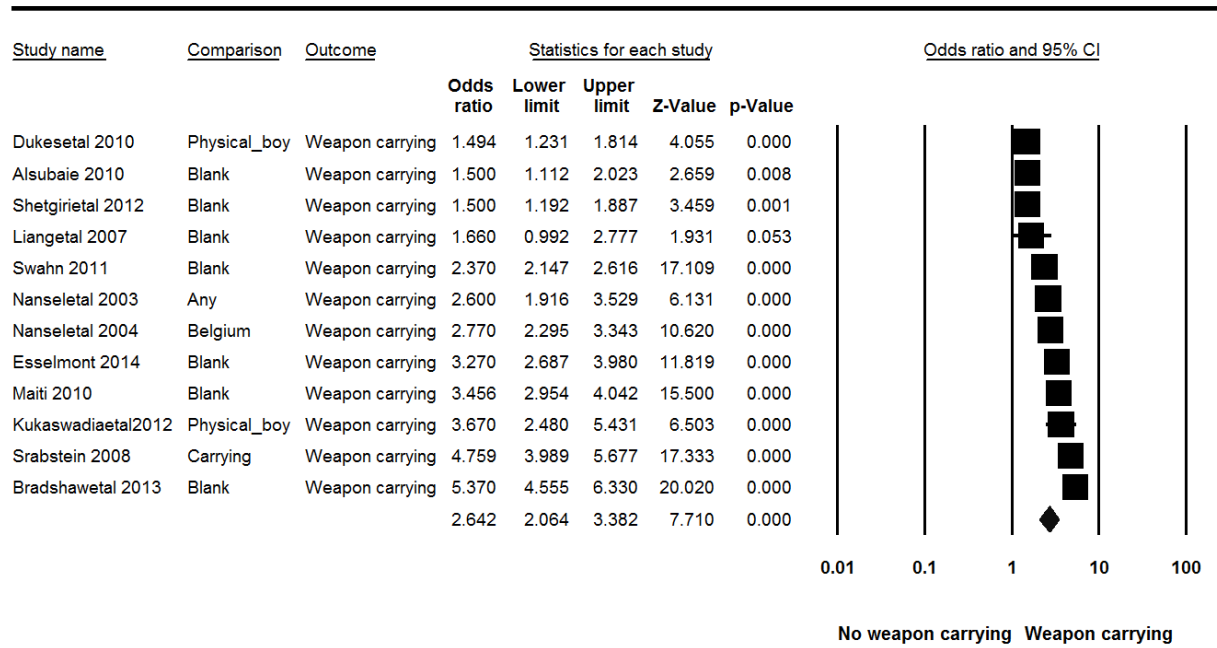
Wolke, D., Copeland, W.E., Angold, A., & Costello, E.J. (2013). Impact of bullying in childhood on adult health, wealth, crime, and social outcomes. *Psychological Science*, 24 (10), 1958 -1970. doi: 10.1177/0956797613481608

*Wong, J. S. (2009). *No bullies allowed. Understanding peer victimization, the impacts on delinquency, and the effectiveness of prevention programs*. Unpublished doctoral dissertation. Pardee RAND Graduate School: Santa Monica, CA.

Figure 1: PRISMA Flow Diagram of the Systematic Searches⁴

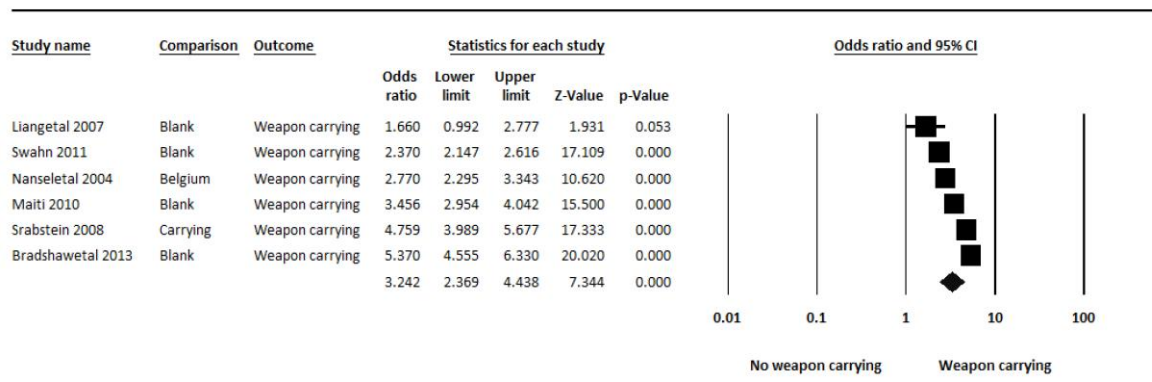
⁴ This diagram is based on Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009).

