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Abstract: Bullying is a common aggressive behaviour in school, with a number of cross-sectional studies showing that it exhibits a high comorbidity with other problem behaviours. The present study aims to estimate the comorbidity of school bullying (perpetration and victimisation) with drug use by incorporating and meta-analysing all available evidence on the cross-sectional association between the two variables. Meta-analytic results are based on a comprehensive systematic review across 20 databases and 46 journals. A total of 61 relevant manuscripts were included in the systematic review. Following explicit methodological criteria for the inclusion/exclusion of reports, 13 of them were eligible for the meta-analysis. The association of school bullying perpetration with drug use (adjusted odds ratio OR=2.82; 95% CI 1.97-4.02; $z=5.71$; $p<.001$) suggests a very strong relationship. For example, if a quarter of children were bullies and a quarter were drug users, this value of the OR would correspond to 40.88% of bullies being also drug users, compared with 19.71% of non-bullies. The association of school bullying victimization with drug use (adjusted odds ratio OR=1.79; 95% CI 1.38 - 2.32; $z= 4.41$; $p<.001$) suggests a moderate relationship. For example, if a quarter of children were victims and a quarter were drug users, this value of the OR would correspond to 33.69% of bullied youth also being drug users, compared with 22.1% of non-bullied youth. Adjusted effect sizes are based on study findings that used statistical controls for confounding variables, thus providing the unique association of school bullying with drug use over and above other important risk factors that may explain this association. Implications for policy and intervention research arising from this review are highlighted.

Dear Editors

My co-authors and I would like to submit the attached paper for your consideration.

Our paper is entitled *Prevalence rates of drug use among school bullies and victims: A systematic review and meta-analysis of cross-sectional studies*. The study aims to estimate the comorbidity of school bullying (perpetration and victimisation) with drug use by incorporating and meta-analysing all available evidence on the cross-sectional association between the two variables. It has been completed following the guidelines provided by the *Aggression and Violent Behavior* journal.

We would like to mention that the paper is submitted for the special issue entitled *Bullying, Cyberbullying and Youth Violence: Facts, Prevention and Intervention* and is not under consideration by another publisher or journal.

Correspondence regarding this document should be addressed to Sara Valdebenito, Institute of Criminology, University of Cambridge, Sidgwick Site, CB3 9DA Cambridge, UK (email: sv331@cam.ac.uk).

Thank you for considering our manuscript for publication.

Yours sincerely,

Sara Valdebenito (PhD Candidate), Dr Maria Ttofi and Dr Manuel Eisner

TITLE: 'Prevalence rates of drug use among school bullies and victims: A systematic review and meta-analysis of cross-sectional studies'

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ABSTRACT

Bullying is a common aggressive behaviour in school, with a number of cross-sectional studies showing that it exhibits a high comorbidity with other problem behaviours. The present study aims to estimate the comorbidity of school bullying (perpetration and victimisation) with drug use by incorporating and meta-analysing all available evidence on the cross-sectional association between the two variables. Meta-analytic results are based on a comprehensive systematic review across 20 databases and 46 journals. A total of 61 relevant manuscripts were included in the systematic review. Following explicit methodological criteria for the inclusion/exclusion of reports, 13 of them were eligible for the meta-analysis. The association of school bullying perpetration with drug use (adjusted odds ratio $OR=2.82$; 95% CI 1.97-4.02; $z=5.71$; $p<.001$) suggests a very strong relationship. For example, if a quarter of children were bullies and a quarter were drug users, this value of the OR would correspond to 40.88% of bullies being also drug users, compared with 19.71% of non-bullies. The association of school bullying victimization with drug use (adjusted odds ratio $OR=1.79$; 95% CI 1.38 – 2.32; $z=4.41$; $p<.001$) suggests a moderate relationship. For example, if a quarter of children were victims and a quarter were drug users, this value of the OR would correspond to 33.69% of bullied youth also being drug users, compared with 22.1% of non-bullied youth. Adjusted effect sizes are based on study findings that used statistical controls for confounding variables, thus providing the unique association of school bullying with drug use over and above other important risk factors that may explain this association. Implications for policy and intervention research arising from this review are highlighted.

Key words: systematic review, meta-analysis, bullying, drug use, cross-sectional studies.

1. INTRODUCTION

Bullying is one of the most prevalent forms of aggression in school (Nansel et al., 2001). It includes a range of direct (e.g., physical damage, injurious words, threats) and indirect behaviours (e.g., rumours or rejection of victims) characterised by being intentional, repeated over time and performed in a context of power imbalance (CDC, 2014). Although the prevalence varies among countries and cultures, a general trend seems to indicate that between 20% and 30% of schoolchildren are involved in school bullying (Craig et al., 2009; Juvonen, Graham, & Schuster, 2003).

Bullying has been the focus of intervention efforts not only because of the problematic nature of the behaviour per se, but also because of its adverse effects on children's physical and psychosocial health (Fekkes, Pijpers, Fredriks, Vogels, & Verloove-Vanhorick, 2006; Gini & Pozzoli, 2009). Notably, longitudinal studies and meta-analyses suggest that bullies are more likely to develop symptoms of depression (e.g., Ttofi, Farrington, Lösel, & Loeber, 2011a) and to be involved in delinquency (e.g., Ttofi, Farrington, Lösel, & Loeber, 2011b) as well as in violence (e.g., Ttofi, Farrington, & Lösel, 2012).

Furthermore, the cross-sectional evidence suggests that bullying can be correlated and co-occur along with other hazardous behaviours which can seriously interfere with the psychosocial development of children (Farrington, 1993, 2005; Loeber, Farrington, Stouthamer-Loeber, & Van Kammen, 1998). This includes, for instance, low self-esteem, depression, anxiety, delinquency, weapon carrying and drug use (Bradshaw, Waasdorp, Goldweber, & Johnson, 2013; Pranjic & Bajraktarevic, 2010; Ttofi & Farrington, 2008).

