Childhood and Adolescent Bullying Perpetration and Later Substance Use: A Meta-analysis

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abstract

CONTEXT: Previous meta-analyses substantially contributed to our understanding of increased drug use risk in bullies but only included research up to 2014 and did not report on other types of substances.

OBJECTIVE: To review and meta-analyze existing evidence regarding the prospective association between peer bullying perpetration in childhood and adolescence and later substance use.

DATA SOURCES: Electronic databases were searched on March 14, 2019.

STUDY SELECTION: We selected peer-reviewed articles and dissertations in English reporting original empirical studies on associations between bullying perpetration in childhood or adolescence and later use of drugs, alcohol, or tobacco. Records were assessed for eligibility independently by 2 authors.

DATA EXTRACTION: Data extraction and quality assessment was performed by one author and checked by another author.

RESULTS: In total, 215 effects were included from 28 publications, reporting on 22 samples, comprising 28 477 participants. Bullying perpetration was associated positively with all types of substance use (drugs, alcohol, tobacco, and general). The results for combined bullying-victimization were more mixed, with generally weaker effects.

LIMITATIONS: Effects were based on a large variability in operationalizations and measures of bullying and substance use, impeding the interpretation of the pooled effect sizes. Although bullying appears to be a risk factor for substance use, no inferences can be made about so-called causal risk factors that can provide the basis for preventive interventions.

CONCLUSIONS: There is evidence that adolescents and particularly children who bully their peers have a higher risk of substance use later in life than their nonbullying peers.

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Dr Vrijen conceptualized and designed the study, conducted the search, screening, and full-text eligibility assessments for all studies, wrote the manual for data extraction and risk-of-bias assessments, performed the data extraction and bias assessments, contacted authors for additional information, conducted the meta-analyses, trained Ms Ackermans for the data extraction and bias assessments, supervised the *P*-curve analyses, drafted the initial manuscript (Methods, Results, and Discussion), and reviewed and revised the manuscript; Ms Wiertsema and Dr van der Ploeg conceptualized and designed the study, conducted screening and full-text eligibility assessments for 33.3% of the studies, and critically reviewed the manuscript; Ms Ackermans checked the data extraction and risk-of-bias assessments performed by Dr Vrijen, conducted all *P*-curve analyses, and critically reviewed the manuscript; Dr Kretschmer conceptualized and designed the study, conducted screening and full-text eligibility assessments for 33.3% of the studies, drafted the initial version of the Introduction, and critically reviewed the manuscript; and all authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

To cite: Vrijen C, Wiertsema M, Ackermans MA, et al. Childhood and Adolescent Bullying Perpetration and Later Substance Use: A Meta-analysis. *Pediatrics.* 2021; 147(3):e2020034751

Research on child and adolescent bullying has surged in the past decade, with most studies focused on the victims, who pay a high price in terms of mental and physical health.[1] Negative outcomes are often implied for bullying perpetrators as well, and meta-analytic evidence suggests that bullying perpetration is associated with depression,[2] suicidality,[3,4] psychosomatic problems,[5] low self-esteem,[6] offending,[2,7] and violence.[8] Whereas internalizing maladjustment is common among victims of bullying, externalizing forms are usually found in perpetrators.[9,10]

Substance use and abuse is one facet of externalizing behavior and shares genetic and environmental antecedents with aggression.[11] As such, a link between child and adolescent bullying perpetration and later substance use is likely and has been supported in a recent systematic review[12] and meta-analyses of cross-sectional[13] and longitudinal[14] studies published up to 2014. Various individual and environmental mechanisms might drive this association: Individual-level explanations include a potential shared-personality basis for bullying and substance use such that, for instance, difficulties in emotion regulation and impulsivity predict both a higher likelihood for bullying perpetration as well as substance use.[15,16] Bullies are also at greater risk for forms of maladjustment that, in turn, are closely associated with substance use, such as delinquency.[17] Such individual-level explanations take the perspective that bullying is a form of externalizing maladjustment, but some argue that bullying (especially in adolescence) can be a strategy to acquire status in the peer group[18–20] and is linked to social dominance[21] and popularity,[19,22] suggesting not only negative but also positive outcomes for bullies. Concerning environmental mechanisms, bullying perpetrators are more likely to affiliate with delinquent peers, who increase exposure to or normalize substance use.[23] Moreover, bullying perpetrators more often come from family environments that include harsh parenting as well as more frequent parental substance use.[24] It is possible that these conditions contribute to substance use among offspring.

Previous meta-analyses[13,14] have substantially contributed to our understanding of increased drug use risk in bullies but have only included research up to 2014 and only reported on drug use but not other substances, such as alcohol and tobacco. The current study updates this work by accounting for the increasing number of studies published on longitudinal cohorts in which researchers have assessed childhood and adolescent bullying and were followed into adulthood and is more inclusive with respect to the type of substance use and type of perpetrator. In the current study, "pure" bullies and bully-victims, who are simultaneously victimized and bully others, were analyzed separately. Research into outcomes for bully-victims is scarcer than for pure victims and bullies, possibly a reason why this group was not examined separately in previous reviews and meta-analyses. The increasing number of studies, however, enable such an endeavor now. We hypothesized (1) that higher levels of peer bullying perpetration would be prospectively associated with higher levels of all types of substance use; (2) stronger effects for bullying during childhood than for bullying during adolescence, which we expected to be more strategic and less unequivocally maladaptive; and (3) stronger effects for double-jeopardized bully-victims than for pure bullies.

We employed novel meta-analytic methods that allow for inclusion of multiple effect sizes per study, conducted innovative analyses of publication bias, and examined whether (1) study quality (ie, risk of bias), (2) sample size, (3) type of sample (ie, population versus high risk), (4) location of sample, (5) sex distribution, (6) self-report versus other report of bullying perpetration, (7) timing of bullying perpetration assessment (childhood versus adolescence), and (8) timing of substance use assessment (adolescence versus adulthood) influenced the size of the association between bullying perpetration and drug, alcohol, and tobacco use. Moreover, to elucidate the influence of confounding mechanisms, we conducted analyses on unadjusted and adjusted estimates because Ttofi et al[14] showed that the adjusted overall effect size (odds ratio [OR] = 1.41) for the association between bullying and later drug use was markedly lower than the unadjusted effect size (OR = 2.22).

METHOD

Preregistration and Preferred Reporting Items for Systematic Reviews and Meta-Analyses Statement

The search has been part of a larger project investigating the mental, social, and academic consequences of childhood and adolescent bullying perpetration later in life. This project was prospectively registered with the International Prospective Register of Systematic Reviews (http://www.crd.york.ac.uk/prospero; identifier CRD42019127712) and preregistered on the Open Science Framework (OSF) (https://osf.io/tu5vd/; see https://osf.io/k9dgt/ for details on deviations from the preregistered plans). Methods and findings were reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement.[25]

Inclusion and Exclusion Criteria

Population

We included studies on bullying in children and adolescents (age: <18). We focused on the normal