Figure 2.1 Forest plot for the effect sizes on the association of bullying perpetration with weapon carrying



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Figure 2.2 Forest plot for the effect sizes comparing the weapon carrying of pure bullies with children non-involved in bullying



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Figure 3.1: Forest plot for the effect sizes on the association of victimization (being bullied) with weapon carrying

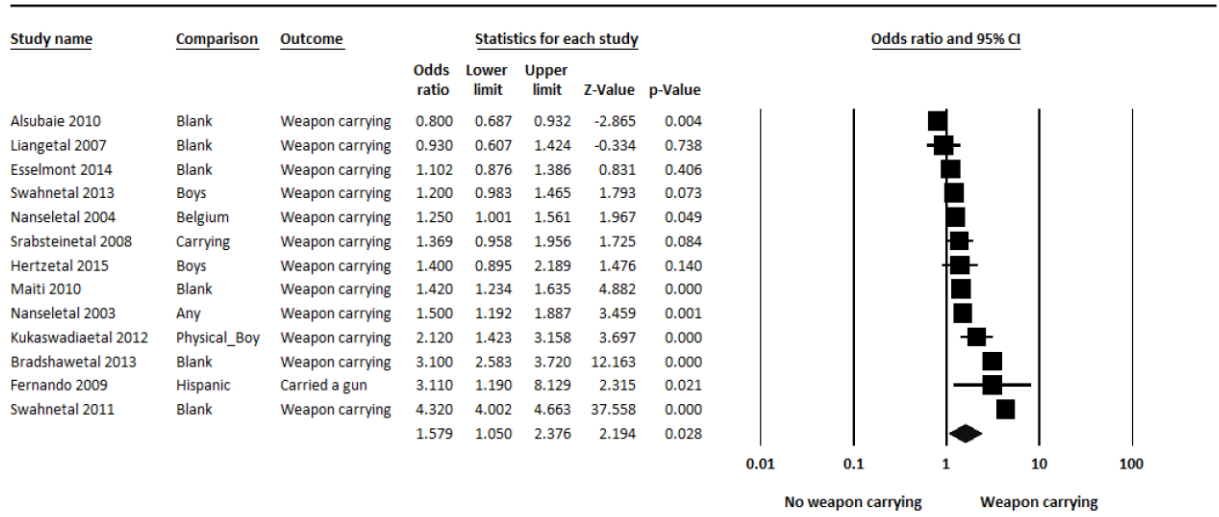


Figure 3.2 Forest plot for the effect sizes comparing the weapon carrying of pure victims with children non-involved in bullying