This paper examines the link between school bullying and drug use. Both are prevalent problem behaviours during the school years and both of them are correlated with a broad array of negative developmental outcomes (Luk, Wang, & Simons-Morton, 2012), highlighting the need for intervening early and addressing both of these risk factors which may function as a stepping stone towards other problem behaviours in adult life (Ttofi et al., 2012). Both factors, for instance, impact negatively the academic development (Beran, Hughes, & Lupart, 2008; Schwartz, 2000) and general mental health (Birkett, Espelage, & Koenig, 2009; Fleming &

Jacobsen, 2009b; Roland, 2002; Waters, Wake, Toumbourou, Wright, & Salmon, 1999; Wei, Williams, Chen, & Chang, 2010) of children.

Despite a growing body of cross-sectional research on the link between drug use and bullying behaviour during school years (Brown, Riley, Butchart, & Kann, 2008; Niemelä et al., 2011; Moon & Alarid, 2014), no previous meta-analysis has been conducted to systematically synthesize relevant evidence and to identify the magnitude and the direction of this association. The current paper addresses this gap by meta-analysing results from existing published and unpublished studies following a comprehensive systematic review. This meta-analytic investigation has obvious implications for intervention research. To the extent that a significant association between school bullying and drug use can be established, then it may be inferred that effective bullying prevention programmes could be viewed as an effective intervention strategy for the reduction of school bullying and other co-occurring problem behaviours, including drug use.

1.1 Bullying and drug use: theoretical perspectives

It is difficult to determine the exact prevalence of bullying involvement and drug use as a comorbid phenomenon, due to varying sampling and other methodological features across available studies. Luk et al., (2012) found that 5.4% of adolescents [$M_{age}= 14.2$; $SD=1.42$] displayed a co-morbid condition, while Radliff, Wheaton, Robinson, & Morris, (2012) found co-morbidity for 4.9% of high school students and for 1.6% of middle schoolchildren. In a sample of adolescents [$M_{age}=15.3$; $SD= 1.58$], Garcia Contiente, Pérez Giménez, & Nebot Adell, (2010) found that 7% of boys and 9.6% of girls displayed a co-morbid condition.

Prevalence rates of drug use also vary between school students who are involved in different bullying roles as perpetrators, victims or bully-victims. Evidence suggests that perpetrators are overrepresented in drug consumption categories compared with non-bullies (Kaltiala-Heino, Rimpelä, Rantanen, & Rimpelä, 2000). Victims are also more likely to use drugs compared to non-involved individuals; however, prevalence rates are higher for perpetrators than victims of school bullying. For instance, Radliff et al., (2012) concluded that 11.4% of bullies reported marijuana use, compared with only 2% of victims and 1% of non-

involved children. Comparable evidence is available from another American survey (Bradshaw et al, 2013), asserting that bullies are two times more likely to use drugs ($OR=2.77$; $95\% CI 2.4-3.2$; $p<.001$) compared with non-involved students, while the association for victims is much weaker ($OR=1.30$; $95\% CI 1.1 - 1.5$ $p <.001$).

A more restricted body of research has collected information for a special group of victims who also display aggressive behaviours, known as bully-victims. The link between drug use and aggressive victims is less conclusive in the literature. While Kaltiala-Heino et al., (2000) and Bradshaw et al., (2013) suggest a high association between those acting as bully-victims and drug use (with $OR=7.1$; $95\% CI 4.1 - 12.2$ and $OR=3.4$; $95\% CI 3.1 - 4.4$; $p<.001$ accordingly), the conclusion of Niemelä et al., (2011) does not support such findings ($OR= 0.3$; $95\% CI .04 - 2.6$; $p<.05$).

The literature offers various theoretical explanations for the link between school bullying and drug use. A notable body of research argues that drug use may function as a coping mechanism against the experience of stressful life events, including school bullying and peer victimisation. Coping theory proposes that adolescents engage in high risk behaviours in response to increased negative affects resulting from exposure to victimisation (Lazarus, 1993). Since bullying is characterised by repeated aggressive acts over time against less powerful (physically or emotionally) individuals, it is plausible that victims of school bullying may engage in substance use as a (maladaptive) way of coping with their negative school experiences.

A similar theoretical framework is that of Agnew's (1992) general strain theory of crime and deviance, which has been used in school bullying research to explain the higher prevalence of self-harm exhibited by victims as compared to non-victimised students (Hay & Meldrum, 2010). Both coping theory and general strain theory could explain the higher prevalence of substance use among school bullies. Specifically, a recent systematic review and meta-analysis of 153 studies (Cook, Williams, Guerra, Kim, & Sadek, 2010:75) concluded that bullies tend to present negative self-related cognitions, come from a conflictive family environment characterised by poor parental monitoring, being more likely to perceive the school as having a

negative atmosphere. In that context, it may be argued that the 'typical bully' is more likely to be involved in drug use as a way to cope with stressful life experiences within the family and school.

Another theoretical model suggests that substance use functions as a trigger for subsequent aggression and violence due to physiological changes (Yudko, Blanchard, Henrie, & Blanchard, 1997) or due to the involvement of drug users with deviant/delinquent groups (Bui, Ellickson, & Bell, 2000). In particular, Goldstein, (1985) argued in favour of a causal link of drug use on crime based on three mechanisms: (1) drug users become more irrational which can trigger off violent behaviours (psychopharmacological explanation) (2) drug users can be compelled to commit crime in order to finance their consumption (economic explanation), and (3) violent behaviours in drug users are the result of their participation in the illegal drugs market (systemic explanation). While any argument about a causal link between bullying and drug use can only be supported by better quality methodological criteria such as by evidence from within-individual analyses and longitudinal research (Murray, Farrington, & Eisner, 2009), the focus of the current paper is to synthesize all available cross-sectional evidence and establish the prevalence rates of drug use among school bullies and victims compared with non-involved students.

Some of the above theoretical frameworks could be transferred to the school setting in order to explain the co-occurrence of drug use and bullying behaviour. Goldstein's economically compulsive framework could explain networks supporting drug distribution within schools, while the systemic framework is in line with existing research on the deviant lifestyle of both drug users and school bullies. Copying theory may be a plausible framework explaining why bullies and their victims may engage in drug use to begin with, although alternative theoretical models could shed light on other aspects of this phenomenon (e.g. differential association theory, explaining how children learn problem behaviour from associations with delinquent peers).