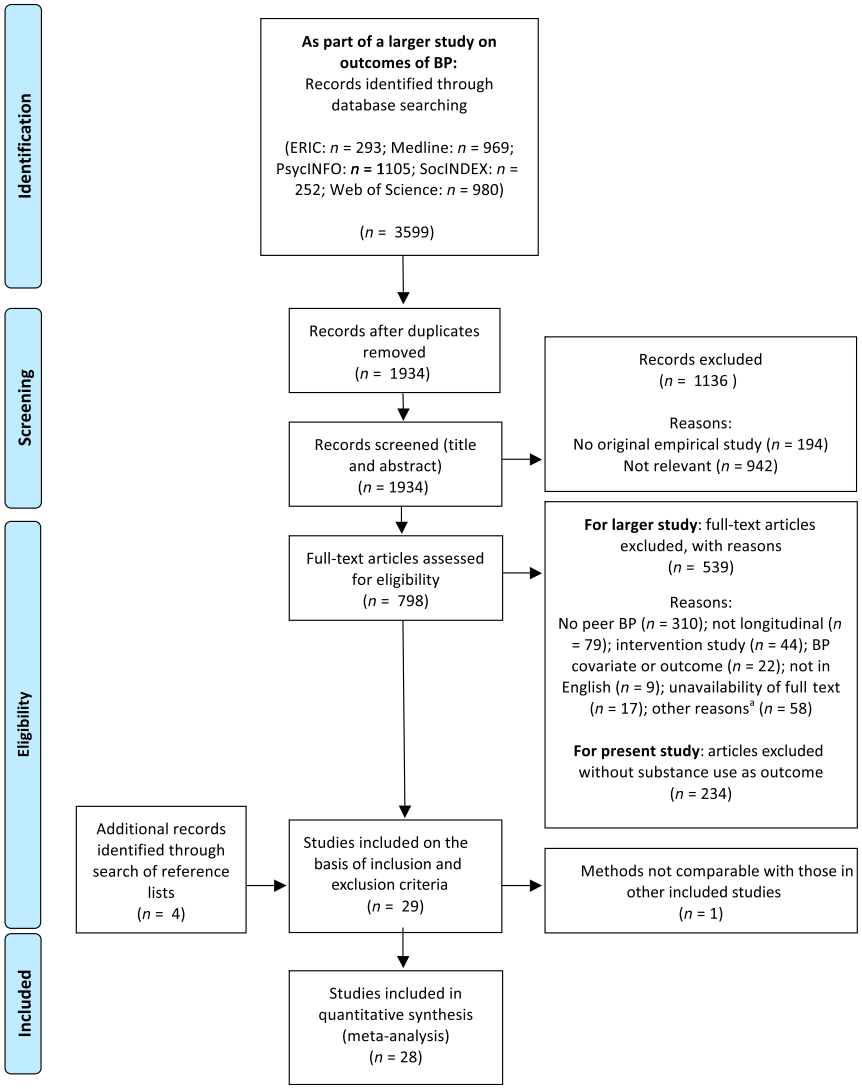

FIGURE 1

Flow diagram of excluded and included studies. [a] Other reasons for exclusion included the following: duplicates discovered during full-text screening (n = 22); no control group or comparison with uninvolved children (n = 4); specific (clinical) subpopulation or bullying directed at a specific target group (n = 6); not about bullying at <18 years of age or assessed only retrospectively in adulthood (n = 7); relevant outcomes not investigated (n = 4); data not analyzed on level of individual, only aggregated (n = 5); no original empirical study (n = 5); no peer-reviewed article or dissertation (n = 3); insufficient information to compute the relevant effect sizes (n = 1); and similar effect was reported in another study (n = 1). BP, bullying perpetration; ERIC, Education Resources Information Center.

population, and studies about children or adolescents with a specific clinical condition were excluded.

Exposure

The conditions of interest (predictors) were peer bullying perpetration and combined bullying-victimization. Studies that only assessed bullying retrospectively in adulthood were excluded because of recall-bias risk.

Comparison

Bullies and bully-victims were compared with same-aged peers uninvolved in bullying.

Outcome

In the larger project, mental health and social and academic functioning were assessed as possible outcomes of bullying. For the current study, we focused on substance use (ie, drugs, alcohol, and tobacco). Because we investigated prospective associations, only longitudinal studies in which substance use was assessed at least 1 wave later than bullying were included.

Additional Criteria

Studies had to be original empirical studies, peer-reviewed articles, or PhD dissertations, written in English, available in a full-text version, and contain sufficient methodologic information to compute effect sizes. If unavailable, corresponding or senior

authors were e-mailed with a request to provide the full text or additional information and were given 2 weeks to respond to the original request, extended with another 2 weeks after a reminder was sent.

Search Strategy and Eligibility Assessments

To identify eligible studies, electronic databases Medline, PsycINFO, Web of Science, ERIC, and SocINDEX were searched by the first author (C.V.) on March 14, 2019. The specific search terms were part of a larger study and have been preregistered on the OSF (https://osf.io/d56na/). All records were assessed for eligibility independently by 2 authors. The first author screened and assessed all studies, and 3 other authors were each randomly assigned 33.3% of the studies. The interrater reliabilities for title and abstract screening were 81% to 85% for the 3 rater couples and 85% to 86% for full-text screening. During full-text screening, the authors independently selected the primary reason for exclusion from an ordered list of possible reasons. All disagreements between authors on the exclusion of a specific study or primary reason to exclude a study were resolved by discussion. As part of the larger project on outcomes of bullying perpetration, 259 studies were included. For the current study, only studies focused on substance use were selected, resulting in 29 included studies. One study[26] was ultimately excluded from the meta-analysis because intercepts and slopes of trajectories of bullying perpetration were used to predict substance use, which rendered the resulting effect sizes incomparable to effects of the other studies, resulting in a total number of 28 included studies.[9,10,27–52] See Fig 1 for a flowchart presenting the search and selection.

Data Extraction and Risk-of-Bias Assessment

Data extraction and risk-of-bias assessments were performed by the first author, on the basis of a detailed

TABLE 1 Effects of Childhood and Adolescent Bullying Perpetration on Later Substance Use

Model			Effect					Effect After Removal of Influential Outliers			
Outcome	Predictor	Adjusted or Unadjusted Effects	*n* Samples/ Articles	*n* Effects/Total No. Participants[a]	OR	95% CI	*P*	Outliers[b]	OR	95% CI	*P*
Drug use	BP	Unadjusted	9/9	21/11 763	1.76	1.41 to 2.20	<.001	28	1.88	1.53 to 2.31	<.001
	BV	Unadjusted	4/5	7/6461	1.61	1.14 to 2.28	.007	—	—	—	—
	BP	Adjusted	13/13	33/17 749	1.47	1.29 to 1.68	<.001	—	—	—	—
	BV	Adjusted	8/8	13/12 201	1.49	0.89 to 2.47	.127	50	1.75	1.46 to 2.08	<.001
Alcohol use	BP	Unadjusted	11/14	25/12 022	1.62	1.35 to 1.93	<.001	75	1.54	1.31 to 1.80	<.001
	BV	Unadjusted	4/5	5/6340	1.16	0.88 to 1.54	.295	76	1.00	0.62 to 1.61	.998
	BP	Adjusted	12/13	33/17 970	1.40	1.18 to 1.66	<.001	140–105	1.45	1.24 to 1.70	<.001
	BV	Adjusted	8/8	13/12 203	1.31	0.76 to 2.24	.330	—	—	—	—
Tobacco use	BP	Unadjusted	7/7	11/9911	1.96	1.50 to 2.57	<.001	154	1.65	1.34 to 2.04	<.001
	BV	Unadjusted	4/4	4/5629	2.61	1.14 to 5.98	.023	—	—	—	—
	BP	Adjusted	10/10	22/15 669	1.66	1.33 to 2.06	<.001	169–171	1.46	1.28 to 1.67	<.001
	BV	Adjusted	6/6	9/10 716	1.49	1.23 to 1.80	<.001	—	—	—	—
General substance use	BP	Unadjusted	2/2	2/7013	3.25	1.96 to 5.38	<.001	—	—	—	—
	BV	Unadjusted	3/3	3/7432	3.61	2.07 to 6.31	<.001	—	—	—	—

BP, bullying perpetration; BV, bullying-victimization (ie, bullies who are bullied); —, not applicable.

[a] Participant numbers were counted only once per sample for a specific substance use subcategory. If multiple effects were included for a specific subcategory, only the largest *n* was used to compute the number of participants. An exception to this is when effects were reported separately for boys and girls; in that case, the *n*s for boys and girls were used to compute the total number of participants.

[b] Influential outliers were only computed for analyses on the basis of ≥4 effects.

manual (https://osf.io/axm36/). Bias assessments were performed separately for each included effect, by using an adapted version of the Newcastle-Ottawa Scale[53,54] The maximum Newcastle-Ottawa Scale score was 8, with higher scores representing lower possibilities of bias. One of the coauthors checked the complete data extraction and bias assessments. All disagreements were resolved by discussion.

Analysis

Effect Sizes

ORs were used as the main type of effect size. Two online effect-size calculators[55–58] and R package esc[59] were used to convert other estimates to ORs. More details about the calculations can be found in the data extraction manual (https://osf.io/axm36/) and calculations of specific effects in the data extraction file (https://osf.io/7pqae/). When both bullying measures and substance use measures were continuous and no grouping variable needed for conversion to ORs was reported, correlations were used to represent the association between bullying perpetration and later substance use. Because effects based on continuous assessments are not comparable to effects based on dichotomous assessments, ORs and correlations were analyzed in separate meta-analyses. Because only few effects were available that could be converted to correlations and the correlational analysis could thus at most provide provisional evidence, OR meta-analyses are presented as the main analyses, and the correlational ones are presented as supplemental (see Supplemental Information, part 3).