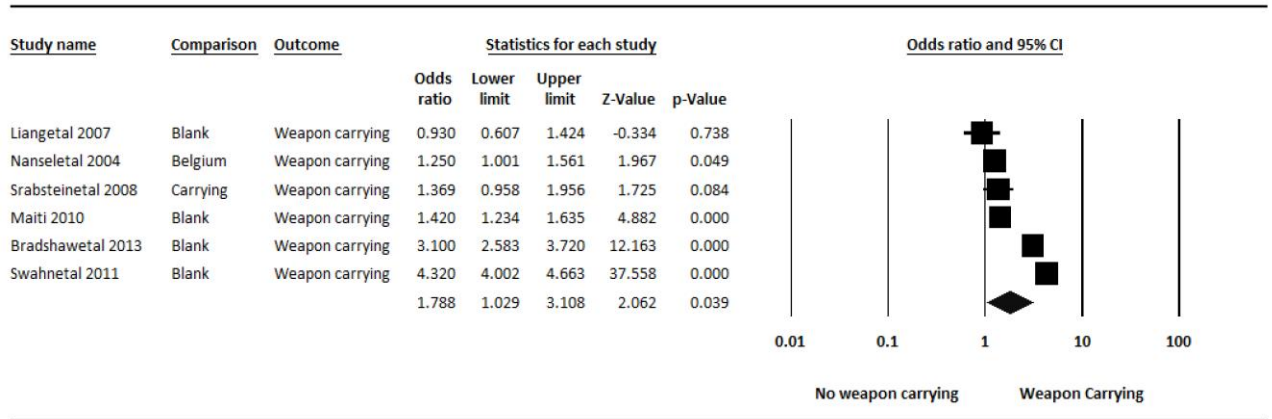
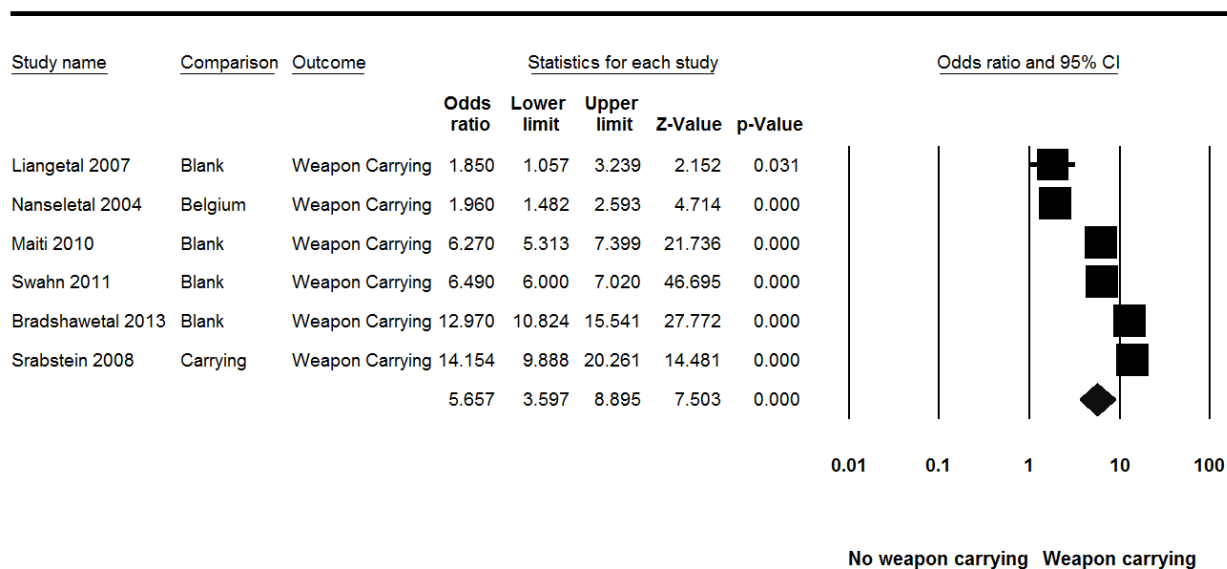


Figure 4: Forest plot of the effect sizes comparing the weapon carrying of bully-victims with children non-involved in bullying



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Table 1
Effect size data for weapon carrying within different bullying roles (cross-sectional studies)

Authors (date of publication) & Country of the sample	Sample size (age) Outcome measure	Unadjusted effect size	Adjusted effect size	Statistical controls for possible confounders
Alsubaie (2010) Saudi Arabia	N = 1501 (M=17.4; SD: ±1.18) Weapon carrying in the last 30 days	Not Applicable	B: OR=1.5 (95% CI: 1.1-2.0) V: OR=0.8 (95% CI: 0.6 -1.2)	Age, father's education, mother's education, living district, eating breakfast, brushing teeth, physical activity, smoking status, want to use drugs, threaten, physical fight, unsafe going to school, performing car drifting, friends car drifting, attempting suicide, abused by teacher, abused by family
Andershed et al. (2001) Sweden	N = 2561 (14-15 years) Weapon carrying	Boys: C: M=1.13; SD=0.55; N= 1103 B: M=1.89; SD=1.27; N=82 B/V: M=2.32; SD=1.60 N=25 Girls C: M=1.05; SD=0.35; N=1182 B: M=1.51; SD=1.09; N=35 B/V: M=1.22; SD=0.67; N=9	Not applicable	Not applicable
Barboza et al. (2009) United States	N = 9816 (11-14 years) Carried a weapon to school	B: OR=1.461 [95% CI 1.339; 1.594]	Not applicable	Not applicable
Bhandari (2014) United States	N = 84103 (9 th -12 th grade) Carried a gun	Boys: B: 599; N=4392 C: 1416; N=40926 V: 177; N=4398 C: 1427; N=41248 Girls:	Not applicable	Not applicable