All in all, children involved in school bullying as perpetrators or victims are children in need. Irrespective of whether children do drugs in order to cope with stressful life events or

simply because of their antisocial lifestyle, research efforts should be invested in understanding the extant magnitude of this phenomenon. This paper aims to address this by synthesizing all available scientific evidence arising from cross-sectional studies.

1.2 The current review

This paper aims to produce a standardised effect size on the association between bullying and drug use based on a thorough systematic review and meta-analysis. Two summary effect sizes will be reported: one on the association of bullying perpetration with drug use; and one on the association of bullying victimisation with drug use. To the best of our knowledge, there are no previous meta-analyses based on cross-sectional studies intending to summarise findings on the drug-bullying link.

The study is guided by the following research questions:

- What is the size and direction of the association between school bullying and drug use?
- Are victims of school bullying more likely to score highly on drug use when compared with non-involved children?
- Are perpetrators of school bullying more likely to score highly on drug use when compared with non-involved children?
- Is the bullying-drug link stronger for perpetrators or victims?
- Are there gender-specific effects? In other words, does bullying have a stronger impact on boys than girls?
- Are there ethnic-specific effects?

2. METHODS

2.1 Search strategies

In order to identify all possibly relevant studies and control for publication bias, an extensive search was carried out. We explored 20 databases, including searches on manuscripts produced in Latin American and other Spanish-speaking countries. In an attempt to target the grey literature (Wilson, 2009), our searches cover also databases specific to unpublished graduate theses (e.g., Ethos – Electronic Theses Online Service). We also conducted hand

searches in all volumes of 46 journals. Bibliographies from earlier narrative reviews were also checked.

2.2 Criteria for inclusion or exclusion of reports

Studies included in the meta-analysis met the following criteria:

- We targeted manuscripts measuring school bullying rather than other general forms of aggression. Papers on bullying within other settings, such as bullying at work, or other manifestations of victimisation or violence (e.g., fights, school shouting) outside or inside the school were excluded (Lambert, Scourfield, Smalley, & Jones, 2008).
- In terms of the time frame, databases and journals were searched from inception to the end of 2014.
- Included studies provided a statistical measure of the association between bullying (victimisation and/or perpetration) and drug use. For this meta-analysis, drug use refers to hard drugs, for instance cocaine and/or inhalants (e.g., Kaltiala-Heino et al., 2000), or softer drugs such as marijuana/cannabis (e.g., Liang, Flisher, & Lombard, 2007). Studies reporting on combined measures of alcohol or cigarette use plus drugs (e.g., Carlyle & Steinman, 2007) were excluded. Similarly, studies reporting on other unspecified substances were excluded (i.e., Gruber & Fineran, 2007).
- Included studies sampled children and adolescents from mainstream schools so that results are generalisable to the wider school population. Studies reporting measures for adults (e.g., Bebbington et al., 2004) or psychiatric inpatients (e.g., Luukkonen, 2010) were excluded.
- As cross-sectional studies are particularly suitable for estimating the prevalence of behaviours (Sedgwick, 2014; Levin, 2006), the present study focused only on cross-sectional research, including reports with adjusted measures of the targeted association. When the report provided adjusted and unadjusted data, we only used adjusted results for the meta-analysis.

- Sources included were book chapters (e.g., Pepler, Craig, Connolly, & Henderson, 2002) journal articles, and academic MSc and PhD theses (e.g., Edwards, 2002).

Appendix Table A presents the studies that were excluded from the meta-analysis as well as justifications on why this decision was reached.

2.3 *Combining effect sizes within a report relating to the same outcome measure*

In some cases reports presented more than one effect size that could be coded. For instance, some reports presented the same outcome for different groups of respondents (subgroups within the study), namely boys and girls (e.g., Pepler et al., 2002), or middle and high school students (e.g., Radliff et al., 2012) or respondents from different ethnic groups (e.g., Fernando, 2009). In these cases, the results were combined in a single summary effect size for each study under investigation.

Additionally, some studies reported separate results for pupils who were bully-victims. Since the number of studies was limited (four studies), we did not meta-analyse results for this category (e.g., comparing bully-victims and non-involved children). However, following the criteria used in previous studies (e.g., Ttofi et al., 2012) bully-victims were added (combined) to both bullies and victims categories so that the increase in the prevalence of each category was proportionate.

3. RESULTS

3.1 *Systematic review*

Initial online searches resulted in hundreds of hits, but only 61 reports were relevant to the aims of our systematic review, namely reports with relevant data on both school bullying (perpetration and/or victimization) and drug use. Upon further screening of the full text of these reports, it was established that the majority were not included in the meta-analyses, because they did not provide an *adjusted* effect size on the association of drug use with either school bullying (perpetration and/ or). The meta-analyses included studies that investigated the relationship between school bullying (perpetration and/or victimization) and drug use after controlling for other childhood risk factors (e.g. child, parental, child-rearing, peer, school,

socio-economic and neighbourhood variables) that are significantly correlated with school bullying and drug use. In this way, relatively robust conclusions could be drawn about the extent to which school bullying may have an effect on the outcome measure *over* and *above* the contribution of other confounding variables. Appendix Table A gives reasons for the exclusion of the majority of these studies from the meta-analyses.

Table 1 provides further information about the 61 studies that were relevant for the aims of the systematic review. Most studies are based on samples from Europe and North America. Three studies (i.e., Brown et al., 2008; Rudatsikira, Muula, & Siziya, 2008; Siziya et al., 2013) examined populations from low-income countries in Latin America or Africa. Seventy seven per cent of the studies were retrieved from peer-reviewed journal articles. Unpublished reports are a minority, as has been found in other recent systematic reviews and meta-analyses (e.g., Ttofi et al., 2012; Lösel & Beelmann, 2003, 2006).

TABLE 1 ABOUT HERE

In almost all studies, the samples involved both boys and girls, with the exception of three studies that only reported results for boys (i.e., McMahon, Reulbach, Keeley, Perry, & Arensman, 2010; Stein et al., 2007; Waters et al., 1999). However, few studies provided results for boys and girls separately (e.g., Siziya et al., 2013). The same is applicable with variables such as ethnicity (e.g., Liang et al., 2007). In terms of age, the mean age ranged between 11 and 15 years.