Main Analyses

We used state-of-the-art multilevel random effects models to analyze the data. Traditional univariate meta-analytic methods assume independence of effect sizes; however, often multiple effects are reported from the same study sample (eg, for different operationalizations of a predictor or outcome).[60,61] Dependence of effects has often been avoided by selecting only 1 effect per sample or averaging all available effects. This leads to a loss of information that not only decreases power but may also result in elimination of informative differences between effect sizes needed for moderator analyses.[60,61] We included all relevant effects and used multilevel random effects models to account for dependence between effects from the same sample.[60–62]

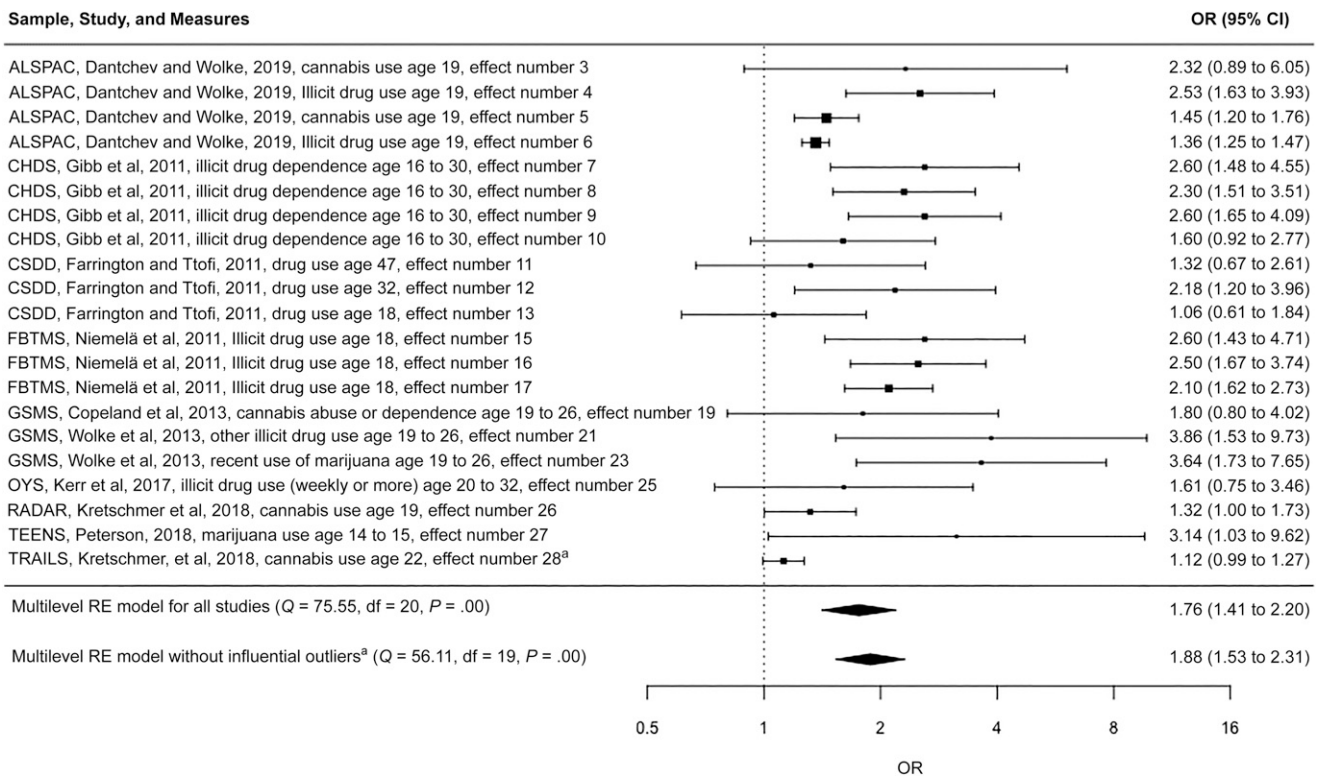

FIGURE 2

Forest plot unadjusted effect of bullying perpetration in childhood and adolescence on later drug use. [a] influential outlier. ALSPAC, Avon Longitudinal Study of Parents and Children; CHDS, Christchurch Health and Development Study; CSDD, The Cambridge Study in Delinquent Development; df, degree(s) of freedom; FBTMS, From a Boy to a Man Study; GSMS, Great Smoky Mountain Study; OYS, Oregon Youth Study; RADAR, Research on Adolescent Development and Relationships; RE, random effects; TEENS, Teenage Networks in Schools study; TRAILS, TRacking Adolescents' Individual Lives Survey.

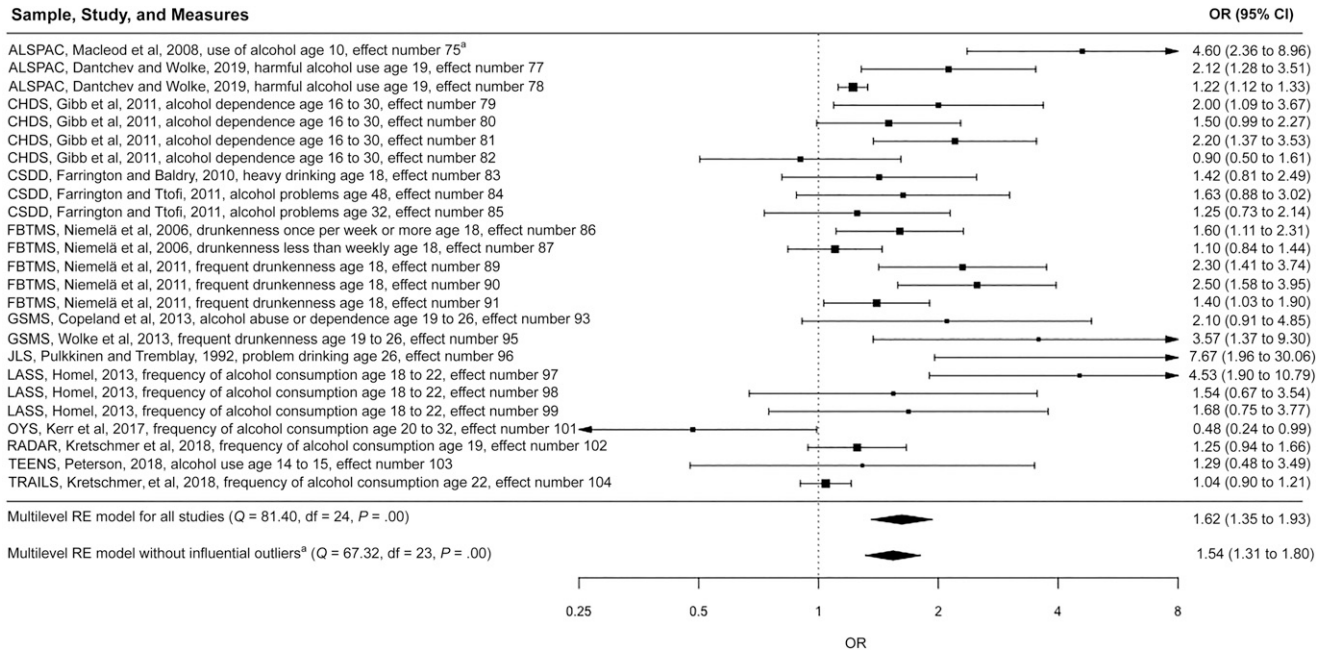

FIGURE 3

Forest plot unadjusted effect of bullying perpetration in childhood and adolescence on later alcohol use. [a] influential outlier. ALSPAC, Avon Longitudinal Study of Parents and Children; CHDS, Christchurch Health and Development Study; CSDD, The Cambridge Study in Delinquent Development; df, degree(s) of freedom; FBTMS, From a Boy to a Man Study; GSMS, Great Smoky Mountain Study; JLS, Jyväskylä Longitudinal Study; LASS, Life at School Study; OYS, Oregon Youth Study; RADAR, Research on Adolescent Development and Relationships; RE, random effects; TEENS, Teenage Networks in Schools study; TRAILS, TRacking Adolescents' Individual Lives Survey.

We used 3-level multilevel random effects models, accounting for sampling variance at level 1, within-sample variance at level 2, and between-sample variance at level 3.[62] Occasionally, multiple articles reported on the same sample but not frequently enough to justify adding article as another level to the model.

Meta-analyses were performed with R package metafor, version 2.1-0,[63] R version 3.6.1,[64] RStudio version 1.1.442.[65] Separate models were estimated for the effects of bullying perpetration and combined bullying-victimization, for the different types of substance use (ie, drugs, alcohol, tobacco, and general substance use) and for unadjusted and adjusted effects. Forest plots and heterogeneity indices Q and I^2 are reported for each model.

Moderator Analyses

Moderator analyses were performed only for adjusted effects models on the basis of at least 10 effects with sufficient within-sample and between-sample heterogeneity (ie, if <75% of the total amount of variance could be attributed to sampling variance; I^2 level 1).[62,66] Moderators that were already planned at the time of the preregistration of the project were study bias (sum score), statistical quality, sample size, and long- versus short-term effects. Originally, we planned to perform separate analyses for childhood and adolescent bullying perpetration, but this was not feasible because of the low number of studies on childhood bullying. Therefore, we analyzed child (age: ≤9) and adolescent (age: 10–18) bullying in the same model, examining if adolescent versus childhood bullying perpetration moderated the effects on later substance use. Instead of the originally planned long- versus short-term effects, adolescent versus adult substance use was tested as a moderator. The following moderator analyses were not preregistered and should, therefore, be regarded as exploratory: year of publication, type of sample (population based versus other types), proportion of girls, country (United States versus other), self-report bullying perpetration versus other reports, and a variable indicating whether the effect was adjusted for baseline substance use. All moderators were tested in separate models. Because the large number of tested moderator effects increased the risk of false-positives, only moderator effects found in multiple models were interpreted.