		B: 113; N=3823 C: 221; N=41906 V: 18; N=4338 C: 225; N=42167		
Bradshaw et al. (2013) United States	N = 16302 (12-16 years; and 17-21 years) Carried a weapon to school	Not applicable	B: OR= 5.37 [95%CI 4.552; 6.326] V: OR= 3.10 [95%CI 2.582; 3.718] B/V: OR = 12.97 [95%CI 10.832; 15.523]	Gender, age, ethnicity, school enrollment, % of minority in school, school suspension, urbanicity.
Del Rey and Ortega (2008) Nicaragua	N = 2813 (M=15.52; SD=2.65) Weapon carrying	Rarely: C: 40 [2.2%, N=1828] B: 24 [7.8%, N=307] V: 13 [3.7%, N=349] B/V: 26 [7.9%, N=329] Frequently: C: 9 [0.5%, N=1828] B: 11 [3.6%, N=307] V: 8 [2.3%, N=349] B/V: 34 [10.4%, N=329]	Not applicable	Not applicable
De Voe et al. (2005) United States	N = 8374 (12-18 years) Weapon carrying	V: 129 [3.7%, N=3494] C: 290 [1.4%, N=20680]	Not applicable	Not applicable
De Voe and Murphy (2011) United States	N = 4326 (12-18 years) Weapon carrying to school for protection during the school year	V: 290 [4.1%, N=7066] C: 381 [2.1%, N=18151]	Not applicable	Not applicable
De Voe (2007) United States	N = 7521 (12-18 years)	V: $r=0.039$; N=7153	Not applicable	Not applicable

	Weapon carrying in last six months		Physical victimization, injury, relational victimization, grades at school.
Dukes et al. (2010)	N = 2662 [Boys: 1362] (M=14.7)	Boys: B(physical): $r = 0.39; p < .001$ B(relational): $r = 0.55; p < .001$ V(physical): $r = 0.18; p < .001$ V(relational): $r = 0.24; p < .001$ Girls: B(physical): $r = 0.26; p < .001$ B(relational): $r = 0.31; p < .001$ V(physical): $r = 0.17; p < .001$ V(relational): $r = 0.13; p < .01$	Boys: B(physical): $r = 0.11; p < .01$ B(relational): $r = 0.47; p < .001$ Girls: B(physical): $r = 0.12; p < .01$ B(relational): $r = 0.26; p < .001$
Esselmont (2014)	N=7464 (M=14; SD=1.3) Weapon carrying	V: $M=0.18; SD=0.38; N=1064$ C: $M=0.10; SD=0.30; N=6400$ B: $M=0.29; SD=0.46; N=1064$ C: $M=0.09; SD=0.32; N=6400$	V: $OR=1.251; SE=0.117$ B: $OR=3.270; SE=0.107$
Fernando (2009)	N = 3131 (12-18 years) Carried a weapon to school Carried a gun	Weapon to school: White: V: $OR=1.63$ [95% CI: 1.01; 2.62] Hispanic: V: $OR=2.78$ [95% CI: 1.23-6.31] Other: V: $OR=2.42$ [95% CI: 1.17-5.02] Carried a gun: White: V: $OR=1.38$ [95% CI 0.72; 2.64] Hispanic: V: $OR=2.52$	Weapon to school: White: V: $OR=1.86$ [95% CI 1.14; 3.05] Hispanic: V: $OR=3.42$ [95% CI 1.43; 8.18] Other: V: $OR=2.33$ [95% CI 1.11; 4.90] Carried a gun: White: V: $OR=1.69$ [95% CI 0.862; 3.327] Hispanic: V: $OR=3.11$
		Age and gender	Gender and perception of safety at school