Self-report questionnaires were the dominant tool to collect data in the screened reports. In fact, among the studies included in the systematic review, only one was based on multi-informant measures. In terms of the role played by schoolchildren in bullying, most of the studies encompassed measures for victims (46%) or bullies (15%) only. Thirty nine per cent of the studies measured more than two roles (e.g., bullies, victims and/or bully-victims).

Table 2 reports all manuscripts included in the meta-analyses and relevant effect sizes for each report. Not all studies provided both measures of association (bullying perpetration with drug use and bullying victimisation with drug use). Table 2 also presents covariates that were used in statistical controls across studies in order to provide the adjusted and un-

confounded effect size on the drug-bullying association. The variability in statistical controls used across studies is evident, with some studies controlling for basic demographic measures (e.g. Brown et al., 2008) while other studies controlling for a notable number of childhood variables from the individual, family and school domain (e.g. Romera et al., 2011). This could explain the notable variability in effect sizes across individual studies (see below).

TABLE 2 ABOUT HERE

3.2 Meta-analysis

A total of 13 studies provided enough statistical information to calculate an effect size on the prevalent association between bullying (perpetration and/or victimisation) and drug use. They represented a total of 152,326 cases.

3.2.1 The association between bullying perpetration at school and drug use

Figure 1 illustrates that only eight eligible studies reported effect sizes on the association of bullying *perpetration* and drug use. Individual effect sizes for each study are available in the forest plot, with most suggesting a positive association between bullying perpetration and drug use. For them, the adjusted summary effect size (under a random model) was $OR=2.817$ (95% CI 1.974-4.020; $z=5.709$; $p < .001$). One study (Kaltiala-Heino et al., 2000) provided a notably larger individual effect size, despite the eligibility of the study based on the inclusion criteria. Removal of this study marginally changed the summary effect size to an OR of 2.4 (95% CI: 1.7 – 3.5) hence the decision was made to keep this study in the final analyses. The final summary effect size of $OR = 2.8$ indicates a very strong relationship between bullying perpetration and drug use. For example, if a quarter of children were bullies and a quarter were drug users, this value of the OR would correspond to 40.88% of bullies becoming drug users, compared with 19.71% of non-bullies.

Given the heterogeneity in methodological features (e.g., location and sample size) of the studies included, heterogeneity tests were conducted. Cochran's test, Q , was significant at $p < .001$ level ($Q= 514.60$; $I^2= 99$), supporting the presence of high dispersion in effect size across studies. As already mentioned, this was expected given the variability in statistical controls used across studies.

FIGURE 1 ABOUT HERE

3.2.3 *Bullying perpetration at school and drug use: publication bias analysis*

We ran analyses for publication bias given the small number of studies included in this meta-analysis. 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 $OR= 2.94$; $95\%CI 2.86 - 3.03$). Correspondingly, under the random effect model, the values again did not vary (in both cases they were $OR=2.82$; $95\%CI 1.97 - 4.02$). Based on the parameter of Duval and Tweedie's trim-and-fill, it seems that no studies are missing.

Additionally, Rosenthal's fail-safe N test is a technique for computing the number of missing studies that would be necessary to nullify the found effect. Small numbers of missing studies would reveal likelihood of biased effects. Test was equal 777.3, suggesting that it would be necessary to allocate and include 777.3 missing studies with no effects for every observed one to achieve the combined 2-tailed p -value exceeding 0.05. It therefore is highly unlikely that missing studies could alter the substantive conclusion.

3.2.4 *The association between school bullying victimisation and drug use*

Eleven studies were concerned with the association between bullying victimisation and drug use. Individual effect sizes across studies are shown in Figure 2. The adjusted effect size for the association between bullying victimisation and drug use, after controlling for covariates, was $OR=1.790$ ($95\% CI 1.382 - 2.318$; $z= 4.409$ $p<. 001$). One study (Brown et al., 2008) provided a notably larger individual effect size, despite the eligibility of the study based on the inclusion criteria. Removal of this study marginally changed the summary effect size to an OR of 1.5 ($95\% CI: 1.3 - 1.9$) hence the decision was made to keep this study in the final analyses. A summary effect size of $OR = 1.8$ indicates a moderate relationship between bullying

victimization and drug use. For example, if a quarter of children were victims and a quarter were drug users, this value of the OR would correspond to 33.69% of bullied youth becoming drug users, compared with 22.1% of non-bullied youth. Cochran's Q suggests substantial variability in the estimates between studies (Cochran's $Q = 220.682$; $p < .001$; $I^2 = 95$).

FIGURE 2 ABOUT HERE

3.2.5 *Bullying victimisation at school and drug use: publication bias analysis*

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 $OR = 1.78$; $95\%CI$ 1.72 – 1.83). Correspondingly, under a random effect model, the point estimate for the combined studies did not vary (in both cases it was $OR = 1.78$; $95\%CI$ 1.38 – 2.31). In other words, Duval and Tweedie's trim-and-fill procedure shows that results cannot be invalidated because of publication bias.

Rosenthal's fail-safe N test was equal to 141.3, suggesting that it would be necessary to allocate and include 141.3 missing studies with no effects for every observed one to achieve the combined 2-tailed p -value exceeding .05. 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. DISCUSSION

4.1 *Conclusions and Implications for Policy and Practice*

This meta-analysis provides support for the strong link between bullying at school and drug use. Specifically, bullies are roughly three times more likely to take drugs compared with non-involved children. Victims, on the other hand, are roughly twice as likely to take drugs compared with non-involved youth. Although the correlational nature of these cross-sectional studies precludes any causal inference, they are consistent with the notion that bullying is an important childhood risk for the physical and mental health of students (Bradshaw et al, 2013; Brown et al., 2008). Notably, meta-analytic results are based on an adjusted effect size,

indicating the association of school bullying with drug use over and above the impact of other major childhood risk factors, thus providing the independent bullying-drug link.