Sensitivity Analyses

Standardized Z values were computed to check for extreme outliers (ie, more extreme than −3.29 or 3.29)[67] and influential outliers were identified by computing Cook's distances. Models including influential outliers were repeated without these outliers as

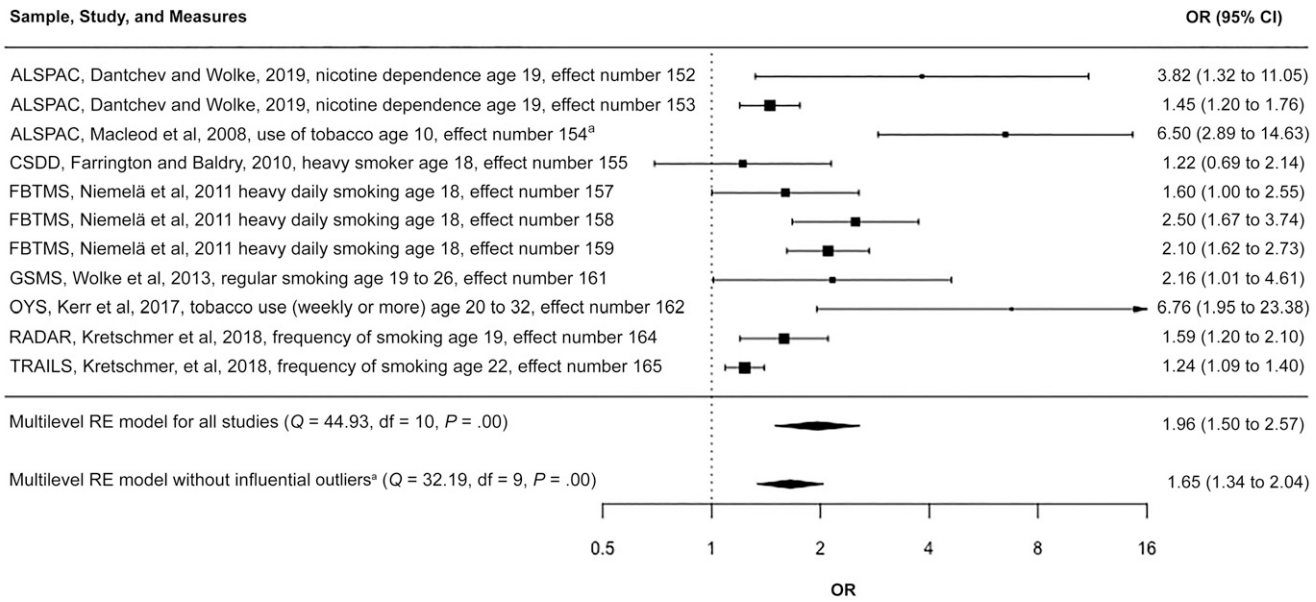

FIGURE 4

Forest plot unadjusted effect of bullying perpetration in childhood and adolescence on later tobacco use. [a] influential outlier. ALSPAC, Avon Longitudinal Study of Parents and Children; CSDD, The Cambridge Study in Delinquent Development; df, degree(s) of freedom; FBTMS, From a Boy to a Man Study; GSMS, Great Smoky Mountain Study; OYS, Oregon Youth Study; RADAR, Research on Adolescent Development and Relationships; RE, random effects; TRAILS, TRacking Adolescents' Individual Lives Survey.

part of the sensitivity analyses. In addition, sensitivity analyses were performed to examine whether using correlations of 0.5 and 0.8 between effects from the same sample for computing the variance-covariance matrix would change our results. Variance-covariance matrices were created by using the function make_VCV_matrix from R package metaAidR version 0.0.0.9000[68] (see Supplemental Information, part 4).

Publication Bias and Reporting Bias

Egger's tests for funnel plot asymmetry and *P*-curve analyses were performed to assess the likelihood of publication and reporting bias (see Supplemental Information, part 5).

Open Science Statement

Excel files including all full-text screening assessments, calibration files with initial disagreements between authors and final decisions, the data extraction and bias assessment manual, and all data and syntaxes have been made available on the OSF (https://osf.io/57aqh/).

RESULTS

The Final Data Set

The final data set consisted of 215 effect sizes from 28 publications that

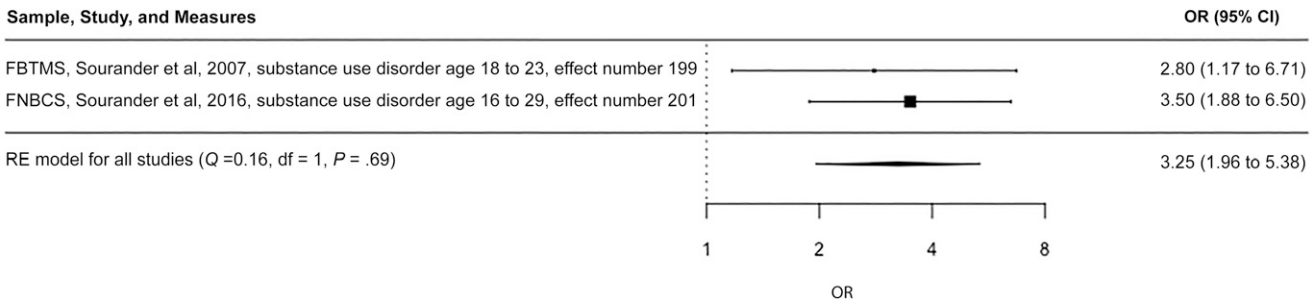

FIGURE 5

Forest plot unadjusted effect of bullying perpetration in childhood and adolescence on later general substance use. df, degree(s) of freedom; FBTMS, From a Boy to a Man Study; FNBCS, Finnish Nationwide 1981 Birth Cohort Study; RE, random effects.

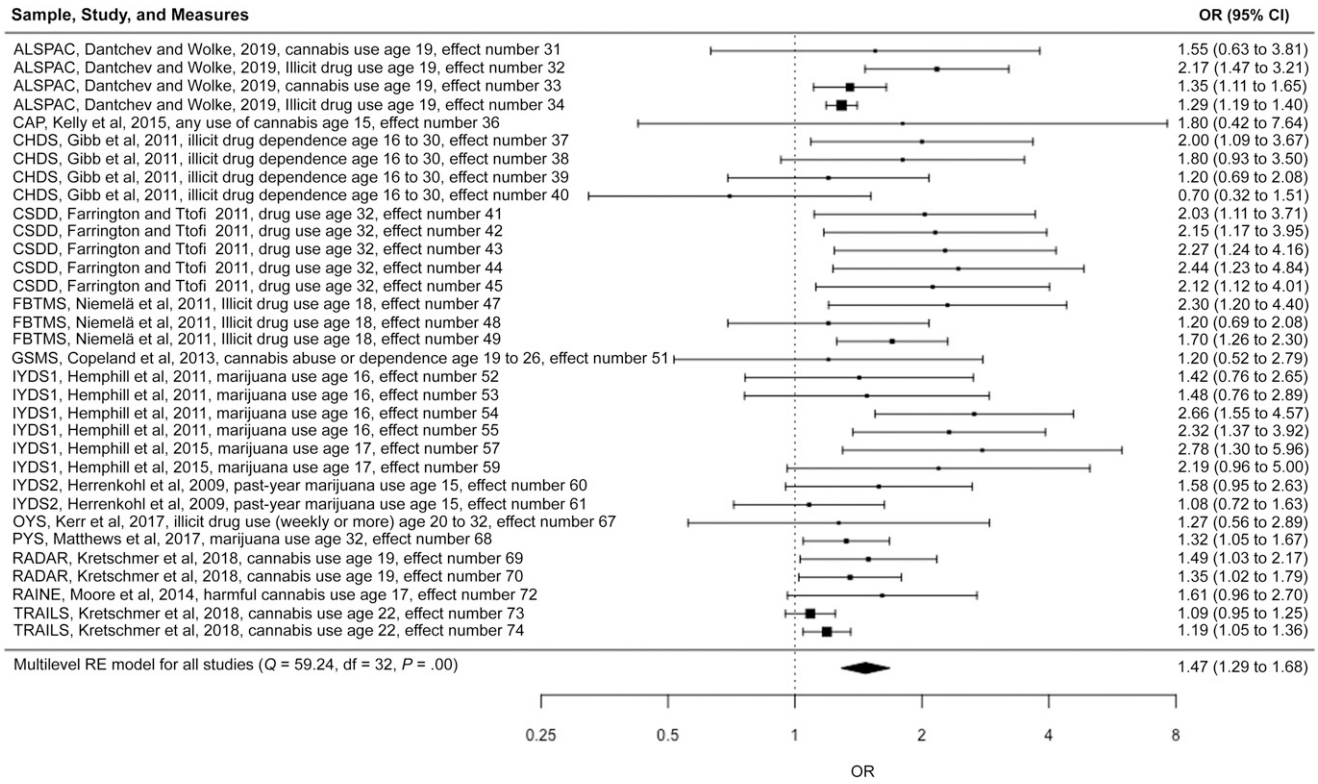

FIGURE 6

Forest plot adjusted effect of bullying perpetration in childhood and adolescence on later drug use. ALSPAC, Avon Longitudinal Study of Parents and Children; CAP, Climate and Preventure study; CHDS, Christchurch Health and Development Study; CSDD, The Cambridge Study in Delinquent Development; df, degree(s) of freedom; FBTMS, From a Boy to a Man Study; GSMS, Great Smoky Mountain Study; IYDS1, International Youth Development Study, Australian subsample; IYDS2, International Youth Development Study, American subsample; OYS, Oregon Youth Study; PYS, youngest cohort of the Pittsburgh Youth Study; RADAR, Research on Adolescent Development and Relationships; RAINE, Western Australian Pregnancy Cohort study; RE, random effects; TRAILS, TRacking Adolescents' Individual Lives Survey.

were published between 1992 and 2019, reporting on 22 samples (*k*) and a total of 28 477 participants. All effect sizes and descriptive statistics are presented in part 1 and Supplemental Table 2 of the Supplemental Information. In the upper panel of Supplemental Table 2, we describe 201 effect sizes for which the predictor bullying perpetration or the outcome substance use was a dichotomous or ordinal measure, enabling conversion to ORs. In the middle panel, we describe 14 effect sizes on the basis of continuous predictors and outcomes, which were analyzed separately. In the lower panel, we describe effects that were initially included but not comparable with the other included studies. More detailed information on the included effects is available on the OSF (https://osf.io/7pqae/).