		[95% <i>CI</i> 1.03; 6.14]	[95% <i>CI</i> 1.19; 8.13]	
		Other:	Other:	
		V: <i>OR</i> =2.48	V: <i>OR</i> =3.03	
		[95% <i>CI</i> ; 1.07; 5.75]	[95% <i>CI</i> 1.25; 7.34]	
Gaspar de Matos et al. (2009) Portugal	N= 6131 (<i>M</i> = 14; <i>SD</i> = 1.85) Weapon carrying	V(name calling): <i>r</i> =0.05; <i>N</i> =6025 V(exclusion): <i>r</i> = 0.06; <i>N</i> =5964 V(humiliate): <i>r</i> = 0.11; <i>N</i> =5955 V(rumors): <i>r</i> = 0.10; <i>N</i> =5944 V(skin color): <i>r</i> = 0.14; <i>N</i> =5933 V(religion): <i>r</i> = 0.13; <i>N</i> =5896 V(sexual): <i>r</i> =0.11; <i>N</i> =5952 B(name calling): <i>r</i> =0.19; <i>N</i> =6026 B(exclusion): <i>r</i> = 0.19; <i>N</i> =5970 B(humiliate): <i>r</i> = 0.25; <i>N</i> =5966 B(rumors): <i>r</i> = 0.23; <i>N</i> =5941 B(skin color): <i>r</i> = 0.22; <i>N</i> =5961 B(religion): <i>r</i> = 0.22; <i>N</i> =5948 B(sexual): <i>r</i> =0.23; <i>N</i> =5966	Not applicable	Not applicable
Greene (2003) United States	N=5960 Ever bring a gun or knife to school?	V: $\chi^2=38.78$; <i>p</i> <.001; (12-18 years)	Not applicable <i>N</i> =5908 ⁵	Not applicable
Hertz et al. (2015) United States	N= 13846 (9 th -12 th grades) Carried a weapon to school property	Not applicable	Boys: V: <i>OR</i> = 1.4 [95% <i>CI</i> 0.9; 2.2] Girls: V: <i>OR</i> =1.9 [95% <i>CI</i> 1.0; 3.5]	Race, ethnicity and grades

⁵ Effect size was estimated using the Campbell Collaboration Effect Size Calculator: http://www.campbellcollaboration.org/resources/effect_size_input.php

Kukaswadia et al. (2012) Canada	N=7877 (Age: Not available) Weapon carrying	Not Applicable	Boys: B(relational): $OR=3.55$ [95% CI 2.36; 5.35] B(physical): $OR=3.67$ [95% CI 2.48; 5.43] V(relational): $OR=1.70$ [95% CI 1.19; 2.44] V(physical): $OR=2.12$ [95% CI 1.42; 3.15] Girls: B(relational): $OR=5.71$ [95% CI 2.65-12.3] B(physical): $OR=5.49$ [95% CI 2.04-14.7] V(relational): $OR=2.64$ [95% CI 1.35-5.18] V(physical): $OR=6.21$ [95% CI 2.84-13.6]	Age, life satisfaction, SES, physical activity, perceived quality of the home, neighborhood and school environment
Liang et al. (2007) South Africa	N= 5074 $M=14.2$; $SD=1.37$ (Grade 8) $M=17.4$; $SD=1.76$ (Grade 11) Weapon carrying	Not applicable	B: $OR=1.66$ [95% CI 0.99; 2.77] V: $OR=0.93$ [95% CI 0.61; 1.43] B/V: $OR=1.85$ [95% CI 1.06; 3.25]	Weapon carrying suicidal ideation, suicide attempt, theft, vandalism, walking alone, risky passenger, risky driver, smoking, alcohol, and cannabis.
Maiti (2010) United States	N=13403 ($M=13.3$; $SD=1.56$) Weapon carrying	Not applicable	V: $OR=1.42$; $SE=0.07$ B: $OR=3.45$; $SE=0.08$ B/V: $OR=6.27$; $SE=0.08$	Gender, ethnicity, urbanicity and grade at school
Marsh et al. (2011) New Zealand	N=1169 (15-16 years) Weapon carrying with or without intent	With intent: V: $OR=2.2$ [95% CI 1.3; 3.7] B: $OR=4.7$ [95% CI 1.7; 13.4] Without intent: V: $OR=1.0$ [95% CI 0.7; 1.4] B: $OR=1.6$ [95% CI 1.0; 2.5]	Not applicable	Not applicable