Meta-analytic results are concordant with earlier research that children involved in school bullying as either perpetrators or victims are at increased risk for drug use (Sullivan, Farrell, & Kliewer, 2006). In fact, both cross-sectional and longitudinal studies suggest that bullying perpetration at school is a strong co-current correlate (Bradshaw et al., 2013) or predictor of future drug use (Farrington & Ttofi, 2011). Findings are also comparable with previous results in terms of the idea that perpetrators show more externalising problems than victims. For instance, previous meta-analyses showed that the perpetration of bullying was more predictive of violence and offending later in life than victimisation (Ttofi, Farrington, Lösel, & Loeber, 2011b; Ttofi, Farrington, & Lösel, 2012). In any case, following our results, the odds of victims for drug use are almost double those for non-involved. Although the explanations given for the drug-bullying victimisation association are not part of this research, it seems plausible that drugs aid victims in coping with the negative effects of rejection (Carlyle & Steinman 2007).

Interestingly, the magnitude of the effect sizes in the present meta-analysis is similar to earlier meta-analytic findings on the drug-crime link among adults (Bennett, Holloway, & Farrington, 2008). Although these results represent a different population, it is quite reasonable to hypothesise that externalising problem behaviours such as bullying, criminal behaviour and drug use may be viewed as manifestations of the same underlying theoretical construct expressed differently across life (Farrington, 1997; Loeber et al., 1998; Ttofi et al., 2012).

Children involved in school bullying are children that could present other associated risks for their future development. Our meta-analytic investigation, based on a thorough systematic review, supports that school bullies and their victims have a heightened risk of being involved in drug use. Therefore, intervention strategies aiming at tackling school bullying and promoting safer school communities should be promoted. It can be inferred that effective bullying prevention programmes could be seen as having a potentially positive effect in reducing associated problem behaviours such as drug use.

To the best of our knowledge, this is the first meta-analytic investigation to establish a clear link between bullying and drug use. There is a higher prevalence rate of drug use among bullies and their victims compared with non-aggressive children. To an extent, this is expectable given that existing research supports the comorbidity of aggressive, violent and other externalizing problem behaviors (Loeber, Farrington, Stouthamer-Loeber, & van Kammen, 1998). An important question arising from this research is why such a link exists. What are the mechanisms linking bullying perpetration and victimization with drug use? This question cannot be addressed from the current study findings although it could be hypothesized that this is related to the marked shared variance in risk factors predicting these co-morbid behaviors (Bebbington et al., 2004; Brown et al., 2008; Farrington, 2002).

Childhood bullying is a significant risk factor for adverse outcomes in adult life (Ttofi et al., 2011, 2012) while substance use early in youth, combined with other childhood risks, is predictive of adult substance dependence (Sartor, Lynskey, Heath, Jacob & True, 2006). Therefore, this meta-analysis highlights the importance of early intervention research in targeting school aggressive behavior and associated externalizing problems at root before they develop into more serious problems later in life. Current meta-analytic findings have important implications for policy and practice. They underline the need for school communities and relevant authorities to create a violence-free school environment and the need to devise and implement measures that promote the healthy psychosocial development of youth. More efforts should also be made to implement evidence-based policies and programmes with individual bullies and victims, perhaps based on child skills training (Lösel & Beelmann, 2003) and family-based programmes (Farrington & Welsh, 2003). Both bullying prevention programme and more general multi-component programmes may be equally beneficial for multi-problem children (Ttofi et al., 2012), reducing aggression among schoolchildren as well as other comorbid behaviours such as drug use. In fact, early intervention aimed at preventing or stopping school bullying should be understood as an early and cost-effective way to counteract risks and prevent antisocial behaviour, including drug use (Beelmann & Lösel, 2006; Farrington, 1993; Gottfredson, Wilson, & Najaka, 2002).

4.2 *Limitations and future research*

Despite the large number of studies indicating a link between bullying and drug use, to the best of our knowledge, this is the first quantitative synthesis of the existing research. The results of this meta-analytic investigation show that the primary studies included were mainly based national and international large-scale surveys that intended to cover many aspects of schoolchildren's health and psychosocial development. While the epidemiological nature of many of the primary studies is a positive feature supporting the meta-analytic synthesis of homogeneous studies, it also comes with some methodological concerns. Specifically, many of the included studies were based on the Global School-based Student Health Survey (GSHS) or the Health Behaviour in School-aged Children Survey (HBSC). Both surveys use only few items to measure school bullying, meaning that important aspects may not be adequately covered. Although bullying shares defining features with peer aggression and harassment, the distinctions among them point towards different legal remedies and policy repercussions (Cascardi, Brown, Iannarone, & Cardona, 2014), including practical methodological implications since broad definitions of school bullying could be responsible for overestimated prevalence rates (Cornell & Cole, 2012).

One of the initial aims of this meta-analysis was to report separate effect sizes for males and females as well as separate effect sizes for different ethnic groups. However, only one study reported data for different ethnic groups and only two studies reported gender-specific effect sizes. These limitations were present in many other covariates, making it impossible to run analyses to explain the heterogeneity of our findings.

It would be ideal if future research drew safe conclusions about variability in effect sizes based on different moderators such as gender and ethnicity. Future research should also investigate the comorbidity of bullying and drug use in low-middle income countries, especially given the higher prevalence rates of bullying in these countries (Fleming & Jacobsen, 2009a; Muula et al., 2009).

We suggest that future research should pay more attention to bully-victims and investigate the actual rates of drug use among this specific group. Due to the fact that they tend

to attack when victimised, they can also be targets of retaliation in a vicious circle of aggression (Nansel et al., 2001). Bully-victims are also more rejected than bullies or victims, experiencing frequent isolation and avoidance (Juvonen et al., 2003). Bearing in mind that it has been identified as the most at risk group (Schwartz, 2000), more research needs to be carried out into their characteristics and comorbid risks.

Finally, future research should focus on the development of better instruments for measuring school bullying, including multi-informant measures (surveys) that may potentially achieve a more precise perspective on the phenomenon of school bullying (Crothers & Levinson, 2004). This will enable investigations into whether school bullies are more likely to use drugs compared with children who score high on general aggression instruments and potentially address whether this differentiation is really necessary (Finkelhor, Turner, & Hamby, 2012).