Meta-analyses

Main Analyses (ORs)

Childhood and adolescent bullying perpetration predicted later substance use for all 3 specific outcome categories (ie, drugs, alcohol, and tobacco) as well as general substance use. Bullying perpetration also predicted later substance use when effects were adjusted for possible confounders. The resulting adjusted effects (only available for the specific outcomes) were smaller than the unadjusted effects but remained statistically significant. For more details, see Table 1 and Figs 2–8.

Childhood and adolescent combined bullying-victimization predicted later drug and tobacco use but not later alcohol or general substance use. The adjusted effect on drug use was no longer significant. In general, compared to bullying perpetration, confidence intervals (CIs) were wider, and effects were weaker, with the exception of tobacco use, which was more strongly predicted by bullying-victimization than by bullying. For more details, see Table 1 and Figs 9–15.

Heterogeneity indices are reported in Supplemental Table 3. *Q* reflects the total amount of heterogeneity, and I^2 was computed separately for sampling variance, within-sample variance, and between-sample variance. For all models, the indices suggested more heterogeneity than would be expected on the basis of sampling variability, and the I^2

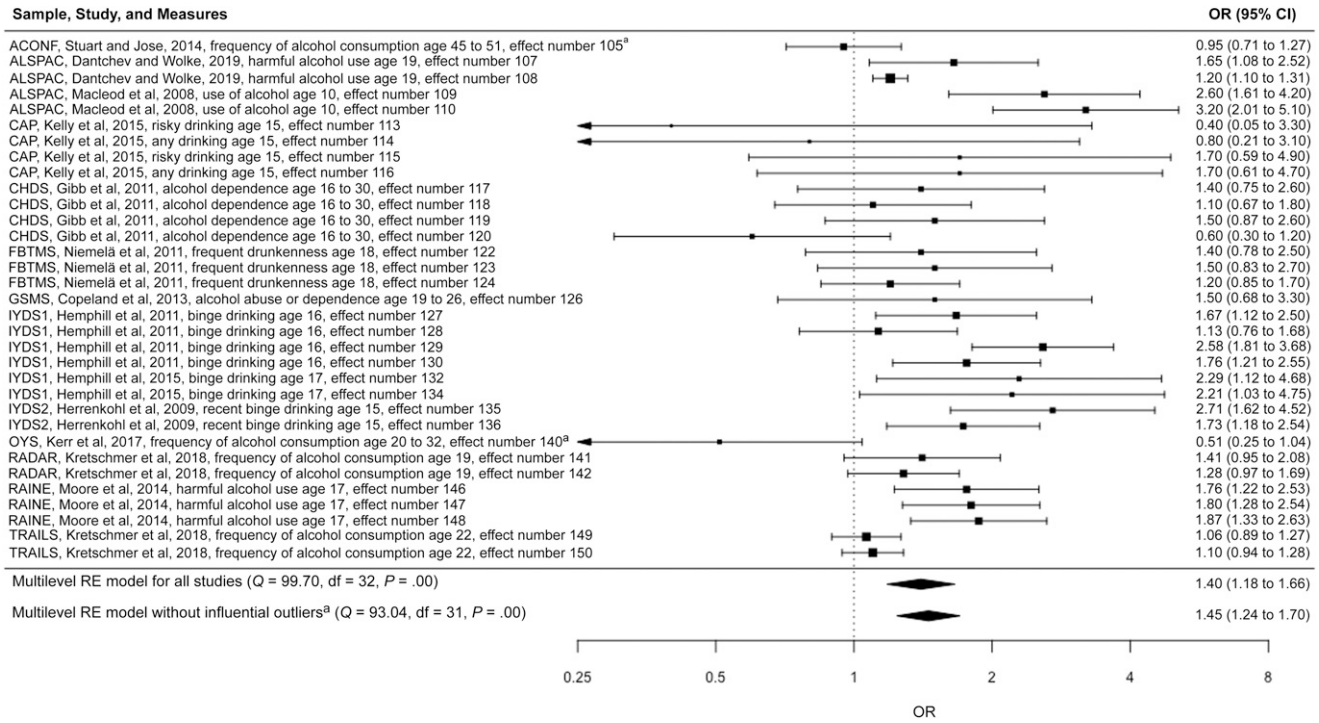

FIGURE 7

Forest plot adjusted effect of bullying perpetration in childhood and adolescence on later alcohol use. [a] influential outlier. ACONF, Aberdeen Children of the 1950s study; ALSPAC, Avon Longitudinal Study of Parents and Children; CAP, Climate and Preventure study; CHDS, Christchurch Health and Development Study; df, degree(s) of freedom; FBTMS, From a Boy to a Man Study; GSMS, Great Smoky Mountain Study; IYDS1, International Youth Development Study, Australian subsample; IYDS2, International Youth Development Study, American subsample; OYS, Oregon Youth Study; RADAR, Research on Adolescent Development and Relationships; RAINE, Western Australian Pregnancy Cohort study; RE, random effect; TRAILS, TRacking Adolescents' Individual Lives Survey.

indices of the adjusted models suggested sufficient within- and between-sample heterogeneity to perform moderator analyses.

Moderator Analyses

The results of moderator tests can be found in Supplemental Table 4. The timing of bullying involvement and substance use moderated the effect of bullying-victimization on later drug use and of bullying perpetration on later alcohol and tobacco use. More specifically, adolescent bullying-victimization more strongly predicted later drug use than childhood bullying-victimization, and bullying-victimization more strongly predicted drug use in adolescence than in adulthood. For bullying perpetration, the timing of bullying moderated the effects in a different direction, ie, compared to adolescent bullying perpetration, childhood bullying perpetration more strongly predicted later alcohol and tobacco use. Bullying perpetration more strongly predicted alcohol and tobacco use in adolescence than in adulthood. Bullying assessment (ie, self-report versus other report) moderated 2 effects, namely that of combined bullying-victimization on later drug use and the effect of bullying perpetration on later alcohol use. Self-report bullying more strongly predicted both types of substance use than bullying reported by others.

DISCUSSION

The aim of this study was to investigate the available evidence for an association between childhood and adolescent bullying perpetration and later substance use. Previous meta-analyses[13,14] have substantially contributed to our understanding of increased drug use risk in bullies but have only included research up to 2014 and did not report on alcohol and tobacco use. We provide a more comprehensive perspective, not only by including more types of substance use but also by presenting separate analyses for bullying perpetration and combined bullying-victimization.

In line with our first hypothesis, results of the current meta-analyses indicate that compared with nonbullying peers, children and adolescents who bully have a higher risk of drug, alcohol, and tobacco use later in life. In addition to these specific types of substance use, bullies also had a higher risk of nonsubtyped substance use (for example, general substance use dependence). All effects were small and decreased, but remained statistically significant, after adjusting for possible confounders. Our findings suggest that early bullying