Meyer-Adams & Conner (2008) United States	N= 5351 (11-14 years) Weapon carrying	V: $r=.06$; $p<.001$; $N=2676$ B: $r=.11$; $p<.001$; $N=2676$	Not applicable	Not applicable
Morris et al. (2006) Canada	N=3314 (10-20 years) Weapon carrying	C: 504 [27.2%, $N=1852$; 95% <i>CI</i> 21.3-34.1 B: 172 [33.2%, $N=517$; 95% <i>CI</i> 27.6-39.4] V: 63 [13.6%, $N=460$; 95% <i>CI</i> 9.4 - 19.3] V/B: 126 [26% $N=485$; 95% <i>CI</i> 20.2 – 36]	Not applicable	Not applicable
Nansel et al. (2004) Belgium, Hungary, Israel, Portugal, Republic of Ireland, And the United States	N=113200 M1=11.5; M2=13.5; M3=15.5 (p. 731) Weapon carrying	Not applicable	Belgium, Flemish [$N=4824$] B: <i>OR</i> =2.77 [95% <i>CI</i> 2.30; 3.35] V: <i>OR</i> = 1.25 [95% <i>CI</i> 1.00; 1.56] B/V: <i>OR</i> =1.96 [95% <i>CI</i> 1.48; 2.59] Hungary [$N=3609$] B: <i>OR</i> =2.88 [95% <i>CI</i> 1.99; 4.16] V: <i>OR</i> =1.12 [95% <i>CI</i> 0.74; 1.70] B/V: <i>OR</i> =1.64 [95% <i>CI</i> 1.00; 2.69] Israel [$N=5054$] B: <i>OR</i> =4.43 [95% <i>CI</i> 3.27; 6.00] V: <i>OR</i> =1.98 [95% <i>CI</i> 1.55; 2.52] B/V: <i>OR</i> =3.44 [95% <i>CI</i> 2.55; 4.64] Portugal [$N=3721$] B: <i>OR</i> =3.20	Sex and age

Nansel et al. (2003) United States	N=15686 (6 th -10 th grade) Weapon carrying Carried a weapon to school	Weapon carrying: B: <i>OR</i> =8.0 [95% <i>CI</i> : 6.5-9.7] V: <i>OR</i> =2.6 [95% <i>CI</i> : 2.0-3.3] Carried a weapon to school: B: <i>OR</i> =9.6 [95% <i>CI</i> : 7.7-11.9] V: <i>OR</i> =3.0 [95% <i>CI</i> : 2.3-4.0]	[95% <i>CI</i> 2.00; 5.12] V: <i>OR</i> =1.40 [95% <i>CI</i> 0.93; 2.12] B/V: <i>OR</i> =2.88 [95% <i>CI</i> 1.87; 4.43] Rep. of Ireland [N=4394] B: <i>OR</i> =3.50 [95% <i>CI</i> 2.54; 4.81] V: <i>OR</i> =1.99 [95% <i>CI</i> 1.40; 2.83] B/V: <i>OR</i> =4.12 [95% <i>CI</i> 2.16; 7.86] USA [N=5169] B: <i>OR</i> =4.34 [95% <i>CI</i> 3.58; 5.26] V: <i>OR</i> =2.27 [95% <i>CI</i> 1.74; 2.97] B/V: <i>OR</i> =8.50 [95% <i>CI</i> 6.42; 11.26] Weapon carrying: B: <i>OR</i> =2.6 [95% <i>CI</i> 1.9; 3.5] V: <i>OR</i> =1.5 [95% <i>CI</i> 1.2; 1.9] Carried a weapon to school: B: <i>OR</i> =3.2 [95% <i>CI</i> : 2.3; 4.3] V: <i>OR</i> =1.6 [95% <i>CI</i> : 1.2; 2.2]	Gender
Niolon et al. (2015) United States	N=1653 (6 th -8 th grade) Weapon carrying such as knife, gun, or club	Boys [N=772]: V: <i>r</i> = -0.07; ns B: <i>r</i> = 0.09; ns B/V: <i>r</i> =0.10; ns Girls [N=848]: V: <i>r</i> =0.02; ns B: <i>r</i> = -0.01; ns B/V: <i>r</i> =0.09; <i>p</i> <0.05 V: $X^2=12.667$; <i>df</i> =1; <i>p</i> <0.005; N=2564	Not applicable	Not applicable
Nguyen (2012) United States	N=2564 (9 th -12 th grades)		Not applicable	Not applicable