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Appendix Table A

Studies excluded from the meta-analyses

Description of exclusion criteria

- 1 **Alexander, Currie, & Mellor, (2004)**. The exact Ns for female and male bullies are not given. All that is indicated is that 16.2% of female bullies used cannabis compared with 9% of female non-bullies; and 16.7% of male bullies used cannabis versus 12.7% of male non-bullies (see penultimate page of the report)
- 2 **Azevedo da Silva et al., (2012)**. Although the report offers information on the association of bullying victimisation and drug use, data is presented incomplete. They report means and standard deviations, and also percentages but sample size for subgroups are not reported (see p.21-22)
- 3 **Bebbington et al., (2004)**. The sample population consisted of school children (aged 16 onwards) and also adults up to age 74 (p. 220)
- 4 **Birkett et al., (2009)**. Data on drug use is included in a general report of alcohol consumption (p.993). Figure 4 (p.996) doesn't offer enough statistical information.
- 5 **Brunner et al., (2007)**. Bullying and illicit drug use are both included as predictors for self-harm (Table 1 p.644) but statistical data on the association between bullying and drug use is not provided in this report (p.632-646).
- 6 **Carmona-Torres, Cangas, García, Langer, & Zárata, (2012)** The study compares a paper-based and computer-based questionnaire that aims to measure bullying and drug use. Psychometric properties of the two instruments and results from factor analyses are shown (p.44). The paper does not report the association between bullying and drug use. (See table 2 and 3 in p. 45-46).
- 7 **Carlyle & Steinman, (2007)**. The concept substance use involves alcohol and cigarettes (p.625)
- 8 **Cruzeiro & Azevedo da Silva, (2008)**. Bullying and drug use are used as predictors for conduct problems (relevant OR given in table 1, p.2015) but the association between both variables is not reported.
- 9 **Cuevas, Finkelhor, Turner, & Ormrod, (2007)**. The outcome measure includes alcohol and drug combined (table 2 and 3 p. 1591 and 1592)
- 10 **Cullen, Unnever, Hartman, Turner, & Agnew, (2008)**. Statistical information on bullying victimisation versus drug use is presented on table 2 (p. 355) but the outcome measure included both drug use and alcohol use (see p. 353)
- 11 **Duffecy, Bleil, Labott, Browne, & Galvani, (2008)**. Data on bullying and drug use are presented in table 2 (p.624) but statistical information on the association between bullying and drug use is not provided in this report.
- 12 **Gruber & Fineran, (2007)**. The study presents data on the association of bullying with substance abuse (table 3, p. 637) but it is not clear whether substance abuse includes only drugs. On p. 633 the authors refer to the questionnaire they used to measure substance abuse by Hanisch & Hulin, (1991) but the paper makes no mention of drug use at all. Additionally it is not helpful in clarifying what involves 'substance abuse'.
- 13 **Gruber & Fineran, (2008)**. The study presents data on the association of bullying and substance abuse (table 3, p. 9), which involves alcohol and drug use combined (p. 6).
- 14 **Hinduja & Patchin, (2008)**. It refers to cyber bullying (p.138) and also the consumption of drugs measure is combined with liquor use (p.140).
- 15 **Jablonska & Lindberg, (2007)**. Although drug use is measured (p.657), the study did not regard the association between bullying and drug use. *OR* on drug use are given for adolescents who had different family structures (p.659).
- 16 **Kaltiala-Heino, Marttunen, Rantanen, & Rimpelä, (2003)**. Data on bullying perpetration and substance use are presented on table 3 (p.1060) but the statistical information on their association is not presented.
- 17 **Konu & Lintonen, (2006)**. The outcome drug use is not measured.
- 18 **Konu, Lintonen, & Rimpelä, (2002)**. Although drug use is measured (Table 1, p.159), the study doesn't present statistical results regarding the association between bullying and drug use.
- 19 **Lambert et al., (2008)**. Bullying victimisation was measured along with 'being badly treated'; and the equivalent for bullying perpetration (see p. 272).
- 20 **Luk, Wang, & Simons-Morton, (2010)** Substance use includes alcohol and drugs (p.356).
- 21 **Luk et al., (2012)**. Although marijuana use is measured (p. 1354), the results refer to 'substance-using bullies'. The category of substance use, combine alcohol and marijuana (figure 1 and table 3, p.1356).
- 22 **Martinelli et al., (2011)**. Data on bullying and cannabis use are presented in table 1 (p.341) but statistical

- information on the association between them is not provided. The authors present results only for significant variables and results on cannabis use are not indicated because they were non significant (p.341).
- 23 **McMahon, Reulbach, Corcoran, et al., (2010)**. Bullying perpetration and drug abuse are used as predictors for self harm (adjusted *ORs* are given on table 2, p. 4) but no statistical information is given on the association between bullying and drug abuse.
- 24 **Messerschmidt, (2011)**. Qualitative study (p.207), which does not report statistical results for meta-analysis.
- 25 **Muula, Herring, Siziya, & Rudatsikira, (2009)**. Although drug use is measured, its results are presented combined with alcohol use (p.2 and table 1 p.3). The association between bullying and drug (substance abuse) is not given in this report.
- 26 **Nansel et al., (2001)**. The study reports information for alcohol and smoking instead of actual drugs (p.2098).
- 27 **Pérez Milena et al., (2010)**. Table 2 (p. 27) gives the percentage of non-victims, victims and perpetrators who do drugs. However, the exact sample size of each group is not specified and the *OR* cannot be calculated (see also p. 23 where the percentage of each group is given, but there is an overlap between groups that total more than 100%).
- 28 **Peeters, Cillessen, & Scholte, (2010)**. Excluded for two reasons: a) drug use and bullying are used as predictors for suicidal ideation but the association of the two predictors is not given (see table 2 p. 268); and b) also, bullying is part of a total score which also includes "abuse and taunting" (see table 2, p. 268).
- 29 **Rivers et al., (2009)**. The outcome measure, substance use, includes both drugs and alcohol use (p.215).
- 30 **Romani & Gutiérrez, (2010)**. Although the paper includes data on the association of school bullying and drug use, it was incomplete for effect sizes calculation. The author was contacted by mail, but the additional information is not yet available.
- 31 **Saluja et al., (2004)**. Although drug use is measured (p.762). Bullying and drug use are both used as predictors for depression (see tables 2 and 3 p. 763), but the study didn't present statistical results regarding the association between bullying and drug use.
- 32 **Santinello & Vieno, (2008)**. Although bullying perpetration and cannabis use are measured (p.15), their association is not presented in subsequent analyses.
- 33 **Sobotkova, Blatny, Jelinek, & Hrdlicka, (2012)**. The study focuses on Antisocial behavior. Although the authors report results on marijuana use at school (see table 3 p.9), there is not measure (p.8) referring to Bullying behavior.
- 34 **Tharp-taylor, Haviland, & D'Amico, (2009)**. The paper shows effect sizes for bullying victimisation versus drug use after controlling for prior drug use (see table 3b, p. 565). However, the study is excluded because Risk Ratios are presented and they cannot be included in the meta-analysis.
- 35 **Vaughn et al., (2010)**. The sample involves individuals aged 18 or older.
- 36 **Volk, Craig, Boyce, & King, (2006)**. The statistical information provided does not allow calculating effect sizes for all the categories defined for the meta-analysis.
- 37 **Wang, Iannotti, & Luk, (2012)**. Substance use includes alcohol and drugs (p.525).
- 38 **Waters et al., (1999)**. The outcome measure is 'drug concern' (see table 2, p.30) and the report does not provide statistical information for bullied children versus drug use (tables 3 and 4, p.31).
- 39 **Zaborskis & Vareikiene, (2008)** A translation of this report was required. However, the report with results in English is not yet available.
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Table 1: Characteristics of studies included in the systematic review*