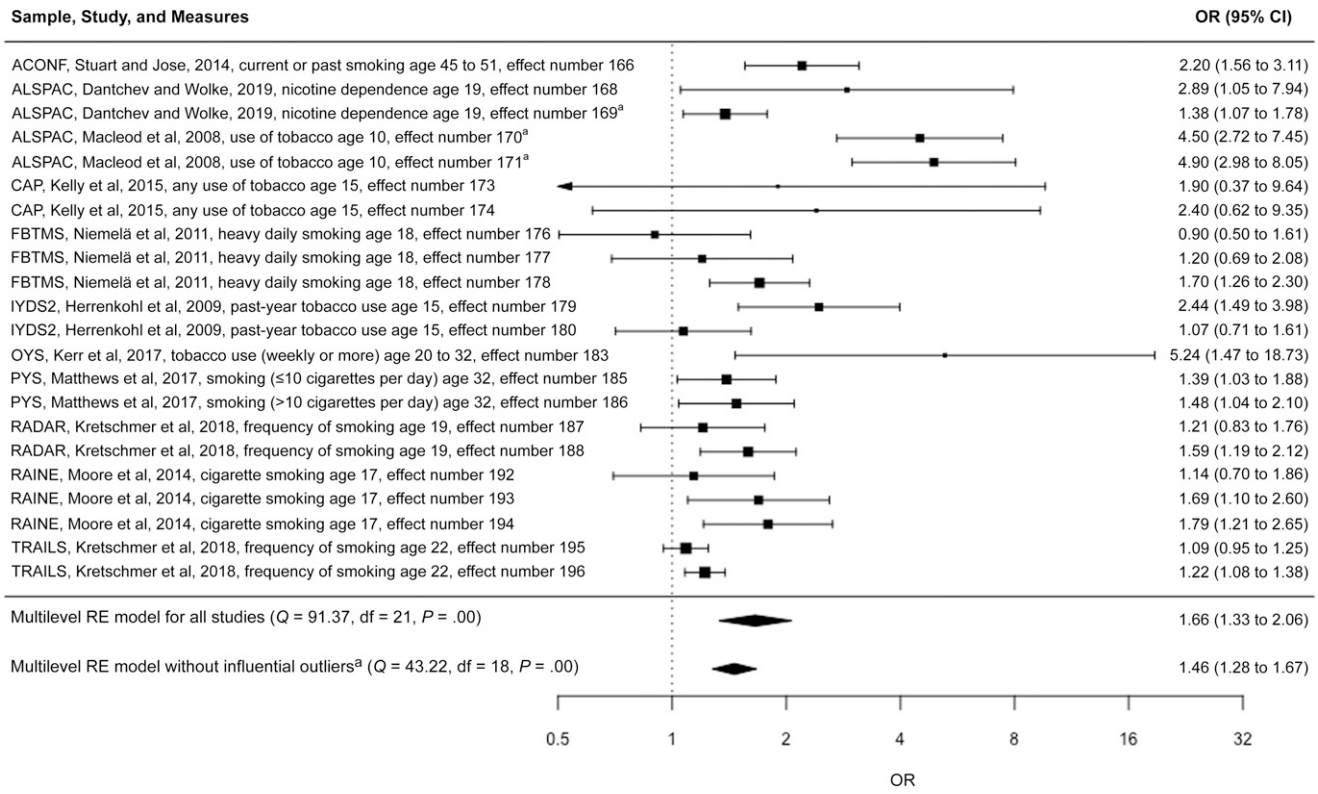

FIGURE 8

Forest plot adjusted effect of bullying perpetration in childhood and adolescence on later tobacco use. [a] influential outlier. ACONF, Aberdeen Children of the 1950s study; ALSPAC, Avon Longitudinal Study of Parents and Children; CAP, Climate and Preventure study; df, degree(s) of freedom; FBTMS, From a Boy to a Man Study; IYDS2, International Youth Development Study, American subsample; OYS, Oregon Youth Study; PYS, youngest cohort of the Pittsburgh Youth Study; RADAR, Research on Adolescent Development and Relationships; RAINE, Western Australian Pregnancy Cohort study; RE, random effects; TRAILS, TRacking Adolescents' Individual Lives Survey.

predicts substance use even many years later and over and above common confounders. Despite different methods and different included studies, our findings for drug use were largely similar to the ones reported by Ttofi et al[14] (OR = 1.76 and 1.88 versus OR = 2.22 for unadjusted effects and OR = 1.47 versus OR = 1.41 for adjusted effects). In line with our second hypothesis, we found evidence of differences in effects between childhood and adolescent bullying. Childhood bullying perpetration was more

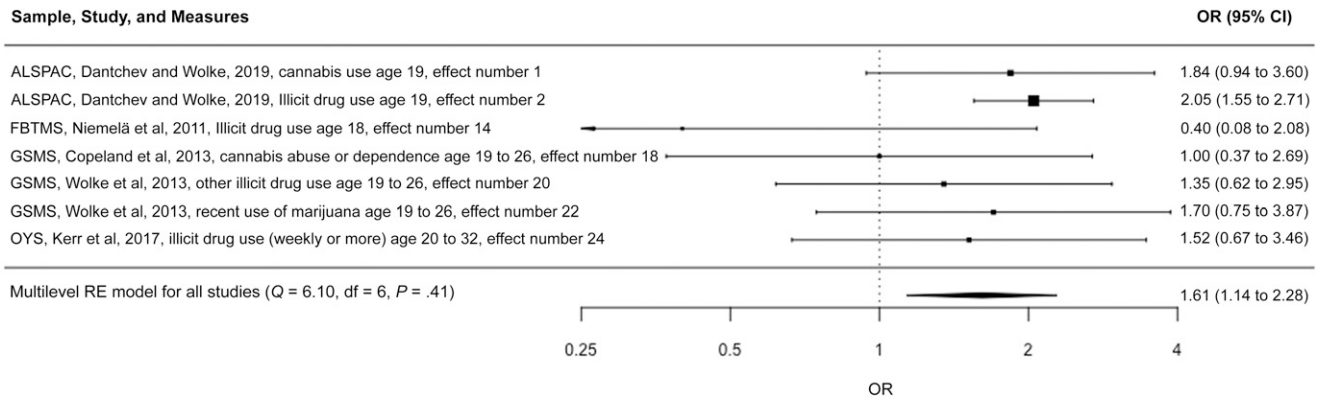

FIGURE 9

Forest plot unadjusted effect of combined bullying victimization in childhood and adolescence on later drug use. ALSPAC, Avon Longitudinal Study of Parents and Children; df, degree(s) of freedom; FBTMS, From a Boy to a Man Study; GSMS, Great Smoky Mountain Study; OYS, Oregon Youth Study; RE, random effects.

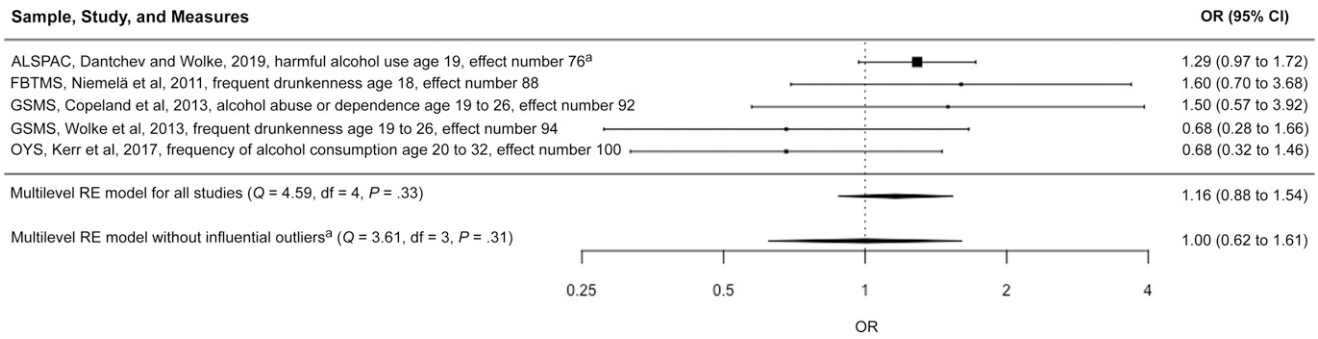

FIGURE 10

Forest plot unadjusted effect of combined bullying victimization in childhood and adolescence on later alcohol use. [a] influential outlier. ALSPAC, Avon Longitudinal Study of Parents and Children; df, degree(s) of freedom; FBTMS, From a Boy to a Man Study; GSMS, Great Smoky Mountain Study; OYS, Oregon Youth Study; RE, random effects.

strongly linked to later alcohol and tobacco use than was adolescent bullying perpetration. This may partly be explained by evidence that, contrary to childhood bullying, adolescent bullying may be a strategic and functional response to acquire a dominant position in the peer group that is not necessarily related to negative outcomes.[18–20] We not only found evidence of different effects of timing of bullying perpetration but also that bullying perpetration was associated more strongly with alcohol and tobacco use in adolescence than in adulthood, which may be explained by the fact that in adolescence, social dominance and popularity are associated with substance use.[69] Other explanations are possible as well, for example, that in adulthood individuals become more concerned about the health risks of tobacco and alcohol. Different effects of timing of bullying perpetration and substance use were not found for drug use, suggesting that, perhaps, partly different mechanisms underlie the association between bullying and drug use. Speculatively, in many countries, drug use was illegal at the time of data collection of the individual studies and may be explained more by involvement with criminal peers than by popularity.