Schapiro et al. (2014) United States	Weapon carrying N=15425 (9 th -12 th grades) Weapon carrying Carrying a weapon to school	V: $X^2=0.000$; $df=1$; $p=0.986$; $N=2564$ Weapon carrying: V/B: $OR=1.34$ [95% CI 1.04; 1.71] To school: V/B: $OR=1.96$ [95% CI 1.61; 2.38]	Not applicable	Not applicable
Shetgiri et al. (2012) United States	N=13710 (6 th - 10 th grades) Weapon carrying in the last 30 days	B(any): $OR=25.7$ [95% CI 23.7; 27.7] C(any): $OR=9.8$ [95% CI 8.7; 10.9] B(moderate): $OR=40.9$ [95% CI 37.7; 44.1] C(moderate): $OR=12.1$ [95% CI 11.0; 13.2] B(frequent): $OR=46.3$ [95% CI 42.2; 50.3] C(frequent): $OR=13.6$ [95% CI 12.4-14.8] To school: C: 192 [3.3%, $N=5830$] B: 192 [14%, $N=1372$] V: 38 [3.3%, $N=1164$] B/V: 249 [20.6%, $N=1208$]	B(any): $OR=1.5$ [95% CI 1.2; 1.8] B(moderate): $OR=1.6$ [95% CI 1.2; 2.1] B(frequent): $OR=1.8$ [95% CI 1.3-2.4]	Fought in the past 12 months, bullied by another student, drug use, gender, school satisfaction, academic performance, race/ethnicity, weekly alcohol use
Srabstein et al. (2008) United States	N=9938 (6 th - 10 th grade) Carried a weapon to school Using a weapon	To school: C: 192 [3.3%, $N=5830$] B: 192 [14%, $N=1372$] V: 38 [3.3%, $N=1164$] B/V: 249 [20.6%, $N=1208$] Using a weapon: C: 332 [5.7%, $N=5830$] B: 309 [22.5%, $N=1372$] V: 80 [6.9%, $N=1164$] B/V: 227 [18.8%, $N=1208$]	To school: B: $OR=4.79$; $SE=1.12$ V: $OR=1.37$; $SE=1.20$ B/V: $OR=14.17$; $SE=1.17$	Gender, race and grade
Stein et al. (2007) United States	N=1312 ($M=14.3$; Grades 7-12) Carried a weapon	C: $M=1.23$; $SD=0.57$; $N=638$ B: $M=1.60$; $SD=0.88$; $N=299$ V: $M=1.34$; $SD=0.60$; $N=180$	Not applicable	Not applicable

	to school	B/V: $M=1.96$; $SD=1.11$; $N=195$			
Swahn et al. (2013) United States	$N=16410$ (9 th -12 th grades) Weapon carrying	Not applicable	Boys: V: $OR=1.20$ [95% <i>CI</i> 0.98; 1.46] Girls: V: $OR=1.48$ [95% <i>CI</i> 1.13; 1.95]		Sex, grade at school, ethnicity, sad, unsafe, early alcohol initiation, binge drink, drug exposure, asthma, low grades, suicide attempts.
Swahn et al. (2011) United States	$N=175,311$ (Grades: 8 th , 10 th , 12 th) Carried a weapon to school	Not applicable	B: $OR=2.37$ [95% <i>CI</i> 2.15; 2.62] V: $OR=4.32$ [95% <i>CI</i> 4.00; 4.66] B/V: $OR=6.49$ [95% <i>CI</i> 6.00; 7.02]		Alcohol initiation, sex, ethnicity, grade at school, binge drinking, current alcohol and drug use, peer drinking
Testani-Caffero (2003) United States	$N=354$ (12 – 19 years) Weapon carrying	V: $OR=1.84$ [95% <i>CI</i> 0.75; 4.5]	Not applicable		Not applicable
Trajtenberg and Eisner (2014) Uruguay	$N=2500$ ($M=15.1$; $SD=0.91$) Weapon carrying	B: $OR=3.49$ [95% <i>CI</i> 2.44; 4.93]	Not applicable		Not applicable
Van de Looij et al. (2006) The Netherlands	$N=704$ ($M=16.62$; $SD=0.75$) Weapon carrying	V: $r=-0.300$ $p<0.0001$	Not applicable		Not applicable
Wang et al. (2012) United States	$N=7508$ ($M=14.2$; $SD=1.4$) Weapon carrying in the last 30 days	Boys: C: 819 [18.2% $N=4500$] B: 375 [47.8% $N=785$] Girls: C: 239 [4.8% $N=4978$] B: 80 [26.7% $N=299$]	Not applicable		Not applicable