	Systematic Review		Meta-analysis	
	Number of Studies	%	Number of Studies	%
Total	61	100%	13	100%
Included	22	36%	-	-
Excluded	39	64%	-	-
Age of the participants				
Less than 12 years old and more than 18 years old			2	16%
Between 12 and 18 years old			11	84%
Location of the sample studied				
Europe	22	36%	3	23%
North America	23	37%	5	39%
Asia	1	2%	-	-
Latin America	8	13%	1	8%
More than 1 low-income country (comparative)	3	5%	2	15%
Africa	3	5%	2	15%
Australia and New Zealand	1	2%	-	-
Type of Publication				
Journal	57	93%	10	77%
Book	1	2%	1	8%
Reports (Governmental)	1	2%	-	-
Academic Thesis	2	3%	2	15%
Language				
English	54	88%	12	92%
Spanish	4	6%	1	8%
Italian	1	2%	-	-
Lithuanian	1	2%	-	-
Portuguese	1	2%	-	-
Type of Measure				
Self-report	58	94%	13	100%
Life-story	1	2%	-	-
Interview	1	2%	-	-
More than 1 measure	1	2%	-	-
Role in Bullying				
Victims	26	43%	6	46%
Bullies (perpetrators)	7	11%	2	15%
Bullies (perpetrators) + Victims	12	20%	-	-
More than 2 roles measured	14	23%	5	39%
Not Measured	2	3%	-	-

* A fraction of these studies are included in the meta-analysis

Table 2: Adjusted effect sizes for school bullying and drug use¹

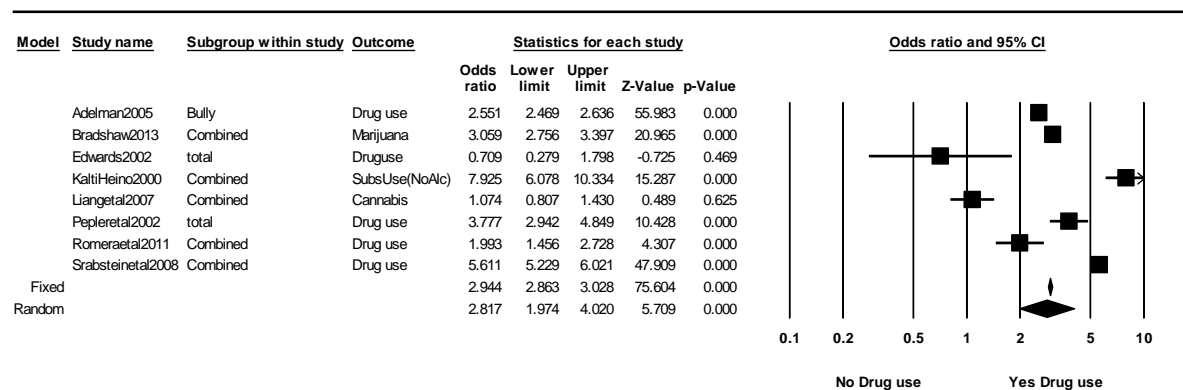
Study	Age and Sample Size	Adjusted effect size (Bullying perpetrators)	Adjusted effect size (Victims)	Covariates
1) Adelman, (2005)	11 to 12 years (Sixth grade) N = 50148	Drugs: B: $\beta = .25$ $p < .001$ N= 50148 ²		Family violence, family substance abuse, illegal activity at school, victimization by others, family caring, teacher civility, student civility, school safety, caring by others.
2) Bradshaw et al., (2013)	12 to 16 years (65.4%) 17 to 21 year (34.6%) N = 16302	Marijuana use: B: $OR = 2.77$ (2.439-3.155) B/V: $OR = 3.71$ (3.101-4.438)	Marijuana use: V: $OR = 1.30$ (1.145-1.485) B/V: $OR = 3.71$ (3.101-4.438)	Gender, age, African American ethnicity, victimization, Ease of access to substance, school enrolment, % minorities in school, school suspensions, urban schools.
3) Brown et al., (2008)	13 to 15 years N = 26510		Drug use: V (bullied 6-9 times in last month): $OR = 6.1$ (4.6-8.2) V (bullied 10 or more times in last month): $OR = 10.8$ (8.4-13.9)	Age and sex
4) Edwards (2002)	$M_{age} = 14.33$ $SD = .66$ N = 263	Use of stimulants: C: 13 [12.5% of N=104] B: 4 [9.8% of N=41] B/V: 4 [8.7% of N=46]	Use of stimulants: C: 13 [12.5% of N=104] V: 9 [13.4% of N=67] B/V: 4 [8.7% of N=46]	Not specified
5) Fernando (2009)	12 to 18 years (High school) N = 3131		Used marijuana White V: $OR = 1.13$; 95%CI (0.87-1.46) Hispanic V: $OR = 1.14$; 95%CI (0.63-2.08) Other V: $OR = 1.49$; 95%CI (0.89-2.49) Used marijuana at school	Age and gender

¹ Abbreviations: *ES*, Effect size; *OR*, Odd Ratio; (confidence interval); *M*, mean; *SD*, standard deviation; *SE*, standard error; *r*, Pearson correlation; β , Beta correlation; V, victims; C, children non-involved in bullying; B, bullies or perpetrators; B/V, bully-victims.