We found no evidence for our third hypothesis (ie, of stronger effects for bully-victims than for bullies). If anything, compared with pure perpetration, effects were generally weaker for bullying-victimization, with the exception of tobacco use, which seems more strongly predicted by bullying-victimization. We expected more negative effects for bully-victims because the combined profile puts them in double jeopardy, which is supported by evidence that bully-victims show poorer mental and social functioning than pure bullies or pure victims.[70–72] Speculatively, our findings of weaker rather than stronger effects for bully-victims compared with that of bullies may be explained by the 2 bullying profiles being differentially linked to social dominance and popularity. It has been proposed that, compared with the more strategically operating pure bullies, bully-victims may lack the social, emotional, and cognitive skills required to achieve high social

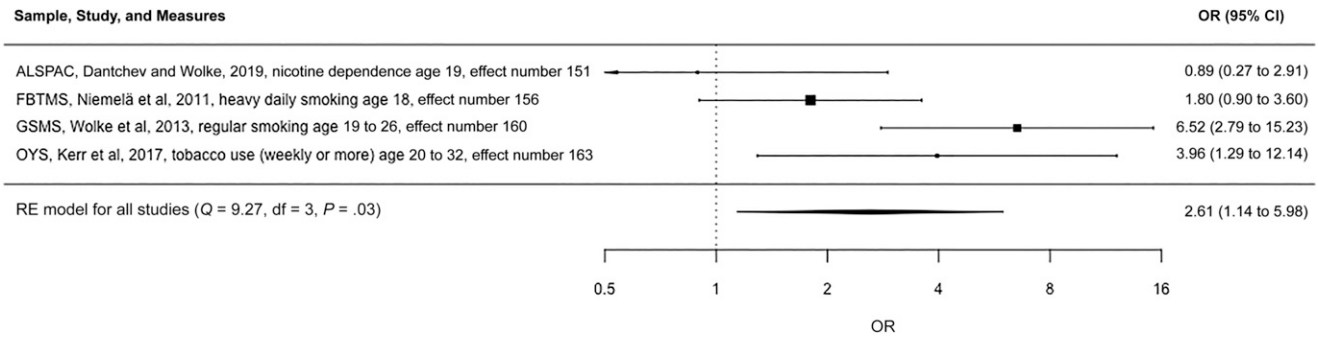

FIGURE 11

Forest plot unadjusted effect of combined bullying victimization in childhood and adolescence on later tobacco use. ALSPAC, Avon Longitudinal Study of Parents and Children; df, degree(s) of freedom; FBTMS, From a Boy to a Man Study; GSMS, Great Smoky Mountain Study; OYS, Oregon Youth Study; RE, random effects.

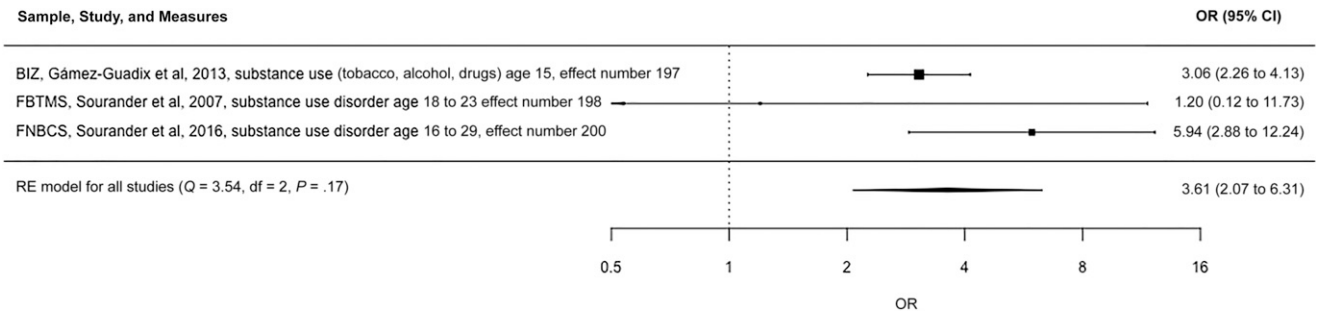

FIGURE 12

Forest plot unadjusted effect of combined bullying victimization in childhood and adolescence on later general substance use. BIZ, unnamed study from Bizkaia; df, degree(s) of freedom; FBTMS, From a Boy to a Man Study; FNBCS, Finnish Nationwide 1981 Birth Cohort Study; RE, random effects.

status[72] and have been found to be more socially isolated than bullies.[73] Because social dominance and popularity are in turn linked to substance use,[69] this may partly explain why we did not find the hypothesized stronger effects for bully-victims. Additionally, the larger heterogeneity of included effects for bullying-victimization compared with bullying perpetration suggests that bully-victims constitute a less homogeneous group, with less easily identifiable characteristics.

We found no indications of reporting or publication bias for most meta-analyses. Three effects may be biased (ie, the adjusted effect of bullying perpetration on tobacco use, adjusted effect of combined bullying-victimization on tobacco use, and adjusted effect of bullying perpetration on drug use). Please note that funnel plot asymmetry and non–right-skewed *P*-curves may be due to publication or reporting bias but should not be considered conclusive evidence.

Because all effects were small, mostly smaller than the rule of thumb of 2 ORs that has been suggested as the lower limit for a practically relevant effect in social sciences,[74] we should be careful not to overestimate the societal relevance of the effects of bullying. This being said, we know that bullying is linked to other negative life outcomes (ie, depression,[2] offending,[2,7] and violence),[8] and a higher risk of multiple adverse outcomes may indicate serious problems for child and adolescent bullies later in life.

Limitations

The included effects were based on a large variability in operationalizations and measures to assess bullying perpetration and substance use, which was reflected in a large variability in reported percentages of bullies, bully-victims, and substance users (see Supplemental Information, part 1). This means that whereas in certain studies researchers investigated extreme groups of bullies or substance users, comparing them with a large group of uninvolved

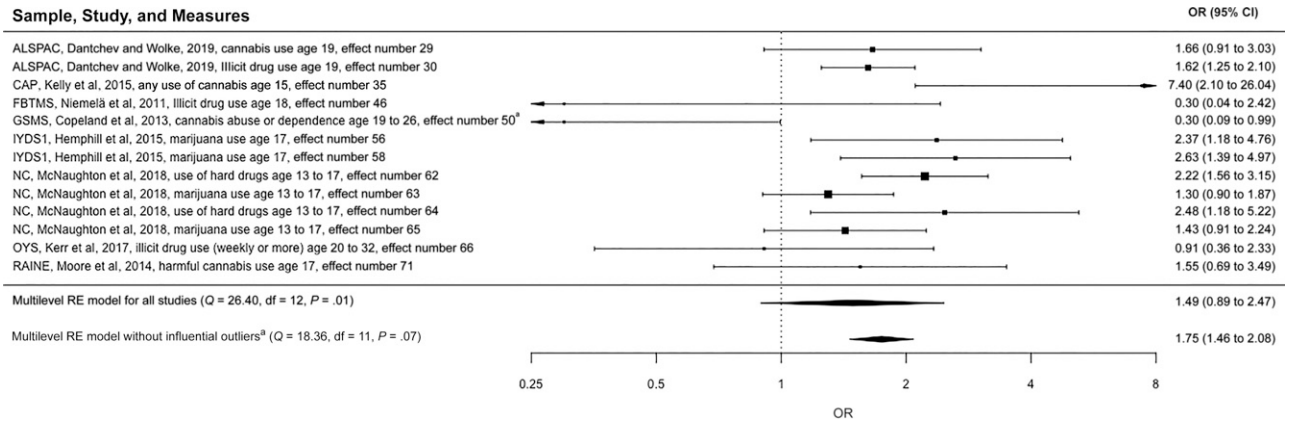

FIGURE 13

Forest plot adjusted effect of combined bullying victimization in childhood and adolescence on later drug use. [a] influential outlier. ALSPAC, Avon Longitudinal Study of Parents and Children; CAP, Climate and Preventure study; df, degree(s) of freedom; FBTMS, From a Boy to a Man Study; GSMS, Great Smoky Mountain Study; IYDS1, International Youth Development Study, Australian subsample; NC, unnamed study from North Carolina; OYS, Oregon Youth Study; RAINE, Western Australian Pregnancy Cohort study; RE, random effects.

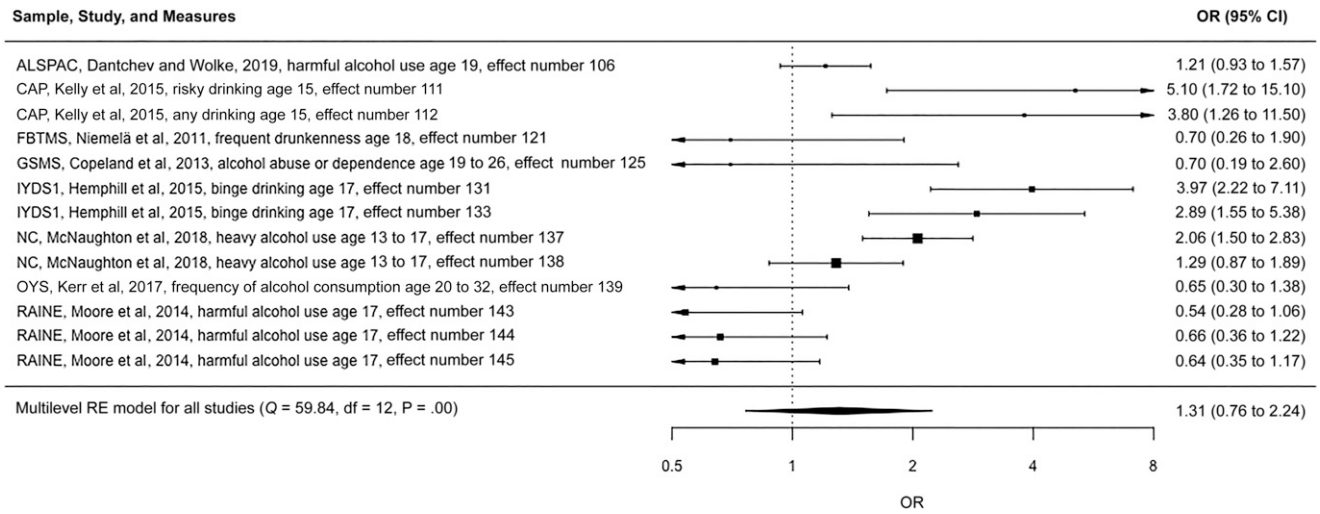

FIGURE 14

Forest plot adjusted effect of combined bullying victimization in childhood and adolescence on later alcohol use. ALSPAC, Avon Longitudinal Study of Parents and Children; CAP, Climate and Preventure study; df, degree(s) of freedom; FBTMS, From a Boy to a Man Study; GSMS, Great Smoky Mountain Study; IYDS1, International Youth Development Study, Australian subsample; NC, unnamed study from North Carolina; OYS, Oregon Youth Study; RAINE, Western Australian Pregnancy Cohort study; RE, random effects.