Note: Abbreviations: ES, effect size; OR, odds ratios; (95%CI), 95% confidence interval; M, mean; SD, standard deviation; SE, standard error; r , Pearson correlation; β , Beta coefficient; V, victims; C, controls or non-involved in bullying; B, bullies or perpetrators; B/V, Bully-victims or aggressive victims.

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Table 2: Systematic review of longitudinal studies on weapon carrying within different bullying roles

Study, location (study details)	Grade/age and sample Size information	Role in bullying (measurement type)	Study findings
Baly et al., 2014; Virginia, USA (3-year follow-up study on cumulative impact of bullying based on annual assessments)	Students in grades 6, 7, 8 followed over three years (292 students, 49.3% males, with data on all time points)	Victimization (Self- and peer- reports)	Being bullied was significantly positively associated with weapon carrying ($\beta = .148^*$) based on self-reports but not based on peer-reports. After validity screening (i.e., based on data of students who answered yes on the items for 'Telling the truth on this survey' and 'I am not paying attention to how I answer the survey') the association was no longer statistically significant
Hemphill et al., 2011; Victoria, Australia (International Youth Development Study)	Students from the youngest (Year 7) Victorian cohort of the study (around 700 students)	Perpetration/ victimization (Self-reports)	Bullying perpetration (OR = 1.42; 95% CI: 0.62–3.26) and victimization (OR = 1.27; 95% CI: 0.62 – 2.61) at Year 7 was positively associated with weapon carrying at Year 11. Bullying perpetration (OR = 1.93; 95% CI: 0.97 – 3.85) and victimization (OR = 1.63; 95% CI: 0.86 – 3.12) at Year 10 was positively associated with weapon carrying at Year 11. All effect sizes were adjusted, with statistical controls in regression analyses. Study findings are non-significant (but close to significant in some cases)
Luster & Oh, 2001; National Longitudinal Survey of Youth 1997)	Analyses based on males only (51% of the NLSY97 sample; N = 2387) and for two age groups: less or above Age 15 as of December 1996	Victimization (Self-reports)	Victimization before Age 12 was negatively associated with carrying a handgun under Age 15 (OR = 0.83; 95% CI: 0.56 – 1.22) Effect sizes were adjusted, but results are non-significant. Results for Age 15 and over are not available
Turner et al., 2015;	Students from the	Childhood victims	After controlling for pre-existing gun carrying, a

(National Longitudinal Survey of Youth 1997)	cross-sectional NLSY97 sample with data up to Wave 7 (around 6641 male and female participants)	(experiencing repeat bully victimization before Age 12) Adolescent victims (with repeat victimization after Age 12) Chronic victims (with repeat victimization before and after Age 12)	significant but small likelihood of gun carrying was found for childhood victims (OR = 1.2) but not for adolescent or chronic victims. Further analyses matching individuals on their probability of ever being repeatedly bullied (propensity score matching analyses) suggest that the average treatment effect (ATE) of ever being a victim on ever carrying a gun was highly significant ($b = 0.036^{**}$). ATE effect of ever being a victim on carrying a gun in the last year was also significant ($b = 0.031^{**}$)
Wong, 2009; (National Longitudinal Survey of Youth 1997)	Students from the cross-sectional NLSY97 sample and from the supplemental sample of non-black Hispanic and non-Hispanic black youth (with data up to Wave 7)	Childhood victims (experiencing repeat bully victimization before Age 12)	Propensity score matching analyses suggest a positive but small association between being bullied before Age 12 and carrying a handgun (at any time point between Wave 2 to Wave 7) with an effect size, OR, of 1.3 ^{**} . However, analyses did not control for earlier weapon carrying like in the 2015 paper by Turner and colleagues