² β was inputted in CMA software as a correlation coefficient. In fact, it should be said that regression coefficients and correlation coefficients are quite similar, though their distribution is different. This assumption was also confirmed by Peterson & Brown, (2005)

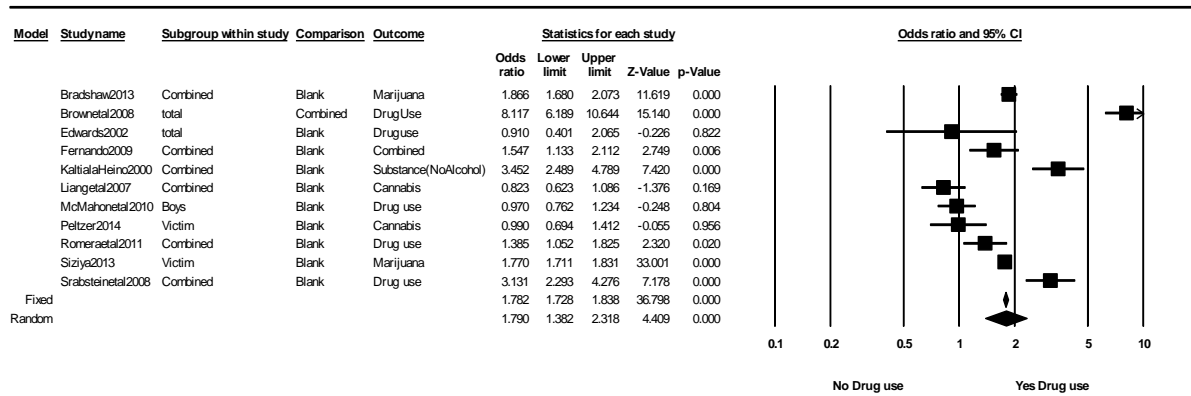
			White V: <i>OR</i> =1.47; 95% <i>I</i> (0.88-2.44) Hispanic V: <i>OR</i> =3.20 (1.43-7.17) Other V: <i>OR</i> =3.01 (1.36-6.69)	
6) Kaltiala-Heino et al., (2000)	$M_{age}=15.3$ $SD=0.6$ N = 17643	Use of other substances than alcohol B: <i>OR</i> =8.2 (6.1-11.2) B/V: <i>OR</i> =7.1 (7.1-12.2)	Use of other substances than alcohol V: <i>OR</i> = 2.3 (1.5-3.4) B/V: <i>OR</i> =7.1 (7.1-12.2)	Age, sex, family structure and parental education
7) Liang et al., (2007)	Two subgroups: $M_{age}= 14.2$ years (grade 10) $M_{age}= 17.4$ (grade 11) N = 5074	Cannabis B: <i>OR</i> =1.17 (0.80-1.71) B/V: <i>OR</i> =0.96 (0.62-1.48)	Cannabis V: <i>OR</i> =0.74 (0.52-1.07) B/V: <i>OR</i> =0.96 (.62-1.48)	Fighting, weapon carrying, suicidal ideation, suicide attempt, theft, vandalism, walking alone, risky passenger, risky driver, smoking, alcohol
8) McMahon et al., (2010)	15 to 17 years N = 1870		Drug taking (Boys) V: <i>OR</i> = 0.97 (0.76 -1.23)	Age
9) Peltzer & Pengpid, (2014)	13 to>16 N = 15226		Cannabis V: <i>OR</i> =0.99 (0.71 – 1.36)	Age, gender, poverty, current smoking cigarettes, physical fight, injury, fast food consumption.
10) Pepler et al., (2002)	$M_{age}=12.7$ $SD=0.88$. Grades 6-8 N = 922	Drug use B: $\beta= .34$ $p< .01$ N= 922		Gender, age, SES, sexual harassment, peer orientation
11) Romera, Del Rey, & Ortega, (2011)	$M_{age}= 11.3$ $SD= 1.6$ N = 3042	Drug use B: <i>OR</i> =1.964 (1.179 - 3.271) B/V: <i>OR</i> = 2.011 (1.351-2.995)	Drug use V: <i>OR</i> =0.984 (0.672-1441) B/V: <i>OR</i> = 2.011 (1.351-2.995)	Sex, witness of violence, negative relationship with peers, negative relationship with teachers, negative relationship between parents-teachers, victimization by adults, self-esteem, antisocial behaviour
12) Siziya et al., (2013)	< or =13 to > or =16 N = 2257		Use of cannabis V: <i>OR</i> =1.77 (1.71- 1.83)	Not specified
13) Sraabstein & Piazza, (2008)	Three subgroups $M1_{age}=11.5$ $M2_{age}=13.5$ $M3_{age}=15.5$ N = 9938	Use of drugs B: <i>OR</i> =5.22 $SE= 1.11$ [N=9574] B/V: <i>OR</i> =6.39 $SE=1.15$ [N=9574]	Use of drugs V: <i>OR</i> =0.95 $SE=1.20$ [N=9574] B/V: <i>OR</i> =6.39 $SE=1.15$ [N=9574]	Gender, race and grade

Figure 1: Forest plot for bullying perpetration and drug use (adjusted effect size): meta-analysis of cross-sectional studies



Meta Analysis

Figure 2: Forest plot for bullying victimisation and drug use (adjusted effect size): meta-analysis of cross-sectional studies



Meta Analysis