peers, in other studies researchers compared more or less equally frequently occurring phenomena. Therefore, the outcomes of our meta-analysis cannot be interpreted as reflecting simple homogeneous effects. However, with all of these different effects based on different methodologic choices, if an effect is found, as in the current study, this does make a strong case for the robustness of the finding in that we can be fairly confident that bullying perpetration is associated with later substance use in the population.

We meta-analyzed effects of bullying at one time point on substance use at a later time point. From our findings we can conclude that bullying is a risk factor for later substance use. Ideally, to inform preventive interventions, we would want to know if being a bully somehow causes individuals to use drugs, alcohol, or tobacco later in life. Of course, causal claims can never be inferred from the observational studies included in the present meta-analysis. However, it has been suggested that, in nonrandomized observational studies, investigating if within-individual change in bullying is followed by within-individual change in substance use is the closest we can get to identifying what are sometimes referred to as "causal risk factors" that can provide the basis for preventive interventions.[75,76] Note that the

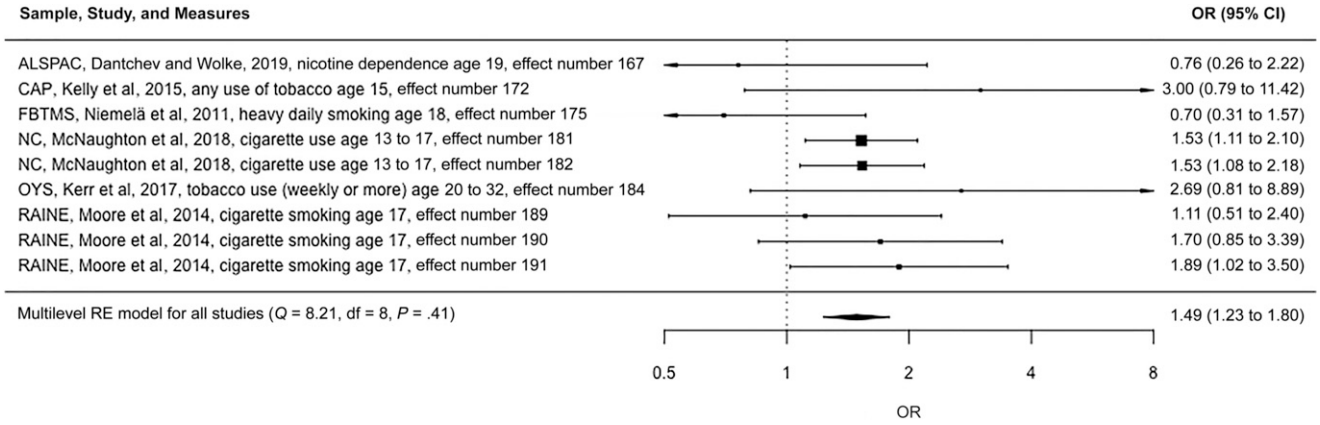

FIGURE 15

Forest plot adjusted effect of combined bullying victimization in childhood and adolescence on later tobacco use. ALSPAC, Avon Longitudinal Study of Parents and Children; CAP, Climate and Preventure study; df, degree(s) of freedom; FBTMS, From a Boy to a Man Study; NC, unnamed study from North Carolina; OYS, Oregon Youth Study; RAINE, Western Australian Pregnancy Cohort study; RE, random effects.

suggested approach is not the same as adjusting for substance use at baseline, which was only done for less than one-half of the included effects anyway because this does not separate within- from between-subject changes. Because at least 3 study waves would have to be available to investigate whether changes in substance use follow changes in bullying and reported analyses would have to be performed with within-subject change scores, not enough studies were available to conduct a meta-analysis on within-subject change scores.

Future Research

During the screening of studies and data extraction we noticed that from titles and abstracts alone it was often unclear if bullying perpetration or victimization was investigated. The use of the unspecified term "bullying" is not informative on whether perpetrators, victims, the combined profile, or all profiles are investigated. Future meta-analyses would become considerably less time consuming if this information was disclosed in the abstract. Standard reporting of correlations between main study variables would also benefit future meta-analyses.

Although we were able to perform separate analyses for bully-victims, power was still lower than for "pure" bullies because of fewer included publications on bully-victims, in combination with larger heterogeneity of effects. Research into outcomes for bully-victims is still relatively scarce, and it remains important that researchers of more studies investigate bully-victims.

For future research, it is important to examine if bullying may be a so-called causal risk factor for later substance use and the possible mechanisms underlying the association between bullying and substance use (for example, by taking into account popularity). Currently, not enough studies with a longitudinal design and a sufficient number of waves are available to investigate this with a traditional meta-analysis. The way forward may be to perform a so-called individual participant data (IPD) meta-analysis, in which no aggregate data from publications are used but the raw individual-level data for each study are obtained and analyzed centrally, allowing for harmonization of predictors, outcomes, confounders, and statistical methods.[77] This type of meta-analysis not only avoids the large methodologic variability underlying the current study but, because of its independence on published findings, also allows for meta-analytic investigations that are not well represented in publications. An IPD meta-analysis of prospective cohort studies with sufficient numbers of waves and participants would, for example, allow using random-intercept cross-lagged panel models,[78] suitable for unraveling directions of effects and making inferences about so-called causal risk factors in a better way than has been done up to now. Additionally, regardless of whether findings for bully-victims are reported in publications, an IPD meta-analysis could provide opportunities to combine raw data on bullies and victims, resulting in more statistical power to study effects for bully-victims compared with the present meta-analysis. Although an IPD meta-analysis is extremely time consuming, costly, and legally challenging, this type of meta-analysis may be the way forward.

CONCLUSIONS

Contrary to the commonly used approach of selecting only 1 effect from a particular sample, with our multilevel approach, we accounted for dependence between effects from the same sample and allowed inclusion of all available relevant effects, thereby avoiding unnecessary loss of information. Our findings suggest that, compared with their nonbullying peers, bullying children and adolescents have a higher risk of drug, alcohol, and tobacco use later in life. Childhood bullies have more risk of alcohol and tobacco use later in life than adolescent bullies, which may be related to bullying being more functional to achieve higher social status during adolescence versus indicating more dysfunctional social behavior during childhood. Findings for bully-victims were more heterogeneous, with generally smaller effects and lower reliability and were on the basis of fewer effects. For future research, it would be interesting to investigate the possible mechanisms underlying the link from bullying to substance use, for example, by taking popularity into account, and investigate bullying as a so-called causal risk factor because this type of research may provide the basis for preventive interventions.

ACKNOWLEDGMENT

We thank Dr Marlies Maes for the stimulating methodologic discussions and for sharing the R script to adjust cross-lagged correlations for zero-order correlations (Supplemental Information, part 3).

ABBREVIATIONS

CI: confidence interval
IPD: individual participant data
OR: odds ratio
OSF: Open Science Framework

DOI: https://doi.org/10.1542/peds.2020-034751

Accepted for publication Dec 11, 2020

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PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: Funded by the European Research Council Starting Grant awarded to Dr Kretschmer under the Horizon 2020 Research and Innovation program (grant agreement 757364; title: "Ghosts from the Past: Consequences of Adolescent Peer Relations Across Contexts and Generations"). The European Research Council had no role in the design and conduct of the study.

POTENTIAL CONFLICT OF INTEREST: Eleven of the screened studies (ie, 0.6% of the total number of screened studies), were coauthored by Drs Kretschmer and/or van der Ploeg. One of these studies was included in the present meta-analysis, accounting for 3.6% of the total number of included studies. To avoid bias toward one's own articles as much as possible, a third screener was involved if these coauthors had been assigned their own articles to screen or assess for eligibility, and they were not involved in the risk-of-bias assessment. Dr Vrijen, Ms Wiertsema, and Ms Ackermans have indicated they have no potential conflicts of interest to disclose.

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